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Science of Gymnastics Journal (ScGYM®)

Science of Gymnastics Journal (ScGYM®) (abbreviated 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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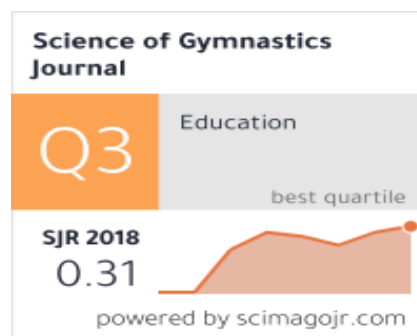
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In Memoriam**Bruno Grandi**

(9 May 1934 – 13 September 2019)



Dear gymnastics friends,

Sad news came to us. Professor Bruno Grandi is no longer among us in material world, but his spirit will flow around us. We would like to express condolences to his family and his gymnastics family.

He supported many ideas, and was open to novelties. His biggest obstacle was how to implement novelties politically wise, and to persuade those who do not want changes.

For what I'm especially grateful is, he supported publishing Science of Gymnastics Journal.

Great man, leaves great works – Academy, Open ended Code of Points, Judging education, Judges control, new sports in Olympic family just to name from my perspective huge steps in our sport.

Prof. Ivan Čuk, Editor in Charge

Photo by Anton Gajdoš

EDITORIAL

Dear friends,

Let me start with the latest news: at the World Championships in Stuttgart (GER), gymnasts from Turkey, Hong Kong, Ireland and the Philippines won medals for their countries for the first time ever. Simone Biles (USA) is now officially the most decorated gymnast at world championships. We saw some excellent gymnastics one year prior to the Olympic Games in Tokyo. Parkour was included in the games. October was really full of events. Additionally, there were two symposiums about gymnastics, one held in Freiburg (GER) and one in Osaka (JPN). In Slovenia, our Olympic champion Miroslav Cerar is celebrating his 80th birthday this year and as a gift, his club (established in 1863) set up an exhibition about his achievements in the Ljubljana City Hall.

In this issue, we have seven articles by authors from the USA, Greece, the United Kingdom, Slovenia, Finland and Brazil.

The first article is about trampolining. It is authored by an international group of researchers lead by William A. Sands (USA). The second article is from Slovene authors; they discuss symmetries at take-offs and landings. The third article is from Greece and is about anxiety in young male gymnasts. The fourth article comes from Finland and looks at the relationship between test motor abilities, technical knowledge and competition results. The fifth article is from Brazil and examines the importance of rhythmic in university programmes. From Greece comes another article, about diet in rhythmic and aerobics. The last article is from Brazil and is about choreography in gymnastics for all.

Anton Gajdoš drafted another article related to the history of gymnastics, refreshing our awareness of Miroslav Cerar, an excellent Slovene (formerly Yugoslav) gymnast.

Just to remind you, if you quote the Journal, its abbreviation on the Web of Knowledge is SCI GYMN J.

I wish you pleasant reading and a lot of inspiration for new research projects and articles,

Ivan Čuk
Editor-in-Chief



Above: 8 Decades of Miroslav Cerar exhibition in city hall in Ljubljana (Photo Ivan Čuk)
Below: Opening ceremony in front of City Hall in Ljubljana (Photo Nik Rován)



COMPARISON OF BUNGEE-AIDED AND FREE-BOUNCING ACCELERATIONS ON TRAMPOLINE

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Original article

Abstract

Trampolines remain the single best apparatus for the training of aerial acrobatics skills. Trampoline use has led to catastrophic injuries from poor landings. Passive injury prevention countermeasures such as specialized matting have been largely ineffective. Active injury countermeasures such as hand spotting, “throw-in” mats, and overhead spotting rigs provide the most effective methods. The recent addition of several bungee cords between the ropes and the gymnast’s spotting harness has resulted in altered teaching and coaching of trampoline-related acrobatics. Bungee cords have eliminated the need for a coach/spotter to manage the ropes during skill learning. The purpose of this study was to assess the influence of the addition of bungee cords with a traditional rope-based overhead spotting rig. There is a paucity of any research involving trampoline injury countermeasures. Ten experienced trampoline acrobatic athletes (5 males, 5 females) from the U.S. Ski and Snowboard Association Aerials National Team performed 10 bounces as high as they could control. A triaxial accelerometer (200 Hz) characterized 10 bungee cord aided bounces and 10 free-bounces on a trampoline from each athlete. Bed contact times, peak accelerations, and average accelerations were obtained. The results supported our hypotheses that the bungee-aided bounces achieved only 40% (average) to 70% (peak) of the free-bouncing accelerations (all $p < 0.001$ and all $\eta^2_{\text{partial}} > 0.092$). The bed contact time was approximately 65% longer during the bungee-aided bounces ($p < 0.001$). Bungee cords may reduce the harshness of landings on trampoline.

Keywords: *safe jumping, biomechanics data, time, peak values.*

INTRODUCTION

Trampolines have received increased attention as both a performance apparatus

and as a training tool for acrobatic athletes. Trampolines offer athletes the ability to

rise as high as five or more meters in the air with minimal physical effort (Eager, Chapman, & Bondoc, 2012), practice difficult skills, and land on a flexible and elastic trampoline bed. However, trampolines can embody a revenge effect (Tenner, 1996). Providing easy access to high jumps that gives more air time to learn a skill also results in increased velocity and force at landing. Revenge effects are unanticipated consequences of some change to a complex system (Tenner, 1996). An uncontrolled fall that often occurs during learning may increase the risk of a serious injury aggravated by a greater descent distance.

The dangers of trampolines have been well documented for decades (Council on Sports Medicine & Fitness, 2012; Kakel, 2012; Torg, 1987). The apparatus was banned from schools for years following position statements from the American Association of Health, Physical Education, Recreation, and Dance (J.O.P.E.R., 1978), American Academy of Pediatrics (American Academy of Pediatrics, 1982, 1999), and the American Academy of Orthopedic Surgeons (American Academy of Orthopaedic Surgeons, 2001).

However, trampoline is a competitive sport with more than a million of active athletes worldwide and an Olympic discipline since 2000 (Jensen, Scott, Krustup, & Mohr, 2013). Despite the amount of research associated with trampoline jumping, evidence is limited on injury prevention countermeasures for trampoline including both passive and active methods (Sands, 2000). Passive methods involve the use of various types of padding. Specialty mats can be used to cover the trampoline frame as well as the springs of the trampoline bed. Mat tables are placed flush with the height of above-ground trampolines, which are then padded with thick mats. Floor matting is also common. Unfortunately, trampoline injury research has indicated that none of the passive countermeasures are capable of preventing injury (American Society for

Testing and Materials, 1990; Torg & Das, 1984). Active injury prevention countermeasures include, “throw-in” mats (Sands & Drew, 2007), and various types of manual hand and belt spotting (USA Tumbling and Trampoline, 2007). Throw-in mats are mats that are pushed onto the trampoline bed by coaches or athletes adjacent to the trampoline when an athlete is out of control. Throw-in mats may also be used to simply reduce the energy of the bounce (Sands & Drew, 2007).

Perhaps the most effective injury countermeasure for trampolines is the overhead spotting belt or rig. The overhead spotting belt involves a snug waist and hip harness which is attached to ropes or bungee cords which are attached to the ceiling or a rigid frame (Figure 1). Such overhead spotting rigs allow the athlete to be suspended from above so that they are supported throughout the bounce, and have protection in the event of an unexpected fall. Overhead spotting rigs provide the highest degree of safety for athletes performing on a trampoline (Figure 1). For example, USA Diving, in their U.S. Diving Safety Certification manual, requires that all divers using a trampoline as a training tool, must use an overhead spotting rig or hand spotting with a belt and short ropes, and the coach must have completed special training provided by U.S. Diving (Kimball, 1999b).

Overhead spotting rigs have been ubiquitous for decades (Figure 1). However, the addition of bungee cords has been more recent. There are two primary ways to support the athlete from an overhead spotting rig: using ropes or by bungee cords. In a rope-based overhead rig, two ropes are suspended from the ceiling or a rigid frame directly above the center of the trampoline (Figure 1). The ropes pass through pulleys spaced widely apart, with one end of each rope attached to the sides of a harness worn around the athlete’s waist. The other ends of the ropes are controlled through active muscular effort provided by a skilled spotter

(typically a coach). As the athlete bounces the spotter has to maintain tension on the ropes in order to provide continuous support for the athlete by avoiding slack in the ropes. The spotter accomplishes this by pulling down on the ropes as the athlete bounces upward, and letting the ropes rise upward as the athlete descends downward in the bounce. This up-and-down motion of the grip of the spotter on the rope requires considerable skill to maintain proper tension and timing (Hennessey, 1990; Kimball, 2007; Sands, 1990, 2000). If the athlete experiences an error or an unexpected fall, the spotter holds the ropes tightly and slows the athlete's descent. The spotter needs to be strong, heavier than the athlete, and possesses quick reflexes with high vigilance. Often the spotter is pulled completely off the floor while lowering the athlete.

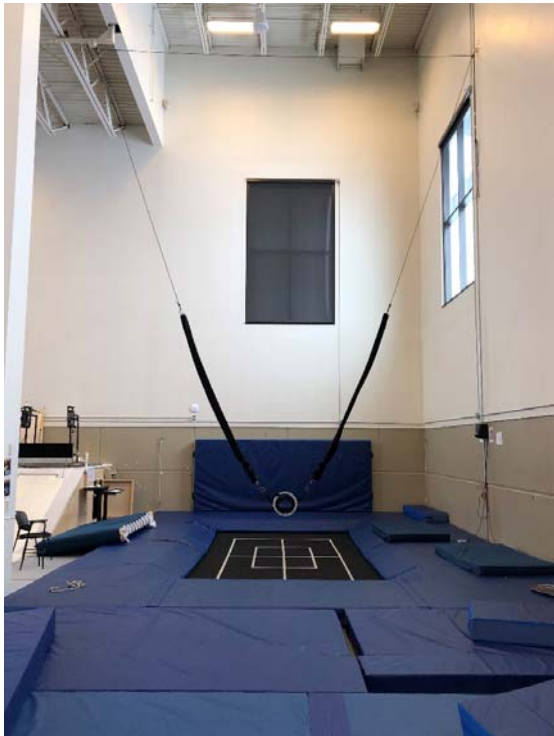


Figure 1. Overhead spotting rig using ropes and bungee cords.

An overhead spotting rig which utilizes bungee cords to attach to the athlete removes the need for a skilled human spotter. The ropes and bungee cords need only be set in their optimal

tension position and mechanically fixed (Figure 1). Setting the tension of the ropes and bungee cords is usually accomplished by an electric winch that pulls the ropes while stretching the bungee cords (Figure 1). The tension applied by the bungees and ropes lifts the athlete off of the trampoline bed. To begin bouncing, a teammate or assistant has to pull downward on the athlete in order to stretch the elastic bungees and initiate contact with the trampoline bed. After several preparatory bounces, the athlete is able to effectively use the trampoline spring characteristics and the recoil of the elastic bungee cords to rise into the air. Athletes can bounce higher with the combined forces from the trampoline springs and the bungee cords. Most importantly, high bounces are paired with rapid deceleration of the athlete as he or she returns back to the trampoline bed, softening the landing. The assured soft landing frees the athlete to perform many repetitions of difficult skills without a threat of falling harshly and possibly experiencing injury.

Despite the widespread use of bungee cord overhead spotting rigs in trampoline, no studies have been conducted which quantifies how this system affects the bouncing athlete. The purpose of this study was to characterize the differences between bungee cord aided bouncing and bouncing without the aid of a bungee apparatus, known as 'free-bouncing'. As the first study of bungee cord aided trampoline bouncing the results may provide information that can be used to determine the levels of accelerations involved. We hypothesized that bouncing with the aid of bungees and bouncing freely would show statistically different bounce characteristics with the bungee-aided bounces showing longer acceleration times and lower peak and average accelerations.

METHODS

Participants. Five male (Mean \pm SD; age 23.02 y \pm 2.45 y; height 168.66 cm \pm 9.77 cm; mass 73.2kg \pm 8.22 kg) and five female (Mean \pm SD; age 20.97 y, \pm 3.43 y; height 162.52 cm, \pm 6.17 cm; mass 59.56 kg, \pm 5.07 kg) experienced trampoline athletes from the U.S. National Aerials Team and the Center of Excellence of the U.S. Ski and Snowboard Association volunteered to participate in this study.

Equipment. Athletes bounced on a large trampoline called a Super-Tramp (bed size 3.05m x 6.10m, one-string bed, Rebound Products, Thornhill, Ontario, Canada). The bungee setup included five tubular cords (3.66m long relaxed and 1.27cm diameter) attached at each end to holes in a plastic circle with end plugs that prevented the cords from slipping out of the attachment device (Figure 2). The bungees descended from ropes that were in turn attached to steel cables. Steel cables ran from the ropes to two pulleys and then were joined to an electric winch that raised and lowered the tension on the athlete, belt harness, bungees, and ropes.



Figure 2. Attachment of bungee cords.

Instrumentation. Accelerations were obtained from a PASCO Scientific, triaxial accelerometer (PASCO Scientific, Roseville, CA, USA PS-3202, \pm 16 G all axes, no electronic filtering) attached rigidly to a waist belt that was worn tightly about the waist of the athlete placing the

accelerometer posterior to the lumbar spine at approximately the level of lumbar vertebrae L3 to L4 (Simons & Bradshaw, 2016). Acceleration data were transmitted via Blue Tooth™ to a laptop computer. Data were captured (200 Hz), displayed, and stored using Capstone software (PASCO Scientific, Roseville, CA, USA, V1.11.1). Calibration was performed using gravitational vertical. Calibration was conducted by rotating the accelerometer systematically such that one of the three axes of the accelerometers was oriented to the line of gravity approximately 9.806 m/s², while the remaining axes measured approximately 0 m/s².

Procedures. At arrival for testing the athletes were weighed, measured for height, and queried for birthdate. The athletes were fitted with the belt and accelerometer. Athletes performed a self-selected number of initial bounces, and progressively increased bounce height until they verbally announced that they were bouncing at their greatest controllable height. The athletes first completed the bungee-aided trials, followed by free bouncing (belt and bungees removed). The fixed order of conditions was required because of the athletes' training schedules. The highest ten sequential bounces were used as the bounce trials to characterize each condition's acceleration profile, although sampling was undertaken throughout all bounces, similar to previous procedures (Briggs, 2014; Harden & Earnest, 2015). The interval between the two bounce conditions was approximately five minutes.

Data analysis. Descriptive statistics and athlete demographics were collected and recorded. Following data capture and storage, MatLab™ (Natick, MA, USA) was used for data extraction and analysis. Initially, 9.806 m/s/s was added to the vertical-axis signal so at rest the accelerometer read 0 m/s/s. The z-axis was -9.806 m/s/s when the accelerometer was at rest on a flat surface. The added

value for gravity was due to the orientation of the accelerometer on the belt of the athlete. Resultant acceleration was calculated from triaxial accelerations (resultant acceleration = $\sqrt{(x^2 + y^2 + z^2)}$). Using the resultant is necessary to account for the orientation of the accelerometer, which is subject to change during human movement. The vertical acceleration adjustment converts free fall *resultant* acceleration to 0 m/s/s, which is critical to defining the start and end points of acceleration due to the trampoline or bungee systems. Acceleration time, peak acceleration, and average acceleration were obtained from the acceleration data and MatLab™ algorithms. Acceleration time during the bungee trials represents the entire acceleration performed by the bungee and trampoline (acceleration occurs pre- and post-trampoline contact), while acceleration time during the free trials represents acceleration performed by the trampoline alone. Bounce acceleration time, peak acceleration, and average acceleration were obtained from the acceleration data and MatLab™ algorithms. The acceleration data were digitally filtered using a 4th-order low-pass Butterworth filter with a cutoff frequency of 50Hz. The filtering was used on all axes individually prior to calculating the resultant acceleration. A bounce was defined as the time from acceleration rising above zero to acceleration reaching zero again.

Trends across the ten trials (i.e., bounces) were analyzed using procedures provided by Hopkins (<http://www.sportsci.org/resource/stats/relycalc.html#bot>). The Hopkins procedure calculates correlations and intraclass correlation coefficients (ICC) for pairs of trials such as, trial 1 with trial 2, trial 3 with trial 4, and so forth. The final ICC for the ten trials is determined by the mean of the paired ICCs.

All data were analyzed using IBM SPSS software (IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY:

IBM Corp). The ten trials were collapsed to means for each athlete, condition, and variable resulting in ten means of trials for three variables, and two conditions. Three one-way repeated measures ANOVAs (RMANOVA) were calculated to assess differences (i.e., bungee-aided vs free-bounce) for the variables: acceleration time, peak acceleration, and average acceleration. Effect size estimates were calculated as partial eta² (η^2_{Partial}), values: ≤ 0.02 = small, 0.02 to 0.13 = medium, 0.13 to 0.26 = large (Cohen, 1988). Experiment-wise statistical significance was set at $p \leq 0.05$. Type I error correction for the three RMANOVA procedures was provided by the Dunn-Sidak method (Sokal & James Rohlf, 1969).

RESULTS

The means of the ten trials from the two conditions and three variables were examined first for differences by sex. No statistical differences between the sexes were observed (all $p > 0.05$). Since the means of the ten trials did not differ statistically by sex, the data were collapsed across sex (all $p > 0.05$). The Shapiro-Wilks test for normality revealed that all variables met normality assumptions (all $p > 0.05$). Four of the six variables showed excellent ICCs (all > 0.90) (Table 1).

The negative and low ICC values for the free-bounce acceleration times and for free-bounce average accelerations indicated a near complete lack of pairwise stability of the trials of the ten bounces. Closer inspection of these data showed no consistent pattern of variability such as increasing values indicative of learning or decreasing values indicative of fatigue. Therefore, because four of the six variables' ICCs were extremely high, CoVs were low or modest for all six variables (i.e., bungee-aided acceleration time, bungee-aided peak acceleration, bungee-aided average acceleration, free-bounce acceleration time, free-bounce peak

acceleration, and free-bounce average acceleration), a reluctance to discard data (Henry, 1950), and no apparent pattern of variations across trials, all data were retained and means were calculated utilizing all ten trials for each athlete and bounce condition (Kroll, 1967). The poor ICCs supported observations that the athletes had more variability during free-bounces (Figure 3). Figure 4 shows all bounces for both conditions from one athlete.

Descriptive information from the three variables and two conditions are shown in Table 2. The RMANOVA analyses for the three variables comparing bungee aided bounces versus free-bouncing conditions

are shown in Table 3. The Sphericity assumption was met and no adjustment of degrees of freedom was merited.

Bungee acceleration times were statistically longer for the bungee-aided condition (almost 3 times longer, 290.2%). Peak accelerations for bungee-aided bounces were statistically lower (70%). Average bungee-aided accelerations were statistically lower (41.1%). Acceleration times were statistically longer for the bungee-aided condition (almost 3 times longer, 290.2%). Peak and average accelerations were statistically lower (70% and 41.1%, respectively) in the bungee-aided condition compared to free bouncing.

Table 1
Trials Analyses.

Variables	ICC	Lower CI Bound	Upper CI Bound	CoV(%)	Std Dev
Bungee-Aided					
Acceleration time (s)	0.948	0.892	0.981	6.74	4.80
Peak Acceleration (m/s/s)	0.960	0.917	0.986	3.73	1.41
Average Acceleration (m/s/s)	0.970	0.937	0.989	1.99	1.87
Free-Bounce					
Acceleration time (s)	-0.099	-0.178	0.107	11.38	3.48
Peak Acceleration (m/s/s)	0.987	0.972	0.995	2.25	0.90
Average Acceleration (m/s/s)	0.271	0.059	0.589	10.30	2.46

Note: ICC = intraclass correlation coefficient, Lower CI Bound = Confidence interval lower bound, Upper CI Bound = Confidence interval upper bound, CoV = Coefficient of variation, Std Dev = Standard deviation

Table 2
Descriptive Data – Bounce Variables.

Variables	Mean	Standard Error	95% CI Lower Bound	95% CI Upper Bound
Bungee-Aided				
Acceleration time (s)	1.486	0.091	1.280	1.692
Peak Acceleration (g)	6.945	0.302	6.261	7.629
Ave Acceleration (g)	1.720	0.081	1.536	1.905
Free-Bounce				
Acceleration time (s)	0.512	0.010	0.491	0.534
Peak Acceleration (g)	9.913	0.381	9.051	10.775
Ave Acceleration (g)	4.185	0.110	3.937	4.423

Table 3

Results of ANOVAs comparing bungee-aided bounces with free-bouncing.

Tests	F _(1,9)	Sig.	η^2_{Partial}	Power
Bungee-Aided vs Free Bounce				
Acceleration time (s)	108.01	<.001	0.923	1.0
Peak Acceleration (m/s/s)	207.04	<.001	0.958	1.0
Ave Acceleration (m/s/s)	342.90	<.001	0.974	1.0

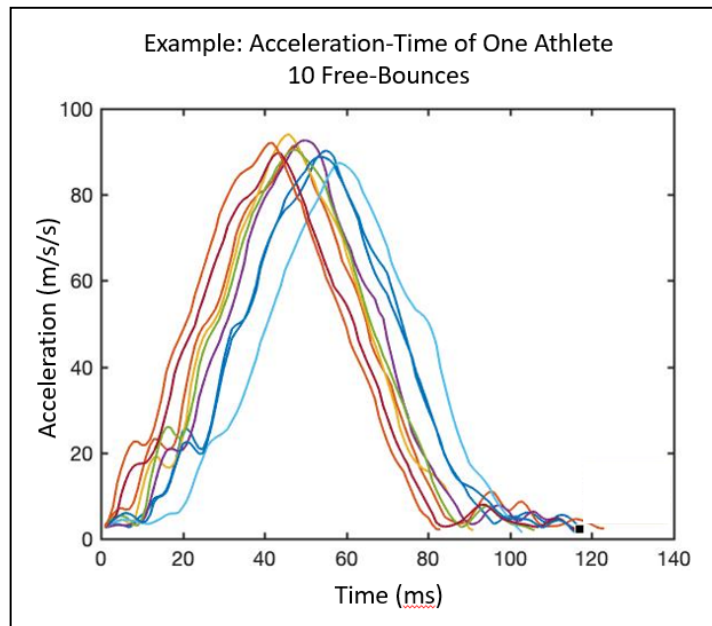


Figure 3. Example of acceleration-time data for one athlete performing in the free-bounce condition.

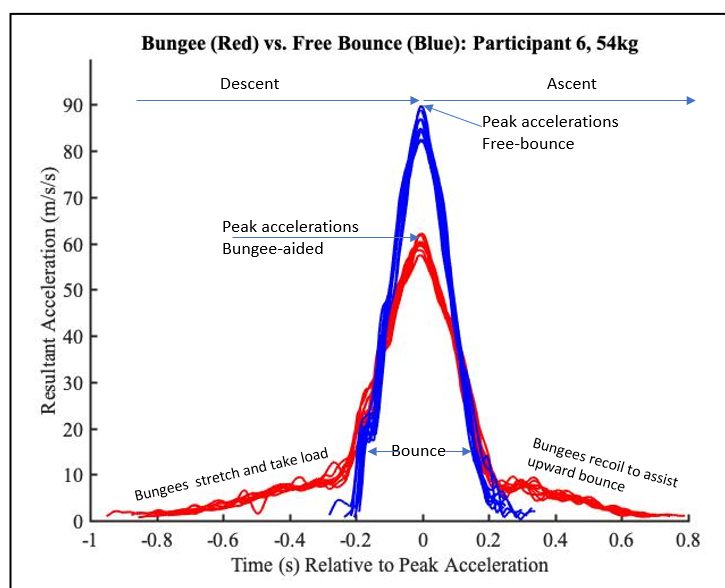


Figure 4. Comparison of Bungee-aided and Free-bounce acceleration-time data.

DISCUSSION

Our original hypothesis was supported in that the two conditions differed with longer acceleration times and lower peak and average accelerations in the bungee-aided condition. Moreover, the effect size statistics indicate that the differences were very large (i.e., all $\eta^2_{\text{partial}} > 0.75$). The problem with bounce data stability was troubling and a limitation of this study with regard to the athlete's abilities to bounce under control. This problem is supported by the larger CoVs of the bungee-aided bounces' acceleration times and average accelerations. In spite of the poor ICCs from acceleration time and average accelerations, we believe that the acceleration times and average accelerations do not represent error but rather the actual variability of the individual athletes' performance values.

The decreased peak and average accelerations found with the bungee-aided bounces helps clarify how much the bungee cords reduce the harshness of landings from 41% to 70% as compared to free-bouncing. Given this, it is important for coaches and practitioners to utilize bungee-aided conditions, especially during the execution of complex and new or technical skills. In addition, since all the jumps performed on a trampoline are maximal or near maximal, the metabolic load and neuromuscular fatigue are also high (Jensen et al., 2013).

The accelerations experienced by both types of bounce conditions studied here are greater than those used by roller coaster designers (+4-6g) (Elvin, 1999; Smith & Meaney, 2004). Spine injuries have been studied from the Rattler roller coaster in San Antonio, TX, for a 19-month period in 1992 and 1993 (Freeman, Croft, Nicodemus, Centeno, & Elkins, 2005). The results of the roller coaster study of 656 reported spine injuries showed that relatively low vertical peak acceleration levels (+4-6g) and horizontal acceleration g levels of 1.5g sustained occurred in less

than 100ms (Smith & Meaney, 2004). Although reports of the maximum acceleration to the head are important, information is incomplete without the duration of the force and direction. The durations of the applied accelerations in the referenced study were at least five times briefer than those observed in the present study, and all of the acceleration directions in the present study were positive (i.e., vertical). Estimated maximum acceleration values obtained from injurious bungee jumping have reached 7-8g (Hite, Greene, Levy, & Jackimczyk, 1992). By g value alone, the National Aeronautics and Space Administration has indicated that sustained g levels of this magnitude may easily injure an astronaut's neck or spine (Hite et al., 1992). Bungee jumping is not the same as the task assessed in this study while some factors are shared.

Although the bungee-aided method of bouncing safety is helpful, this method may not be a panacea. Diving coaches have demonstrated that a skillful coach/spotter can aid or detract from somersaulting angular velocity by "bumping" the athlete through small and quick tugs on the spotting ropes mid-somersault (Kimball, 1999a, 2007). Moreover, the use of bungee-aided bounces and the accompanying ropes precludes the practice of extreme skiing and parkour skills such as "corks," "grabs," and modified somersaults with combinations of body shapes because the skis or legs strike the bungees.

CONCLUSION

The etiology of trampoline injuries is well documented in the literature (Esposito, 2003; Nysted & Drogset, 2006; Silver, Silver, & Godfrey, 1986), and an alarming magnitude of serious injuries (e.g. cervical spine) have been reported. Bungee-aided jumping is commonly

practiced as an effective means to prevent injury from an uncontrolled fall and to provide optimal conditions to learn difficult skills and correct technical errors. This study presents the first data that describes the behavior of bungee-aided bouncing on a trampoline. With no comparative data found in the literature, one is forced to compare with tangentially related studies. While not ideal, related literature from different tasks can present some interesting, but in the end, poor comparisons. In practical terms, bungee cord spotting devices, such as the one described here, can reduce peak and average accelerations substantially. Acceleration reduction favors the safety and comfort of the athlete bouncing on trampoline. Lower accelerations translate to an increased number of repetitions prior to fatigue, an increased number of repetitions that allow more learning repetitions due to the freedom to learn by trial and error, less chance of a harsh impact and injury, and freeing the former spotter to shift from spotting to coaching.

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EFFECTS OF DIFFERENT LEG LOADINGS AT TAKE-OFF ON LANDING CHARACTERISTICS IN TWISTING SOMERSAULTS

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Original article

Abstract

The purpose of the study was to determine whether take-off asymmetry affects landing asymmetry. Eleven male gymnasts performed forward and backward somersaults with 1/2, 1/1, and 3/2 twists. The leading leg for each participant was defined according to the twisting direction. Ground reaction forces under each foot were measured with Parotec insoles. Absolute and relative measures of lateral asymmetry were used as dependent variables. Three-way ANOVA and a series of one-way ANOVAs were used to determine the main effects between take-off and landing. A series of paired t-tests with Bonferroni corrections were used to find differences between the leading and non-leading legs. Maximal ground reaction forces showed that the leading leg was set out to a higher load at take-off than the non-leading leg for twisting somersaults. There were no statistically significant differences found in the maximal ground reaction force between the legs at landings. Index of bilateral asymmetry indicated landings with negligible asymmetry. However, the maximal force differences between the legs in somersault 3/2 were higher when compared to other somersault variations. No evidence was found to affirm that the asymmetry at take-off affects asymmetry at landing in a twisting somersault. Presumably, gymnasts can take corrective measures during the aerial phase of the twisting somersault that effectively diminish the tilt of the body and enable gymnasts to prepare for the landing with small proportional asymmetry. Prudence is required as these proportions rise in the quantity of load with the height of the somersault.

Keywords: *Acrobatics, floor, asymmetry, twisting technique.*

INTRODUCTION

In gymnastics, most injuries on the floor occur during landing (Pettrone & Ricciardelli, 1987; Hudash & Albright, 1993; Gervais, 1997; Kirialanis, et al., 2002). The greatest dynamic loads on the lower extremities occur for asymmetrical landings rather than for unsuccessful landings, as typically assumed. The

asymmetrical, yet reasonably successful landings appear to represent the greatest injury potential for the Achilles tendon, knee joint, and spine (Panzer, 1987). Additionally, landing asymmetry decreases landing quality and the possibility of landing without deductions (Marinšek, 2010; Čuk & Marinšek, 2013; Pajek Bučar,

Hedbávný, Kalichová, & Čuk, 2016). Landings with different dynamic loading on legs (which we refer to in this article as asymmetrical landings) occur in non-twisting and in twisting (rotations around longitudinal axis) somersaults. The different loading on legs in the non-twisting somersault can be explained by the fact that a small rotational motion exists even in the non-twisting somersault. During the wobbling motion in the non-twisting somersault, the body tilts first in one way and then the other way (Yeadon, 2000). These small sideway tilts of the body can result in sideway landing and thus produce different loading to the legs. In the twisting somersaults, landing characteristics are associated with the twisting technique. In the somersault, any technique that tilts the body away from the somersault plane will result in twisting in order to maintain constant angular momentum (Frolich, 1980). When the tilt of the body is introduced while the feet are in contact with the take-off surface, this can be defined as a contact twisting technique; when the tilt of the body is introduced in the aerial phase of the somersault, this can be defined as an aerial twisting technique (Yeadon, 1993a; Yeadon, 1993b). To stop twisting, gymnasts must eliminate the tilt of the body. If the tilt is not eliminated, asymmetrical landing occurs. In the aerial twisting technique, asymmetrical movements of the arms, chest, or hips about the sagittal plane can eliminate the tilt; while piking, the body can remove it in the contact twisting technique (Yeadon, 1993a; Yeadon, 1993b). Modification of the shoulder joint moment is believed to be the most effective mechanism for controlling the body in the aerial phase in preparation for landing without inducing a modification in mechanical loading after foot contact (Requejo, McNitt-Gray, & Flashner, 2002). In contrast, modifications in neck, knee, and hip joint cause less advantageous joint angles at touchdown.

There is evidence that the somersaults that are performed in competition with a lower aerial phase and with more twists are more likely to end in asymmetrical landings (Marinšek & Čuk, 2010). However, to our knowledge no study has explicitly focused on the association between take-off and landing characteristics in twisting somersaults. Does the asymmetrical take-off with different leg loadings mean a potentially greater chance for an asymmetrical landing? Is there a leg that is constantly more loaded at take-off and landing than the other is?

For somersaults with more twists, a greater twisting rate is required. According to Yeadon (1993a, 1993b), gymnasts can achieve a greater twisting rate with appropriate movements at the take-off and/or aerial phase. The movements initiated at take-off are more effective in obtaining the greater twisting rate but boost the initial value of the tilt angle. The tilt of the body at take-off increases the difference in leg loading. Therefore, if gymnasts need to augment the tilt of their body to perform more twists, the asymmetry of leg loading at take-off would be expected to increase with number of twists. In order to initiate the twist at take-off, the body must tilt to the side of the twisting direction (tilt to the left side if the twist is performed to the left direction). The tilt is supposed to be produced with reduced muscle activity of the twisting leg in backward take-offs and with the increased muscle activation of the twisting leg in forward take-offs (McNeal, Sands, & Shultz, 2007). Despite the take-off asymmetry, gymnasts can detect errors and take corrective measures that change the position of the body prior to landing in the aerial phase of twisting somersaults with flight times of 1.4s (Yeadon & Hiley, 2014). The corrections in the body position allow gymnasts to land with negligible quantities of asymmetry. Although the flight times of twisting somersaults on the floor are shorter (Karacsony & Čuk, 2005)

than the ones on trampolines reported from Yeadon and Hiley (2014), it is believed that participants in our study will have enough time to take eventual corrective measures and prepare for landing. Therefore, it is expected that the number of twists and the increase in asymmetry of leg loading at take-off will not increase the asymmetry of leg loading at landing.

The purpose of this study was to use empirical data to examine the effects of absolute and relative measures of take-off characteristics on landings in twisting somersaults in training- and competition-specific situations. For the purpose of this study, the following questions were asked: (a) Does the asymmetry in dynamic loading on legs at take-off and landing change with the number of twists? (b) Does the asymmetry in dynamic loading on legs at take-off affect landing asymmetry? (c) Which leg is more loaded during take-off and landing in twisting somersaults?

METHODS

Eleven male gymnasts took part in the research, who were all competing as national team members on international competitions or higher. Informed consent was obtained from each gymnast and/or parents for minors according to the Helsinki Declaration. The local ethics committee approved the conduct of the study. On the day of the measurements, the average participants' age was 18.83 ± 2.74 years; their average height was 169.63 ± 6.21 cm; and the average weight 67.79 ± 10.64 kg.

Every gymnast had to demonstrate proficiency in performing the acrobatic skills of interest: stretched forward and backward somersault, stretched forward and backward somersault with 1/2 twist, stretched forward and backward somersault with 1/1 twist, stretched forward and backward somersault with 3/2 twist. Because the gymnasts did not twist

in the same direction, the leading and non-leading leg was defined according to the direction of the twist. The leg corresponding to the direction of the gymnast's twist was assigned as the leading leg. In that sense, the gymnast who twisted to the left had his left leg as his leading leg and his right leg as his non-leading leg.

Participants performed two familiarisation sessions with all testing procedures. After the familiarisation sessions gymnasts attended a testing session that was considered for the analysis. All the somersaults were performed on a Spieth competition floor after a warm-up. The difficulty of the somersault was increased in half-twist intervals.

Reaction forces under each foot were sampled at 300 Hz using an insole pressure measurement system (Parotec, Paromed GmbH). The Parotec system was found to be an effective tool for assessing pressure under each foot in dynamic situations. Parotec insoles are equipped with 24 discrete hydro cell pressure sensors for each foot; both insoles are triggered at the same time. Hydro cell technology enables measurement of compressive force and shear force but does not discriminate between them. Sensors have shown less than 2% measurement error in the range of 0-400 kPa and provided highly consistent data (Zequera, Stephan, & Paul, 2006), which was deemed acceptable for the current study. A study by Chesnin, Selby-Silverstein, and Besser (2000) assessed the concurrent validity comparing the Parotec System to a force plate. The Parotec System showed good correlation and small root mean square errors when compared to the force plate; force calculated from the two systems showed excellent correlation (>0.90) for 20/20 trials. Additionally, a study by Koch, Lunde, Ernst, Knardahl, and Veiersted (2016) showed that the use of insoles may be an acceptable method for measuring vertical ground reaction forces in field studies.

The dependent variables were categorized into two groups: absolute measures of lateral asymmetry and relative (proportional) measures of lateral asymmetry. The absolute measures were represented by the following set of variables: (a) maximal ground reaction force for leading (*maxFll*) and non-leading leg (*maxFnl*), and (b) maximal ground reaction force difference between legs (*mFdiff*). The proportional measure was represented by the absolute index of lateral asymmetry (*aIndex*).

Maximal ground reaction force was measured with Parotec insoles within the contact time and normalized on the gymnast's body weight (BW) [times BW]. The contact time was defined as the period from the point of ground contact to the point at which the total ground reaction force reached the magnitude of BW after the maximal ground reaction force. Maximal ground reaction force difference was calculated as a maximal difference between legs during the contact time at take-off and landing. It was normalized on the gymnast's BW [times BW].

The index of lateral asymmetry (Teixeira, 2008; Teixeira, Silva, & Carvalho, 2003) was calculated to measure proportional asymmetry between legs at take-off and landing. An index of lateral asymmetry was proposed by Teixeira, Silva, & Carvalho (2003) as proportional difference between the legs, in relation to summation of the values obtained with each leg:

$$[(maxFll-maxFnl)/(maxFll+maxFnl)] /2*100$$

where *maxFll* corresponds to maximal force for the leading leg, *maxFnl* corresponds to maximal force for the non-leading leg. The absolute values of the proportional difference between leading and non-leading leg were used in our study, thus making magnitude of asymmetry independent of any specific direction.

All statistical analyses were performed using Microsoft Excel software and IBM SPSS Statistics version 21.0. Intra-class coefficient correlations (ICC) were utilised to verify the reliability of forward somersaults (somersault ICC = 0.930; somersault 1/2: ICC = 0.785; somersault 1/1: ICC = 0.875; somersault 3/2: ICC = 0.830) and backward somersaults (somersault ICC = 0.945; somersault 1/2: ICC = 0.810; somersault 1/1: ICC = 0.910; somersault 3/2: ICC = 0.855). Additionally, differences between two familiarisation sessions were tested with paired t-test and no differences were observed ($p > .05$).

For the analysis of maximal ground reaction force three-way ANOVA ($p \leq .05$) with one between-subject factor (*rotation*: no twist, 1/2 twist, 1/1 twist, 3/2 twist) and two within-subjects factors (*contact*: take-off, landing; *laterality*: leading, non-leading) was used with repeated measures on the last factors and Bonferroni post hoc adjustments. Preliminary analyses were also conducted, including *direction of the somersault*, *direction of the take-off* and *direction of the landing* as between-subject factors, but no statistically significant effect was found. For this reason, these factors were not considered in the final analysis. A series of paired t-tests with Bonferroni corrections was used to evaluate differences between take-off and landing for each leg (leading and non-leading). Additionally, the averaged maximal ground reaction forces for leading and non-leading legs were compared for take-off and landing separately across twist modalities (no twist, 1/2 twist, 1/1 twist, 3/2 twist).

For the analysis of maximal force difference at take-off and at landing one-way ANOVA (*rotation*: no twist, 1/2 twist, 1/1 twist, 3/2 twist) was employed ($p \leq .05$) independently with Bonferroni post hoc adjustments. A series of paired t-tests was used to evaluate differences ($p \leq .05$) in maximal force difference between take-off and landing for each twist modality.

A one-way ANOVA ($p \leq .05$) for the proportional measure of lateral asymmetry at take-off and landing with one between-subject factor (*rotation*: no twist, 1/2 twist, 1/1 twist, 3/2 twist) and Bonferroni post hoc adjustments was used. Preliminary analyses on the *direction of the somersault*, *direction of the take-off* and *direction of the landing* as between-subject factors did not reveal a statistically significant effect. Therefore, the latter factors were not considered in the final analysis. A series of paired t-tests with Bonferroni corrections was used to evaluate differences between take-off and landing in relation to proportional lateral asymmetry. The averaged absolute indices of lateral asymmetry were compared for take-off and landing separately for each twist modality.

RESULTS

Nine participants twisted to the left side, which is why their left leg was assigned as the leading leg. Two participants twisted to the right side and had their right leg assigned as the leading leg. Take-off and landing loadings were measured for somersaults with different numbers of twists for each leg separately. The maximal ground reaction forces for leading leg (mFle) and non-leading leg (mFnl) are provided in Table 1. Similar values with ground reaction take-off force below 3.3 times BW have been reported in other research for backward tucked somersault on a force plate (Krol et al. 2016, Mkaouer et al. 2014) and for backward tucked somersault on balance beam (Kim, Ryu & Jeon, 2012). Other authors (Panzer, 1987) reported much higher ground reaction forces (8.8–14.4 times BW), however their research analysed double backward tucked somersault with take-off directly from force plate, without use of elastic floor.

The three-way ANOVA revealed a significant main effect for the interaction

between contact and laterality, $F(1,84) = 26.03$, $p < .001$, $\eta p^2 = .24$. The statistically significant main effects for the interaction were due to the higher maximal ground reaction force of the leading leg at take-off (leading leg 2.14 vs. non-leading leg 1.94 times BW) in comparison to landing (leading leg 1.94 vs. non-leading leg 2.02 times BW). Bonferroni correction was applied for analysis of individual twist modalities, resulting in a significance level set at $p < .008$. Analysis of individual twist modalities revealed no statistically significant difference between leading and non-leading leg at take-off (all $p \geq .031$) or landing (all $p \geq .061$).

Although the results (Table 1) suggest an increase of take-off and landing asymmetry with rising number of twists, a three way Contact x Laterality x Rotation interaction failed to reach significance, $F(3,84) = 0.22$; $p = .885$, $\eta p^2 = .01$. Following the aforementioned interaction, a series of paired t-test for each leg and somersault modality was conducted with Bonferroni correction with a significance level set at $p < .013$. Tests revealed no statistically significant differences between take-off and landing loading for leading (all $p \geq .022$) or non-leading leg (all $p \geq .242$) (Table 1).

The analysis of maximal force differences between legs at take-off indicated a significant main effect for rotation, $F(3) = 5.96$; $p = .001$, $\eta p^2 = .18$, due to the lower maximal force difference for the non-twisting somersault (0.59 ± 0.19 times BW) in comparison to other somersault modalities (1/2 twist 0.82 ± 0.35 times BW, 1/1 twist 0.73 ± 0.35 times BW, 3/2 twist 0.95 ± 0.30 times BW), as seen in Figure 1. A significant main effect was also found for the maximal force differences at landing for rotation, $F(3) = 8.18$; $p < .001$, $\eta p^2 = .23$. Post hoc comparison indicated a significantly higher maximal force difference for the 3/2 twist (1.2 ± 0.52 times BW) in comparison to other somersault variations (no twist 0.66 ± 0.18 times BW, 1/2 twist 0.81 ± 0.39 times

BW, 1/1 twist 1.01 ± 0.48 times BW). Further analysis with series of paired t-test and Bonferroni correction ($p < .008$) indicated no significant differences

between take-off and landing in maximal force difference for individual twist modalities.

Table 1.

Mean maximal forces scaled to BW and standard deviations (in brackets) at take-off and landing, differences in mean maximal forces between take-off and landing, p-values for paired t-test, and Cohen's d for leading and non-leading leg of somersaults with various rotations around longitudinal axis.

	Take-off		Landing		Diff		p(t)	d
Leading leg								
no twist	2.10	(0.46)	1.95	(0.47)	0.14	(0.28)	0.163	-0.31
1/2 twist	2.13	(0.47)	1.93	(0.48)	0.20	(0.47)	0.072	-0.42
1/1 twist	2.14	(0.43)	1.92	(0.36)	0.22	(0.31)	0.022	-0.56
3/2 twist	2.17	(0.39)	1.94	(0.43)	0.23	(0.37)	0.048	-0.55
Non-leading leg								
no twist	1.96	(0.56)	2.06	(0.51)	-0.10	(0.23)	0.242	0.18
1/2 twist	1.90	(0.46)	1.99	(0.45)	-0.09	(0.25)	0.327	0.19
1/1 twist	1.94	(0.55)	2.06	(0.53)	-0.11	(0.34)	0.267	0.21
3/2 twist	1.96	(0.62)	1.96	(0.51)	0.00	(0.39)	0.991	0.00
Sum								
no twist	4.06	(0.97)	4.01	(0.94)	0.05	(0.74)	0.764	-0.05
1/2 twist	4.04	(0.79)	3.92	(0.84)	0.12	(0.70)	0.442	-0.14
1/1 twist	4.08	(0.91)	3.98	(0.84)	0.11	(0.76)	0.516	-0.12
3/2 twist	4.13	(0.89)	3.90	(0.88)	0.23	(0.86)	0.233	-0.26

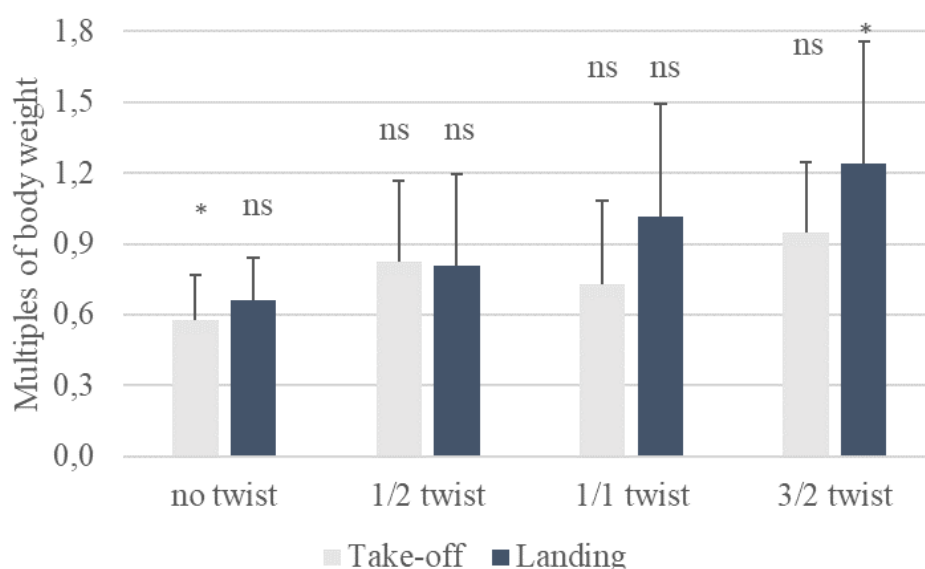


Figure 1. Mean maximal force differences (standard deviations represented by vertical bars) for take-off and landing across somersaults with various rotations around longitudinal axis. * $p < .05$, ns – no significant differences.

Analysis of variance for mean absolute index of lateral asymmetry indicated no significant twist-related effect in take-off, $F(3) = 2.17, p = .097, \eta p^2 = .07$, nor landing, $F(3) = 0.78; p = .510, \eta p^2 = .03$ situations, as depicted in Figure 2. The variation of lateral asymmetries (index of lateral asymmetry) as a function of the number of twists was compared through t-tests for repeated measures, comparing the results of take-off and landing. Bonferroni correction was applied, resulting in a significance level set at $p < .008$. T-tests did not reveal significant differences (all $p > .131$). These results indicate that performance with negligible quantities of asymmetry was consistent across twisting modalities.

DISCUSSION

Twisting somersaults on the floor were initiated during the take-off, which indicates that the contact technique of twisting was used. This was seen as a significant rise in maximal load difference between legs in comparison to non-twisting somersaults; gymnasts probably tilted their body at take-off to the side of the twisting direction to boost the twist (Yeadon, 1993a, 1993b). Leading leg was set out to a higher load at take-off than the non-leading leg. However, the load on the leading leg decreased at landings, which enabled gymnasts to land with negligible asymmetry.

Our results suggest that lateral asymmetry at take-off increased significantly with the initiation of twist but it remained stable following the adding of more twists to the somersault. It seems that for the purpose of up to 3/2 twist executions longitudinal rotational velocity initiated at contact does not need to rise significantly, as probably, the majority of longitudinal rotational velocity needed for the completion of the twist is initiated in aerial phase. Possibly, higher longitudinal rotational velocity is initiated at contact, as

circumstances require when more twists are performed. Therefore, it would be useful to measure the asymmetry at take-off in somersaults with multiple twists. The magnitude of force difference at take-off would be expected to increase because of the need to initiate higher rotational velocity around longitudinal axis.

The index of lateral asymmetry showed that lateral asymmetry at landings was stable. Although the index of lateral asymmetry did not change significantly with the addition of twists to the somersaults, the maximal force difference between legs at landing 3/2 twists was significantly different to other somersaults performed. The reason might be in the magnification of total ground reaction force at landing due to the higher aerial phase. Although the proportions of asymmetry at landing suggest that landings are performed with low outcome variability, caution is needed as these proportions rise in the quantity of load with the height of the somersault. The latter can influence the safety and quality of the landings. This effect is probably even more evident in somersaults with multiple twists that are performed higher.

The current findings show that augmented lateral asymmetry at take-off did not result in augmented lateral asymmetry in landing. One explanation for this effect can be that gymnasts used body movements in the aerial phase of the somersault as correctional movements to adjust their body for the appropriate landing. Gymnasts can initiate and reduce twist in the aerial phase of the somersault with asymmetrical body movements, and twisting somersaults are of sufficient duration to permit the detection of errors in the performed movement; corrective discrete or continuous measures can be taken (Yeadon & Hiley, 2014). The balance mechanisms of the inner ear are the ones that provide information on linear and angular accelerations (Wendt, 1951), which can be used by athletes to help control aerial movements (Yeadon &

Mikulcik, 1996). However, the application of correctional movements is probably highly associated with experience acquired through practice. Voyer and Jansen (2017) found that motor expertise in gymnastics positively influences performance in spatial tasks that require spatial visualization, mental rotation, and spatial perception, which are all the visual-spatial abilities required for execution of twisting somersaults. Although variability is never eliminated, Cohen and Sternad (2009) demonstrated that with practice the cost of movement variability to the performance outcome can be reduced. In the opinion of authors of this paper, only enough experienced gymnasts that were exposed to appropriate twisting somersault progressions when learning how to twist can adequately use correctional movements for a safe and effective landing. Additionally, it is vital that coaches devote enough time to teaching twisting techniques and allow gymnasts to acquire the necessary experience. It should be emphasized that in this study gymnasts executed all somersault attempts without major errors. We can assume that the executions in which the magnitude of lateral asymmetry at take-off leads to major technical errors (and consequently make correctional movements in the aerial phase impossible) can also amplify the asymmetry at landing.

The data in the present study was collected in a real-life environment. Consequently, it could be argued that data are less objective in comparison to laboratory studies. When designing the study we were aware of the bias because of the different twisting techniques or other factors. One of the main goals of the present study was to analyse the data in training- and competition-specific situations. Take-off and landing loadings were tested for up to the 3/2 twist somersaults. Nowadays multiple twists are commonly seen in elite modern gymnastics; thus, it would be interesting to see how multiple twists affect take-off and

landing loadings. The possibility of further studies in the analysis of take-off and landing dynamic characteristics of multiple twists are seen.

CONCLUSIONS

Asymmetry of leg loading at take-off in twisting somersaults does not directly influence landing asymmetry, probably because potential errors that can affect landing symmetry can be adjusted in the aerial phase. However, even small proportional asymmetries, which gymnasts cannot avoid due to the wobbling and tilting motion of their bodies during somersaults, rise in magnitude with higher aerial phases of the somersaults. Gymnasts have to be mindful when including twisting somersaults in their competition routines as other factors (anxiety, fatigue, etc.) can influence twisting performance and consequently landings.

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COMPETITIVE STATE ANXIETY AND PERFORMANCE IN YOUNG MALE ARTISTIC GYMNASTS

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Original article

Abstract

The purpose of this study was to investigate the competitive state anxiety and self-confidence on artistic gymnasts participating in the Greek national competition. 84 gymnasts, aged 9 – 11 years, completed the Competitive State Anxiety Inventory-2, one hour before the competition. The gymnasts, based on the total score they have received in all-around competition were divided into high and low performance, responded to the three subscales: Cognitive Anxiety, Somatic Anxiety, and Self-confidence. Results showed that there was significant difference in Self-confidence between high performance and low performance gymnasts. However, no significant differences were found in cognitive anxiety and somatic anxiety in these gymnasts. The Pearson coefficient revealed statistically significant between cognitive and somatic anxiety. The regression analysis failed to reveal any significant predictor of performance in these young male artistic gymnasts. The findings of the study underline the importance of examining competitive state anxiety and self-confidence in young male artistic gymnasts, mainly developing strategies to improve self-confidence to enable the athletes to better prepare for forthcoming competitions.

Keywords: *anxiety, self-confidence, performance, gymnastics.*

INTRODUCTION

The anxiety occurs in athletes prior to the competition due to the concerns related to the competition and expresses the interpretation of psychological arousal (Hardy, Jones & Gould, 1996). As Abdoli (2008) reported, anxiety is the negative state accompanied by feelings of nervousness, discomfort and uneasiness that are along with somatic activity or

motivation. In these cases, there is a decrease in performance relative to the amount of training experienced by athletes (Weinberg & Gould, 1995). Subsequently, state anxiety that is one dimension of anxiety, is generally regarded as an unpleasant emotional reaction related to stressful situations, in which the arousal component is one inherent element

(Woodman & Hardy, 2011) and described as varying from moment-to-moment and fluctuating proportionately to the perceived threat in a situation (Spielberger, 1966). Various theoretical models have been developed to describe the anxiety for sport competitions (Craft, Magyar, Becker & Feltz, 2003). The Yerkes and Dodson theoretical model, based on the inverted-U hypothesis, stated that there is a curvilinear relationship between physiological arousal and performance (Yerkes & Dodson, 1908). Lower levels of performance occur when levels of arousal are too high or too low, while higher levels of performance are observed with moderate levels of arousal (Craft et al, 2003). The other theoretical models are the catastrophe model (Hardy, Jones & Gould, 1996), the zones of optimal functioning (Hanin, 1986), and the multidimensional anxiety theory (Martens, Vealey & Burton, 1990). Martens and colleagues (Martens, Vealey, Burton, Bump, and Smith, 1990) developed the Competitive State Anxiety Inventory-2 (CSAI-2) to measure the intensity of performers' cognitive and somatic responses, and also self-confidence. Martens, Vealey and Burton (1990) believe that cognitive anxiety is the cognitive dimension of anxiety and is created by the negative expectations of the individual for performance and success while somatic state anxiety is the result of activation of the autonomic nervous system and is the natural dimension of anxiety.

Martens and colleagues (1990) suggested that both lower and higher levels of somatic anxiety would be detrimental to performance. In multidimensional anxiety theory Hardy, Woodman and Carrington. (2004) support the negative linear relation between cognitive components with fulfillment because it deals with results of defeat while the somatic component has reverse U relation with fulfillment. One of the characteristics that distinguish high-level athletes and/or successful athletes is self-confidence, which is a key feature that

states whether athletes believe in themselves and their strengths and whether they can achieve their goals (Vealey, 1986). Self-confidence that states the occasional or transient confidence of a person in his ability to successfully perform a desired task (Psychountaki, 1998) has been shown to protect athletes from the effects of stressful thoughts during competition (Hanton, Mellalieu & Hall, 2004). Furthermore, as Roberts et al. (2004) stated Self-confidence has linear direction with fulfillment, because it is in contrast with cognitive anxiety.

In artistic gymnastics (AG), athletes may feel stressed by performance requirements, (Cottyn, De Clercq, Pannier, Crombez & Lenoir 2006), and the subjective scoring system according to the rules of FIG (2016). During the competition, athletes are possessed by different emotions that may affect their performance (Williams & Krane, 2001). Data by Jones, Swain, and Hardy's. (1993) compared female artistic gymnasts who were divided into good and poor performance groups based on their beam competition scores and found that the more successful gymnasts experienced greater facilitative interpretations of their cognitive and somatic anxiety symptoms than their less successful counterparts. In another study, Pineda-Espejel, Lopez-Walle, Rodriguez, Villanueav and Gurrola. (2013) investigated the pre-competitive anxiety and self-confidence in 60 male and female artistic gymnasts during Pan American Games and found a linear correlation between cognitive and somatic anxiety and that self-confidence was negatively correlated with the intensity of cognitive anxiety.

Other studies indicate that the status of athletes and their future performance can be influenced by various psychological features (McNamara, Button & Collins. 2010) such as anxiety, and self-confidence, motivation (Durnad-Bush & Salmela, 2001; Gould et al, 2002). Status anxiety expresses the subjective feelings of fear,

nervousness and anxiety of the person in a transient, transient state (Martens, Burton, Nealey, Bump & Smith, 1983) and is distinguished in cognitive and somatic. There is a lack of scientific data concerning the psychological characteristics that predispose the outcome of the competition of young male gymnasts, especially in 9 - 11 years, noting that this age is considered by experts to be crucial for the future development of athletes (Smolefski & Gaverdofski, 1999). Furthermore, the fact that boys are less attentive and more agitated (Steindl et al, 2006) is another factor that may be affect the psychological characteristics of sport performance. However, there is lack of scientific data concerning the competitive state anxiety and self-confidence of young gymnasts. So, the aim of the present study was to investigate the competitive state anxiety and self-confidence of young male artistic gymnasts in Greece. More specifically, differences were examined between male artistic gymnasts with high and low scores. In addition, inter-correlations among the three CSAI-2 subscales and performance, and prediction of the gymnast's performance score from the three subscales, were examined. It was hypothesized that gymnast with higher performances score would have lower mean Cognitive and Somatic Anxiety and higher mean Self-confidence compared to gymnasts with lower mean performance scores.

METHODS

84 competitive young male artistic gymnasts, ages 9 – 11 years ($M = 9.66$ yr., $SD = 0.71$) belonging on different clubs affiliated with the Greek Gymnastics Federation were participated in the present study. Their training and competitive experience ranged from 3 to 6 and 3 to 4 years, respectively. According to the technical guidelines of the Greek Gymnastic Federation, gymnasts may

compete from very young ages in official national competition. This result to acquire competitive experience from the age of 8 years old which lead these gymnasts to be prepared their selves in a better way for the following competition. Sixteen of the gymnasts did not compete in all of the apparatus (floor exercise, pommel horse, rings, vaulting, parallel bars, and high bar) and their data were therefore excluded for further statistical analysis.

All participants belong on the same age category group and were competed in the same routines according to the Hellenic Federation of Gymnastics. These routines were evaluated based on the Code of Points of Federation International Gymnastics – FIG (2016). The points earned, according to the criteria used by the judges and the scoring system of the code of point used by the IGF, provided solid evidence of their performance. Accordingly, performance was separated, using the split half method (Scordilis, Douka, Spartali & Koutsouki, 2004; Takei & Dunn, 1996), in the high performance and low performance groups. The goal was to examine the differences of the two performance groups in cognitive anxiety, somatic anxiety and self-confidence.

The present study was concerned with pre-competitive state anxiety of gymnasts and for this reason the CSAI-2 for children questionnaire (Martens, et al., 1990), modified by the laboratory of athletic psychology and motor behavior (Kakkos & Zervas, 1993; Stavrou & Zervas, 2005), was used. A standardized administration procedure was used, following similar studies in the past (Tsopani, et al, 2011). The questionnaires were given one hour before the start of the competition (including the time for warm-up). There was a briefing from the coaches first and their permission was requested. An explanation was given to the athletes, who responded accordingly. The primary researcher was present during the data collection and provided clarifications to

the respondents. The administration process lasted 5-10 minutes approximately.

The questionnaire (CSAI-2) incorporates 15 questions in which the participants evaluated on a 4-point scale the extent of their agreement using anchors of 1: Not at all and 4: Very much so (see appendix A). This questionnaire is used in sports to examine the three subclasses of cognitive anxiety, somatic anxiety and self-confidence. Each of the three subscales incorporates 5 questions; higher scores indicate greater Cognitive and Somatic anxiety or Self-confidence (Martens, et al, 1990).

The Statistical Package for the Social Sciences (Norusis, 1993) was used for the analysis. The sample was separated into two groups (Hardy, Woodman, & Carrington, 2004; Skordilis, Douka, Spartali & Koutsouki, 2004; Takei & Dunn, 1996) according to the median split of their respective all-around competition scores, as either high or low. Accordingly,

the multivariate and Univariate differences were examined with Bonferroni adjustments between high-and low-score groups, on the three CSAI-2 subscales (Cognitive Anxiety, Somatic Anxiety, and Self-Confidence). Further, the intercorrelation matrix was examined to detect sources of multicollinearity among the three independent variables. The independent variables were the three CSAI-2 subscales scores, whereas the dependent variable was the score that received during competition by the judge panel (FIG, 2016).

RESULTS

The responses for all gymnasts on the three CSAI-2 subscales and their respective gymnastics scores are presented in table 1.

Table 1

Means and standard deviations for all gymnasts on CSAI-2 subscales of Cognitive Anxiety, Somatic Anxiety, and Self Confidence and by gymnastics scores (n = 68).

Variable	M	SD	n
Gymnastic score	43.74	9.73	68
CSAI-2			
Cognitive Anxiety	2.03	0.49	68
Somatic Anxiety	2.02	0.77	68
Self-Confidence	3.07	0.54	68
CSAI-2 High scoring			
Cognitive Anxiety	2.12	0.47	34
Somatic Anxiety	1.91	0.70	34
Self-Confidence	3.23	0.29	34
CSAI-2 Low scoring			
Cognitive Anxiety	1.96	0.52	34
Somatic Anxiety	2.13	0.84	34
Self-Confidence	2.92	0.68	34

Table 2

Intercorrelation matrix of athletes' gymnastics scores and responses to CDAI-2 subscales of Cognitive anxiety, Somatic anxiety, and Self-confidence (n = 68).

Variable	1	2	3	4
1. Gymnastics score	1.000	-.038	-.165	.223
2. Cognitive anxiety	-.038	1.000	.363**	.138
3. Somatic anxiety	-.165	.363**	1.000	.069
4. Self-confidence	.223	.138	.069	1.000

The multivariate analysis revealed a significant main effect for the high and low scoring groups ($\Lambda = .854$, $F_{(3,64)} = 3.654$, $p = .017$, $\eta^2 = .143$) on the three subscales. The univariate follow up analysis with Bonferroni adjustments showed no significant differences between the two groups on Cognitive Anxiety ($F_{(1,60)} = 1.497$, $p = .226$, $\eta^2 = .022$) and Somatic Anxiety ($F_{(1,60)} = 1.491$, $p = .226$, $\eta^2 = .022$). However, significant univariate findings were evident for Self-Confidence ($F_{(1,60)} = 6.052$, $p = .017$, $\eta^2 = .084$) and the high scoring performance group had a significant higher mean Self-Confidence than the low performance group. The Pearson coefficient did not reveal any significant inter-correlations between performance score and the responses in the three subscales. Therefore, no multiple regression analysis was conducted and the overall inter-correlation matrix is presented in table 2.

DISCUSSION

The present study intended to examine the competitive state anxiety and Self-confidence on young male artistic gymnasts ages 9 – 11 years old participating in the Greek national competition. The aim of this study was to extend the scientific data concerning the relationship between competitive state anxiety, Self-confidence, and gymnastics performance (score) of male artistic gymnasts. The results revealed that there

were no significant differences between high score and low score groups concerning the Cognitive Anxiety and Somatic Anxiety. This finding reinforces previous data of Tsopani, Dallas and Scordilis (2011), and those of Bejek and Hagtvvet (1996) who examined female rhythmic gymnasts and female gymnasts, respectively. In addition, verify findings by Hanton and Jones (1997) who reported non-statistically significant differences between high- and low-level athletes on cognitive and somatic anxiety. In terms of cognitive anxiety and gymnastics score the absence of statistically significant intercorrelation support partially previous data (Burton, 1988; Gould, et al, 1984; Martens, et al, 1990) who stated a negative linear relation between Cognitive Anxiety and performance but are in contrast with those of Tsopani, et al. (2011). Nevertheless, it must be emphasized the significant intercorrelation between cognitive and somatic anxiety which means that performance of young male artistic gymnasts seems to be affected by these anxiety subscales.

With respect to Self-Confidence a significant difference between high and low scoring groups was found as higher self-confidence was associated with higher performance (Kais & Raudsepp, 2004). This finding is in congruence with those of Tsopani and colleagues. (2011) who reported significant differences in Self-Confidence between finalists (high performance group) and non-finalist (lower performance group) of female rhythmic

gymnasts and those of Bejek and Hagtvet. (1996) who found a significant difference in Self-Confidence between elite and non-elite athletes. In addition, our results verify data by Vealy who considered that self-confidence is an important factor that distinguish high-level athletes and/or successful athletes (Vealey, 1986). The no statistical correlation between self-confidence and somatic anxiety confirm previous data of Pineda-Espejel and colleagues. (2013) who found that self-confidence did not correlate statistically significantly with somatic anxiety. However, opposed to the other studies (Jones, Swain, and Hardy, 1993; Kais & Raudsepp, 2004; Tsopani, et al, 2011). It is hypothesized that Self-Confidence has a positive linear relation with athletic performance upon the multidimensional anxiety theory of Martens et al. (1990). The fact that Self-Confidence did not significantly correlate with gymnastics score is in line with findings by Cottyn et al. (2006) who revealed no statistically significant intercorrelation between self-confidence and gymnastics score. However, results of the present study are in contrast to those of previous studies (Jones et al, 1993; Tsopani et al, 2011) who revealed a statistical significant intercorrelation between self-confidence and performance score, and those of Kais and Raudsepp. (2004) who reported a significant negative intercorrelation between Cognitive anxiety and Self-confidence.

The present study failed to support any significant predictor of performance a finding that opposed of Tsopani et al. (2011) data who examined female rhythmic gymnasts. However, results of the present study should be applied with some caution. First, the competitive state anxiety was evaluated with a paper-and-pencil questionnaire, without retrospective assessment of relevant attributes, such as heart rate (Cottyn et al, 2006). Second, anxiety was measured one hour prior to competition. Finally, only young male

artistic gymnasts were assessed, ages 9 to 11 years, and the results may not be generalized to other age groups or on female gymnasts or other sports (e.g., team sports; Stavrou, et al, 2006). Further research is required to refer to other individual sports with male athletes of the same age in order to form a wider database with competitive state anxiety norms or to evaluate pre-competitive anxiety by heart rate monitoring during the various phases of the warm-up prior to competition. The results of our work are practical in terms of pre-competitive mental preparation strategies of male artistic gymnasts. Sport psychologists should take into account that cognitive and physical anxiety does not always seem to adversely affect performance. In addition, Jones et al. (1993) has shown that cognitive techniques that include redefinition of stress symptoms as complications and facilities can be as effective as trying to reduce symptom intensity through various relaxation strategies.

CONCLUSIONS

The findings of the study underline the importance of examining competitive state anxiety and self-confidence in young male artistic gymnasts, mainly developing strategies to improve self-confidence to enable the athletes to better prepare for forthcoming competitions.

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THE RELATIONSHIP BETWEEN WOMEN'S ARTISTIC GYMNASTICS TECHNICAL SKILL, PHYSICAL PERFORMANCE TEST RESULTS AND SUCCESS IN COMPETITIONS IN FINLAND

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Original article

Abstract

The aim of this study was to find out the potential of the Minoritest to identify the most likely talented gymnasts to join the national team pre-training group in Finland. The study examined the relationships between gymnasts' (N=215, age 10–13) Minoritest results (2006–2010) and success in competitions after the Minoritests until the end of 2016. The competition results were also compared between the gymnasts who had participated in the test and a random number (N=180) of gymnasts who had not. According to this study, the majority (92%) of the best gymnasts in competitions had participated in the Minoritest. 39% of the best in competitions were among the top 10 in the Minoritest. The test results from the technical skills showed a significant connection to the average competition results in all age groups and to the average competition level in the 10–12-year-olds. The test results of the flexibility section did not show relation to competition success. The test results of the strength section showed a significant connection to the average competition results and to the average competition level in the 10–11-year-olds. In the 12–13-year-olds the test results of the strength section showed a relation to the average competition level. According to this study Minoritest success have a positive connection to the future competition success. However, the relation cannot be considered unequivocal. The test results of the strength section can be considered a significant section for the 10–11-year-olds to predict future potential to succeed.

Keywords: *Women's artistic gymnastics, talent identification, technical skills, physical performance, competition success.*

INTRODUCTION

In women's gymnastics the training is typically started at about the age of five and the high intensity of training is maintained through the growth (Arkaev & Suchilin, 2004; Armstrong & Sharp 2013; Sands, 2000). It takes about 10 years of intensive training to achieve the elite level in women's gymnastics (Arkaev & Suchilin, 2004; Armstrong & Sharp, 2013;

Sands, 2000). Because training is started at early childhood and the elite level is reached at middle to late adolescence, a talented gymnast must be identified earlier than in many other sports. Without early talent identification gymnasts might be excluded from the buoyant training and may not have the time required to reach the top level during the career. Talent

identification at an early stage is important also to ensure gymnast's motivation. (Prescott, 1999.)

There is no uniform world wide test for the identification of a potential gymnast. Each country has their own tests for talent identification which are, however, very much alike and include different kinds of measures of gymnast's physical fitness and technical skills (Bale & Goodway, 1990; Jemni, 2011). The importance of physical, anthropometric and motor characteristics have been highlighted in the talent identification (e.g., Bale & Goodway, 1990; Pion, et al, 2014; Prescott, 1999). However, comparison of these different characteristics has been shown to produce varying data (Pion, Hohmann, Liu, Lenoir & Segers, 2017). In addition, each apparatus has its own key elements for a successful performance. There is also a considerable variability in the ability of gymnasts to perform in different apparatuses. (Bradshaw & Le Rossignol, 2004).

To understand the physiological conditions of gymnast's early adolescence, it is necessary to take into account the gymnast's age, growth and maturation (individual timing and tempo of puberty) (Armstrong & Barker, 2012; Armstrong, Welsman & Chia, 2001; Armstrong & Sharp, 2013; Brown, Patel & Darmawan, 2017; Mountjoy, 2008; Van Praagh & Dore, 2002). The stage at which the gymnast's growth is, affects the gymnast's physical performance (Brown et al., 2017; Rowland, 2005). Aerobic and anaerobic fitness as well as muscle strength develop with the growth (Goswami, Singha Roy, Dalui & Bandyopadhyay, 2014; Rowland, 2005) and especially during puberty (Beunen & Thomis, 2000; Geithner et al., 2004; Van Praagh, 2000). Increase in the size of the body or its body parts is the most important factor affecting physical performance. The development of physical performance, especially anaerobic fitness and muscle strength, is also influenced by other factors independent of the body size,

which explains why gymnasts of the same size do not have the same level of physical performance. Such size-independent factors include e.g. functioning of the nervous system (recruitment, coordination) and the organization of the muscle fibers. (Rowland, 2005.)

Talent identification with an individual test is difficult because of the multidimensional nature of gymnastics, gymnast's individual growth and differences in coaching (Pion, Lenoir, Vandorpe & Segers, 2015; Pion, et al, 2017; Prescott, 1999; Sands, 2003; Vayens, Lenoir, Williams & Philippaerts, 2008). The weaknesses in predicting future performance by a single test are that the performance tests are testing only a few characteristics at a time and that the evaluation is strongly governed by the gymnast's current physical and technical skill level (Vayens, et al, 2008). It is often assumed that the child's physical performance and characteristics are in linear relation to adult's ones (Morris, 2000; Vayens, et al., 2008). The problem in selection processes is also the high dropout rate of gymnasts (Pion & al. 2015) due to various reasons (Crane & Temple, 2015). In Finland, majority of gymnasts quit gymnastics during the 11-15 years of age (Lämsä & Mäenpää, 2002). In the talent identification it would be important to understand and identify the factors that influence the development of a gymnast, and to assess the development of talent characteristics, motor learning and the ability to develop performance in the long term (Di Cagno, et al, 2014; Pion, et al, 2015; Prescott, 1999; Vayens, et al, 2008).

Minoritest is an annual test camp for female gymnasts in Finland where the gymnasts are selected for the Finnish national team pre-training group. All the 10-13-year-old gymnasts that have fulfilled the requirements of reaching the minimum competition score in the minimum competition level and completing successfully a certain performance badge, are able to participate

in the Minoritest. Participation in the test is optional. The test is based on FIG Age Group Development and Competition Program and consists of various technical skill and physical performance test exercises. The technical skill section consists of different kinds of individual movements and their combinations on each apparatus testing the gymnasts' specific technical prerequisites. The flexibility section consists of exercises that are designed to measure the gymnasts' shoulder and hip flexibility. The strength section tests the gymnasts' explosive power, speed, agility and specific strength-resistance characteristics with various static and dynamic exercises. The gymnasts are divided into three different age groups: 10–11-, 12- and 13-year-olds. The strength and flexibility sections are the same for all age groups, while the test exercises of the technical skills vary by age group. The technical skill exercises have changed somehow each year due to the problems in interpretation in some of the exercises and/or due to the deficiencies in gymnasts' techniques or in general skills. Example of Minoritest exercises can be found on the following websites (only in Finnish):

<https://www.voimistelu.fi/Portals/0/Nainen%20telinevoimistelu/2019%20Minoritestist%C3%B6.pdf> (technical skill test exercises).

https://www.voimistelu.fi/Portals/0/Nainen%20telinevoimistelu/NTV%20valmennusryhmien%20fyysiset%20testit_09032018.pdf (physical performance test exercises).

The purpose of this study was to examine the relationships between gymnasts' Minoritest results and success in competitions after the test and also to see whether any of the test sections predict future success in competitions. The aim of this study was to find out the Minoritest's potential to identify the most likely talented gymnasts to join the national team pre-training group.

METHODS

This study was conducted as a retrospective quantitative research that compared the test results of the gymnasts (N=215; age 10–13) who participated in the Minoritest in 2006–2010 to the competition results after the Minoritest until the end of 2016. The test results of those gymnasts who participated in the Minoritest in several different years, were analysed as separate performances. The total number of the test participants was 328. The competition results consisted of all the available results between 2006–2016, depending on when the gymnast participated in the test and for how long she has been competing after the test, but did not include results before Minoritests, apparatus specific competition results, team competition results or international competition results.

The Minoritest results as well as competition results were scaled to the seven-step-scale so that a certain percentage of the maximum points corresponded between values 1–7. The purpose of the scaling was to make the test and competition results comparable, and to separate the inadequate performances from the excellent ones (1=inadequate, 2=satisfactory, 3=fairly good, 4=good, 5=very good, 6=credible, 7=excellent). The Minoritest results were divided into three sections: technical skill (subdivided into vault, uneven bars, balance beam and floor sections), flexibility and strength sections. The competition results were divided into vault, uneven bar, balance beam, floor, total competition score and competition level. In addition, the competition levels (shown in table 1) were scaled to a five-step-scale because the Finnish competition system in female gymnastics changed during the review period.

Each gymnast had a different amount of competition results, still at least five, after the Minoritest. The average

competition result, weighted for the competition level, were calculated for each gymnast separately for each apparatus and for total competition score by using the scaled results and competition levels $[(\text{Result } 1 * \text{competition level} + \text{result } 2 * \text{competition level} + \dots + \text{result } n * \text{competition level}) / N \text{ (the amount of results)}]$. The average competition levels were calculated for each gymnast. The average total competition scores and levels of the gymnasts who participated in the Minoritest were also compared to the average total competition scores and levels of a random number (N=180) of gymnasts who had not participated in the test. This was made to find out the level on which the non-participants were on their competition success. Finally, from the average total competition scores, the top 50 gymnasts among those who participated in the test and among all (gymnasts who did and did not participate in the test) were separated (as value 1) from the rest of the gymnasts' average total competition scores (as value 0). All the comparisons of this study between the test results and competition results, as well as the comparison between the gymnasts who participated in the test and those who did not, are made by using the gymnasts' average competition results (vault, uneven bar, balance beam, floor, total competition score) and average competition level.

Table 1
Scaling of the competition levels.

Scaling category	Old system competition level	New system competition level
1	2, 3	D
2	4	E, 2
3	5	F, 3
4	6	4
5	7, 8	5

The research material was analysed using IBM SPSS Statistics 24 -software. The normal distribution of the material was

tested by the Kolmogorov-Smirnov test. Nominal and ordinal measures were used to classify the material variables.

Crosstabs and Chi-Square tests were used for testing how the top 50 gymnasts in the average total competition scores were divided into the group of gymnasts who had participated in the Minoritest and into the group of gymnasts who had not participated in the test. In the analysis, those gymnasts who had participated in the Minoritest were subdivided into the test ranking groups of 1–10, 11–20, 21–30 and >30.

The Kruskal-Wallis test was used to analyse the differences in the distribution of the average total competition score and the average competition level by test ranking groups. It was also used for testing the age effect on test results by testing the distribution equality of the test results of different test sections between different age groups (the 10–11-, 12- and 13-year-olds).

The Mann-Whitney U test was used to analyse the differences in the distribution of the average total competition score and in the average competition level between the gymnasts who had and gymnasts who had not participated in the Minoritest.

Spearman's correlation coefficient was used to explore the correlations between the test results of different test sections and competition success. In the analysis the apparatus specific test results of the technical skills were compared to the similar apparatus specific average competition results. The total test results of the technical skills were compared to the average total competition score and to the average competition level. The test results of the flexibility and strength sections were compared to the apparatus specific average competition results, to the average total competition score and to the average competition level. The total test score was compared to the average total competition score and to the average competition level. Spearman's correlation coefficient was also used to explore the relationships of the

test results of different test sections to the average total competition score and to the average competition level by age groups.

RESULTS

Minoritest results connection to the competition success

Figure 1 shows the distribution of the average total competition score and of the average competition level by test ranking groups. The differences between the test ranking of 1–10 and 21–30; 1–10 and >30; 11–20 and >30 were statistically very significant ($p \leq 0.001$). The differences between test ranking of 21–30 and >30 were statistically significant ($p \leq 0.01$). Those gymnasts with top 10 results in the test showed relatively the highest values in the average total competition score and in the average competition level.

Figure 2 shows the distributions of the average total competition score and of the average competition level between the gymnasts who participated in the test and those who did not. The gymnasts who participated in the test showed relatively higher competition scores and progressed into higher competition levels compared to those who did not participate in the test. The differences between these two groups were statistically very significant ($p < 0.001$). The results of the gymnasts who did not participate in the test showed some clear deviating values (marked with black spots) from the rest of the results.

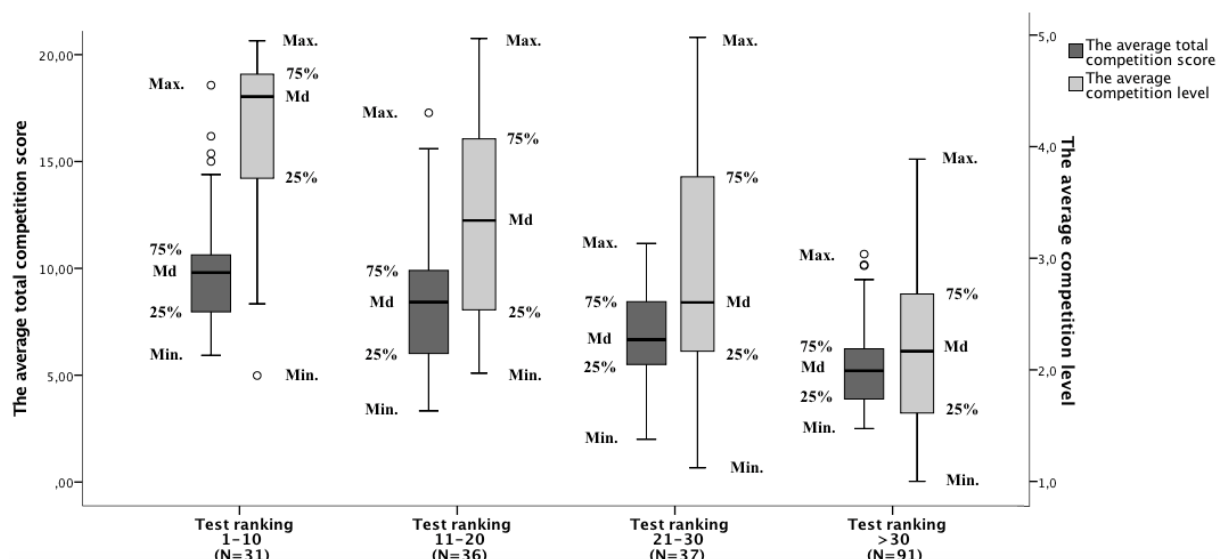
The crosstabs of how the top 50 gymnasts in the average total competition scores were divided into the gymnasts who did and into the gymnasts who did not participate in the Minoritest, showed that the majority (92%) of the best gymnasts in competitions participated in the Minoritest. Those with top 10 results in the test had the highest proportion (39%) of being among the best in the competitions. Test ranking of 11–20 showed also a connection

(31%) of being among top 50 in the competition results. 8% of the best in competitions didn't participate in the test. The Chi-Square test showed statistically a very significant reliance ($p < 0.001$) between the top placing in the test and the top placing in the competitions.

The test characteristics' connection to the future competition success

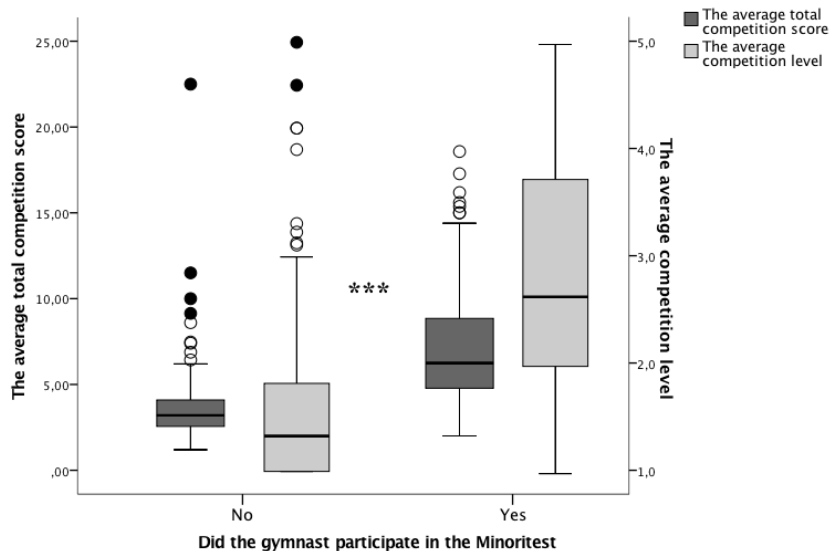
Table 2 shows the different test sections' test results correlation coefficient (r) and the coefficient of determination (r^2) to the average competition results and level. In the comparisons, the strength section showed significant coefficient of determination ($25 \leq r^2 \leq 36$) to the average floor competition result, total competition score and especially to the average competition level. The total test score showed very significant coefficient of determination ($30 < r^2 \leq 37$) to the total competition score and especially to the average competition level. Rest of the table 2 correlation comparisons showed either slight ($10 \leq r^2 < 25$) or not significant ($r^2 < 10$) coefficient of determination.

Table 3 shows the correlation coefficient (r) and coefficient of determination (r^2) of the test results of different test sections to the average total competition score and to the average competition level by age groups. In the 10–11-year-olds the test results of the technical skills and strength section showed very significant coefficient of determination ($28 \leq r^2 < 35$) to the average total competition score and to the average competition level. In the 13-year-olds the test results of the technical skills showed very significant coefficient of determination to the average competition score ($r^2 \approx 35$) and the test results of the strength section showed significant coefficient of determination to the average competition level ($r^2 \approx 27$).



N =count, Md =median, 25%=lower quartile, 75%=upper quartile, $Min.$ =minimum, $Max.$ =maximum

Figure 1. Descriptive statistics of test ranking groups in the average total competition score and level.



*** Statistically very significant difference ($p \leq 0.001$) between the gymnasts who participated and those who did not participate in the Minoritest.

Figure 2. The distribution of the average total competition score and the average competition level between the gymnasts who had and gymnasts who had not participated in the Minoritest.

Table 2
 Test results correlations to the competition results.

The average competition results and competition level							
		Vault	Uneven bar	Balance beam	Floor	Total competition score	Competition level
Minoritest results							
Vault	r	0.094					
	r ²	-					
Uneven bar	r		0.461**				
	r ²		21.3%				
Balance beam	r			0.348**			
	r ²			12.1%			
Floor	r				0.436**		
	r ²				19.0%		
Technical skills	r					0.478**	0.408**
	r ²					22.8%	16.6%
Flexibility	r	0.228**	0.161*	0.219**	0.260**	0.231**	0.328**
	r ²	5.2%	2.6%	4.8%	6.8%	5.3%	10.8%
Strength	r	0.496**	0.430**	0.427**	0.510**	0.501**	0.600**
	r ²	24.6%	18.5%	18.2%	26.0%	25.1%	36.0%
Total test score	r					0.554**	0.609**
	r ²					30.7%	37.1%

*Statistically almost significant reliance in the level of ($p \leq 0.05$).

** Statistically significant reliance in the level of ($p \leq 0.01$).

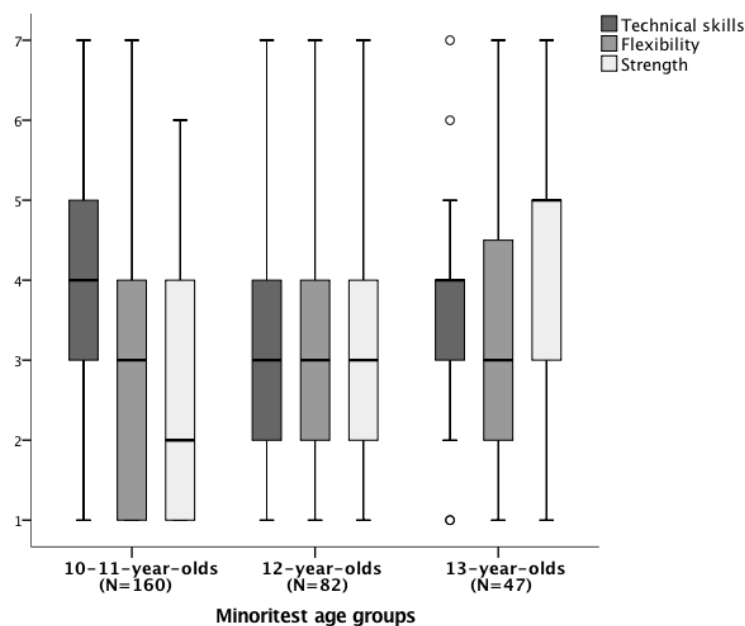


Figure 3. The distribution of the test results of different test sections by age groups.

Table 3

Test results correlation to the competition success by age groups.

		Average total competition score	Average competition level
Minoritest results:			
<i>Technical skills</i>			
10–11-year-olds (N=124)	r	0.578***	0.589**
	r ²	33.4%	34.7%
12-year-olds (N=40)	r	0.441**	0.423**
	r ²	19.4%	17.9%
13-year-olds (N=31)	r	0.589**	0.266
	r ²	34.7%	-

<i>Flexibility</i>			
10–11-year-olds (N=124)	r	0.281**	0.354**
	r ²	7.9%	12.5%
12-year-olds (N=40)	r	-0.034	0.023
	r ²	-	-
13-year-olds (N=31)	r	0.134	0.269
	r ²	-	-

<i>Strength</i>			
10–11-year-olds (N=124)	r	0.532***	0.560***
	r ²	28.3%	31.4%
12-year-olds (N=40)	r	0.286	0.497***
	r ²	-	24.7%
13-year-olds (N=31)	r	0.341	0.523**
	r ²	-	27.4%

Statistically significant reliance in the level of ($p \leq 0.01$).* Statistically very significant reliance in the level of ($p \leq 0.001$).

DISCUSSION

The purpose of this study was to examine the relationships between gymnasts' Minoritest results and competition success after the Minoritest and by that to find out the potential of the Minoritest to identify the most likely talented gymnasts to join the Finnish national team pre-training group.

Minoritest results connection to the competition success

The purpose of the gymnasts' performance and technical skill tests is to help the clubs and organizations to identify and select potential gymnasts objectively and utilizing the existing resources as

efficiently as possible. The problem in the talent identification is the poor ability of the tests to predict the future performance and the dropout of the selected gymnasts due to various reasons. (Pion, et al, 2017.)

Those gymnasts with top 10 results in the test had relatively higher competition scores and competed in higher levels after the test compared to the other gymnasts who participated in the test (Figure 1). Although the total test score and the average total competition score showed a positive relationship, the relation, however, cannot be considered unequivocal. This was shown for example by the fact that 36% of the top 10 gymnasts in the test were not among the top 50 in the competition results. The difference

between the test success and the competition success after the test can be influenced by injuries as well as, for example, the fact that at the time of the test gymnasts are still young which is why the gymnast's development is strongly governed not only by the gymnast's biological growth and development, but also by training responses (Armstrong & Barker, 2012; Armstrong, et al, 2001; Mountjoy, et al, 2008; Van Praagh & Dore, 2002; Prescott, 1999; Vayens, et al, 2008). A gymnast who does well in the test is not necessarily be able to maintain talent through the growth (Vayens, et al, 2008). The training and the amount and quality of training also have an impact on the competition success of the gymnasts. Those gymnasts with top 10 results in the test have had the opportunity to be part of the buoyant training, unlike the non-selected gymnasts. The best-performing gymnasts in the test can thus be expected to have a greater success in competitions in the future. On the other hand, if there are defects in training after the tests, potential gymnasts might drop out.

Participation in the Minoritest is optional which is why all the 10-13-year-old gymnasts do not participate in the test annually. The purpose of the comparison between the gymnasts who participated and gymnasts who didn't participate in the test was to get information on whether all the potential gymnasts participate in the Minoritest, and whether some of the potential gymnasts outside the tests are excluded from the national team pre-training group. The results showed that the gymnasts who participated in the test received, with the exception of exceptions, relatively higher competition results and competed in higher competition levels (Figure 2) compared to the gymnasts who did not participate in the test. The majority (92%) of the best gymnasts in the competitions had participated in the Minoritest. Those with top 10 results in the test showed the highest ratio (39%) of being among the best in the competitions.

However, the deviations in figure 2 of the gymnasts who had not participated in the test and the fact that nearly 8% of the top 50 gymnasts in the competitions were those who had not participated in the test, shows that some, yet a very small number, of potential gymnasts outside the tests are excluded from the national team pre-training group. This gives a consideration on how to get all the potential gymnasts cost-effectively participate in the Minoritest.

The test characteristics' connection to the future competition success

Gymnastics is versatile type of sport which makes it difficult to highlight individual characteristics that are important for success. Previous studies consider strength, speed, flexibility and certain type of body composition important in elite gymnasts. However, consensus about what features predict success in the future has not been found. In this study individual test exercises were not considered but the test results were examined by test sections. The purpose was to find out whether any of the test sections predict the future competition success and whether it is worth to underline some test sections' importance in the selection process.

The gymnast's physical and technical characteristics develop through training as the gymnast progresses to higher competition levels. The test results measuring the gymnast's physical fitness have been shown to be related to the gymnast's current competition level. For example, in the study of Sleeper, Kenyon and Casey, (2012) which assessed the relationships between the competitive female gymnast's physical fitness test scores and the gymnast's current competition level, there was a significant correlation between the gymnast's total test score and current competition level. In this study, the total test score and the average total competition score and particularly the average competition level showed a positive connection. Unlike

Sleeper, et al, (2012) study which compared the test scores to the gymnast's current competition level, in this study the test results were compared to the average competition level from the test year to the end of year 2016. On this basis, the connection between the test results and competition success can be found to predict also the future competition success. In other words, a gymnast who performs well in the test is supposed to perform well in the competitions in the future and consequently progress to higher competition levels. Participation in the Minoritest requires a certain minimum competition level. However, there is no upper limit for the competition level for the test participation. For this reason, it would be advisable in the test results to take into account the gymnast's current competition level and the amount of training associated with the competition level, due to their impact on the test results of the gymnast.

The gymnast's physical and technical skill characteristics depend not only on the amount and quality of training but also on the stage of growth. Age and on the other hand the effect of growth and training background to the test success was studied by comparing the distribution of the test results between different age groups. Comparison of the test results of different test sections between different age groups showed a statistically significant difference in the test results of the strength section, while there were no significant differences in the technical skill and flexibility sections or in the total test scores. A closer look at the correlations between the test results of the different age groups to the competition success showed that the test results of the strength section were most closely related to the competition success in the 10–11-year-olds. In the 12–13-year-olds the test results of the strength section did not correlate to the average total competition score but did show a connection to the average competition level. The test results from the technical

skills showed a significant connection to the average total competition score in all test age groups and to the average competition level in the 10–12-year-olds but not in the 13-year-olds. The test results of the flexibility section showed a weak connection to competition success in all age groups. Despite the fact, that there was a statistically significant difference between the different age groups in the test result of the strength section, there was no statistical difference between the different age groups in the total test scores. This suggests that the test results from the technical skills compensate the differences in the total test scores between the different age groups because the test exercises in the technical skills are different in each age group.

Gymnasts mature and develop at different stages, making it difficult to identify gymnasts with potential, especially by age group (Vaeyens, et al, 2008). If the test results are compared only to the gymnast's chronological age, there is a risk that potential gymnasts will not be selected (Vaeyens, et al., 2008). The tests can take part at the ages of 10 to 13, which gives a sliding margin to the not simultaneous growth and participation in the tests. On the other hand, the age groups have different difficulty levels in the technical skill section, which limits the consideration of non-simultaneous growth at different-aged gymnasts. Also, the test results of the technical skill section are influenced by the skill level of test movements in relation to the current skill level of the gymnast. The gymnast's competition level at the time of the test, the stage of growth, and the "unsuitable" test movements, may, in other words, skew the gymnast's future potential to succeed. This gives some reflection on how to eliminate the gymnast current technical skill level related to the current competition level when testing gymnast technical skills.

The Minoritest strength section included various exercises which tested the gymnast's explosive power, speed, agility

and specific strength-resistance. In this study the finding of the connection between the test results of the strength section and competition success, especially in the 10-11-year-olds, supports previous studies (e.g., Bale & Goodway, 1990), which emphasized the importance of strength, power, local muscular strength and agility to the competitive performance. Surprisingly, there was no significant reliance between the test results of the flexibility section and competition success, although, flexibility is considered to be an important feature for gymnastic performance. These findings support the statement, that the natural strength is more important than the natural flexibility as flexibility is easier to gain in the later years than strength, from which it is more than 50 % hereditary (Hohmann, Lames & Letzelter, 2007).

In previous studies (e.g., Bencke, Damsgaard, Saekmose, Jørgensen & Klausen, 2002; Nelson, Johnson & Smith, 1983, Hicks, 2005; Prescott, 1999) it has been found that the gymnast's strength characteristics are associated with higher training levels when competing in higher competition levels. In this study, the strength properties were studied before the development of the strength properties in the higher competition levels. The results showed a clear positive correlation between the test results of the strength section and the average competition level. In higher competition levels performing more difficult movements, it requires more strength. For naturally powerful gymnasts it is supposedly easier to upgrade to higher levels than non-powerful gymnasts, because they have in principle more strength for more difficult movements. The clear link between the test results of the strength section of the 10–11-year-olds and the competition success, support the idea that naturally stronger gymnasts will have a greater likelihood of success in competitions in the future (Ho, 1987). This is justified by the fact that the strength characteristics of the 10–11-year-olds were

measured while the gymnasts competed in the lower competition levels before the strength characteristics developed in the higher competition levels. The fact that the test results for the 12- and 13-year-old did not show a connection to the competition results but showed a connection to the average competition level, suggests that older gymnasts' test results of the strength section are likely to be more related to the current competition level than predicting the future competition success. What may affect this is the fact that the older gymnasts' strength characteristics are compensated not only by the growth but also by the training effects as gymnasts get older and move into higher competition levels.

CONCLUSIONS

The Minorititest results give the direction of the gymnast's potential to succeed in the future. Those gymnasts with top 10 results in the Minorititest showed the highest probability of being among the best in competitions in the future. Top placing in the test does not, however, directly guarantee that the gymnast would also be among the best in the competitions in the future. This is influenced by the various factors from the gymnast herself and from what opportunities the environment has to offer for the success after the test. The majority of the best gymnasts in competitions had participated in the Minorititest. However, outside the Minoritests, single potential gymnasts are excluded from the selection. This issue requires consideration on how to get all the potential gymnast participate in the Minorititest.

Based on this study, it is not possible to underline any individual test characteristics to identify talented gymnasts. According to the results, the strength section can be considered as a significant unity in the 10–11-year-olds to predict the future potential to succeed. In

the 12–13-year-olds the test results of the strength section were more related to the gymnast's current competition level than predicting the future potential of success. The test results of the flexibility section showed a weak connection to the competition success in all age groups. The test results from the technical skills showed a connection to the average competition results in all age groups. However, the gymnast's current competition level, the stage of growth and the current technical skill level related to the test movements, should be considered when observing the test results.

Based on the findings, it would be more desirable for the Finnish national team pre-training group to choose the gymnasts who get good test results from the technical skill and strength sections rather than from the flexibility section. In the talent identification it would be also good to emphasize the gymnast's potential to develop in the long term. As the gymnasts are getting older and progress into higher competition levels the differences in the technical and physical characteristics are more related to the gymnast's current competition level than separating the future potential to succeed. It would be desirable to monitor the gymnast's performance characteristics and the ability to develop in the long term before the Minoritests as the gymnast is still competing in lower competition levels.

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BENEFITS OF THE UNIVERSITY RHYTHMIC GYMNASTICS EXTENSION PROJECT FOR UNDERGRADUATE STUDENTS OF PHYSICAL EDUCATION AND SPORTS

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Abstract

University Extension is a core activity of Higher Education that joins educational, cultural and scientific processes that develop and feed Education and Research. The purpose is to put knowledge into practice through its programs, projects and events; the university extension can be held on different fields, such as sports and physical activities. Purpose of the present study was to analyze the experiences of undergraduate students participating in the university extension project in Rhythmic Gymnastics (RG), which was designed to enhance their professional development. Semi-structured interviews were carried out with twelve students who were part of the Physical Education Teacher Education and/or Bachelor in Physical Education Undergraduate Programs. The interviews were delivered with the Ethical Terms of the research objectives, in order to answer students' questions and guarantee their privacy. For data analysis, the Elaboration Technique and Signified Units Analysis were used. From the data obtained, we verified eight categories that initiated discussions about being part of the RG Extension Project. The four most cited were: a) the experience was positive; b) they learned in action; c) they felt what it was like to be a coach; d) they had direct contact with novice gymnasts. The majority of the participating undergraduate students agreed that the university extension allowed them to think about RG and others gymnastics disciplines as a potential profession, and the mentoring process as a significant way of developing coach and/or physical education teacher education to deal with gymnastics.

Keywords: *rhythmic gymnastics, physical education and sports, coach education, physical education teacher education (PETE).*

INTRODUCTION

A coach and/or physical education teacher's knowledge is built not only by accumulation of information, but by the interaction between that information and experience. In other words, the coach and/or physical education teacher must

reflect on his or her actions and reorganize the knowledge required for the task as he or she carries it out (Martins, Dias & Martin Filho, 2016).

Tardif (2014) describes three ways of acquiring teaching knowledge: academic

(acquired in undergraduate academic courses); professional (obtained in professional settings); and experience (acquired through personal, social, and professional experiences), all of which must be considered and valued.

Universities promote effective reflection on professional education through teaching-learning practices. This assumes the inseparability of teaching, research, and extension activities favoring independent, competent, ethical, critical and creative professionals (Martins, Dias & Martin Filho, 2016; Moita & Andrade, 2009).

Extension activities complement educational, scientific, and social projects, allowing the student to participate in the teaching process and evaluate knowledge, both of which are essential to the student's trajectory. In addition, critical and creative integration into society is encouraged by social commitment (Carvalho & Síveres, 2013). Based on this assumption, extension activities should be aligned with the guidelines of higher education (Síveres, 2013).

In the case of this study, the guidelines for the university extension are based on the Brazilian National Politics for University Extension (FORPROEX, 2012), according to which two aspects must be considered when developing the programs: the educational process as a dialogical relationship and the training process as a relationship between theory and practice.

The Rhythmic Gymnastics University Extension Project is part of the Program on Dance, Circus Activities and Gymnastics (PROGAGIN) linked to the Federal University of Amazonas (Brazil), in Manaus, that offers the local community classes in dance, circus and gymnastics for all ages including people with disabilities.

Considering the local context (Northern Brazil), rhythmic gymnastics has some advantages as a gymnastic discipline. It can be practiced in a courtyard, ball games courts, dance studios, and it can be done with official

portable apparatus -- rope, hoop, ball, clubs and ribbon-- or with built and/or adapted apparatus. The practice is closely related to rhythm and dance and can be adapted to the traditional rhythms and dances of the local culture. It also requires and develops coordination in multiple ways, as the participants move according to music while handling different apparatus.

From this perspective, the teaching-learning process must follow a student-centered approach, where the instructor not only administers classes, but guides the students' personal learning processes (Goulart, 2004), especially regarding disciplines with which students are not familiar such as, dance, gymnastics, and corporal expression.

Studies indicate that most undergraduate students have little knowledge related to gymnastics, rhythm, and dance when they arrive at the university, because ball games appear more frequently on TV and social media and are more valued in physical education during the primary and secondary school years (Carbinatto, Gonçalves, Simões, Moreira, & Nunomura 2017; Alves, 2016; Schiavon & Nista-Piccolo, 2007). Thus it is necessary to give students access to concepts related to those subjects and the opportunity to apply their knowledge.

The objective of this study was to analyze the experiences of undergraduate students in a Rhythmic Gymnastics University Extension Project and its benefits for coach and/or physical education teacher education development.

METHODS

The present study was a descriptive case study with a qualitative approach. The research participants were 12 undergraduate students (seven males and five females) from the Physical Education Teacher Education and Bachelor in Physical Education Undergraduate

Programs who were engaged in the Rhythmic Gymnastics Course and joined the Rhythmic Gymnastics University Extension project in a university located in the north of Brazil. Being part of the university extension project was mandatory, as it was one of the assessment instruments displayed in the RG course syllabus.

The instrument used for data collection was individual semi-structured interviews, which allowed us a higher level of interaction with the participants of the study. This type of interview facilitates a deeper knowledge of the interviewee's personal motivations, values, beliefs, feelings, and opinions (Laville & Dione, 1999). Data were collected only after the project was approved by the Ethics Research Committee under CAAE 96192618.7.0000.5020.

At the beginning of the semester, children from the local community randomly registered for the Rhythmic Gymnastics (RG) project. Even though the program was open to both genders, only girls took part in the sessions ($n=30$) and were between 7 to 10 years old. During four months (one semester), the training sessions took place on Tuesdays and Thursdays for 90 minutes per day.

The undergraduate students were simultaneously enrolled in the RG Course and the Extension Program. First, they were invited to observe the training sessions with a mentor; in the classroom, they got to know the history, concept, rules and methods used to teach RG. After eight weeks, the undergraduate students were in charge of preparing the training sessions. Organized in groups of three, they were responsible for creating, teaching and training an RG routine to one girl. This routine was to be performed in a Gymnastics Festival at the end of the semester.

After every session, a mentor discussed with the undergraduate students their opinions: Did they like what they had prepared? How did they feel about the

children's performance? Would they change anything, and if so, why?

In the RG course, the mentor brought theories, videos and different sources to address the undergraduate students' concerns. Together, they planned the weekly sessions and discussed the performances of their gymnasts and the whole group.

When the semester ended, the undergraduate students were individually interviewed according to the established protocol. The questions focused on their perceptions about Rhythmic Gymnastics (RG), the RG project, the gymnasts, RG training routines and others issues. The interviews were audio-recorded, transcribed, and shown to the participants for review. If everything was accurate, they allowed disclosure.

The Elaboration Technique and Signified Units Analysis proposed by Moreira, Simões and Porto (2008) were used for data analysis. This technique is used to understand and interpret the reports of participants who issue opinions on a subject based on their feelings and values.

Two researchers did the analysis separately and then decided on the categories that emerged to prepare the final results. The analysis encompasses the following steps: raw narrative, identification of attitudes and interpretation.

1. Raw narrative – Responses of the interviewees to the following questions:

a) Tell us about your experience with the Rhythmic Gymnastics University Extension Project.

b) What is your opinion about being evaluated for your performance in the RG University Extension Project?

2. Identification of attitudes – Several readings of the interviewees' raw narratives were done in order to ascertain the main points of the respondents' discourse. The most frequently signified units that appeared were selected to create indicators and categories that were used as references for the interpretation.

3. Interpretation –We identified and assembled the most significant units of meaning, derived from the general framework of each individual’s discourse.

RESULTS

The analysis revealed eight categories that summarize what was most meaningful and relevant to this study (Table 1). The students were identified by the letter “S” followed by a number to indicate the order in which they were interviewed.

Table 1
Signified Units of experiences of coach education and physical education teacher education undergraduate students in the RG University Extension Project.

Signified Units	Participants											
	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12
Positive experience	√	√	√	√	√		√	√	√	√	√	√
Learned through application		√	√		√	√	√					√
Experienced being coach/teacher	√			√		√	√			√	√	
Enjoyed working with children		√	√	√	√		√	√				
Considered gymnastics as a profession		√		√		√	√	√	√			
Experienced the challenges of competition		√				√	√	√	√			
Had to think “outside the box”			√		√		√			√	√	√
Considered the experience a good instrument of assessment			√			√					√	

DISCUSSION

The category with the highest convergence was “Positive experience”. As many students had never done and/or taught gymnastics, this was a new experience for them. According to the participants, (S2) *It was very good; for me it was a new thing, not something that I had already experienced;* (S5) *It was the first experience [of the extension program] that I had up to that point in the three years that I have spent here . . . we have started to have an experience that we do not have in other places most of the time;* (S9) *It was good, and an area that I had no experience in at all;* (S11) *It was very useful to me;* (S12) *It was quite interesting . . . a very nice experience.* The university extension activities benefit both the

undergraduate students and the community being served. While the community receives a service, free of charge in most cases, the students learn about teaching, as they have the opportunity to apply the theories discussed in the undergraduate modules (Rodrigues, Prata, Batalha, Costa & Passos Neto, 2013). It is necessary to deal with the people from the community to establish an academic culture and an environment of interconnection between society and university (Fernandes, Silva, Machado, & Moreira, 2012).

The university extension project could be considered an institutional guideline, that is, an intermediate step between the learning process and the application of

knowledge. This must be experienced by students daily, ensuring intellectual and professional development, so that they can become competent and conscientious citizens (Siveres, 2013).

One of the difficulties usually reported by coach education and physical education teacher education students in teaching gymnastics is their lack of experience. Teachers often cannot transcend the technical content of gymnastics, reinforcing the idea that only those who have mastered gymnastic techniques can work with gymnastics. Similarly, Schiavon and Nista-Piccolo (2007) reported that primary school physical education teachers stated that the main difficulties encountered in working with gymnastics activities were related to specific knowledge of its modality, the working method, and strategies for teaching the sport. The teaching of gymnastics is perceived as limited to procedural content, emphasizing the technique behind the movements.

One means of addressing this problem would be to provide opportunities during the undergraduate program that enable students to establish a practical relationship with the labor market (Lopes & Fátima, 2012). It is essential that the university allow students to practice what is learned in the classroom. For example, one who is in the process of learning ends up learning much more when theory is put into practice, thereby removing the sense of intimidation about teaching gymnastics (Rodrigues et al, 2013; Schiavon & Nista-Piccolo, 2007).

Doing research and working with extension activities during academic development makes the student a proactive contributor to changing a world in which information acquisition has been the main method of professional education for too long (Goulart, 2004).

Half of the participants confirmed that the experience was rewarding, as they "Learned through Application," exemplified by S1 and S5 respectively:

(S1) It is an amazing feeling to teach and pass on the knowledge that we picked up during this time! (S5) Seeing what they did today was quite rewarding!

The discourses about "Being a Coach/Teacher" were filled with emotion. Student S3 stated, *"It was gratifying to see the results of the girls at the end, knowing that we grew a little together . . . we have learned from them and they have learned from us! It was amazing!"* Two interviewees cried after confirming that *"The relationship goes beyond that of a student and teacher. We end up becoming attached to the students [gymnasts], which is very beautiful"* (S4) and *"To mix our profession with the emotion of having a student before finishing college was wonderful!"*(S10). In addition, they "Enjoyed Working with Children," because they expressed that the children were involved in and motivated by the sessions.

Participating in the Gymnastics Festival made the undergraduate students "Experience the Challenges of a Competition." The final festival intended to simulate the RG Championship on a local scale: *(S1) It was cool for the competitive style because, like it or not, it is a competitive evaluation; (S2) We get a little nervous, but is a good experience because it is something concrete . . . being presented to the public is a nice experience; (S7) It was hard, and there was a little tension, but in the end everything was all right; (S8) It was difficult and exciting, but I found it interesting;(S9) It was a little tense, and everyone wanted everything to be correct and beautiful; (S12) It was tense, but in the end, everything came out right.*

These four categories highlight the importance of university extension programs for the professional education of students. Although challenging, the RG discipline was demystified through these experiences.

Similar results were found by Sargi et al (2015), when studying participants in a

Gymnastics for All University Extension Project. It was clear that participation in an extension activities projects in the discipline of gymnastics increases the interest of undergraduates in this modality.

Accordingly, we suggest that the interaction between university and community through university extension programs enables the student to closely comprehend the cultural, historical, and educational aspects of a particular social group, thus making him or her more aware of the context in which he or she must participate (Oliveira & Almeida Junior, 2015).

Extension activities expand classroom knowledge through a democratic experience that generates a new way of seeing the world, respecting differences, and learning to exercise citizenship (Jantke & Caro, 2013). Therefore, extension activities reinforce students' critical and reflective views of physical education and sports fields, especially gymnastics (Pizani, Araújo, Braguin, Barbosa-Rinaldi & Lourenço, 2015).

Teaching gymnastics in the Physical Education Teacher Education and Coach Education Programs should motivate students and bring them personal satisfaction regarding what they do, giving meaning and importance to actions in different contexts of professional practice (Campestrini, 2014).

Meaningful learning occurs when theory and practice are combined for those who are in the midst of the educational process (Sousa et al, 2015); on the contrary, the educational process becomes limited when there is no application of theory (Rinaldi, Lara & Oliveira, 2009). Thus, we infer that the experience in the university extension program added meaning to the physical education and sports students' learning within the context of gymnastics. Half of the interviewees now "Considered Gymnastics as a Profession."

We highlight the statements of participants eight and eleven as an

example: (S8) *I did not intend to work in this area, with this training method and style . . . who knows whether, one day in the future, I will work with this;* (11) *First, I never imagined having a job working with rhythmic gymnastics, and of course the possibility of it has increased. This increases the range of opportunities in life . . . thus, of course, it can be something in my future.*

These findings are like those reported by Vieira, Santos and Ferreira Neto (2012), and Costa, Baiotto and Garces (2013). The former study was conducted with physical education teachers who narrated their trajectories during training, and the latter focused on undergraduate students who reported their perceptions of involvement in university extension programs for academic and professional development and social commitment. In both studies, the subjects stressed the importance of their participation in university extension programs, which contributed to academic knowledge and the discovery of new professional fields.

When they interviewed PETE and Coach Education students in a Gymnastics for All University Extension project in the city of São Paulo, Bahu and Carbinatto (2016) found that the prospect of gymnastics as a profession was a signified unit.

Having experience in university extension activities broadens students' professional views, sensitizes students to a different reality, contextualizes professional practices, enables self-knowledge, allows a reflexive critical development (Siveres, 2013), and can inspire new directions in students' development (Fadel et al, 2013).

The usually isolated content offered in the classroom is not enough to transform the undergraduate student into a reflective and critical professional. The mentor must incorporate research and extension activities into his or her educational process in order to complement and give meaning to learning (Goulart, 2004).

Providing these practices parallel to the courses can facilitate the participation of undergraduates who did not experience university extension activities until the present moment, due to either lack of time, lack of knowledge about how to join projects, or lack of understanding the role university extension activities play in academic development.

The Signified Unit “Had to Think ‘Outside The Box’,” expresses the interviewees’ opinions about how extension activities delivered broader knowledge than the syllabus’ contents, as indicated in the following statements: (S3) “[The Project] *deviates from the sameness of the classroom and encourages us to be creative . . . I had never participated in any university extension program;* (S7) [The Project] *went beyond the classroom;* (S10) *I thought I was going to take the class and study gymnastics in the classroom, but not that I would have the experience of acting as a coach;* (S11) *We always study theory and we never get to put it into practice;* (12) *We ended up leaving that “classroom-only” context!*

It is notable that undergraduates seek activities that surpass the classroom, even though what is done in the classroom is important, such as discussion and analyzing theories and concepts. Limited classroom time does not allow for application of theory in the way that RG training does. Síveres (2013) and Rodrigues, et al (2013) agree that extension activities definitely complement the teaching-learning process acquired in the classroom courses.

Students’ participation in extension activities projects allows them to better understand the reality that they will encounter after becoming professionals (Manchur, Suriani & Cunha, 2013). This will provide reassurance when they are asked to teach unfamiliar modalities that are considered challenging, such as gymnastics.

This type of insecurity occurs in other modalities as well, such as most rhythmic

disciplines. It is very common for physical education professionals to stop working with dance classes, for example, because they do not feel capable of imparting the content to their pupils. This difficulty may reflect their experiences in childhood and adolescence, which mainly focused on competitive sports. Thus, they are unable to visualize the range of professional possibilities (Alves, 2016).

In the Physical Education and Sports culture, we still believe that previous experiences in a sport offer enough knowledge to ensure a good job as a teacher or coach of that sport (Carbinatto, 2012). These experiences provide an undeniably good base of knowledge, but when the coach/teacher is restricted to this, without seeking other sources, he or she ends up promoting the idea that the professional can only teach the content if he or she has mastered all the specific techniques of that sport.

Gymnastics should be viewed holistically and not just as a series of bodily techniques that the student often cannot replicate. Student monitoring activities are important strategies for dissolving prejudices and promoting reflective approaches backed by practice (Alves, 2016).

In relation to the last Signified Unit, “Considered the Experience a Good Instrument of Assessment,” participants offered the following comments: (S3) *It’s a different evaluation; it is cool because it is creative and encourages people to be creative, to exercise the profession of coaching;*(S6) *Dude, everything has been a challenge and having a grade included was even more challenging, but we used it as an incentive to do our best at the tasks we were given;* (S11) *In fact, I completely forgot that it was an evaluation because I was worried about her (the gymnast) performing well in the presentation, liking it, and being happy with her presentation, but I really did not worry about it, which may seem incredible, because I worry a lot about grades.*

The instrument of assessment was not perceived by the students as something they might fail, but as a method of evaluating learning. The evaluation should be considered a natural consequence of the learning process. The aim of assessing students is to provide the student and the teacher with evidence of how the teaching-learning process is progressing and what, if anything, needs to be improved. Therefore, it is important to avoid qualification as an “A student” or “C student,” which is often accompanied by feelings of success or failure (Lima & Grillo, 2010).

The formative assessments became interesting because they included diverse instruments that followed the progress of each student during the semester (Carbinatto et al, 2016). If the goal of university education is to develop creativity and reflective thinking skills, it is essential to develop a curriculum that aligns with this goal and entails the selection of new content and skills, in addition to rethinking the evaluation strategies used (Garcia, 2009).

It is important to provide undergraduate physical education and sports students with knowledge in order to make them reflect on the wide array of possible fields of activity, especially in the area of gymnastics (Pizani, et al 2015). From this perspective, gymnastics classes should value initiative, autonomy, creativity, discovery and action versus memorizing concepts, regurgitating information and copying plans (Carbinatto, 2012).

CONCLUSION

Participating in a Rhythmic Gymnastics University Extension Project provided benefits to the undergraduate participants, ranging from practical knowledge to the expansion of employment possibilities.

The Signified Units discussed enable us to confirm that having a sport as a key

practice in an extension project produced important experiences for the future development of Physical Education and/or Sports, from better understanding of children and training children to comprehension of the competitive environment.

Breaking the paradigm in which only ex-athletes or those who have practiced gymnastics can work with the modality was possible because of the students’ experiences in the university extension project, which enabled them to understand what it is to be a teacher/coach.

We underline the importance of the inseparability of the components of the “university tripod” (teaching, research, and extension activities). We discovered that the out-of-classroom activities surpassed the classroom environment in multiple ways. Leaving the classroom to teach gymnastics, as a reworked form of evaluation, richly complemented the teaching-learning process of these future professionals. This points to the importance of enabling the student to apply the knowledge that is generated in the classroom, thereby reducing the dichotomy that stills exists between theory and practice.

In conclusion, we affirm that the university extension program belongs in the teaching process. It can and should be tried with other modalities and their respective courses, so as to ensure student development that is more realistically aligned with the labor market.

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SOCIAL PHYSIQUE ANXIETY, DISTURBED EATING ATTITUDES AND BEHAVIORS, AND PERCEIVED PRESSURE FOR THIN BODY IN COMPETITIVE RHYTHMIC AND AEROBIC GYMNASTS

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Original article

Abstract

This study investigated social physique anxiety (SPA), disturbed eating attitudes and behaviors (DEAB), and perceived pressure for thin body by the “significant others” (coach, parents, peers, experts) in 41 female rhythmic gymnastics (RG) and 49 aerobic gymnastics (AG) athletes at competitive level. Moreover, the potential impact of gymnasts' BMI was examined and controlled. Results showed that BMI associated with gymnasts' SPA, DEAB and perceived pressure, so its effect was controlled. There were no significant differences between RG and AG regarding SPA and DEAB, whereas AG athletes had higher parental pressure for thin body than RG athletes. When RG and AG data were merged, a high percentage (40%) of gymnasts presenting DEAB was revealed. Gymnasts with DEAB had significantly higher SPA and perceived pressure for thin body than those with normal eating attitudes and behaviors. These results underline the need for interventions involving “significant others” and aiming at DEAB prevention in female gymnasts.

Keywords: *eating disorders, female athletes, “significant others”, health.*

INTRODUCTION

Athletes often present high levels of Social Physique Anxiety (SPA) (Martin Ginis, Lindwall, & Prapavessis, 2007; Prapavessis, Grove & Eklund, 2004) and disturbed eating attitudes and behaviors (DEAB) (Lanfranchi, Maïano, Morin, & Therme, 2014; Petrie & Greenleaf, 2007; Thein-Nissenbaum & Carr, 2011), with females being more vulnerable (Fairburn, & Beglin, 1990). SPA is defined as “a subtype of social anxiety that occurs as a result of the prospect or presence of interpersonal evaluation involving one’s physique” (Hart, Leary, & Rejeski, 1989,

p. 96). DEAB refer either to abnormal beliefs, feelings and thoughts regarding food (Alvarenga, Pereira, Scagliusi, Philippi, Estima & Croll, 2010) or abnormal dieting behaviors (Nattiv et al., 2007) and can have a negative effect not only on athletes’ performance (Costarelli & Stamou, 2009) but also on their health, since they can lead to eating disorders (Chamay-Weber, Narring, & Michaud, 2005; Jacobi, Hayward, de Zwaan, Kraemer, & Agras, 2004).

Differences in SPA and DEAB among different types of sports are often reported,

with female athletes participating in individual sports presenting higher SPA levels, dieting and bulimic behaviors than those participating in team sports (Haase, 2009). Particularly those who participate in aesthetic sports, such as synchronized swimming, gymnastics, and diving, tend to present higher levels of SPA and DEAB (Gay, Monsma & Mc Gehee, 2011; Haase & Prapavessis, 2001; Sundgot-Borgen & Torstveit, 2004). Especially in competitive gymnastics, where low body fat and low body weight are considered important factors for better appearance and performance (Sundgot-Borgen, 1993), female athletes present high percentage of DEAB (26% in rhythmic gymnasts [Kosmidou et al., 2015, Kosmidou, Giannitopoulou, & Proios, 2018]; 30% in rhythmic and artistic gymnasts [Theodorakou & Donti, 2013]).

Among the factors associated with SPA is the perceived pressure to have a thin body by the “significant others” (Francisco, Narciso, & Alarcao, 2012). In recent years, more than ever, a greater pressure on athletes to be thinner has been noticed (Hausenblas & Fallon, 2006; Hausenblas & Downs, 2001). In gymnastics, the pressure to be thin is widely recognized as a fact (Salbach, Klinowski, Pfeiffer, Lehmkuhl, & Korte, 2007; Theodorakou & Donti, 2013). Female gymnasts train intensively and receive pressure to have thin bodies from a very young age (Kosmidou et al., 2018; Salbach et al., 2007). Adolescence is a period of hard training (Balyi, 2001); nevertheless, it is also a period in which females’ body dissatisfaction begins to increase (Bearman, Presnell, Martinez, & Stice, 2006). The aforementioned, in conjunction with perceived pressure by “significant others”, increase gymnasts’ SPA (Stice & Shaw, 2002). Coaches, family and friends play an important role in young gymnasts’ life, so they may contribute to both a negative body image and DEAB.

In light of the negative consequences that DEAB can have in athletes’

performance and health, as well as the high percentage of DEAB prevalence in female gymnasts, the investigation of the association among SPA, DEAB and perceived pressure for thin body in female gymnasts seems important. However, current literature on this issue is restricted, as there is no study having investigated those three factors simultaneously. Moreover, to our knowledge, there is no study focusing on aerobic gymnastics, a gymnastics discipline with thousands of young female athletes. Based on the above, this study aimed at investigating SPA, DEAB and perceived pressure for a thin body by the “significant others” in female rhythmic and aerobic gymnasts at competitive level. In order to achieve a clear picture of the association among the aforementioned factors, the potential impact of athletes’ BMI was examined and controlled, taken into account that significant relationships between BMI and DEAB (Atalay & Gencoz, 2008; Neumark-Sztainer, Wall, Story, & Standish, 2012; Snoek, van Strien, Janssens, & Engels, 2008; Theodorakou & Donti, 2013), SPA (Neumark-Sztainer et al., 2012; Snoek et al., 2008), and perceived pressure to be thin (Stice & Shaw, 2002) have been reported.

METHODS

A total of 90 Greek female gymnasts with a mean age of 13.9 years ($SD= 2.42$ years) participated in this study. Among them, 41 were Rhythmic Gymnastics (RG) athletes and 49 were Aerobic Gymnastics (AG) athletes. All of them were taking part in competitions at national and international level. Athletes’ characteristics are presented in Table 1.

Social Physique Anxiety

For the measurement of gymnasts’ SPA, the Greek adaptation (Psychountaki et al., 2004) of the Social Physique Anxiety Scale (SPAS, Hart et al., 1989)

was used. The SPAS aims at measuring the concerns of the individual about his/her physical appearance and the stress for a negative evaluation from others. The SPAS items are answered in a 5-point Likert scale (not at all [1], slightly [2], moderately [3], very [4], and extremely [5]), with higher values revealing higher SPA. Its original version (Hart et al., 1989) consists of twelve items; however, in the present study, a nine-item version was used (Martin et al., 1997), since it is thought to be conceptually clearer (Haase, 2009; Martin et al., 1997). Regarding the psychometrics of this SPAS version, high internal consistency and construct validity are reported (Martin et al., 1997). In the current study, Cronbach's alpha value was found at .77.

Disturbed eating attitudes and behaviors

Participants' DEAB were assessed with the Eating Attitudes Test (EAT-26; Garner & Garfinkel, 1979; Garner, Olmstead, Bohr, & Garfinkel, 1982), adapted for the Greek population (Douka, Grammatopoulou, Skordilis, & Koutsouki, 2009; Varsou & Trikas, 1991). The EAT-26 is a questionnaire evaluating a variety of attitudes and behaviors directly related to eating disorders. It consists of 13 items assessing dieting, six items assessing bulimia and food preoccupation, and seven items assessing oral control. Each question is answered in a Likert scale (always [3], usually [2], often [1], sometimes [0], rarely [0] and never [0]). A total EAT-26 score more than or equal to 20 shows an abnormal eating behavior and possible eating disorders (Garner et al., 1982).

As far as the technical adequacy of the EAT-26 is concerned, acceptable discriminant and criterion validity (Garner et al., 1982) as well as internal consistency (Haase, 2009; Kosmidou et al., 2018, 2015) are reported. In this study, Cronbach's alpha values for the total EAT-26, dieting, bulimia and oral control subscales were found at .80, .79, .65 and .64, respectively. For the statistical

analyses the total EAT-26 score was used.

Pressure for thin body by coaches, parents, peers and experts

In order to evaluate the pressure for thin body the athletes receive by "significant others", the questionnaire developed by Durkin, Paxton and Wertheim (2005) was used. The aforementioned authors assessed only parental and peer pressure; however, in this study the pressure by coaches and gymnastics experts (i.e., judges) was also measured, as Kosmidou et al. (2015) did in their study. So, two items for each "significant other" group were used to assess pressure to be thin, rated in a 5-point Likert scale (never [1], rarely [2], sometimes [3], often [4] and very often [5]), with higher scores indicating higher perceived pressure. Researchers having used the questionnaire report sufficient internal consistency of its subscales (pressure by parents/experts/coaches/peers) (Kosmidou et al., 2015, 2018), despite their limited number of items. In the current study, Cronbach's alpha was .87 for coach; .79 for parents; .69 for peers and .87 for experts.

Anthropometric characteristics

The athletes completed a questionnaire which included demographic and personal details such as age, weight and height. Participants' Body Mass Index (BMI) was calculated following the formula $\text{weight}/\text{height}^2$ (kgr/m²). Then, BMI z-scores were computed and were used for the classification of the athletes into BMI categories (underweight, normal weight, overweight, obese), according to the World Health Organization guidelines (World Health Organization, 2007).

First, an informative meeting was held in sport clubs, in which the first author informed athletes about the purpose and the procedure of the study, and assured them that their participation would be voluntary and anonymous. In this meeting,

written consent forms for participation were given to athletes, who had to fill them out and sign on their own (if they were adults) or by their parents (if they were minors). One week later, the first author visited the sport clubs again and distributed the questionnaires at the end of the training. She also gave oral instructions on how to fill in the questionnaires and stayed there until their completion, available to answer any potential questions.

At a preliminary level, potential BMI differences between RG and AG athletes were investigated, using a t-test. Then, Pearson correlation coefficients were calculated to investigate the association between BMI and gymnasts' scores in the EAT-26, the SPAS and the Pressure for thin body Questionnaire. If statistically significant correlations were found, BMI should be controlled to reduce their potential impact on the analyses. The cut-offs provided by Cohen (1988) were utilized to estimate the strength of the statistically significant correlations ($r \leq .29$ indicates a weak correlation, $.30 \leq r \leq .39$ moderate, $.40 \leq r \leq .69$ strong and $r \geq .70$ a very strong correlation). The correlation analysis results revealed that BMI was statistically significantly correlated with (a) SPAS total score and (b) pressure for thin body by coaches, parents and experts subscales. There was no statistically significant correlation between BMI and EAT-26 score. According to the above, to check potential differences between RG and AG athletes a t-test was computed on EAT-26 scores, an analysis of covariance (ANCOVA) was utilized on SPAS scores, and a multivariate analysis of covariance (MANCOVA) was computed on the scores of the Pressure for thin body by coaches/parents/peers/experts subscales, using BMI as a covariate.

In the next step, since there were no statistically significant differences between the RG and AG athletes on the variables of interest, their data were merged and were further analyzed to check whether athletes' abnormal eating behavior was associated

to their SPA and the perceived pressure by "significant others". Thus, athletes were classified as (a) presenting normal eating behavior (EAT-26 total score < 20) and (b) presenting DEAB (EAT-26 total score ≥ 20) and an ANCOVA was computed on SPAS scores, whereas a MANCOVA on pressure by coaches, parents, peers and experts, using BMI as covariate.

For the above statistical analyses the SPSS 24 for Windows statistical package was used and the level of significance was set at .05.

RESULTS

BMI associations with gymnasts' DEAB, SPA, and pressure for thin body

According to the t-test utilized, statistically significant differences were revealed between RG and AG athletes on their BMI ($t=5.20$, $p < .001$), with AG athletes presenting higher values. The correlation results revealed that BMI was statistically significantly correlated with SPA and pressure for thin body by coaches, parents and experts. Specifically, BMI had a moderate correlation with athletes' SPAS score; a strong correlation with pressure for thin body by coaches and parents and a moderate correlation with pressure by experts, whereas there was no correlation with pressure by peers. No other significant correlations were identified (Table 2).

Differences between RG and AG athletes

In Table 3, means and standard deviations of RG and AG athletes on the variables of interest are presented. The t-test utilized on EAT-26 scores showed that there were no significant differences between the two groups for DEAB ($t=1.23$, $p=.22$). Moreover, BMI was found to be a significant covariate both in the ANCOVA computed on SPAS scores ($F=10.52$, $p=.002$) and the MANCOVA applied on pressure for thin body by coaches/parents/peers/experts subscales

(Pillai's trace=.41, $F=14.25$, $p<.001$). However, the discipline of Gymnastics (RG vs AG) did not differentiate either gymnasts' SPAS score ($F=0.17$, $p=.68$) or

the pressure they received by "significant others" (Pillai's trace=.07, $F=1.69$, $p=.16$).

Table 1

Participants' anthropometric characteristics.

	RG athletes	AG athletes	Total
Age (years)	13.25±2.13	14.43±2.53	13.90±2.42
Height (m)	1.53±.12	1.56±.09	1.55±.11
Weight (Kg)	38.70±9.73	44.68±7.30	41.99±8.94
BMI	16.14±2.07	18.05±1.38	17.19±1.96
BMI classification (%)			
Underweight	14.6%	2%	7.78%
Normal weight	85.4%	98%	92.22%

Table 2

Pearson r values of the correlations between athletes' BMI and variables of interest.

	EAT-26	SPAS	Pressure for thin body from			
			coach	parents	peers	experts
BMI	.186	.352*	.560*	.544*	.071	.358*

* $p<.001$

Table 3

Means and standard deviations on EAT-26, SPAS, and Press of thin body Questionnaire.

		RG athletes	AG athletes	Total
Pressure for thin body by	EAT-	15.57±11.69	18.32±9.39	17.08±10.51
	SPAS	19.52±6.00	21.16±6.06	20.42±6.06
	coach	5.25±2.72	6.46±2.25	5.92±2.53
	parents	3.70±2.34	4.08±2.12	3.91±2.22
	peers	2.60±1.23	2.46±.93	2.52±1.07
	experts	4.47±2.41	5.38±2.28	4.97±2.37

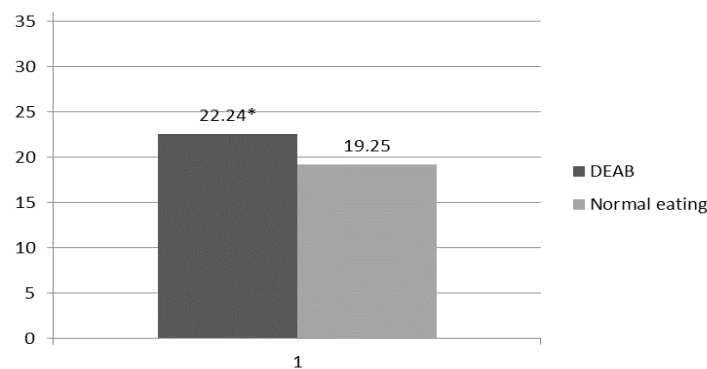


Figure 1. Total SPA scores per eating behavior category (*Estimated marginal means are presented)

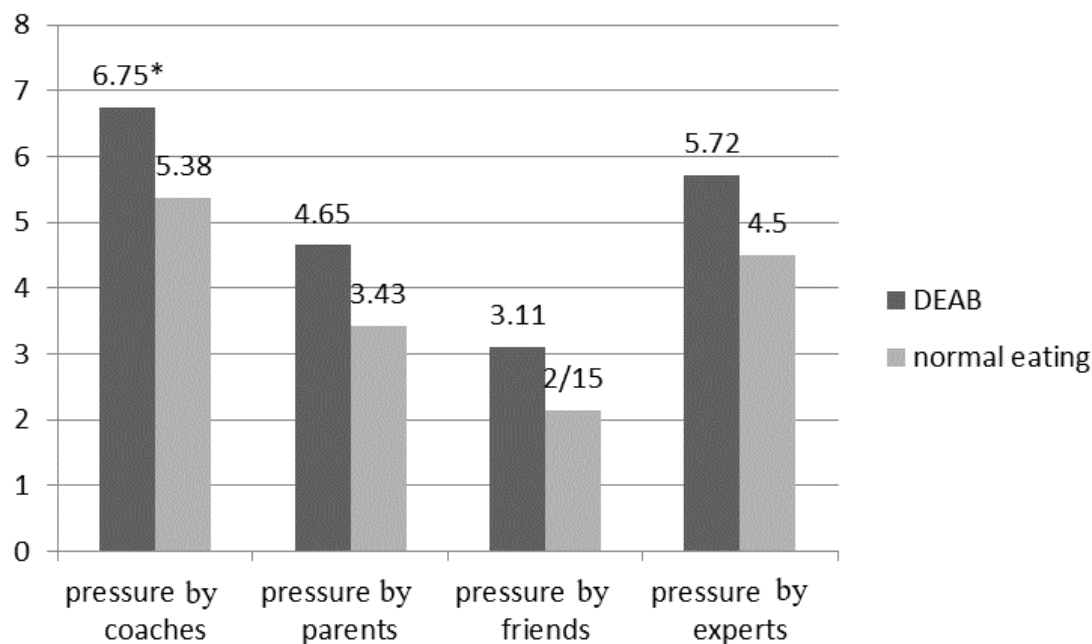


Figure 2. Perceived pressure by coaches, parents, peers and experts per eating behavior category (*Estimated marginal means are presented)

The univariate analyses of covariance that followed the MANCOVA showed that BMI associated significantly with the pressure the athletes received by their coaches ($F=32.26$, $p<.001$), parents ($F=42.92$, $p<.001$) and experts ($F=9.03$, $p=.003$), but not by peer pressure ($F=1.16$, $p=.28$), whereas significant differences between RG and AG athletes were revealed only on parents' pressure for thin body ($F=5.46$, $p=.02$) and not on coaches' ($F=.17$, $p=.68$), peers' ($F=1.04$, $p=.31$) and experts' ($F=.04$, $p=.84$).

Differences between gymnasts with and without DEAB

When the data of RG and AG athletes were merged into one group (gymnastics athletes), it was revealed that 40% of the total sample had a total EAT-26 score > 20 , a result that indicates DEAB, whereas the remaining 60% presented normal eating attitudes/behaviors. The ANCOVA that applied on SPAS scores showed significant associations between gymnasts' SPAS scores and BMI ($F=10.17$, $p=.002$),

whereas eating behavior (normal vs abnormal) significantly differentiated gymnasts' SPA ($F=6.04$, $p=.02$), with athletes presenting DEAB having higher SPAS scores (Figure 1).

Finally, regarding the perceived pressure for thin body, according to the MANCOVA results, BMI was found to be a significant covariate (Pillai's trace=.39, $F=13.55$, $p<.001$), whereas eating behavior significantly differentiated athletes' perceived pressure (Pillai's trace=.26, $F=7.16$, $p<.001$). From the univariate analyses that followed, it was revealed that there were significant differences between athletes with normal eating behavior and those with DEAB on the pressure they received by their coaches ($F=9.59$, $p=.003$), parents ($F=9.56$, $p<.003$), peers ($F=20.16$, $p<.001$) and experts ($F=5.53$, $p=.012$). As it can be noticed in Figure 2, athletes with DEAB receive higher pressure for thin body by "significant others" than their peers with normal eating behaviors.

DISCUSSION

The purpose of the present study was to investigate DEAB, SPA and perceived pressure for a thin body by “significant others”, such as coaches, parents, friends and experts, in RG and AG female athletes at competitive level, while examining (and controlling) the potential effects of athletes’ BMI.

BMI associations with gymnasts’ DEAB, SPA and pressure for thin body

Results revealed that RG gymnasts’ BMI was similar to that found in previous studies focusing on RG gymnasts (Kosmidou et al., 2015) and significantly lower than that of AG gymnasts of the current study. RG had a higher percentage of underweight athletes than AG. Moreover, athletes’ BMI had a moderate correlation with their SPAS score, a finding that confirms the opinion of Gay et al. (2011), according to which in aesthetic sports, BMI can predict SPA, and a BMI increase can increase the possibility for higher SPA around 6%. Furthermore, in the present study, BMI had a strong correlation with perceived pressure for a thin body by coaches and parents, whereas its correlation with perceived pressure by experts was moderate. This result was expected as it is known that in gymnastics a specific body type is thought to be a prerequisite for performance or success (Cook & Hausenblas, 2011; Smolak et al., 2000). Kosmidou et al. (2015), in their study with RG gymnasts, found a weaker correlation between BMI and perceived pressure by parents ($r=.29$, $p=.042$), a similar correlation with pressure by coaches ($r=.52$, $p <.001$) and a much higher pressure by gymnastics experts ($r=.62$, $p <.001$).

The significant correlation between BMI and perceived pressure for a thin body found in this study requires attention, since it shows that the gymnasts with increased BMI (although lower than the BMI of their non – athletes peers) receive

pressure to be thinner by “significant others”. One can imagine how negatively an adolescent female gymnast experiences even a small weight gain.

Differences between RG and AG athletes

RG and AG gymnasts had similar EAT-26 mean scores (RG= 15.57; AG = 18.32, $p>.05$), which were in close agreement with those from the study of Kosmidou et al. (2015), who found EAT-26 total score of 16.27 in RG athletes. As far as gymnasts’ SPA and perceived pressure to be thin are concerned, it was revealed that, when the effect of athletes’ BMI was controlled, the two groups had similar SPAS scores; nevertheless, there were significant differences regarding the pressure for thin body by parents, with the AG athletes presenting higher scores than the RG athletes. It is interesting to note that the gymnasts of the present study, both RG and AG ones, felt like being more pressed to be thin by coaches, parents and experts than it was reported by RG athletes in the study of Kosmidou et al. (2015). Nevertheless, the current results of AG athletes cannot be compared to previous ones, as to our knowledge there is no previous research focusing on AG gymnasts. Taking into account that RG athletes receive pressure for a thin body from a very young age (Sample, 2000) and tend to have a thinner body compared to other kinds of gymnasts (Nordin, Harris, & Cumming, 2003), the current findings of higher pressure to be thin presented by the AG gymnasts are worrying. Nevertheless, they can be interpreted under the prism of the strong correlation found between athletes’ BMI and parents’ pressure for thin body in conjunction with the higher BMI presented by AG athletes.

Differences between gymnasts with and without DEAB

When the data of RG and AG athletes were merged it was revealed that DEAB had a high prevalence (40%) among the participants of this study. This percentage

is much higher compared to previous studies in which 26% (Kosmidou et al., 2015, 2018) up to 37.7% (Ferrand, Champely, & Filaire, 2009) of RG athletes and 30% of artistic and RG gymnasts (Theodorakou & Donti, 2013) were found to have DEAB. It is also similar to the percentage found in the study of Sundgot-Borgen and Torstveit (2004) in which, 42% of the female athletes of aesthetic sports (diving, synchronized swimming, artistic and rhythmic gymnastics) presented DEAB. Although it is well known that in aesthetic sports the athletes tend to show DEAB (Gay et al., 2011; Haase & Prapavessis, 2001; Sundgot-Borgen & Torstveit, 2004), due to the significant role physical appearance plays for success, the high DEAB percentage of the present study is alarming. Taking into account that DEAB can have a negative impact on both the performance (Costarelli & Stamou, 2009) and health of those young athletes (Chamay-Weber et al., 2005; Jacobi et al., 2004), the need of professional help to tackle the problem is imperative.

Moreover, it was revealed that gymnasts with DEAB presented higher SPA than those with normal eating attitudes/behaviors, a finding that is in agreement with previous studies (Gay et al., 2011; Haase & Prapavessis, 2001; Sundgot-Borgen & Torstveit, 2004). As far as the association between DEAB and perceived pressure for a thin body is concerned, gymnasts with DEAB presented higher perceived pressure for thin body by every “significant others” – group (coaches, parents, friends, experts) than the gymnasts without DEAB.

Several researchers refer to the important role of coaches in adolescent athletes’ development (Fraser-Thomas & Côté, 2009), underlining that they are the most suitable people to influence athletes’ eating behavior (Wheatley, Khan, Székely, Naughton, & Petróczi, 2012). However, the strong and positive correlation between the diet of elite gymnasts and the perceived

pressure for a thin body by their coaches has been also noticed (de Bruin, Oudejans, & Bakker, 2007). As Petty and Cacioppo (1986) state, in RG, coaches argue for years with their athletes about controlling their weight and this kind of pressure can create serious problems to athletes’ body image and body esteem. Several researchers (Heffner, Ogles, Gold, Marsden, & Johnson, 2003; Kerr, Berman & De Souza, 2006) point out that if coaches insist on believing that the low weight of their athletes is beneficial for their performance, their attitudes and behaviors can unintentionally lead their teenage athletes to be at risk for DEAB. In addition, according to the current results, young gymnasts perceived that they receive great pressure for a thin body from gymnastics experts (i.e., judges), a finding that shows the critical role of the judges for technical performance and the physique in athletes’ weight control (Kerr et al., 2006).

Nevertheless, in the current study two other groups of “significant others”, parents and friends, have been found to press young gymnasts to be thin. Regarding parents, it is known that since the peak of gymnasts’ career comes during adolescence, their parents are closely involved in their daily routines, driving them to the sport club, accompanying them at competitions, etc, so they may be influenced by coach’s behavior regarding dieting. As far as perceived pressure by friends is concerned, it can be assumed that the gymnasts who participated in the current study being at competitive level and spending a lot of hours in gymnastics training, had created friendships within the gymnastics club, with other gymnasts who also care about their thinness.

Limitations and strengths

This study presents some limitations that should be mentioned. To begin with, information regarding gymnasts’ DEAB, SPA and pressure for thin body was gathered using self-reported questionnaires and that should be taken into account when

interpreting its results. Moreover, the cross-sectional design does not allow for examining causal relationships among the variables.

However, this study goes along with several strengths. First, it is the first one examining simultaneously DEAB, SPA and perceived pressure for thin body and controlling the effect of athletes' BMI, providing, in that way, valuable information about this important issue. Furthermore, this is the first study focusing on AG athletes, shedding light into their SPA, DEAB and perceived pressure for thin body by "significant others".

CONCLUSION

It is obvious that if gymnasts' DEAB is to be confronted, educating both athletes and "significant others" is essential. Several researchers (Cover, Hanna, & Barnes, 2012; Nagel, 2003; Thein-Nissenbaum & Carr, 2011) state that coaches should be informed about their athletes' DEAB so as to help them. Optimizing athletes' performance without sacrificing their health should be every coach's concern. Apart from coaches, everyone who is involved with female athletes should understand the negative consequences of their behavior on athletes' eating attitudes/behaviors. Moreover, it has been proved that an intervention aiming at the improvement of self-concept and dieting attitudes of gymnasts can have positive results, providing, in that way, a promising message in the direction of DEAB confrontation (Kosmidou et al., 2015). More interventions, including "significant others", must be carefully designed and implemented for the benefit of athletes' health, whereas further research of the factors that contribute to athletes' DEAB is needed.

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CHOREOGRAPHIC PROCESS IN GYMNASTICS FOR ALL

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Abstract

To transcend the idea of objectifying the body and its movements in gymnastics and its technique-based sessions and/or classes, we propose some reflection on the artistic and aesthetic aspects of gymnastics for the Gymnastics for All (GfA) program. Officially guided by FIG (Fédération Internationale de Gymnastique), it is common that GfA composition includes group performances in festivals, whether they are competitive or not. This article describes the journeys of two GfA teams that developed practitioner-centered, not coach-centered choreographies supported by the stages of creativity proposed by Kneller (1973). More than learning/doing or even learning/memorizing coded, standard sequences, it is essential to explore possibilities of dialogue between the individual and the various elements that surround him/her, by establishing a parallel between GfA features and the creative, collaborative choreographic process in the Arts (Dance and Theatre). The coach's egocentrism is redefined, and he/she is stripped of the choreographer's role. The choreography should be considered a sketch and should inspire constant change. It will be influenced by what spectators think of it, how it can inspire other artists, and how participants will feel fulfilled by it. There should be endless opportunities. Shaping movement and connecting actions gradually reveal the proposed theme and give rise to technique and aesthetics: that is the major challenge of the choreographic process.

Keywords: *Gymnastics for All; collaborative choreographic process; creative process.*

INTRODUCTION

In past decades, research studies have focused on understanding the body and its movements beyond biological and biomechanical conditions. Influenced by traditional educational theories in teaching-learning scenarios, we often observe sports situations where the practitioner is oblivious to the process and simply repeats the movements or follows the commands

determined by a teacher and/or coach. To transcend the idea of objectifying the body and its movements in sports (Brasileiro; Marcassa, 2008; Steinman, 1986), as well as in its technique-based practice sessions and/or classes, we propose some reflection on Gymnastics for All (GfA) practice that is filled with artistic and aesthetic aspects (Best, 1980), especially since one of its

ultimate goals is a choreographic performance.

This paper will focus mainly on the choreographic process, where phases of the creative process and the role of teachers/coaches in the so-called “collaborative process” is characterized by the collective and creative participation of everyone. We also assume that these processes will encourage a non-hierarchical system, in which the responsibility does not lie solely on the coach (Soares, 2007).

Gymnastics for All

Gymnastics for All (GfA) is one of the official activities of FIG (*Fédération Internationale de Gymnastique*) that encourages experimenting with new movements and forms of body expression based on the fundamentals of biomechanical movements (support, suspension, rotation, swinging, balance, landing) with fun, fitness, and friendship.

To become a discipline that encompasses all the aspects described above, its contents are organized as follows: Gymnastics and Dance –involve dance, theatre, modern dance, aerobics, folklore, jazz, rhythmic gymnastics, ballet, rock’n roll, fitness; Exercise with Apparatus – gymnastics with and on apparatus, such as trampoline, rings, balance beams, gymnastics wheels; Games –small games, social games, sports games, reaction games, and games to develop fitness(FIG, 1993, p.7). It can be noted that GfA was a pioneer in encouraging other disciplines to interact with gymnastics, focusing on pleasure and leisure.

Additionally, GfA appreciates all forms, styles, and trends influenced by the traditions and cultural values of various peoples and addresses a variety of contents. It is a discipline that allows for all-inclusive participation, not bound by restrictions and rules, such as gender, number of practitioners, or expertise, and can therefore foster personal and social growth, especially by respecting the

individual skills of each practitioner (Toledo; Tsukamoto; Carbinatto, 2016).

Public performances often take place in mostly non-competitive festivals, that highlight the cultural aspects of the groups and allow participants to celebrate the practice of sports without losing the specific aspects of their local, regional, or national cultures (Carbinatto; Soares; Bortoleto, 2016).

Creating a choreography is optional and depends on the goals of the group (whether it wants to participate in festivals or not, for example). However, researchers advocate that it is important to develop choreographies to foster aspects related to creativity, aesthetics, collective participation, which are essential elements of human development (Toledo; Tsukamoto; Carbinatto, 2016; Sborquia, 2008).

GfA choreographies should go beyond the mere physical, biomechanical performance of the choreography using expressive movements. In a choreography, we see formations in space, change of planes/levels, unexpected combinations that will spark the curiosity of both spectators and practitioners/performers about the theme.

In a paradoxical opposition to the freedom provided by the practice of GfA (regarding gymnastics disciplines, interactions between gymnastics and music/dance or other folklore expressions), the choreographic process will select options according to the group’s preferences. There are choices to be made: What movements will be performed? Will other cultural aspects be included? Will the group use apparatus? What is the most appropriate costume? Although GfA seems to be comprehensive, there comes a time when it narrows its focus: everything converges so that the group can effectively communicate the chosen theme to the audience.

The problem at hand deals with “how” these choices are made. Pérez-Gallardo (2008), for example, shows that, groups of

competitive gymnastics disciplines may use GfA festivals as another opportunity to perform, but they ignore the pedagogical aspects that are inherent to this discipline. They focus on the product, not on the process, which could be so enriching to the personal growth of participants.

When participants reflection artistic elements that go beyond the acquired physical skills, they reach a higher level of understanding and performance. Such reflective work includes issues that permeate sports in society, such as the rights of children and adolescents, gender issues, the popularization of sports by the media, the rules of various sports disciplines and their influence in societal rules.

We believe it is essential that teachers/coaches/coordinators of GfA groups take the choreographic process into consideration but should not restrict their focus to it. The work methodology should reflect the pedagogical basis so that GfA can provide opportunities of inclusion and social interaction, where everyone can contribute with their experiences and can become active players in the moments they share (Paoliello, 2008).

To reinforce the pedagogical purpose of GfA, we have analyzed studies on creative and collaborative processes and found principles that helped us confirm the importance of cooperation and the effective engagement of participants during the choreographic process.

Creative Process

Studies on creativity argue and especially refute the mythological paradigm that inspiration - often considered divine - is responsible for showing what is unexpected, new, or original (Sternberg, 1999). Discussions on this topic also involve sports in general and not only choreographic performances (Samulski; Noce; Costa, 2001).

Traditionally, practicing gymnastics has been determined by a set of rules involving body patterns capable of

performing some movements, usually ruled by the scoring system of gymnastics disciplines. But even scoring systems foster originality: new elements or combinations of elements can be added to the choreography and this is appreciated by experts (technical committees or judges in general) (FIG, 2018a; FIG, 2018b).

There are several disputable concepts about creativity. Nowadays, theorists confirm that the definition assumes its dynamic process. Briefly, creativity requires originality and effectiveness and includes novelty, utility, aesthetics and authenticity (Nanni, 1998), since it is aligned with the methods adopted by professionals who work with GfA, like us.

In GfA, participants' movements are often determined by external evaluation criteria (Fortin, 2004), which prevents them from discovering innovative ways to move, for example.

In Dance, the opposite could be observed in the modern German school of dance (Louie Fuller, Isadora Duncan, Ruth Saint-Denis), which allowed the combination of the roles of choreographer and practitioner, especially with individuality and subjectivity as inspiration and theme (Kleinubing; Saraiva; Melo, 2011).

The term "creation lab," used in research studies about artistic composition, has become more prevalent in dance (Soares, 2007; Costa, 1997), music (Coulangeon, 2004), theatre (Silva, 2008; Pavis, 2001; Garcia, 1990) and circus (Cozer, 2006). In a creation lab, the development of a choreography requires negotiation and compromise. Choreographies take shape in the lab.

For Miller (2007), the early processes of choreographic creation are called "in-action" and they report some "powerlessness," since improvisations arise, but still lack structure. To the choreographer, these labs should involve a state of "readiness", because one needs to be alert to be able to connect and align the technique with the creative process and

with the theme. Silva (2008) describes these moments as territories, -- not territories in the sense of a “geographical location,”-- but rather as a “zone of experimentation” where the composition is a work-in-process.

The choreography is created in alignment with the individual and collective interests and requires knowing

how to deal with and respect different ideas and opinions. It fosters situations of self-knowledge and knowledge of others. So why not use these labs in GfA?

Here are some examples of the diversity we want to represent in the choreographies, such as the use of alternative apparatus and movements to enrich them.

Table 1

Alternative use of materials, themes, and movements in a choreography

Apparatus	Official apparatus from competitive gymnastics disciplines (ball, hoop, ribbon, balance beam, parallel bars); complementary apparatus that are typically used in gymnastics (plinth, step, fitness trampoline, Pilates ball); other apparatus adapted to the practice of gymnastics (water bottle jug, buckets, ladders, tires); apparatus built for the practice of gymnastics (plastic tubes; giant foam tangram).
Movement	Displacement (with or without); positions (standing, kneeling, sitting, lying); action verbs (walking, running, hopping, jumping, spinning, balancing, pushing, extending, bending, crawling); rhythm (beat, time/duration, pace, emphasis); dynamics (swinging, leading, pushing, holding); space (lines: vertical, horizontal, intermediate/ direction: forward, backward, right, left / Plane: frontal, horizontal and sagittal/ Trajectory: line, curve, combined)
Theme	Children’s story; sci-fi book; folklore tale; holidays; a country’s political situation; celebrity; historical fact; something that happened in the life of one of the group members; folk dance; food; toy; among others.

Source: Adapted from Nanni (1998); Bratfische; Carbinatto (2016); Silva (2016).

We advocate that there is not one but countless ways to create a choreography. If we want to consider GfA as a means to develop autonomous, critical, and creative people, it is crucial to allow gymnastics practitioners to let their creative and expressive skills flourish. Like sound and its resonant waves, a choreography should create a stir in the audience, and those who are directly or indirectly engaged in the choreographic experience should experience intangible dimensions of perception (Soares, 2007; Miller, 2007). The most important take-home message is that creativity is present not only in the product but also in the journey!

Collaborative process

When we watch a choreography, it is impossible to determine if it is the result of the work of one person or many, since the way a choreography is developed does not lead to a specific aesthetic outcome. Therefore, there is no direct relationship between a good or bad choreography and the way it was created.

It is risky to assume that a collaborative process is a methodology if it is seen as a recipe or formula. We intend to propose concepts that foster collective participation in agreement with the specific context and goals of the choreography.

Additionally, we believe it is too early to say that there is a new paradigm in the coach-practitioner relationship in GfA, or

even in other environments, but it is a fact that current teaching-learning methodologies have opposed the traditional, centralizing-unifying model as to how a group or class should be conducted.

Evidence shared by GfA groups in Brazil – especially university-based groups - have used small choreographic groups that, after experimenting and organizing a choreography, perform for each other in a class session (Paoliello et al, 2014). This methodology aims at expanding possibilities since each part that was created separately can be added to the final piece.

In this process, the dominance of one gymnast gives way to the relationship among practitioners and how they use the apparatus (Sborquia, 2008). That is, in the collaborative process, a choreography is collectively created, and practitioners have significant participation in the process. Therefore, like in dance movements (Costa, 1997) and in the theatre (Silva, 2008), the collective creation system in GfA is based on a shared, cooperative, and democratic process of doing gymnastics.

The processes of performing and creating a choreography are intertwined. Moreover, performing and creating sessions/classes/meetings are encouraged. The role of the coach is not eliminated but rearranged to become a catalyst and a trigger for the creative polyphony (Silva, 2008).

The words of the Colombian playwright and director, Carlos José Reyes, clarify the collaborative process and the role of the director in the theatre, when he explains that the collaborative method “does not imply eliminating the director, but rather destroying his omnipotence. The director no longer controls movements mechanically, according to his aesthetic tastes or whims” (Rizk, 1987, p. 69). All members are free to suggest ideas, which grants them agency and sparks their curiosity, fosters respect and critical thinking. The goal is to not

suppress individual personalities; it is to liberate the strict relationships that are traditionally established (Pianca, 1990).

Together with the aforementioned creation lab, the group should experiment when faced with new ideas and should test all suggestions. Everyone is responsible for the activities; participants are not inhibited by the presence of experts, and there is no fixed hierarchy. Although the coach plays a less emblematic role, in fact, he has more influence and his opinions end up having more weight on the decisions made and directions taken for the choreography.

As the result of a collective development process, the choreography is not created in a peaceful and organized setting. It is characterized by asymmetries, bursts, an overflow of opinions, conflicts, and instabilities (Silva, 2008). To minimize the effects of conflicts (which are inherent to the process), decisions should ideally be justified based on concrete aspects, as much as possible. After all, we expect individual wishes to be turned into group decisions.

The collaborative process should not be restricted to the choreography. The organization and management of the group should also be a collective effort (organizational structure, management, financial control, etc.) to be evaluated by everyone.

The coach/teacher in GfA is committed to allowing participants to become more tolerant and empathetic; fostering values that will make society more just and caring; to experiencing those values in the class and making it an environment that allows participants to reflect on and challenge the world they live in.

Please note that coaches/teachers are required to have an attitude that allows them to understand “the creative ability of other participants, the in-depth knowledge of characteristics and skills of your peers, as well as the limitations and insecurities that prevent them from unleashing their creative potential. By encouraging a

creative attitude – and not just a reactive one - coaches are committed to a creation process that involves more risks and that challenges his own centralizing, leading role” (Silva, 2008, p. 2).

METHODS

This research addresses the experience of the two authors conducting a GfA choreographic composition focusing on creative and collaborative process. To analyze that, we focused on studies conducted by Kneller (1973) that shed some light on this topic.

Kneller (1973) indicates that several theories acknowledge the existence of stages that systematize collaborative creativity. According to the author, these theories are organized as follows: **a. the early moment** or first insight related to raising interest that will set the tone for the **b. preparation stage**, or collection of data through a literary, musical, photographic, or sports study, among others. The larger the collection, the higher the likelihood of exploring skills in the group. **c. The incubation period** is variable and allows for a time of reflection on the collected survey material, thus improving the next step, **d. an epiphany**. In this stage, the group is in the “hands-on” mode, so the movements, combinations and elements suggested by each member of the group start to take shape. Finally, there is the **e. polishing stage**- choosing the elements to be kept. After this phase, the choreography is completed. Our question was: Did our GfA groups employ these steps?

The Gymnastics for All Group of the University of São Paulo (Gymnusp) has its meeting once a week, which lasts an hour and a half. It is open to any interested person above eighteen years old, and participants must register on the Extension Commission of the School of Physical Education and Sport of University of São Paulo. Approximately ten people participated in the whole process, but it is important to explain that we had people

who came in and out, as the composition took one year (two semesters), and the students’ schedules underwent changes. We affirm, however, that participants could offer opinions about the choreography at all times.

The Gymnarteiros, GfA group of the Federal University of Ceará, meet twice a week for two hours sessions. It’s an Extension Project of the Physical Education and Sports Institute, and it is open to people above fifteen years old. This choreography the group had about thirteen participants, and its process took ten months. As in the Gymnusp experience, every member of the group could offer suggestions and opinions throughout the process.

Both researchers analyzed field notes, each group’s social media, and photos and videos that were taken during the process. Finally, they categorized the steps following Kneller’s codes.

RESULTS

We present the stages of the creative process (Kneller, 1973) parallel to the choreographic process of two GfA groups (Gymnarteiros, from the Federal University of Ceará, and Gymnusp, from the University of São Paulo) led by the authors of this paper, followed by a collaborative and creative process.

Collecting data and proposing the first ideas somehow determined the epiphany stage. That is, meetings and/or practice sessions were planned and developed in alignment with the ideas that were initially raised and that focused on the theme. But we highlight that the choreographic process aiming at a product to be performed at an event does not need to be the focus of every group meeting.

The group spent months in various exploratory experiences. The choreography was developed depending on the short-, medium-, and long-term goals of the group, especially if the group wished to participate in festivals.

Until the group decided to finish the choreography, it was possible to hold sessions filled with the exploration of choreographic structures and possibilities

involving movement and music, movement and space, movement and aesthetic elements, among others (Costa, 1997).

Table 1

Stages of the creative process and how they relate to the experience of GfA groups

Stages of the creative process		Experience of the Gymnarteiros GfA group	Experience of the Gymnusp GfA group
First insight	Have an idea (insight) that will be developed	The first idea was to represent a typical element from the Brazilian Northeast region - hammocks and how they are used (to replace a bed) became the focus of the choreography.	The city of São Paulo (where the group lives) sparked this idea; the Tietê River, which crosses the city, became the focus of the choreography
Preparation	Collecting data; investigation of first insights	We studied how hammocks started to be used by indigenous peoples in South America. They were initially used both for rest and for other purposes, such as a means of transportation and to carry the dead in the rural area.	We studied the cartography of the Tietê river and its round curves, which made it navigable and suitable for leisure. With the expansion of the city, its margins were redesigned, and its function was recovered.
Incubation	Unconscious action; when the topic is still the object of analysis, even outside the formal environment of creation.	Reflection on the possibilities to portray the current uses of a hammock - specially to depict <i>sertanejo</i> people (people who live in the countryside of the Northeast in Brazil), and characteristics of the countryside; the group looked for a song that represented this scenario.	Group members told stories about the river; they looked for songs by Brazilian singers Fernanda Porto and Fernanda Abreu; most of the points raised by the group members had to do with how the river relates to the ring roads that run alongside the river
Epiphany	Discovering solutions to problems; determining the paths to take	Understanding that the choreography should show different ways to use a hammock, in the context of gymnastics. Understanding that the song to be used should portray the life of <i>sertanejos</i> .	Understanding that the choreography should have a smoother beginning, indicating how quiet the river was back in the day. Later, the buzz of the city, the typical São Paulo rush and the ring roads alongside the river filled with cars and buildings would be portrayed as rigid movements and acrobatic poses.
Polishing	Corrections, adaptation, analysis, polishing of the product	Choreography: "Enredando com Gonzaga" (In a hammock with Gonzaga) Song: Asa Branca by Luiz Gonzaga (orchestrated version)	Choreography: "Rio Tietê" (Tietê river) Song: O Paraíso (Buscemi's Afro Mix) by Madredeus

DISCUSSION

From the perspective of aesthetic education, GfA choreographies are focused on expanding perceptions and unleashing the human potential; they contribute to an enhanced understanding of oneself and of the world.

For example, the onset of creative effervescence in dance, represented by North American post-modern dance in the 50's and 60's of the 20th century, was characterized by performances and events that involved the integration of artists who spoke different languages, which led to a breakdown of structures of shows and genres in performances (Costa, 1997).

In sports, a similar movement took place involving Sports for All and Gymnastics for All: it proposed opening space to gymnasts who had different cultural and historical backgrounds and also included expressions of folklore. This movement opened a wide range of possibilities. There is polymorphism in GfA that enhances the breadth and depth of the repertoire, making choreographies more challenging.

The problem is that we address choreographic elements in a unidirectional way, that is, we are concerned only with the symmetrical space/time dimensions, which ensures efficiency and functionality, but we ignore the subtle dimension of gestures (Soares, 2007). Despite portraying gesture in dance, Soares also emphasizes that the choreography should depict situations of gestures that go beyond their mere functional, Cartesian elements, i.e., as an execution of coded steps. We should achieve an expressive gesture in which "senses are intertwined and deeply affect the sensitivity of the practitioner" (p.2).

Moreover, Nanni (1998) advocates that the body has a unique language that is complementary to oral language. Nanni (1998) also says that a choreography not only uses that language but also expands and codes it to establish communication and expression. The fact that choices and

decisions involved in the creation of choreographies are embedded in a cultural context confirms that choreographies are "the expression of an artist's individuality, combined with the influences of his/her socio-cultural environment" (p. 168).

Research studies - such as the one about choreology by Preston-Dunlop (1989) and about dance composition by Smith-Autard (1992) - focus more specifically on the object of our study. Both make an in-depth analysis of choreographic variations, such as the relations between movement and space, costume and stage set, music, and the proper care in integrating all these elements. Sometimes it is difficult to make a linear description of the choreographic research because these steps are part of a journey that swings like a pendulum over time, moving from one direction to another. We wondered, however, what conditions are required to create choreographies.

During that experience we noticed some principles on how to work in GfA to achieve a creative and collaborative choreographic process, namely:

- a) Each participant should, if possible, work actively in all choreographic creation stages: think about the song, the costume, reflect on the relationship between theme and movement, prepare work plans. But one must realize that not all participants have skills, interest, or desire to take on roles in the creative process.
- b) It is important that suggestions are considered, at least to be tested and discussed, and to encourage everyone to participate at all times. This is the only way a choreography can represent the whole group.
- c) Sessions (meetings/practices) can be led by all - in a rotation system, for example - so that all members can share responsibilities for the group experiences.

d) The group can (and should!) organize and document the collected data. Logbooks, pictures and/or footage can be helpful to a group's creative process.

e) It is crucial to give special attention to the theme that was selected, since the overwhelming creative organization can lead to an excessive number of suggestions (leading to digressions), and the group might find it difficult to finish the choreography.

f) The dynamic negotiation process (or conflict resolution) can prolong rehearsal times, but this should not be considered a waste of time. It is rather an opportunity to develop the creative process and collaborative relations.

CONCLUSION

Looking only at the mechanics of gestures of a choreography and its series of movements reduces the energy of a choreographic performance. Intentionality is part of the choreography. In GfA classes, it is essential to explore the possibilities of dialogue between the individual and the various elements that surround him/her. This is far more important than merely learning/memorizing/doing coded, standard sequences.

In a way, the coach's egocentrism is redefined, and he/she is stripped of the choreographer's role. The practitioners are called to action as partners, and the coach becomes a facilitator of the creative process.

The choreography should be considered a sketch since what it reveals inspires constant change. It will be influenced by what spectators think of it, how it can inspire other artists, and how participants will feel fulfilled by it. Therefore, there are endless opportunities. Shaping movement and connecting actions gradually reveal the proposed theme and give rise to technique and aesthetics: that is

the major challenge of the choreographic process!

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Above: Exhibition 8 Decades of Miroslav Cerar - Miroslav Cerar medals at OG, WC and EC;
Below: Youth at exhibition (Photos: Ivan Čuk)



SHORT HISTORICAL NOTES XVI

Anton Gajdoš, Bratislava, Slovakia & Ivan Čuk, Faculty of Sport, University of Ljubljana, Slovenia

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.



MIROSLAV CERAR (October, 28 1939 Ljubljana, Slovenia)

Miroslav Cerar was born to father Ivan (navy officer) and mother Pavla (housekeeper and seamstress). In 1947 he started with gymnastics at TVD Partizan Narodni dom (the first Slovene gymnastics club, established in 1863). His development was extremely fast due to his excellent physical preparation, as he was very flexible and strong. He was between 1958 and 1970 the best gymnast on pommel horse, with great achievements also on other apparatus. He was famous for his scissors and excellent double leg circles, which allowed him to perform Russian circles on pommels.

Medals from major competitions:

Olympic games

1964 Gold: Pommel horse, Bronze: Horizontal bar

1968 Gold: Pommel horse

World Championship

1958 Bronze: Pommel horse

1962 Gold: Pommel horse, Parallel bars

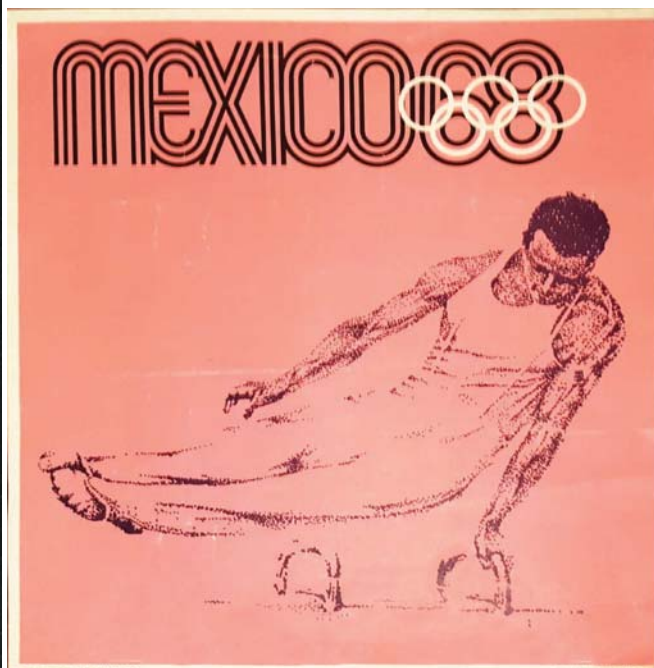
1966 Gold Pommel horse, Parallel bars

1970 Gold: Pommel horse



Left: Miroslav Cerar on poster for WC 1970

Bellow: Miroslav Cerar on poster for OG 1968



European Championship

1961 Gold: All around, Pommel horse, Rings, Bronze: Floor exercise, Vault

1963 Gold: All around, Horizontal bar, Rings, Silver: Vault, Bronze: Floor exercise

1965 Gold: Parallel bars, Silver: Pommel horse, Floor exercise, Bronze: Rings

1967 Silver: Pommel horse, Bronze: Horizontal bar

1969 Gold: Pommel horse Silver: Parallel bars, Bronze: Horizontal bar

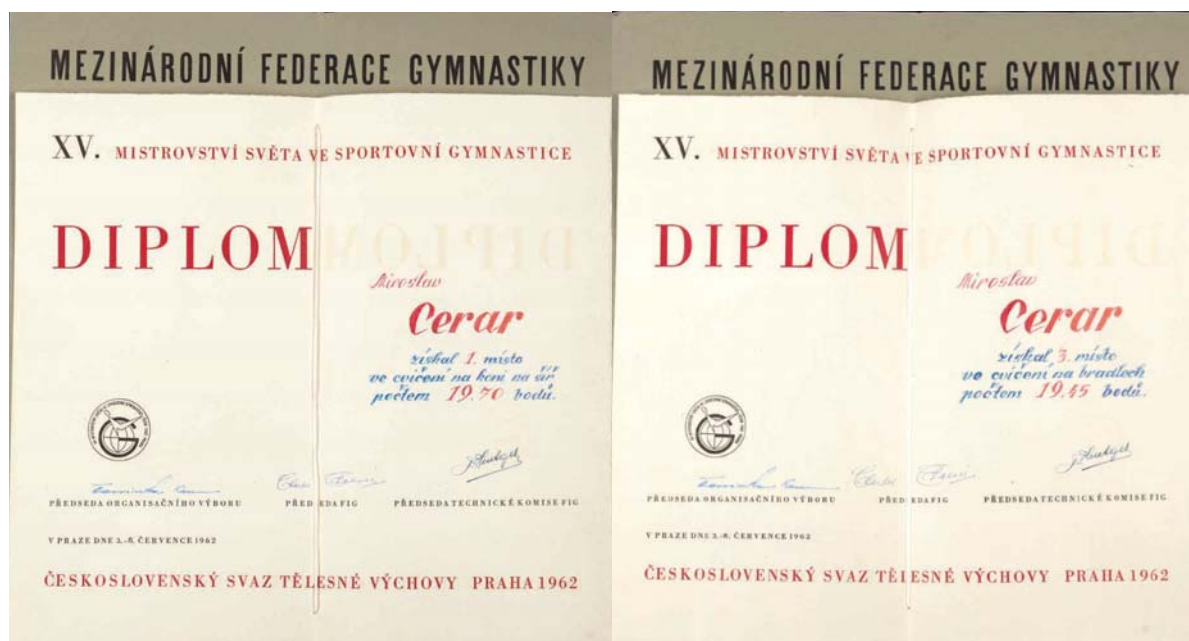
He also won Mediterranean Games in all around two times and at Spartakiada in Prague 1965 (CZE) he won 6 gold medals and for his exercise on pommel horse he scored perfect 10.

He was named as the best Yugoslav athlete 9 times, and also named as the best athlete after the WWII. He earned major state awards as award AVNOJ in Yugoslavia and The Golden Order of Merit in Slovenia.

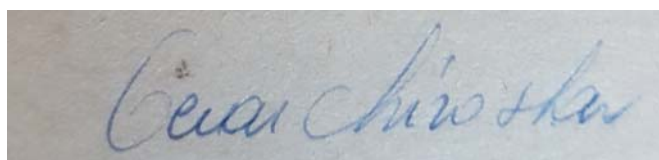
Silver Olympic Order for his distinguished service to sport from IOC received in 1985, and order for his excellence in gymnastics by FIG in 1971. He was introduced into Gymnastics Hall of Fame (USA) in 1999.

After his gymnastics career, he became lawyer, since 2005 he is retired and works for Slovene Olympic Committee (which he personally cofounded with Leon Štukelj and Slovene national sport associations) as volunteer. He is very much involved into international Fair Play organization.

At World Championship in Prague 1962 he won gold on pommel horse. Later in finals on parallel bars, Boris Šahlin (Ukraina, ex Soviet Union) was better evaluated by judges than Cerar. Crowd in the gym hall disagreed and they made such a noise for more than a half hour and stopped competition. FIG officials changed score for Cerar and he was by this decision the first. When preparing exhibition into his honor of 80th birthday we found in archive he has two gold medals and two diplomas, the first diploma is for the first place on pommel horse, while the second diploma states he was the third on parallel bars. Probably this is something worth for Guinness book of records.



He will be leader of Slovene Olympic Delegation at Olympic games 2020 in Tokyo.



Happy 80th birthday!

Slovenski izvlečki / Slovene Abstracts

William A. Sands, Kelly Bret, Gregory Bogdanis, Leland Barker, Olivia Donti, Jeni R. Mcneal, Gabriella Penitente

PRIMERJAVA ZNAČILNOSTI ODRIVOV NA VELIKI PROŽNI PONJAVI PRI PROSTIH SKOKIH IN SKOKIH S POMOČJO GUMIJASTIH VRVI

Ponjave ostajajo najboljši pripomoček za vadbo veččin leta. Uporaba ponjav lahko povzroča izjemno težke poškodbe zaradi slabih doskokov. Protiukrep za preprečevanje poškodb, kot so blazine na ponjavi, je v veliki meri neučinkovit. Najbolj učinkovite metode so dejavni protiukrepi poškodb, kot so varovanje vadečega s prijem, metanje blazine na mesto doskoka in vadba na varnostnem pasu. Nedavno dodajanje več gumijastih vrvi na varnostni pas je privedlo do spremenjenega poučevanja in vadbe letov na ponjavi. Gumijaste vrvice so odpravile potrebo po vaditelju za upravljanje varnostnega pasu med učenjem. Namen študije je bil oceniti vpliv dodajanja gumijastih vrvic s tradicionalnim varnostnim pasom. Deset izkušenih akrobatov na ponjavi (5 moških in 5 žensk) iz ameriške državne vrste za akrobatskih smučarjev in deskarjev je opravilo 10 skokov. S triosnim merilnikom pospeška (200 Hz) je bilo izmerjenih 10 prostih skokov in 10 skokov na pasu z gumijastimi vrvmi. Dobljeni so bili časi stika s ponjavo, najvišji pospeški in povprečni pospeški. Rezultati so podprli našo hipotezo, da so skoki na pasu z gumijastimi vrvmi dosegli le 40% (povprečno) do 70% (največ) pospeševanja (vsi $p < 0,001$ in $\eta^2_{delni} > 0,092$). Čas stika s ponjavo je bil pri skokih s pasom in gumijastimi vrvmi 65% nižji ($p < 0,001$). Varnostni pas z gumijastimi vrvmi je dober pripomoček za zmanjšanje težav pri doskoku.

Ključne besede: varni skoki, podatki biomehanike, čas, najvišje vrednosti.

Miha Marinšek, Ivan Čuk

VPLIV NESKLADNE OBREMENTITVE NOG PRI ODRIVU NA OBREMENTITVE PRI DOSKOKU PRI SALTIH Z OBRATI

Namen študije je bil ugotoviti, ali neskladnost obremenitve nog pri odriu vpliva na neskladnost pri doskoku pri saltih z obrati. Enajst telovadcev je izvedlo salto naprej in nazaj ter le-ta z 1/2, 1/1 in 3/2 obratom. Vodilna noga za vsakega je bila določena glede na smer obrata. Sile na podlago na vsaki nogo so bile izmerjene s vložki Parotec. Kot odvisne spremenljivke so bile uporabljene spremenljivke absolutnih in relativnih razlik med levo in desno stranjo. Za določitev glavnih učinkov med odrivom in doskokom smo uporabili tristransko ANOVA in vrsto enosmernih ANOVA. Za ugotavljanje razlik med vodilno in nevodilno nogo smo uporabili vrsto parnih t-testov s Bonferronijevimi popravki. Največje sile na podlago so pokazale, da je bila vodilna noga pri odriu bolj obremenjena kot nevodilna. Ni bilo statistično pomembnih razlik v največji sili na podlago med nogami pri doskoku. Vendar pa so bile največje razlike med silami na podlago pri saltu z 3/2 obratom višje v primerjavi z drugimi skoki. Ni bilo nobenih dokazov, ki bi potrjevali, da neskladnost ob odriu vpliva na neskladnost pri doskoku.

Ključne besede: akrobatika, skoki, sile na podlago, obrati.

George Dallas, Stelliou Charis, Theodorou Apostolos, Costas Dallas

TESNOBA PRED TEKMOVANJEM PRI MLADIH TELOVADCIH

Namen raziskave je bil ugotoviti, kako vplivata tesnoba pred tekmovanjem in samozavest telovadcev na uspeh na državnem tekmovanju. Skupaj 84 telovadcev, starih 9 - 11 let, je eno uro pred tekmovanjem odgovorilo na vprašalnik Predtekmovalna tesnoba 2. Telovadci so se glede na skupni rezultat, ki so ga prejeli v tekmovanju po mnogoboju, razdelili na uspešne in neuspešne ter na tri kategorije: razumska tesnoba, telesna tesnoba in samozavest. Rezultati so pokazali, da je med uspešnimi in neuspešnimi telovadci značilna razlika v samozavesti. Vendar pa pri teh telovadcih ni bilo ugotovljenih bistvenih razlik v razumski ali telesni tesnobi. Pearsonov koeficient povezanosti je pokazal statistično pomembno povezavo med razumsko in telesno tesnobo. Regresijska analiza ni uspela razkriti nobenega pomembnega napovedovalca uspešnosti teh mladih telovadcev. Ugotovitve študije poudarjajo pomen preverjanja tesnobe pred tekmovanjem in samozavesti pri telovadcih, predvsem pa naj razvijajo strategije za izboljšanje samozavesti, da se športniki bolje pripravijo na prihodnja tekmovanja.

Ključne besede: tesnoba, samozavest, predstava, telovadba.

Elina Virkki, Teppo Kalaja

POVEZANOST MED TEHNIČNIM ZNANJEM, GIBALNIMI SPOSOBNOSTMI IN USPEŠNOSTJO NA TEKMOVANJU PRI FINSKIH ORODNIH TELOVADKAH

Namen raziskave je bil ugotoviti, kakšen je zmožnost mladih nadarjenih telovadk, ki bi se lahko pridružile vadbi državne članske vrste na Finskem. Študija je preučila razmerje med telovadkami (N = 215, starost 10–13), ko so bile merjene v letih (2006–2010) in uspehom na tekmovanjih do konca leta 2016. Rezultati tekmovanja so bili primerjani tudi med telovadkami, ki so sodelovale pri meritvah in naključno število (N = 180) telovadk, ki niso. Večina (92%) najboljših telovadk na tekmovanjih je sodelovala na meritvah v mlajši dobi. 39% najboljših na tekmovanjih je bilo med najboljšimi 10 na meritvah v mlajši dobi. Rezultati preskusov tehničnih znanj so pokazali pomembno povezavo s povprečnimi tekmovalnimi rezultati v vseh starostnih skupinah in s povprečno stopnjo tekmovanja pri 10–12-letnicah. Rezultati preskusov v gibljivosti niso bili povezani s kasnejšim uspehom. Rezultati preskusov v moči so pokazali pomembno povezavo s tekmovalnimi rezultati in ravno tekmovanja pri desetletnicah. Rezultati preskusov moči so pri 12–13-letnicah povezani z ravno tekmovanja. Sodelovanje pri meritvah v mladosti je pozitivno povezano s prihodnjim tekmovalnim uspehom. Vendar pa povezanosti ni mogoče obravnavati nedvoumno. Rezultati meritev moči se lahko štejejo za pomemben del za 10-11 letnice, ki napovedujejo, da bodo tekmovalno uspešne.

Ključne besede: prepoznavanje nadarjenih, meritve, tekmovalni uspeh.

Lionela da Silva Corrêa, Michele Viviene Carbinatto, Evandro Jorge Souza Ribeiro Cabo Verde

DOBROBITI PODALJŠANJA UNIVERZITETNEGA PROGRAMA RITMIKE NA ŠTUDENTE TELESNE VZGOJE IN ŠPORTA PRVE STOPNJE

Razširitev univerz je temeljna dejavnost visokega šolstva, ki se pridružuje izobraževalnim, kulturnim in znanstvenim procesom, ki razvijajo in hranijo izobraževanje in raziskave. Namen je prenos znanja s pomočjo njegovih programov in dogodkov; univerzitetno delo lahko poteka na različnih področjih, kot so športne in telesne dejavnosti. Namen raziskave je bil razčleniti izkušnje študentov dodiplomskega študija, ki sodelujejo v univerzitetnem predmetu ritmike (R), ki je bil zasnovan za izboljšanje njihovega poklicnega razvoja. Polstrukturirani pogovori so bili opravljeni z dvanajstimi študenti, ki so bili del dodiplomskega programa telesne vzgoje in / ali so diplomirali pri telesni vzgoji. Pogovori so bili opravljeni skladno etičnimi pogoji raziskovalnih ciljev, da bi odgovorili na vprašanja študentov in zagotovili njihovo zasebnost. Za razčlenitev podatkov sta bila uporabljena tehnika izvedbe in razčlenitev vadbenih enot. Iz pridobljenih podatkov smo preverili osem kategorij, ki so sprožile razprave o predmetu Ritmike. Štirje najbolj citirani so bili: a) izkušnja je bila pozitivna; b) so se učili skozi vadbo; c) čutili so, kako je biti učitelj; d) imeli so neposreden stik z začetniki. Večina sodelujočih študentov dodiplomskega študija se je strinjala, da jim razširitev predmetnika omogoča, da razmišljajo o R in drugih telovadnih disciplinah kot morebitnem bodočem poklicu, mentorski proces pa kot pomemben način razvoja izobraževanja učiteljev in / ali učiteljev telesne vzgoje za ukvarjanje s telovadbo.

Ključne besede: ritmika, telesna vzgoja in šport, izobraževanje vaditeljev, izobraževanje učiteljev telesne vzgoje (PETE).

Christina Ioannidou, Fotini Venetsanou

DRUŽBENO TELESNA TESNOBA, MOTNJE HRANJENJA IN VEDENJA TER SPREJEMANJE PRITISKA ZA VITKIM TELESOM PRI RITMIKI IN TELOVADNIH PLESIH

V tej raziskavi se je so preučevala družbeno telesna tesnoba (SPA), motnje hranjenja in vedenja (DEAB) in pritisk na vitko telo s strani "pomembnih drugih" (vaditelja, staršev, vrstnikov, strokovnjakov) pri 41 tekmovalkah ritmiki (RG) in 49 tekmovalkah telovadnih plesov (AG). Poleg tega se je preučil in nadziral zmožnost vpliva na razmerje telesne mase BMI. Rezultati so pokazali, da je bilo razmerje telesne mase povezano z SPA, v prehodnem obdobju in zaznanimi pritiski, zato je bil učinek na BMI nadzorovan. Med SPA in DEAB ni bilo bistvenih razlik med RG in AG, medtem ko so imele tekmovalke AG višji starševski pritisk na vitko telo kot tekmovalke RG. Ko so se podatki o RG in AG združili, je bil razkrit visok odstotek (40%) tekmovalk, ki so imele DEAB. Tekmovalke z DEAB so imele občutno višji SPA in zaznaven pritisk na vitko telo kot tiste z običajnimi prehranjevalnimi navadami in vedenjem. Ti rezultati poudarjajo potrebo po ukrepih, ki vključujejo „pomembne druge“ in katerih cilj je preprečevanje DEAB pri tekmovalkah.

Ključne besede: motnje prehranjevanja, športnice, "pomembni drugi", zdravje.

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KOREGRAFSKO DELOVANJE PRI TELOVADBI ZA VSE

Da bi preseгли idejo o stvarnosti telesa in njegovih gibanj v športu ter na vadbi in / ali tečajih, ki temeljijo na tehniki, predlagamo nekaj razmišljanj o vadbi, ki je napolnjena z umetniškimi in lepotnimi vidiki, zlasti zato, ker je eden od njenih končnih ciljev koreografska predstava: Telovadba za vse (GfA). FIG (Mednarodna telovadna zveza), ki uradno vodi Telovadbo za vse, zahteva da sestava GfA vključuje skupinske nastope na festivalih, ne glede na to, ali so tekmovalni ali ne. Z vzpostavljanjem vzporednic med nalogami GfA in ustvarjalnim, sodelovalnim koreografskim procesom v umetnosti (ples in gledališče) in podprtimi obdobji ustvarjalnosti, ki jih je predlagal Kneller (1973), opisujemo potovanja dveh skupin GfA, ki sta se razvila v središču, ki je usmerjen v prakso, in ne koreografije, osredotočene na vaditelja. Bolj kot učenje / početje ali celo učenje / pomnjenje kodiranih standardnih zaporedij je bistveno, da raziščemo možnosti dialoga med posameznikom in različnimi prvinami, ki ga obkrožajo. Na nek način je egocentrizem vaditelja na novo opredeljen in mu je odvzeta vloga koreografa. Koreografijo je treba obravnavati kot skico, saj tisto, kar razkrije, navdihuje nenehne spremembe. Vplivalo bo na to, kaj si bodo gledalci omislili, kako lahko navdihuje druge umetnike in kako se bodo udeleženci počutili izpolnjene. Zato je neskončnih priložnosti. Oblikovanje gibanja in povezovanje dejanj postopoma razkrivata predlagano temo in sprožata tehniko in lepoto: to je glavni izziv koreografskega procesa.

Ključne besede: telovadba za vse; sodelovalni koreografski postopek; ustvarjalni proces.