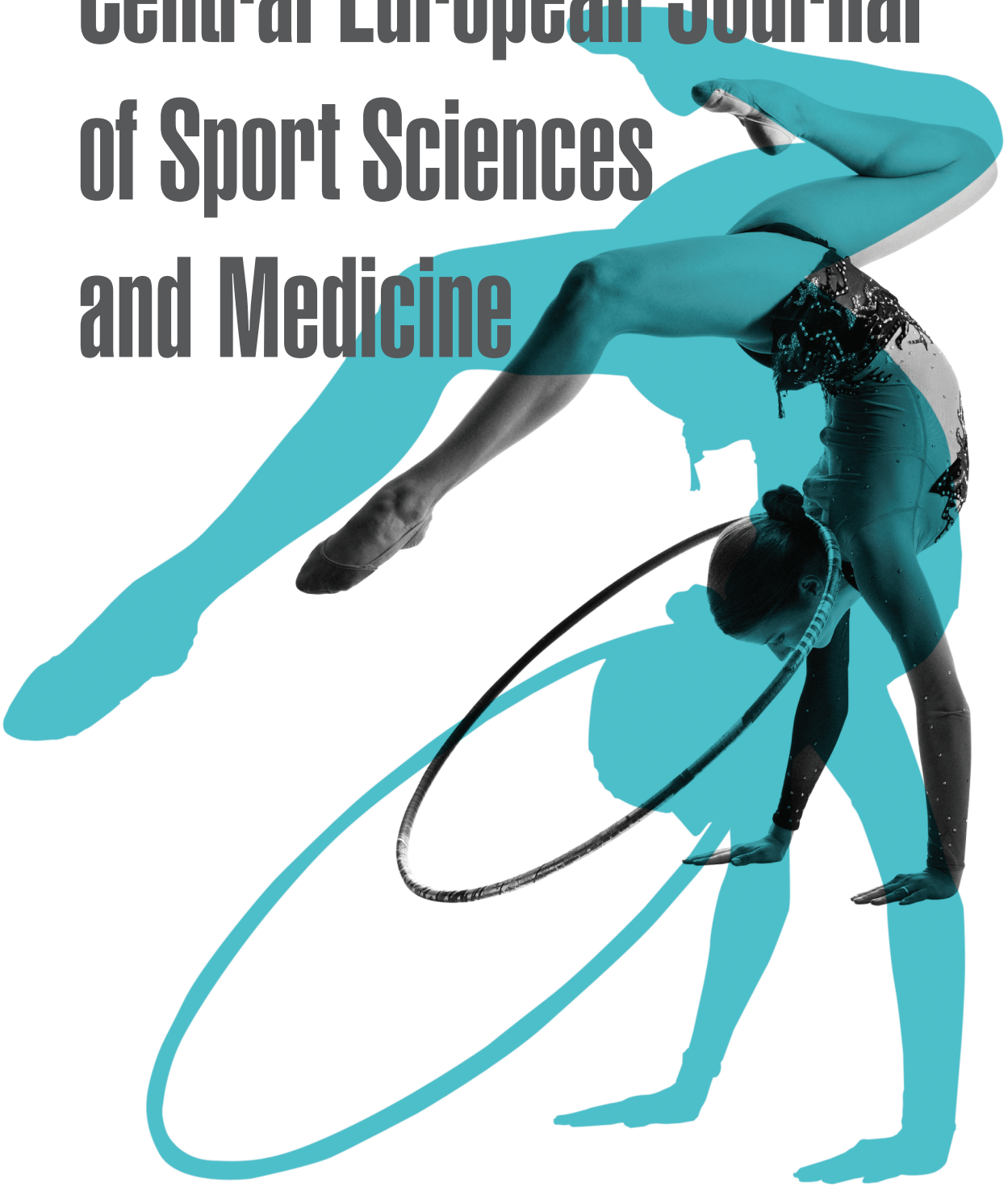
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QUANTIFYING THE PHYSICAL DEMANDS OF SMALL SIDED GAMES IN RUGBY UNION: CONTACT VS. NON-CONTACT

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Abstract This study aimed to compare the physical demands of contact small sided game (CSSG), non-contact small sided game (NCSSG) and match play in female rugby union. Fifteen female rugby union players participated within this study. Participants completed two testing sessions. Session one involved two 20-minute small sided games (contact and non-contact). Session two involved a competitive rugby union game. Movement characteristics, heart rate, PlayerLoad™ and tackles were recorded using GPS units and heart rate monitors. No significant differences were identified between conditions in relation to average heart rate or time spent in different heart rate zones. Significant differences were identified between conditions for distance, normalised PlayerLoad™ and tackles. Distance covered was significantly higher in the non-contact small sided game, while normalised PlayerLoad™ and tackles were significantly lower in this condition. These findings suggest that the physiological stress, in terms of heart rate, is comparable between the match and both small sided games. Thus both small sided games seem to elicit an appropriate internal training response. However, the reductions in tackles and normalised PlayerLoad™ in the non-contact small sided game are likely to reduce injury risk, while the increase in distance covered may enhance the training stimuli provided in this condition.

Key words GPS, rugby, time motion analysis, small sided game, physical fitness

Introduction

Rugby Union is a physically demanding, invasion based intermittent team sport lasting over 80 minutes (Duthie, 2006). Throughout the course of match players engage in a number of high intensity activities such as sprinting, tackling, rucking, mauling, scrummaging and kicking interspersed with short periods of active and passive recovery (Bradley et al., 2015). The contact elements of a rugby union match-play frequently expose the players to high impact forces (~5,300 N) (Seminati et al., 2017), thus increasing injury risk when compared to other team sports (Fuller, Sheerin, Targett, 2013). Contact accounts for the majority of rugby related injuries, with tackling

the highest risk activity during both training and match play accounting for 44% and 45% of injuries to forwards and backs, respectively (Fuller et al., 2013).

Training is a vital part of rugby, with skills and fitness being developed during training sessions (Gabbett, Jenkins, Abernethy, 2012). It is essential that the physical preparation of players during training meets the specific requirements of match play. An understanding of the physical demands of match play is essential to informing the design of training interventions with a view to reducing injury risk and enhancing performance. Traditional conditioning, repeated high intensity effort exercise, and skills practice are all common methods of rugby training; however, all of these methods have been shown to elicit lower physical demands when compared to match play (Gabbett et al., 2012). Furthermore, traditional training methods commonly involve unopposed tasks, thus reducing ecological validity and limiting the opportunities for players to develop decision making skills in dynamic environments (Davids, Araújo, Correia, Vilar, 2013).

Small sided games (SSG) are becoming increasingly popular training tools within team sports as they provide a dynamic environment, that is easily modifiable, yet requires fewer players and reduced pitch sizes compared to the traditional game on which they are based (Hill-Hass, Dawson, Impellizzeri, Coutts, 2011). There is a growing body of evidence (Hill-Hass et al., 2011; Vaz, Goncalves, Figueira, Garcia, 2016; Impellizzeri et al., 2006; Gabbett, 2006) demonstrating the efficacy of SSG, due to comparable physiological demands between SSG and traditional conditioning activities or match play. Within rugby union, both contact SSG (CSSG) and non-contact SSG (NCSSG) are commonly used within training sessions (Fuller et al., 2013; Vaz et al., 2016; Jones, West, Crewther, Cook, Kilduff, 2015). However, to the author's knowledge, no studies have compared the physical demands of CSSG and NCSSG relative to each other or match play. If the physical demands of NCSSG match those of match play, this type of training may offer a means of maximising physiological adaptations while reducing injury risk by removing tackling. Previous work (Fuller et al., 2013) has demonstrated that non-contact skills based training has a lower injury rate (1.2/1,000 hours) compared to semi-contact (4.7/1,000 hours) and full contact skills (6.1/1,000 hours) based training.

Traditionally, rugby has been viewed as a male dominated sport but over recent years women's rugby union has grown in popularity (Chase, 2006). Despite this there is limited work exploring female rugby union. As such the aim of this study is to compare the physical demands of CSSG, NCSSG and match play, in female rugby union. Four hypotheses were tested within this study; (1) distance covered would be greater in the NCSSG; (2) time spent performing high speed movements would be greater in the NCSSG; (3) heart rate would be greater during the match and (4) PlayerLoad would be lower during the NCSSG.

Methods

Participants

Fifteen female rugby union players (19.8 ±1.6 years, 1.65 ±0.07 m, 70.5 ±13.1 kg) participated in this study. All participants were recruited from a collegiate level Women's Rugby Team. Participants were free from injury for at least 6 months prior to testing and free from illness at the time of testing. All participants provided informed written consent and ethical approval was granted for this study by the Institutional Ethics Committee.

Procedures

Participants attended two testing sessions. Both testing sessions were completed on an artificial 3G surface to reduce environmental changes to the surface between testing sessions (Burillo, Gallardo, Felipe, Gallardo, 2014). Participants completed standardised warm ups and cool downs at the start and end of each session. Session one required participants to complete two conditioned rugby specific SSG activities; NCSSG and CSSG. SSG were played on a 30 m × 70 m standardised playing area (Johnston, Gabbett, Siebold, Jenkins, 2014). Pitch size and player numbers remained the same throughout both SSG. CSSG was played to standard 15 a side rugby union rules. NCSSG was played to touch rugby rules, with two handed taps replacing tackles. Once tackled, in the NCSSG, participants rolled the ball through their legs to a team mate, whilst the two players from the opposing team closest to the tackle area dropped to the floor and returned to their feet; thus creating space for the attacking side. After six tackles a turn over occurred. Both SSGs were played for 20 minutes with 20 minutes active recovery between each bout, reducing the effect of fatigue. The active recovery involved walking, light jogging and dynamic stretching. Session two was completed two weeks after session one. Within session two, participants competed in a BUCS Northern 1a league game played to full rugby union rules, for over 80 minutes. A schematic representation of the two testing sessions is presented in Figure 1.

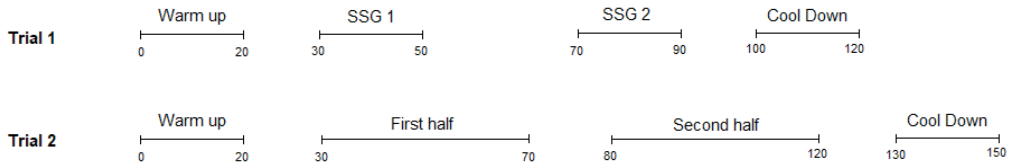


Figure 1. Schematic representation of the data collection sessions

Participants were required to continuously wear a Microelectromechanical systems (MEMS) device (MinimaxX, Catapult Sports, Melbourne, Australia). In an attempt to avoid erroneous data due to excessive movement artefact, the MEMS devices were housed between the participants scapulae in a standardised custom fitted neoprene garment worn directly against the participant's skin. Each MEMS device comprised a GPS component, 3D magnetometer and a tri-axial piezoelectric linear accelerometer (Kionix: KXP94) with sampling frequencies of 10, 30 and 100 Hz respectively. Each player wore the same device across matches to reduce any variation in GPS derived data due to potential between-unit discrepancies (Boyd, Ball, Aughey, 2011; Jennings, Cormack, Coutts, Boyd, Aughey, 2010). Acceptable inter-unit reliability has however been identified for the GPS [CV = 0.7–1.3%] and accelerometer [CV = 1.94%] (Castellano, Casamichana, Calleja-Gonzalez, San Roman, Ostojic, 2011; Boyd et al., 2011) hardware contained within the MEMS devices used in the current study. Prior to the commencement of each season, all units were sent to the manufacturer for calibration using their preferred "jig" method. Units were orientated and secured in a stationary position in each plane of movement and recordings were set at 1g for that position to reduce any bias or drift. Every two weeks, units were checked for calibration, with all units remaining within the manufacturer's tolerance thresholds during the entire testing period. In line with previous research (Malone, Lovell, Varley, Coutts,

2017), GPS data was only included for statistical analyses if a horizontal dilution of precision (HDOP) of <1.5 and a number of satellites ≥6 was achieved.

Data was downloaded from each GPS unit post-trial and analysed using Catapult Sprint Innovations 5.1.4 Team Sport Software (Catapult Innovations, Scoresby, Victoria). The following variables were extracted for analysis in each condition; average distance covered, time spent in working at different speeds, average HR, time spent in different HR zones, PlayerLoad™ and tackles. Movement speed was classified into the following zones in accordance with M.R. Jones et al. (2015), low-speed movements: walking (0–1.6 $m \cdot s^{-1}$), jogging (1.6–2.7 $m \cdot s^{-1}$), cruising (2.7–3.8 $m \cdot s^{-1}$) and striding (3.8–5.0 $m \cdot s^{-1}$), and high-speed movement: high-intensity running (5.0–5.5 $m \cdot s^{-1}$) and sprinting (>5.6 $m \cdot s^{-1}$). Total playing time was determined for each player within the match and time off the field was removed from the data analysis. Prior to data analysis distance covered was converted to distance covered per minute ($m \cdot min^{-1}$) to enable direct comparisons between the three conditions, despite the differing durations. Average HR ($b \cdot min^{-1}$) and time spent in the following HR zones (Vaz et al., 2016) were extracted; <75%, 75–85%, 85–90% and >90%. PlayerLoad™, the square root of the sum of the squared instantaneous rate of change acceleration in each of the three movement planes, was calculated from the accelerometer data (Catapult, 2013), within Catapult Sprint Innovations 5.1.4 Team Sport Software. PlayerLoad™ was normalised to both time and distance covered, to account for differences between the match and SSG durations and any potential changes in distance covered between conditions. Tackles were calculated from the accelerometer data recorded by the minimaxX unit, in accordance with manufacturer guidelines (Catapult, 2013) and normalised to time.

Data Analysis

All data is reported as mean ±SD unless otherwise stated. All statistical analysis was undertaken using IBM SPSS Statistics Editor 22 (IBM, Armonk, NY, USA). Prior to statistical analysis the assumption of normality was assessed using the Shapiro-Wilk test. All data were normally distributed. A repeated measures analysis of variance (ANOVA) was used to explore differences between conditions for distance, average HR, PlayerLoad™ and tackles. A 3 × 4 repeated measures ANOVA was used to explore the difference in the time spent within each HR zone across the three conditions and a 3 × 6 repeated measures ANOVA was used to explore for differences in time spent within each speed band between conditions. The sphericity assumption was checked using Mauchly's test of sphericity, where data violated the assumption the degrees of freedom were corrected using Greenhouse-Geisser corrections. Pairwise comparisons were undertaken post-hoc where significant main effects were reported and the least significant difference correction was applied. The least significant difference was used to correct the level of significant for the pairwise comparisons, over the Bonferroni correction, as it is less conservative (Field, 2013). Partial eta squared (η^2) was used as an estimate of effect size and interpreted as follows; small (0.01–0.059), moderate (0.06–0.137) and large (≥0.138). The level of significant was set at $p < 0.05$.

Results

Distance

A significant main effect ($F = 13.25$, $p = 0.003$, $\eta^2 = 0.77$) was reported for distance covered per minute (Figure 2A). Pairwise comparisons revealed a significant ($p < 0.05$) increase in distance covered during the NCSSG

compared to both the match and CSSG. No significant difference ($p > 0.05$) was reported between the game and CSSG.

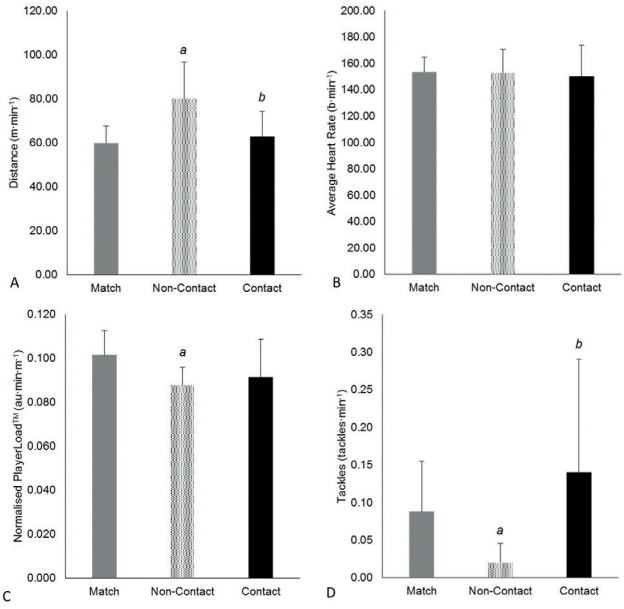


Figure 2. Results for the match (solid grey), non-contact small sided game (grey pattern) and contact small sided game (solid black). A. Distance covered per minute. B. Average heart rate. C. Normalised PlayerLoad™. D. Tackles. Data averaged across all participants. *a* denotes significantly different to the match. *b* denotes significantly different to the NCSSG

Speed

Table 1 shows the percentage of time spent working in each speed zone during all conditions. On average participants spent the majority of time in each condition walking. More time was spent performing low speed movements in all conditions. A mixed design ANOVA revealed no significant condition*speed interaction ($F = 2.51$, $p = 0.073$, $\eta^2 = 0.16$).

Table 1. The percentage of time player's spent in each speed zone in all conditions

	Low-speed Movements				High-speed movements	
	walking (%)	jogging (%)	cruising (%)	striding (%)	HI running (%)	sprinting (%)
Match	53.6 ±11.0	22.3 ±4.4	15.8 ±5.8	5.8 ±2.4	1.1 ±0.8	1.3 ±2.0
NCSSG	49.4 ±7.80	34.6 ±5.0	12.2 ±4.3	2.6 ±1.9	0.2 ±0.4	1.0 ±1.4
CSSG	52.2 ±7.30	28.4 ±7.7	14.6 ±4.6	3.2 ±2.9	0.8 ±0.8	0.8 ±1.3

NOTE: Values are averaged over all players.

Heart Rate

Average HR and the percentage of time spent working in each HR zone in each of the test conditions are shown in Figure 2B and Table 2 respectively. No significant ($F = 0.35$, $p = 0.62$, $\eta^2 = 0.04$) difference was reported for average heart rate between conditions. Participants spent more time working at <75% HRmax and 75–85% HRmax in all conditions. No significant ($F = 0.36$, $p = 0.77$, $\eta^2 = 0.02$) condition*zone interactions were reported.

Table 2. The percentage of time players spent in each heart rate zone and average heart rate during each condition

	Heart Rate (%)			
	<75	75–85	85–90	<90
Match	37.9 ±24.3	38.6 ±13.6	14.9 ±8.7	8.6 ±7.4
NCSSG	41.6 ±34.7	29.6 ±17.9	14.5 ±11.6	14.3 ±21.0
CSSG	34.9 ±33.2	37.5 ±19.7	18.5 ±15.3	9.1 ±10.9

NOTE: Values are averaged over all players.

Normalised PlayerLoad™

A significant main effect ($F = 6.39$, $p = 0.02$, $\eta^2 = 0.62$) was reported for normalised PlayerLoad™ (Figure 2C). Pairwise comparisons revealed that normalised PlayerLoad™ was significantly ($p = 0.02$) lower during the NCSSG compared to the match. No significant ($p > 0.05$) differences were reported between the CSSG and either the match or NCSSG.

Tackles

A significant main effect ($F = 4.17$, $p = 0.04$, $\eta^2 = 0.23$) was reported for tackles per minute (Figure 2D). Pairwise comparisons revealed that significantly ($p < 0.05$) fewer tackles were made per minute of play in the NCSSG compared to both the match and CSSG. No significant ($p = 0.92$) difference was reported between the match and CSSG for tackles per minute.

Discussion

To the authors knowledge this is the first study to explore the physical demands of CSSG and NCSSG relative to match play, despite contact and non-contact SSG commonly being used during rugby union training sessions (Vaz et al., 2016; Jones et al., 2015). The findings of this study support two of the four proposed hypotheses, with greater distance covered and lower PlayerLoad™ during the NCSSG compared to the CSSG and match play. These findings suggest that there are important differences in a number of key metrics that may influence injury risk and training stimuli. It was also identified that no significant differences existed for the heart rate data or time spent within each speed zone between the NCSSG, CSSG and match data. These data therefore suggest that the relative intensity of the two training sessions was not significantly different to that of match play; these findings do however reject hypotheses two and three.

The distance covered per minute was significantly increased during the NCSSG compared to both the match and the CSSG (Figure 2). This increase in distance covered per minute within the NCSSG highlights an increase in average speed during this condition. The match and the CSSG have highly comparable distances covered and

average speeds suggesting that the CSSG replicates the demands of the match. In relation to training the increases in distance covered per minute during the NCSSG would equate to covering an extra 516 m over the course of a 30 minute training session in comparison to the CSSG condition. This substantial increase in distance covered between the conditions would therefore suggest the NCSSG would elicit the greatest training stimuli. Increasing the training stimuli in this way would likely increase the positive adaptations to the aerobic system, which in turn may help players maintain higher work rates within match play. Previous studies (Castagna, Manzi, Impellizzeri, Weston, Barbero Alvarez, 2010; Iaia, Rampinini, Bangsbo, 2009) have demonstrated that teams who cover more distance during match play and who are aerobically fitter have higher performance levels.

Time motion analysis was undertaken to further explore the changes in movement characteristics between the three conditions (Table 1). This analysis revealed that participants spent more time jogging and less time walking during the NCSSG compared to both the match and CSSG. These changes in time spent walking and jogging between conditions may explain the changes in distance covered. However, it must be noted that no significant condition*speed interaction was reported within this study and that, in all conditions, high-speed movements were limited, accounting for ≤2% of the total time (Table 1).

Despite the significant changes in distance covered per minute between conditions there were no significant differences in average HR (Table 2). The HR data therefore suggests comparable internal workloads across the three test conditions, with both SSG replicating the demands of the match. As such, either type of SSG could be used to prepare players for match play. The lack of any significant changes in HR between the three conditions is surprising given the significant increases in distance covered and thus average speed in the NCSSG. A possible reason for the similar HR responses to each condition may be the contact element of the match and CSSG. The contact element adds a resistive factor that may help to elevate the HR during the match and CSSG (Deustch, Maw, Jenkins, Reaburn, 1998; Bowen, Gross, Gimpel, Li, 2017). While the contact element of the CSSG may help to explain the HR findings, it may also increase the risk of injury, as the majority of rugby related injuries are a result of contact (McIntosh, Savage, McRory, Fréchède, Wolfe, 2010; Fuller, Sheerin, Targett, 2013). Removing the contact element from training may therefore help to reduce the risk of injury.

Removing the tackling aspect of the game in the NCSSG resulted in significant reductions in both the tackles per minute and normalised PlayerLoad™ (Figure 2C and D) metrics. The significant reduction in tackles in the NCSSG compared to the CSSG and match is unsurprising given the rules associated with this conditioned SSG. The reduction in tackles during the NCSSG may explain the reduction in normalised PlayerLoad™. PlayerLoad™ has previously been linked to injury risk (Bowen et al., 2017), therefore the significant reduction in both this metric and tackles supports the suggestion that injury risk should be reduced in the NCSSG compared to both the CSSG and match play. In contrast, the match and NCSSG are more closely matched in terms of normalised PlayerLoad™ and tackles per minute. There was a non-significant increase in tackles per minute during the CSSG compared to the match, however this was not replicated in the normalised PlayerLoad™ data, which was higher in the match than the CSSG. This slight reduction in PlayerLoad™ in the CSSG compared to the match, despite the increase in tackles per minute suggests that the tackles made in the CSSG are of a lower intensity. Thus the injury risk in the CSSG may still be lower than in the match.

The findings of this study need to be interpreted in light of a number of factors. This study was completed on artificial 3G turf. Artificial 3G turf was used within this study to reduce environmental changes to the surface between testing sessions (Burillo et al., 2014). While the use of artificial surfaces is increasing within rugby union

(Cunniffe, Proctor, Baker, 2009), studies have demonstrated differences in ground reaction forces and running velocities compared to natural turf (Stiles, James, Dixon, Guisasola, 2009; McGhie, Ettema, 2013). For this reason future work should replicate the current study on natural turf. Finally, the specific design of the SSG undertaken within this study may have altered the manner in which players acted within each session. Both the CSSG and NCSSG were standardised by encouraging players to play with width. For this reason future work exploring the influence of contact and non-contact SSG with different objectives may be warranted.

Conclusions

In conclusion, this study provides a novel insight into the physical demands of common training methods and match play in female rugby union players. The findings of this study revealed that both NCSSG and CSSG appear to replicate the physical demands of match play. As such either type of SSG appear to offer appropriate training methods for female rugby union players. The NCSSG may offer an enhanced training stimuli though, due to the increased distance covered per minute compared to the CSSG. In addition, the NCSSG is also liable to reduce injury risk in comparison to the CSSG as the majority of rugby related injuries are a direct result of contact.

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DANCE AS A CATALYST FOR STRESS BUSTING

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Abstract Dance is a catalyst for inspiration, for creating awareness of movement and self-expression, and to make a difference in the lives of children and adults. The current generation of kids is undergoing different kinds of stress, academic pressure, peer pressure and monotonous routines. Dance can be a fantastic stress-buster.

While we define meditation as "controlled brain activity", dance is surely a form of meditation. When one dances, the brain has to coordinate with the body and mind to completely coordinate between music and movements. Dancing to one's favorite music and enjoying it helps an individual focus strictly on the moment they are in. This aids in controlling the release of cortisol hormones from the brain, which helps in lowering stress and tension levels. "When the body feels good, the mind does too". Dance can be a very therapeutic and healthy way for people to channelize any feeling that they may be experiencing. If anyone is suffering from depression, dance can give an outlet for emotions; connects you to a positive environment. Dance replaces stress hormones with pleasure hormones like endorphins and serotonins.

This paper incorporates the basic principles of learning and reinforcement that are known to be effective methods in helping individuals to dance. The paper attempts to portray the author's experiences about "Dance as a catalyst for stress busting". The research methodology used are literature survey, inputs in the form of survey and personal experiences of the author.

This paper publishes the results of a survey that was conducted amongst teenagers based on the students of Natyashala School of Bharatanatyam. The survey was primarily oriented to answer whether and how dance acts as a stress buster in their lives.

Another, a practical experience-based approach was conducted as, an in-school Dance Program for children with special needs; catering specifically to children with Autistic disabilities is presented here.

Techniques to inculcate dance as an early intervention for teenagers are also discussed. As one continues to dance, we can see how dancing will naturally develop and increase one's self confidence and self-esteem, both on and off the dance floor, helping to further reduce the feelings of tension and pressure.

As the awareness for Autism Spectrum Disorder has increased, so have the number of therapeutic approaches. Therefore, the most effective treatment or combination of treatments remains inconclusive. Creative movement and dance is a practical and feasible option for children with Autism Spectrum Disorder. This article aims to present a narrative review of the literature for dance and stress and it is hoped that parents, teachers, and educators can gain thorough understanding of how dance can be adapted for autistic children who may be thinking about implementing dance movement therapy into an autistic child's routine.

Key words stress, autism, tension, self confidence, self esteem

Introduction

When life tries to bring you down – Just Dance! – Shonna. H. Leiker



Figure 1. Teenage girls posing after the interview

Background

Dance is the language that body speaks. Dance is a beautiful form of art that helps one express themselves saying a word. Just like different languages in the world, dance also has so many languages – be it classical, folk, hip hop, ballet, contemporary, freestyle. Some dance forms are soft and delicate like ballet and contemporary, while some are fierce and powerful like hip hop, folk. Some dance forms are classic and beautiful like Bharatanatyam and Kuchipudi. Dance is not just an art of expression but also a great workout regime it keeps one fit. Dance helps one to improve concentration, memory, build flexibility and strengthen spine and back. The foot-tapping movements are like acupressure that helps press all the points of the body connected to the feet. Dance is a great stress buster and helps relieve mental stress like no other. With dance one can let everything out in a non destructive way and feel lighter. Sometimes dance says more than words can ever describe.

Purpose

The sole purpose is to analyze the benefits of dancing and how dance makes a mark in one's life. This study is hoped to provide evidence necessary to establish dance as an effective medium to reach out to people in various fields and show how it reflects in the daily living of a person, especially teenagers. The aim is to find out the effect of dance to create body awareness, sense of well-being, social skills and empathy among autistic children. This research can help provide new teaching strategies for educators to use dancing methodology in classroom with children and disabled students at every walk of life.

"When the body feels good, the mind does too" – This paper incorporates the basic principles of learning and reinforcement that are known to be effective methods in helping individuals to dance in both solo and group sessions.

Problem Statement

The problem statement explored in this study is based on "Dance as a catalyst for stress busting"; it deals specifically with how dance acts as a stress buster in teenagers and autistic children.

Material and Methods

Initial research was done at libraries and through internet referring to books, journals and magazines to get inputs about meaning of stress, causes for stress, and symptoms of autism.

A research survey was conducted amongst teenagers on how dance acts as a stress buster in their lives. Real life experiences and views are being projected in this paper.

Another, a practical based approach was conducted as an in-school Dance Program for children with special needs, catering to children with Autistic disabilities.

Limitations of the Study

While dealing with teenage students, they were hesitant to give away exact responses. Some of the students provided similar responses to their peers'. The younger participants tended to choose answers that were convenient to them, which created ambiguity in the findings. However, the one on one sessions and individual questions gave the students an opportunity to answer freely helping in inferences.

Working with children diagnosed with Autism Spectrum Disorder had the potential of many limitations, given that they often experience outbursts, anxiety, attitudes, short attention spans, poor coordination, dynamic emotions, varying physical capability, and other behavioral patterns. Each participant had unique needs, and those needs changed every time I met with him/her. I never knew what to expect and was prepared to discard my lesson plan and improvise if the needs of the participant were not being addressed that day. In the classes, two out of the three participants had a difficult time verbally expressing themselves and their needs. This resulted in frustration for the participant, at times making me rely on the parent or guardian for the majority of the feedback and reflection.

Research Questions

1. What are you currently studying and what are your hobbies other than dance?
2. What kind of music do you like and which type of videos do you watch on YouTube?
3. How has dance helped you in your lifestyle?
4. How do you plan to make a difference to the world at large?



Figure 2. Mythology Coloring with imagination of Stories

Dance is a Stress Buster

Creative arts interventions, including art, dance movement, dramas and music, are used to target depression and depressive symptoms in adults and children (Dunphy et al., 2019). This includes interventions led by trained arts therapists as well as health and arts professionals.

Stress is one's body's way of responding to any kind of demand or threat (https://www.helpguide.org/articles/stress/stress-symptoms-signs-and-causes.htm). When you sense danger – whether it is real or imagined – the body's defenses kick into high gear in a rapid, automatic process known as the "fight-or-flight" reaction or the "stress response". Some symptoms of stress include (https://www.webmd.com/balance/stress-management/stress-symptoms-effects_of-stress-on-the-body#2):

- becoming easily agitated, frustrated, and moody,
- feeling overwhelmed or having difficulty relaxing your mind, inability to focus,
- headaches, stomach upset, including diarrhea, constipation, and nausea,
- aches, pains, and tense muscles,
- insomnia,
- frequent colds and infections,
- being pessimistic or seeing only the negative side.

In this generation of stress, academic pressure, peer pressure and monotonous routines, dance can be a fantastic stress-buster (https://www.scribd.com/document/398606720/fpsyg-09-02655-pdf#). Recent studies have also shown it to be effective in improving conditions such as insomnia, anxiety, brain function, and tiredness, which are often the causes of stress and worry.

In today's world meditation is a necessity, where stress catches on faster than the eye can see or the mind can perceive. Meditation holds the power to unconditional happiness and peace of mind. While we define meditation as "controlled brain activity", dance is surely a form of meditation (https://www.artofliving.org/in-en/meditation). When

one dances, the brain has to coordinate with the body and mind to completely focus on the music and movements. Dancing to one's favourite music and enjoying it can help an individual focus strictly on the moment they are in. This aids in controlling the release of cortisol hormone from the brain, which helps in lowering the stress and tension levels.

Techniques

"When the body feels good, the mind does too" – this paper incorporates the basic principles of learning and reinforcement that are known to be effective methods in helping individuals to dance in both solo and group sessions (http://www.arthurmurraydancenow.com/blog/3-ways-dancing-relieves-stress). Techniques on strengthening and stretching muscles, creative body movement, individual and group movements are taught in both creative dancing and basic dance movement.



Figure 3. Yoga Asanas in Bharathanatyam

Techniques to inculcate dance as an early intervention for teenagers are discussed as below:

1. Focus on Strengthening and Stretching muscles – warm up sessions, Yogic Movements like Surya namaskar and imbibing the different Yoga Asanas in Bharathanatyam.
2. Basic dance movement – learning the basic adavus in Bharatanatyam, mastering the Ara mandi posture, learning the Shiro, Drishti, Greeva, Mandala, Pada, Chaari Bhedas. Understanding Theoretical Aspects of Bharathanatyam, Understanding Facial Expression through Theatre.
3. Creative Dancing:
   - Learning Kalaripayattu – Martial Art Kerala,
   - Folk Dances of India – Kalbelia, Garba, Koli, Bhangda, Bihu, Lavani,
   - Zumba Techniques,
   - Exploring Freestyle Dance,
   - Creative Expression – Choreography Techniques.



Figure 4. Dance Make-up Learning by the Teenagers

4. Continuous Knowledge Sharing on dance related topics:
   - Dance Make-up & Hairstyle,
   - Dance Saree Drapery, Dance Charades,
   - Taalam Concepts & Writing Articles related to Art,
   - Mythology Colouring with imagination of the Stories,
   - Classical Video Screening of Stalwarts in the Field.

Dance can be a very therapeutic and healthy way for people to channelize any feeling they may be experiencing. Dance/Movement Therapy is defined as the therapeutic use of movement to supplement the emotional, cognitive, physical, spiritual and social integration of the individual (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5836011). Physically, dance movements stimulate the vestibular and cardiovascular system. Psychologically, embodied feelings and expression improve body image. Exploring one's own movement abilities and limitations helps to increase emotion regulation, impulse control, and relation to reality of life. If you are suffering from depression, dance can give you an outlet for your emotions, connects you to a positive environment. The ability to express with or without talking/singing gives a sense of freedom both physically and physiologically. Dancing replaces stress-hormones with pleasure hormones like endorphins and serotonin.



Figure 5: Classical Video Screening of Stalwarts in the Field

Teenagers Inputs[1]

Avya is a 19-year-old Economics student from Pune, a Model United Nations enthusiast, with an interest in singing, art and public speaking. She listens to hip hop English music and is a huge Bollywood fan. In her spare time, Avya spends time with her parents and friends. Her YouTube search history is filled with dance videos of all style, watching blog videos by David Dobrik and Casey Neistat. She has a keen interest in conspiracy theories.

Avya says: "Dance has done a lot for me but more than anything else, it's been a stress buster. During my 12th standard board exams, the only thing that kept me going was dance! Not only did it serve as a good form of exercise, it also helped me focus better on academics. My concentration level increased and in turn, my stress level plummeted by significant amounts. And now even in college, with all the assignments and deadlines, dance helps me stay focused. A quick practice goes a long way in de-stressing my mind and body."

Avya believes everything happens for a reason and wishes to spread the message of humanity and peace among the masses in addition to the upliftment of all genders simultaneously.

Sitara is a 16-year-old 12th grade commerce student. Sitara is creative, aesthetically inclined, empathetic, and perseverant and always tries to imbibe good quality from our surroundings. She loves to watch science fiction, horror and adventure Hollywood movies, read books on thrill, crime and classics. She is a big fan of music by Tame Impala, Sufjan Stevens, Sleeping at Last and The Big Moon. During her free time she watches different dance choreographies, comedy, fitness and lifestyle videos on YouTube.

Sitara says: "Dancing has always served as an outlet for all my emotions, whether positive or negative. Throughout the pressure of my boards and other exams, dancing was an important part of my day as it was not only a stress reliever, but also helped me relax and distract myself for a while. Besides my dance sessions, my friends at dance class also contribute in a huge way to making me feel better on the days I feel low."

Tahira is 18 years old and she is pursuing graduation in Arts with specialization in Economics. She likes to swim and play badminton and sometimes attend live sports events like a cricket or football match. She listens to songs of different genres that catch her attention on the radio or T.V. She loves to relax and be with friends during free time and on YouTube she usually watches dance videos, standup comedy videos and follows YouTube channels like Filter Copy, Dice Media, Indian Raga, and East India Comedy.

"Dancing helps me relieve stress by keeping me away from stressful events in my life, allowing my brain to recharge and face the day with renewed vigour. It has also helped me during my board exams to cope with the exam stress. My message to the world is 'Expand your boundaries'. Learn to see beyond the limitations that seem real, and empower yourself to push past those boundaries." says Tahira.

Jayantika is a 16-year-old Psychology and Political Science student. She has a melodious voice and loves to sing and take part in dramas. She spends her free time painting. She listens to alternate pop, rock and instrumental English music. She also loves listening to classic Hindi songs and Tamil songs occasionally. She is glued to funny bloggers on YouTube who captures their life on a daily basis. She follows "Last Week Tonight" by John Oliver which is a weekly satirical news show, that's funny and at the same time keeps you well informed.

Jayantika says: "Dance to me is an escape. It's an amazing way to de-stress yourself physically as well as emotionally. We tend to grow as human beings as we learn to express ourselves through Abhinaya. Personally, it's also my only form of exercise and helps me stay quite fit. I honestly couldn't imagine my life without dance."

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[1] The names of the teenage girls are changed in order to keep their identity confidential.

Aarini is a 17-year-old Science student. She is a good listener and she is empathetic to all. She is also an ardent state level swimmer and goes on trekking quite often, recent achievement being walking 40 kms in a day from Panhala to Pawankhind. She watches friends and movies on comedy channel and funny blogs by David Dobrik on YouTube.

"Any type of physical activity releases neurotransmitters and endorphins which serve to alleviate stress. Since I never ended up getting a gym membership, I use dance practice instead. I feel so much better after leaving all my frustration and stress on the dance floor. Be optimistic and pursue your dreams till the very end. If you are serious about something in life keep it your priority and achieve it." says Aarini.

Ragini is a 16-year-old, class 12th Science student. She is a friendly person, who can easily interact with new people and is highly self-confident. She loves listening to classical and Bollywood music. Her interest in traveling has taken her all around India; she has a bucket list of exploring the world. She is an ardent reader and fan of Chetan Bhagat novels.

Ragini says: "Dance is everything to me. It is a form of fitness, more importantly; it helps me express what I feel. Dance boosts my confidence and helps me concentrate on the work I do and execute it with perfection. Dancing relieves me of stress by helping me distance from stressful events in life, allowing my brain to recharge and face the day with renewed energy. The more confident I am after I dance. Challenges are what make life interesting. Overcoming them is what makes life meaningful."

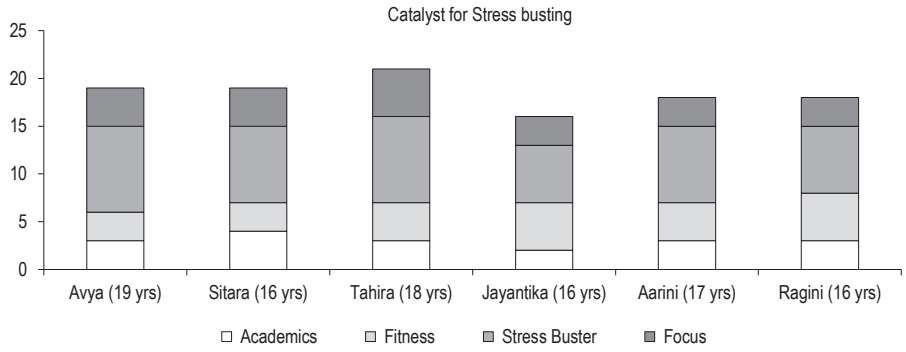


Figure 6. Teenagers Views

The scientific reasoning for why dance has the ability to act as a stress buster stems from the idea that when the body feels good, the mind does too. As one continues to dance, we can see how dancing will naturally develop and increase one's self confidence and self-esteem, both on and off the dance floor, helping to further reduce the feelings of tension and pressure. So let us dance.



Figure 7. Let us dance

Dance for Kids with Autism

Autism, or autism spectrum disorder (ASD), refers to a broad range of conditions characterized by challenges with social skills, repetitive behaviors, speech and nonverbal communication (https://www.autismspeaks.org/what-autism). Autism affects an estimated 1 in 59 children. People with autism often lose the awareness of their mind and body. As awareness for ASD has increased, so have the number of therapeutic approaches; however, no single intervention has proven beneficial, therefore the most effective treatment or combination of treatments remains inconclusive (https://www.researchgate.net/publication/264373169_DanceMovement_Therapy_as_an_Intervention_for_Children_with_Autism_Spectrum_Disorders). Creative movement and dance is a practical and feasible option for children with ASD.

The signs and symptoms of autism include:

1. Low or lack of social skills and communication.
2. Touch or physical contact – do not like to be touched.
3. Difficult to adjust with sudden environmental changes like a sudden loud noise, strong smell or increase in light intensity.
4. Echolalia: people with autism often repeat the words or phrases they hear, known as echolalia.
5. Repetitive or recurrent behaviors.
6. Showing empathy: people with autism can rarely understand others feelings and emotions and thus showing empathy is very difficult for them.

Children learn through seeing and doing, learning patterns and other critical parts of how to function through traumatic experiences and relationships (Devereaux, 2017, p. 36). When individuals learn movement patterns it becomes an individual's response to his or her inner emotional state. This generally means that when an individual sees others communicate socially, their mind connects to the neurons related to the proper response needed for this experience emotionally. Therefore, the rationale is that if movement patterns can be changed, dance movement therapists can promote health and growth in children with autism by teaching new movements.

Symbolic interaction becomes a vital part of therapeutic work that is in dance movement therapy. Both the instructor and the student can find a deeper meaning into what can be seen through symbolic expression. Some examples of symbolic movement include personal touch, eye contact between two individuals as well as group eye contact, facial expressions including smiling and frowning and body movements. These symbols can have multiple meanings depending on the individual. Dance, for a long time, has been used as a stress relief, mirroring, healing and therapeutic tool. Dance can be used to take away a person's need to articulate their emotions and feelings verbally, due to their non-verbal nature. Since autism disorder heavily impairs verbal communication, the combination of dance and movement is an excellent alternative. If an individual does not know where their emotions are coming from, the therapeutic process can be confusing. Dance movement therapy can be an asset in treatment to make children with autism have a less confusing therapeutic process, also acting as a huge stress buster.

Dance Therapy has gained its widest recognition for its applicability and implication on people with autism (https://digitalcommons.lesley.edu/cgi/viewcontent.cgi?article=1011&context=expressive_theses). Movements of dance help to enhance communication of emotions and behaviors and also improve motor ability. Since Dance Movement Therapy focuses on the mind-body approach, thus it helps the people in therapy in re-establishing this mind-body connection and return to harmony.



Figure 8. Academy for Severe Handicaps and Autism – ASHA

Research Findings

Studies and research findings have supported the positive implication of dance on people with autism. When it comes to considering any prospective therapy which may be incorporated into the autism spectrum disorder child's routine; this is something that must be considered carefully. Factors such as the inclusive of cost, time commitment, and even reluctance of the child to attempt a novel activity; all come into play (https://pdfs.semanticscholar.org/5691/9f3c8a8dc7847795d5bf5a12bff738a05881.pdf). The following are a few basic highlighted points from the selected studies as regards dance therapy and its effects on autistic children. A study and teaching was conducted at ASHA, Academy for Severe Handicaps and Autism in Bangalore, for 10 kids in the age group of 7 to 13, with Autism Spectrum Disorder. The aim is to find out the effect dance has on body awareness, sense of well-being, social skills and empathy. The verbatim reports from parents, family, friends and teachers have positively reinforced the fact

that dance movement has a huge impact on improving many of the autism symptoms. A dance movement session included a variety of techniques to help the person overcome the disability symptoms:

1. Simple imitation of the students movements – like playing the music and allowing them to move, later converting it into simple steps.
2. Mirroring techniques like the students being stimulated to copy the movements that the instructor or teacher is doing to increase the movement vocabulary in them.
3. Touch Therapy: stimulate the young kids by a simple and soft touch and directing them to develop movements like walking, running, jumping, hopping, crawling, sitting, standing and bending, which are widely required for daily life activities.
4. Props: usage of props like balls, scarves, pompoms, hoola hoops to promote wider movement.

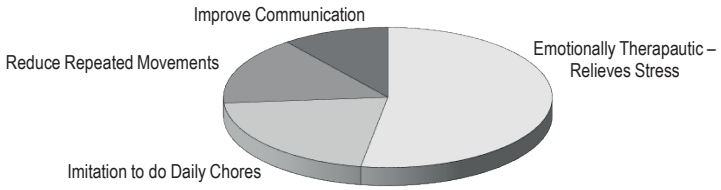


Figure 9. Teachers and Parents Inputs

These creative arts therapy techniques are developed in an individual-specific way, catering to the needs of every child, so that the children affected with ASD get the utmost benefit from the therapy session.

Feedback from Families of Autistic Children[2]

1. Dance is a great stress reliever to my daughter, not only because it is great physically for the body but it is also emotionally therapeutic. I have seen her go to class upset or emotionally energized and within moments of beginning to move with the music she is composed into herself and is willing to understand and dance. – says mother of Aishwarya, 12 years old.

2. The dance program has helped my son, Nikhil, 7 years old, a lot. He imitates a lot now, I hope this will help him in doing things like brush his teeth and wear his dress.

3. The thing that made me happy about the dance sessions was that when Spatika came home she was content and calm. She was able to sit down at the table with us and not get up and down 20 times. She was also able to participate in a conversation with my other daughter and myself without being anxious and interruptive. I feel she was able to think more clearly and when speaking her thoughts were on the topic.

After receiving the dance movement therapy led by me, the children spent less time wandering, showed more time on-task behavior, less time showing negative responses to being touched, and less time resisting the teacher.

[2] The names of the students are changed in order to keep their identity confidential.

The teachings showed that after the sessions of dance movement therapy based on mirroring, children reported improved body awareness, well-being, specifically decreased stress and tension, and increased social competence.

As a teacher-researcher, my role was to provide people with ASD a creative outlet to experience art and movement as a way of expressing themselves. I aimed to empower the students to discover personal expression by exercising their social, mental, and physical well-being.

Benefits of Dance Movement in People with Autism

Dance Movement therapy has helped people with autism in various ways and in all the areas of impairment. The benefits experienced are as follows:

1. It helps in improving attention and concentration and thus helps in guiding the students educationally.
2. Dance as a way of expression of emotion enables autistic people to express through movements – it teaches them to laugh, smile, cry.
3. Group sessions in dance movement therapy enables in developing social skills and communications of an autistic person.
4. Doing a choreographed dance movement sequence in a series of sessions in a row helps in improving memory and recapitulation skills. It helps in stopping the repetitive movements as the students learn different movements in the session.
5. Touch therapy helps in developing trust on others as well as helps in reducing sensitivity to physical contact and touch. It helps in developing body awareness and improves general well-being and can stimulate verbal communication skills.
6. As the social skills develop, it promotes understanding the feeling and emotions of others and thus develops empathy.

With the vast range of benefits and the varied focus that a dance movement therapy session includes, it is sure to benefit anyone taking the session. As for a child with autism, an early diagnosis with a good intervention including dance movement could help the child in developing properly in the cognitive, social, emotional and motor development at the pace and help them lead a better life.



Figure 10. Kids imitating the Instructor



Figure 11. Hoola Hoop helping the kids' wider movement

"Dancing helps to replace stress with pleasure hormones like endorphins and serotonin"

Constructive and Restrained Attributes of the Research Paper

Constructive Attributes

1. Dancing increases one's self-confidence and self-esteem, helping to reduce the feelings of tension and pressure. The dance movement therapy improves the emotional, cognitive, physical, spiritual and social integration of the individual.

2. The formation of a trusting relationship with an adult has an undoubtedly positive impact on an autistic child.

3. Children with autism spectrum disorder can learn to eliminate inappropriate, excessive behaviors, such as throwing tantrums, they can also learn more positive, useful behaviors, such as verbally expressing what is frustrating.

Restrained Attributes

1. The teenage students were hesitant to give away exact responses. Some of the students provided similar responses as their peers, this created ambiguity in the findings.

2. The children diagnosed with Autism Spectrum Disorder often experience outbursts, anxiety, attitudes, short attention spans, poor coordination, dynamic emotions, varying physical capability, and other behavioral patterns.

3. Each participant has unique needs, and those needs to be changed every time I met with him/her. I never knew what to expect and was prepared to discard my lesson plan and improvise if the needs of the participant were not being addressed that day.

4. In the classes, two out of three participants had a difficult time verbally expressing themselves and their needs. This resulted in frustration for the participant at times making me rely on the parent or guardian for the majority of the feedback and reflection.

Discussion and Conclusion

Stress is a problem that any individual in the world can be affected by and stress can take a powerful toll on people's health and lives. When we become stressed we are more likely to engage in activities such as watching television, surfing the web, and other various activities that numb the brain. We tend to put our stresses aside instead of dealing with them directly.

Music, dance and exercise are healthy and efficient ways to reduce stress. Dance is physical movement that conveys the mood or attitude of the dancer. One of the best results of exercise is the production of serotonin. Serotonin is a chemical produced in the brain that relaxes and puts the body in a happy mood. This chemical is essential for a person's well-being because serotonin also regulates sleep, appetite and the ability to learn.

Dancing can be a way to stay fit for people of all ages, shapes and sizes. Dancing improves ones muscle tone, strength, endurance and fitness. Dancing is a great way to meet new friends.

We can rightly say dance:

1. Is an outlet for emotional expression, stress reduction and creativity that benefits youth during stressful situations by channelizing their energy positively.
2. Develops self-confidence and self-awareness with feeling of unity and completeness.
3. Increases self-esteem and more positive outlook among learners of the art.
4. Stabilizes and helps gain better control of the body.

Dance has been repeatedly shown to positively impact a person's mental health. The study has revealed that, despite problems such as stress and other potential challenges in teenage girls, dance can result in high adherence and a positive experience for the students. Dancing has the capacity to contribute to new healthy habits. Teenage girls who were struggling with problems like neck and back pain, stress, anxiety and depression, improved their mental health and reported a boost in mood after they took the dance classes; the positive effects last longer.

Furthermore, many cultures agree that there is a mind and body connection, and many cultures use dance to heal this often damaged connection. Dance therapy is suggested for patients today as treatment for emotional and therapeutic support, as dance allows individuals to connect with their inner-self, this was very well seen with autistic children where they were able to lead a better living and keep themselves focused to a larger extent.

The rhythm of dance can positively impact one's mood by lowering stress and anxiety levels. Dance as an exercise enhances confidence by teaching to trust our instincts and impulses. In group learning sessions, the act of collective movement decreases feelings of isolation and assist students in developing healthy bonds. The art of self-expression has the power to point one in new directions in terms of thought and behavior. Learning new forms of creativity often enables one to non-verbally express emotions that could be challenging to share any other way.

Acknowledgement

The research paper on "Dance as a Catalyst for Stress Busting" has been done to acquire knowledge on this theme. This research would not have been possible without the guidance and the help of several individuals who in one way or another contributed and extended their valuable assistance in the preparation and completion of this study.

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THE EFFECT OF CORRECTIVE EXERCISES ON THE RANGE OF MOTION OF THE HIP JOINTS AND THE RESULT OBTAINED IN THE DEEP SQUAT OF FMS TEST

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Abstract Squat is a fundamental motor pattern in everyday activities, e.g. sitting or lifting objects from the ground. One of the reasons for the poor quality of the squat pattern lies in limited mobility. The study assessed the effects of one-off and 4-week squat correction based on the mobility system exercises. The study involved 40 people, divided into a test group (18 women, 2 men, ±24.6 years) and a control group (10 women, 10 men ±23.6 years). All participants have been subjected to three tests twice: a deep squat test - according to the FMS™ concept, the Active Straight Leg Raise test and the "four" test. After the test, four corrective exercises were recommended and the study continued. The subjects from the test group performed the recommended exercises for 4 weeks, 3 times a week. The protocol was repeated for both groups after 4 weeks, according to the same methodology. For the ASLR test and the "four" test, a significant improvement was observed both after a single session and after a 4-week correction program. With the improvement of these ranges, the result in the deep squat test also improved. A statistically significant improvement in the result was obtained in 9 out of 40 people (22.5%) after a single measurement. As a result of a 4-week correction, the improvement of the squat occurred only after repeated correction. The use of corrective exercises in the hip joints may translate into an improvement in the squat pattern.

Key words squat, mobility, range of motion, foam rolling, stretching

Introduction

Sitting is one of the basic movement patterns used in everyday life. However, this seemingly natural activity, performed incorrectly, dozens of times a day, can become the cause of overload changes and lead to permanent degenerative changes in the musculoskeletal system (Mankin, Treadwell, 1986). Biomechanics of sitting is strongly related to the mobility of the hip joint. This joint generates the greatest forces, and the work and tension of the muscles included in the entire osteo-joint-muscular syndrome affects the quality of the squat pattern. FMS™ Test

is one of the most popular tests used to assess the squat pattern. Currently, mobility exercise system that uses and combines stretching, auto-massage and joint mobilization techniques is a widely known tool used to increase mobility.

The Concept of Mobility

Mobilization, defined as movement-based, integrated approach to the human body, taking into account all the elements potentially limiting its motor skills, is a relatively modern concept existing in the space of strength-endurance training and physiotherapy. It can be said that mobilization is a tool that allows to move and practice more effectively. From this point of view, it is a system of conduct that can be dedicated both to people who deal with sport professionally, but also to people who train recreationally, and even to people who do not deal with physical activity, e.g. as an element of rehabilitation programs. To understand the essence of novelty represented by the mobility exercise system, a distinction should be made between the concept of flexibility and the concept of mobility. Flexibility is the ability of a man to achieve a large amplitude in movements. Exercise of flexibility is to prepare the movement apparatus for the implementation of the starting tasks and to master the rational technique (Hara et al., 2016).

It turns out that in sports, training flexibility alone is not enough. The own experience of many coaches and the players themselves shows that training flexibility itself, in all its generality and breadth, does not necessarily translate into benefits in the form of better results in a given discipline (Marciniak, 1998). Although being important, the passive range of motion is not enough to achieve high results in spor.

In addition to strength in the final range of movement, mobility is made up of one more value – an aspect emphasized by Moshe Feldenkrais, as an inherent feature of all fully aware movement activities. It is about reversibility, i.e. the possibility of volitional stopping a given movement at any moment and withdrawing or modifying it (Rurak, 2013). The central nervous system (CNS) efficiency plays a key role in this mechanism.

In summary, the components of mobility can be defined as follows:

mobility = passive mobility + strength in the extreme range of motion + motor control

A full understanding of the definition of “mobility” is possible only after a detailed analysis of the motoric feature, which is flexibility and methods of its formation.

Mobility should be understood as a wider notion- not as a single motor feature, but rather a collection of several such features. According to the theory of mobility, there is no one, universal way to correct the limits of movement ranges, loosening tense muscles and treating sore joints. To deal with any problems related to soft tissue stiffness, it is necessary to apply methodological approach and combine several different techniques. The idea of this system is to use as many mobilization techniques as possible, until the limited positions are corrected and the pain is eliminated.

Material and methods

The study included a group of 40 people, aged 20–30, 29 women and 11 men. The subjects were divided into two non-statistically different groups: test (A) and control (B).

Exclusion criteria included: the presence of pain in the hip joints, past injuries, injuries or surgical procedures that could affect the movement of the lower limbs.

The division of subjects into the test or control group was carried out randomly. After recruitment for the study, a total of three functional tests were carried out on all subjects:

1. The test of deep squat – according to the FMS™ concept.
2. Active Straight Leg Raise test.
3. The "four" test.

The deep squat test was assessed according to the standards of the FMS concept. This test was created and named (Functional Movement System) by the American physiotherapist Gray Cook (Aptowicz, 2010). In the ASLR test (Active Straight Leg Raise) the ability to actively lift a straight leg with a stabilized trunk was evaluated. The results were recorded by measuring the goniometric flexion in the hip joint. The last test, which was performed, was the "four" test, measuring the range of external rotation of the hip joint, name after the position of the lower limbs of the examined person, which resembles the number 4. After performing a functional examination using the above-described tests, the subjects were instructed to do four correction exercises.

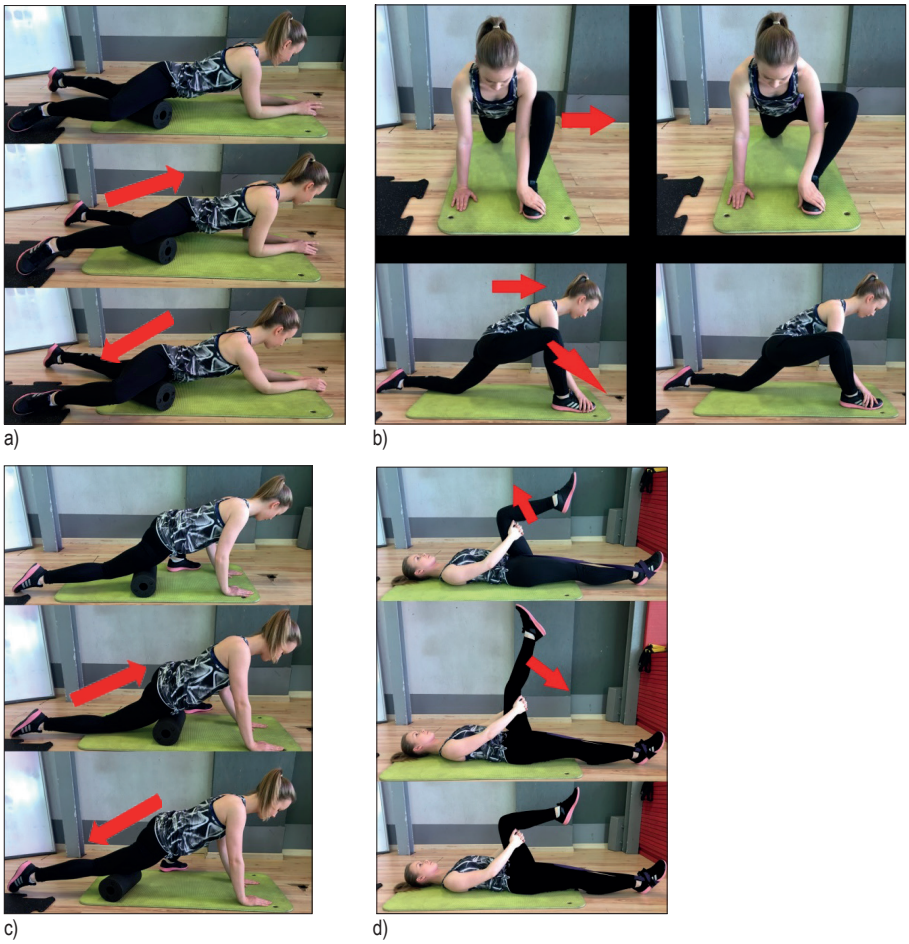


Figure 1. Corrective exercises used in the course of the study

Exercise 1 – Breaking the muscles of the adductor with a roller (Figure 1a), involving the loosening of the muscle group with a foam roller.

Exercise 2 – Bending of one leg with external rotation (Figure 1b) – exercise using dynamic muscle stretching from the group of adductors, ilio-lumbar muscles, deepening the external rotation of the hip joint in a position close to the position of the lower squat.

Exercise 3 – Breaking quadriceps muscles with roller (Figure 1c), which involves loosening the muscle group with a foam roller.

Exercise 4 – Classic mobilization with anatomical back tape (Figure 1d), using dynamic muscle stretching from the ischiocrural group.

The purpose of the above exercises was the normalization of muscle tone of the muscles of the ischiocrural group, the muscles of the adductors and the quadriceps muscle of the thigh.

The main aim of the research was to examinate the influence of this exercises on hip range of motion and compare it with the deep squat FMS™ test.

Both people in group A and people in group B, after performing corrective exercises, were again subjected to functional tests. Test group (A) performed above 4 exercises for 4 weeks, 3 times a week, while control group (B) did not perform any corrective exercises during these 4 weeks. After 4 weeks from the first examination and correction, the subjects in both groups were tested again, using the same measurement methodology and taking into account the same corrective exercises.

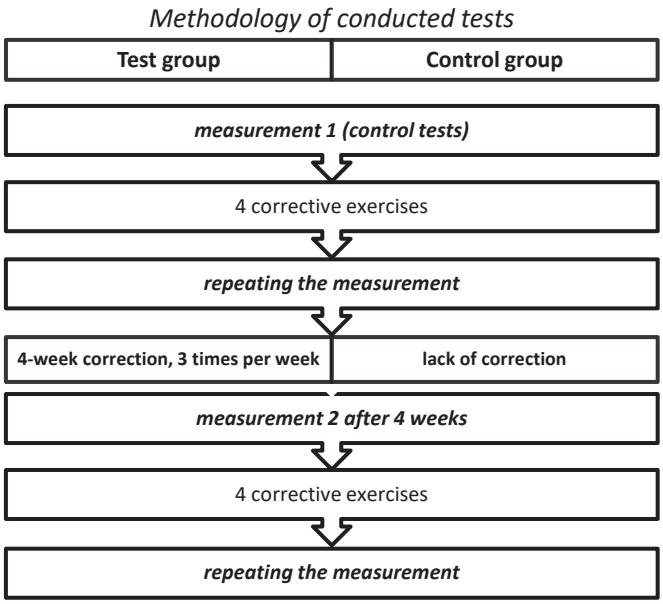


Figure 2. Methodology of conducted tests

The study of empirical data involved standard statistical analysis methods. Kolmogorov-Smirnov test was used to calculate the distribution of normality. The distribution was not normal in all groups. The results of individual tests were presented using arithmetic averages, taking into account standard deviations. Significance of differences between the pairs of variables was evaluated by Student's t-test and Levene's test for normal distributions and U Mann-Whitney test for abnormal distributions, for a minimum significance level of $p < 0.05$.

Results

During the first measurement there was a statistically significant improvement in the range of motion after correction in all subjects, both in the external rotation measured by the "four" test and active hip flexion in the ASLR test for both lower limbs and the result in the deep squat test FMS™ (Table1).

Table 1. Differences (p) between the results of individual tests, performed after a single correction

Tests	Significance (p)
FMS™ squat	0.003
SLR L Test	0.000
SLR P Test	0.000
„Four" Test L	0.012
„Four" Test P	0.016

In the case of the squat test, the score was improved in 9 out of 40 people (22.5%). In 31 (77.5%) people there was no change in the result, while deterioration was observed in no case. The arithmetic mean of this test before the measurement was 2.300, and after measurement 2.5250. The average deviation from the mean was for the test before correction 0.60764, and for the test after correction 0.55412 (Figure 3). The statistical significance was obtained in the analysis at the level of $p = 0.003$ (Table 1).

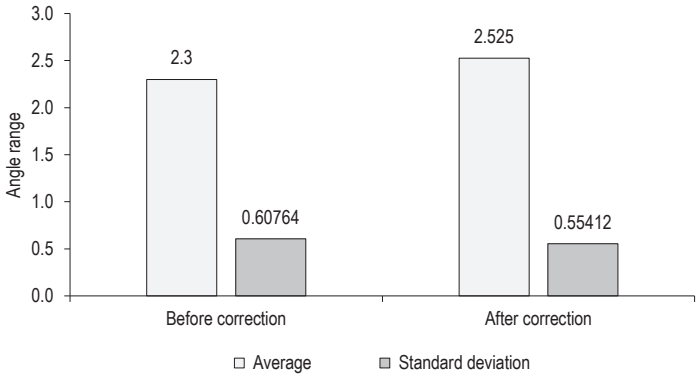


Figure 3. Difference in mean results obtained in the deep squat FMS test after a single correction

The greatest improvement was recorded for the ASLR test in the right limb. For 40 people, 33 obtained a better result in the post-correction test (82.5%). In 5 people (12.5%) no change occurred, and in 2 people (5%) the result was worse. The arithmetic mean of the obtained results before correction was 75.8750 and after correction 80.5250. The standard deviation for the above tests was 9.13485 and 9.12024 respectively (Figure 4).

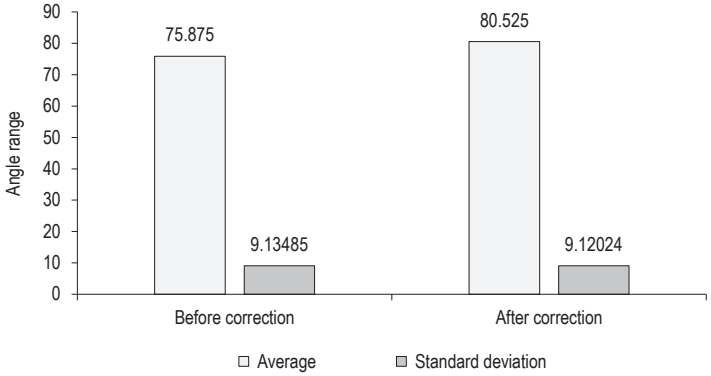


Figure 4. Difference in mean results obtained in the SLR test for the right lower limb after a single correction

The second analysis performed was a comparison of the results from the first measurement before the correction and the second measurement (after 4 weeks) both before and after the correction (Table 2). The results of the second measurement before the correction were analyzed in order to exclude the physiotherapist's influence on the effect of 4-week correction in the test group.

Table 2. Differences [p] between the results of individual tests obtained in measurement 1 and measurement 2 before and after correction

Tests	Significance (p)	
	before correction	after correction
Pair 1 SLR L Test (1) – SLR L Test (2)	0.007	0.000
Pair 2 SLR P Test (1) – SLR P Test (2)	0.005	0.000
Pair 3 "Four" Test L (1) – "Four" Test L (2)	0.012	0.003
Pair 4 "Four" Test P (1) – "Four" Test P (2)	0.022	0.073
Pair 5 FMS squat (1) – FMS squat (2)	0.480	0.007

Statistical analyzes showed a significant difference between the results obtained during the first measurement before correction and the second measurement before the correction for both limbs in ASLR tests and in the "four" test. However, no significant changes were found for the squat test (Table 2).

Finally, the results obtained by the test and control group were analyzed by juxtaposing them together. In the course of the conducted analyzes, there was no significant difference between the test group and the control group in the range both before and after correction for any of the tests.

Discussion

Squat is an ideal test, checking the presence of functional disorders in the human body. Based on the observations and video analysis of the squat, one can find weak points in the bio-kinematic chain, and then make the correction of the pattern disorders. Learning squat technique is a long-term process. It often requires the use of additional exercises, activating weak muscle groups (gluteus maximus, medius, ischiocrural group, abdominals, stabilizers of the shoulder), mobility exercises (ankle, hip joint, spine, shoulder) and stretching (gastrocnemius and soleus muscle, ischiocrural group, hip flexors, hip rotators, backbone rectifier muscle, quadratus lumboeum, latissimus dorsi, pectoralis major and minor) (trenerindywidualny.pl, 2014). The main purpose of this work was to examine whether the range of mobility of the hip joints influences the result obtained in FMS™. The obtained results showed that along with the improvement of these ranges, the result in the deep squat test was also improved, however it was more expressed for the ASLR test than for the "four" test. However, no statistical confirmation of this conclusion was obtained.

Studies have shown that properly selected exercises, aimed at eliminating the cause of limitation after a single correction, give the statistically significant improvement in ranges of mobility for both hip flexion (an active straight leg lift) and external rotation ("four" test). There was also a significant improvement in the results obtained in the deep sit-up test according to FMS™, which may mean that the above-mentioned ranges of motion have a significant impact on the quality of this pattern.

The squat test obtained after 4 weeks of exercising shows an interesting result. In the test before re-correction, no statistical significance was achieved in terms of improvement in relation to the first measurement. This was achieved only after a new correction, which may mean that the improvement of hip mobility, obtained through 4 weeks of exercise, was insufficient to improve the mobility pattern. Only performing the test immediately after correction resulted in a significant improvement.

The above observation suggests that the effects of the applied correction are short-term changes, so performing them "as a spare" will not translate into a general improvement in the quality of the squat.

Similar conclusions were drawn by the authors of other publications regarding the effect of myofascial relaxation and stretching on the range of motion (Davis, 2005; Kiestler, 2010; O'Sullivan, 2009). The study of 2014, Jay et al. showed a significant improvement in active flexion in the hip joint after using a 10-minute session of muscle massage of the ischiocrural group using a roller. However, it was observed that this effect lasted only 10 minutes after the end of the session.

In a study conducted by Macdonald et al. in 2014, the effectiveness of foam-rolling was demonstrated in a group of 20 active men who were ordered to perform a protocol consisting of 10 sets of 10 repetitions of back squats. The results showed a significant increase in the mobility of the hip (72 h after) and knee joint (48 and 72 h after).

Moteiro et al., in their work on the deep squat test according to FMS™, analyzed how the length of self-massage technique of selected areas of the body affects the result in the FMS™ test. For one group the test was preceded by self-massage of the lateral side of the thigh (iliotibial band) with a foam roller, and for the second group by self-massage of the lateral torso (latissimus dorsi) using a foam-roller and plantar side of the foot (plantar aponeurosis) using tennis ball. In his results he obtained a statistically significant improvement of the squat for both groups and noted that the minimum time for obtaining significant changes in the time of performing the auto-massage is 90 seconds.

Sullivan et al. also analyzed the effect of rolling on the length of the rear thigh muscle group, measured by the sit and reach test. The examined group of people was subjected to massage with a special rolling device for 5 and 10 seconds respectively. The results showed a 4.3% increase in the range of mobility in the sit and reach test for the group which was massaged longer and 2.3% for the group with shorter massage. In addition, the group underwent an EMG examination, which did not show significant changes in the nervous excitability of the muscle group being tested.

A similar study was conducted in 2015 by Bradbury-Squires et al., where a group of recreationally practicing, middle aged men underwent quadriceps massage using a roll massager for one group for 5 × 20 seconds, and for the other for 5 × 60 seconds. In the results of these studies, 10% improvement for the first group and for the second 16% improvement in bending range in the knee joint was observed.

The above studies have been quoted to show the effect of the time unit on the effects of myofascial relaxation. They are extremely important and may also confirm the assumptions of this work, which indicate that a significant part of the disorders related to the squat pattern is associated with soft tissues, and therefore myofascial work will be very helpful in the processes of its reeducation.

However, there are studies that contradict the above-mentioned reports. Couture et al. did not show a significant relationship between the time of self-massage and the range of mobility in the knee joint. Moreover, no differences were noted in the ranges as compared to the control group that did not perform the test protocol. It is worth noting that the differences occurring in reports on the effectiveness of foam-rolling can be the result of differences in the tools used (different hardness rollers), intensity (value) of pressure during the execution of individual techniques and methods of measuring joint mobility.

In addition to foam-rolling, the mobility system also uses techniques for stretching and mobilizing the joint using a tape.

Exercises used in this study have been selected in such a way as to increase the elasticity of the ischiocrural group by means of dynamic (active) stretching. A significant improvement in the scope of active straight leg raise (ASLR) was obtained both after a single session and after a 4-week correction program. However, no significant difference was found between the two measurements. The group that performed exercises regularly obtained a partial fixation of the improved ranges, while they were not significantly greater than those achieved in a single session, which may mean that the results obtained during the exercise have a limited range of effectiveness.

Avala et al. shared similar conclusions in studies, which investigated the effect of active stretching of the ischiocrural muscles on the passive flexion range in the hip. The results showed a 26.0 ±8.8% improvement in the range of passive flexion in the hip joint after the end of the protocol. However, it has not been demonstrated that there is a significant difference between measurements during the entire protocol. On the other hand, significant regress was observed both 2 and 4 weeks after the end of the protocol.

The results of the present research may be criticized due to the lack of precise research methods, based largely on the subjective assessment of the researcher (FMS™ Test) and with a high risk of measurement error in the context of registration of motion ranges. It should be noted that they have been selected in a way to be easy to perform in non-laboratory conditions. Nevertheless, the obtained results are a reason to conduct more detailed studies in which a larger group of people would be tested, and the measurement methods would be more sensitive.

In addition, it seems important to conduct research in which the two above-described methods: foam-rolling and stretching combined with the mobilization of the joint with tape, would be separated. In the present study, it cannot be unequivocally determined which of the applied methods turned out to be more effective.

Conclusions

1. The mobility system, which consists of: self-massage, dynamic stretchning and joint mobilization with the help of tape, are an effective method of increasing the ranges of mobility of the hip joints.

2. Greater mobility of the hip joints results in a higher score from the deep squat FMS™ test.

3. Even a single correction allows to improve ranges of movement and the squat pattern.

4. Regularly performed corrective exercises do not translate into a better result than in one-off correction.

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HEALTH RISKS RELATED TO TATTOO PROCEDURE

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Abstract Nowadays, tattoos have become a very common form of body decoration. However, they carry a risk of numerous complications – ranging from allergies to cancer.

The study was divided into two parts. Adult persons, 156 men and 149 women, with one or more tattoos, participated in the first part of study. Anonymous respondents filled in the authorial questionnaire consisting of 14 questions and posted on the Internet. The second part of the study concerned of tattoo salons (n = 38) employees.

The aim of the study was to examine the awareness of people who are tattooing the body about the possible risks associated with such intervention, as well as the ability to obtain information from tattoo artists and analyze client cards in terms of the most important information about tattooing. The second part of the study was devoted to the analysis of the tattoo consent forms.

Most tattoo salons clients claimed that they signed a tattoo consent and were informed about contraindications and possible complications. However, only in very rare cases allergic tests were reported. There were few cases of complications among the respondents. There is a need to educate both the clients of tattoo salons and tattooists themselves. Attention should be paid to the necessity of filling in the informed consent.

Key words tattoo, allergic reactions, infection, health risk, patient awareness

Introduction

Body tattooing has a very long history. The oldest tattoos are considered to be marks found on the skin of the ice man called Ötzi. The man who died more than 5,000 years ago in South Tyrol had more than fifty tattoos in the form of dashes and crosses created in the process of cutting the skin and rubbing charcoal in the wounds (Laux et al., 2016).

Over the centuries, skin marking has had a variety of functions on the social, individual and aesthetic background. Until recently, tattoos were the domain of criminals and seamen. Today, only in Europe, over 100 million

people have one or more tattoos, which play different roles. There are medical tattoos, cosmetic tattoos, as well as those playing the role of decorations performed by professionals and amateurs (Laux et al., 2016; Nowak, 2012).

Today's tattoo inks contain a much richer composition, which mainly consists of dispersed pigments with solvents, and often also with impurities. Each of them must meet modern quality standards, which are updated each year (Ho, Goh, 2015).

Tattoo inks ingredients

The average tattoo ink contains about three preservatives approved for use in cosmetics, one astringent, three viscosity control components, at least three solvents, water and six or more pigments. The soluble and insoluble ingredients are micro- and nanoparticles with very different properties of absorption, distribution, metabolism and excretion. Pigments as insoluble constituents are extremely slowly removed, while soluble components are usually eliminated quite quickly (Serup, Kluger, Bäumler 2015; Pajor, Broniarczyk-Dyła, Świtalska, 2015; Blume et al., 2017; Serup, Bäumler, 2017; Yongbum, Lee 2018).

Although modern tattoo inks contain mainly organic pigments, heavy metals such as nickel, antimony, arsenic, cadmium, chromium, cobalt and lead are clearly visible in the form of chromophores, shading additives or as impurities. Metal oxides, e.g. aluminum oxide or titanium oxide can be also detected. Their effects on the human body are still being studied (Kaur, Kirby, Maibach, 2009; Lehner et al., 2011; Kluger, Koljonen, 2012; Blume et al., 2017; Rogowska et al., 2018).

Black pigments used for most tattoos are a mixture of carbon black and polycyclic aromatic hydrocarbons. However, colored pigments have a much richer composition. They usually contain heavy metal compounds. Regardless of the color, the most common elements detected in the inks are nickel, oxygen, carbon and titanium. Moreover, red-colored inks used by tattoo-learning amateurs often contain toxic mercury (Bonadonna, 2015; Khunger, Molpariya, Khunger, 2015; Schreiver et al., 2016; Serup, Bäumler, 2017; Wilson, O'Boyle, Leach, 2018).

Dangerous ingredients of tattoo inks

Complications that may occur after tattooing can be divided into three groups: infections, allergic reactions and cancerous lesions. The most common changes associated with tattooing of the skin include acute inflammatory reaction, because of local and deep infection, systemic infection, allergic reactions, photodermatoses, granulomas. There are also skin diseases provoked by tattoos and located on tattooed areas, such as eczema, lichen planus, psoriasis and scleroderma (Kaur et al., 2009; Lehner et al. 2011; Serup et al., 2015; Rogowska et al., 2018; Yongbum, Lee, 2018).

One of the most common complications after the tattoo is the occurrence of hypersensitivity reactions. In the study of the toxicity of the inks used for performing tattoos, pyrolysis and chromatography was used to detect the parent compounds, it has been shown that among others, acrylates, including methyl methacrylate, ethyl methacrylate, dodecyl methacrylate are responsible for allergic reactions, 1-methyl-2-pyrrolidinone or styrene are responsible for other skin irritations. The presence of carcinogenic components (naphthalene, benzene, N-vinylpyrrolidone) and toxic substances (styrene, toluene and ethylene glycol) was also shown. Other studies have also shown a significant exceeding the standards for ingredients that can cause allergies such as chromium, nickel or cobalt (Lehner et al., 2011; Schreiver et al., 2016; Blume et al., 2017).

Due to the lack of standard methods to identify pigments in tattoo inks, it is possible to bypass legal regulations and hide some of the components due to the quantity of given substance being too small to detect (Blume et al., 2017).

Research on black tattooing inks have shown the content of at least some substances dangerous for the body. This is, inter alia, dibutyl phthalate, which acts directly on keratinocytes and may elicit Th2 lymphocytes reaction after exposure to the skin. Another component threatening human health is hexachlor-1,3-butadiene exhibiting genotoxic activity *in vitro*. The presence of 9-fluorenone, which is characterized by cytotoxicity producing reactive oxygen species in conditions of exposure to light, was also found in inks (Serup, Bäumler, 2017).

Complications after tattoo procedures

Breaking of skin barrier to inject a dye into the dermis while making a tattoo increases the risk of infection. Even every twentieth person suffers from a bacterial infection after making a tattoo (Lehner et al., 2011; Pajor et al., 2015, Serup et al., 2015). Colored tattoos are particularly dangerous. The most frequent allergic reactions were noted in the case when red, less often blue and green dyes had been used. Symptoms of hyperkeratosis and keloids are also observed. In the case of black inks, papulo-tuberous and non-allergic reactions were observed as a result of the agglomeration of nanoparticle of the pigments (Ho, Goh, 2015; Serup, Bäumler, 2017; Yongbum, Lee, 2018).

Additionally, tattoo inks may be contaminated with microorganisms. This constitutes a great risk of hepatitis B and hepatitis C, and HIV viruses infection. In addition, carcinogenic inks ingredients have also been researched in recent years. Currently, the International Agency for Research on Cancer classifies only several components of tattooing inks as potentially carcinogenic to humans, such as mercury, cobalt sulphate, other soluble salts of cobalt and carbon black (Ho, Goh, 2015; Schreiver et al., 2016).

As part of ensuring microbiological safety, preservatives and sterilization with beta or gamma radiation are used (Serup et al., 2015).

The aim of the study was to examine the awareness of people undergoing tattooing the body about the possible risks associated with such procedure, as well as the possibility of obtaining information on the subject from tattoo artist and analyzing the customer cards of tattoo salon's clients in terms of the most important information concerning tattooing.

Material and methods

The study was carried out in two parts. The first part of the study was addressed to clients of tattoo salons, while the second part of the study concerned of tattoo salons employees.

Adults, 156 men and 149 women, over 18 years old, that had one or more tattoos participated in the first part of the study. Respondents completed the original questionnaire consisting of 14 questions (closed and semi-open) that was posted on the Internet. People who took part in study were anonymous and came from all over Poland.

The second part of the study was devoted to the analysis of consent cards for tattooing. The forms of documents were acquired out electronically. In order to get access to the tattoo consent card, requests were sent to 62 random tattoo salons from all over Poland. Answers were received from 38 studies that expressed a desire to cooperate.

The limiting factor in the research was the inability to determine whether the consent card to the tattoo is actually supplemented with, among others, an oral interview or assessment of skin condition. Only the content of the submitted documents has been subject to analysis.

Results of first part of the study

More than half of the respondents from the first part of the study, both female and male came mainly from the cities with more than 100,000 inhabitants. Up to 111 women and 104 men declared having higher education among. There was no respondent with lower than secondary education.

The most numerous group of respondents (70% women and 62% men) performed the first tattoo between 19 and 30 years of age. The least numerous group were the respondents who decided to tattoo the body after 40 years of age. In case of 6 women and 15 men a tattoo was made on underage people. Respondents most often declared their desire to embellish the body and stand out from the crowd as the reason for performing the tattoo. To a lesser extent, people wanted to commemorate the important moment with the tattoo. However, the smallest percentage of men and women made the tattoo at the instigation of friends and because of the prevailing fashion. The people who took part in the research most often had their tattoos made by professional tattooists. Every tenth man declared that the tattoo was done by a person learning the profession. Only one woman and 4 men admitted that they made their tattoos themselves.

Before the tattoo was made, in most cases the consent for the procedure was signed. Among respondents, 13% of men and 10% of women with more than one tattoo declared that the consents were not signed each time; and 3% of women and 14% of men admitted that they did not sign any documents related to consenting to the procedure. There were extremely rare cases of carrying allergic tests before tattooing among the respondents. This applied only to 4 people (3 women and 1 man) in the group of 305 respondents. In the case of making clients aware of the existence of contraindications and the possibility of complications, the results were more satisfactory because 82% of women and 74% of men declared that they were informed of possible complications each time before the tattoo was made. However, 7 women and 13 men admitted that they were not given such information at all. The other respondents replied that the necessary information had been provided to them, but not before each tattoo.

Among respondents, almost half of men and 60% of women declared that they were witnesses of unpacking sterile tools before making a tattoo. Every third person admitted that they were not present during this activity at every visit to the tattoo salon. However, every fifth man and 13% of women were unsure whether the tools used were sterile.

Complications after tattooing occurred in 6 women and 12 men. The most common complication in both groups was the occurrence of a severe redness. The frequency of other complications is shown in the tables (Table 1 and Table 2).

Table 1. Complications after tattooing in women

A type of complication occurring in women n = 149	Occured	Did not occur
Severe redness	10	139
Allergic reaction	3	146
Bacterial or fungal infection	1	148
Scars or keloids	2	147
Granulomas	1	148
Muscle atrophy	0	149
Other	0	0

Table 2. Complications after tattooing in men

A type of complication occurring among men n = 156	Occured	Did not occur
Severe redness	14	142
Allergic reaction	3	153
Bacterial or fungal infection	1	155
Scars or keloids	1	155
Granulomas	0	156
Muscle atrophy	0	156
Other	0	0

Results of the second part of the study

All the consents for the procedure were characterized by a similar structure. Each document includes the name of the salon, the type of procedure to be performed, a place to enter the data of the person undergoing the procedure and to sign it with the date and place. In terms of other aspects, the cards differed from each other. It was noticed that in the case of 14 of 38 tattoo salons, there is no room for entering the tattoo artist's details. In addition, only every 5 studios have information about the course of tattooing and the possibility of complications in the card. Confirmation of the possibility of asking questions and withdrawing consent was on 8 pages. Half of the salons did not inform clients in writing about possible contraindications. In more than 50% of approvals, no confirmation from the client about the understanding of the information provided was found. However, it was noticed that most salons (87%) expand their consent cards for information about home care recommended after the tattoo. Additional information that was included in 60% of the consent cards included the customer's confirmation that the tools used to make the tattoo were sterile and unpacked in their presence. Nearly half of the submitted documents also included annotations that the client would not claim a person performing the procedure because they were familiar with the risks that the procedure carries.

Discussion

According to the current legal status in Poland, the patient should agree to the procedure before it is performed. Due to the fact that the tattoo appears in the International Classification of Medical Procedures as a form of surgery performed by the aesthetic medicine doctor, the consent for the procedure should also be obtained from clients of tattoo salons. There are various forms of patient authorization. Usually, simple consent is given, expressed orally or through gestures and written consent. In tattoo salons, written consent is usually applied.

The performed study shows, that consents for tatoo procedures are not as expanded as those for medical procedures and do not contain all the necessary elements. We can assume that some of them have been completed with client history and trough necessary oral information, which is also allowed according to the Polish law. On the other hand, analyzing the respondents' answers it can be assumed that the obligation to provide information was often unfulfilled (Baron, 2010; Kubiak, 2018; Lis, 2018; Międzynarodowa Klasyfikacja Procedur Medycznych, 2019).

Conclusions

Body tattooing is a procedure of great interference and the clients of tattoo salons should be aware of it. Information on all aspects of the tattoo should be mandatorily provided by the person performing the procedure. At this point, it is important to educate the tattooists themselves, who when taking up their profession, also accept the risks they may incur in the event of post-tattoo complications. It seems important to collect informed consents from each client, which will be developed based on medical documents. This will help in raising the awareness of customers and tattooists, as well as in reducing the occurrence of complications. Attention should also be paid to allergic tests, which as the study has proven, are very rarely made.

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IMPROVEMENT OF STUDENT PHYSICAL STATE AND COORDINATION OF MOVEMENTS BY MEANS OF ALISH BELT WRESTLING

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Abstract The paper presents data on the improvement of motion coordination in students by means of Alish belt wrestling in the process of physical education and its impact on physical development level. The program of student physical development and physical fitness enhancement by means of motion coordination improvement in the process of taking belt wrestling course and further ways of students' development has been elaborated. The problem's importance and the necessity of further elaborating the methods of student preparation by means of belt wrestling have been substantiated. The problems associated with elaboration of scientifically substantiated system of belt wrestlers' preparation that will permit to increase the reserve capacities of student motor system and improve the quality of motion control have been set up.

Key words Alish, belt wrestling, students, coordination, motions

Introduction

Formation of student motion coordination by means of Alish belt wrestling, that is training of technical actions, is associated with further development of scientifically substantiated system of improving specialized physical fitness, physical development, thus enabling to increase the reserve capacities and the quality of motion control in the process of physical education at higher education institution.

Motor training of students in the process of Alish belt wrestling is aimed at the development of strength, speed, coordination capacities, flexibility and endurance. Depending on exercise direction and the character of their performance, the methods of physical capacity development at the Alish belt wrestling sessions include: repeated serial, continuous and interval, circular, gaming and competitive method.

Means of motor training in the process of Alish belt wrestling sessions are general developing, preparatory and competitive exercises of different coordination structure, the performance of which, at different stages of annual education and training process, contributes to increase of the motor system reserve capabilities.

Despite the fact that the formation of student motion coordination by means of Alish belt wrestling is an important condition for sports training of wrestlers, there are still insufficient scientific data about the reserve capabilities of the motor system of belt wrestlers (Arziutov, Hrishchenko, Chizhaiev, 2009). The issues of different physical education methods impact on both the interrelation of movements of different coordination structures with the level of technical fitness of students-athletes and the reserve capabilities of the motion control system in the process of sports training of students are inadequately treated (Pryimakov, Dotsenko, Prysiazhniuk, 2014; Blume, 1983, 1984; Jascaninas, Monogarov, 1987).

The solution of set problem is associated with the development of a scientifically substantiated system of belt wrestlers' preparation. However, it has not been given sufficient attention, although it is extremely complex and important for improving the physical education of students and enhancing their sports achievements (Pryimakov, Dotsenko, 2006; Samokish, Bosenko, Pryimakov, Biletskaya, 2017).

The modern theoretical basis and practical experience of leading national and foreign researchers have been used as a theoretico-methodical foundation for elaboration of the content of student motor training in the process of Alish belt wrestling sessions: V.G. Arefyeva (2010), H.M. Arziutova, V.N. Hrishenkova, P. Chizhaieva (2009), T.I. Krutsevych (2012), O.O. Pryimakov, O.O. Dovgich (2003).

Material and Methods

Well known tests checked for authenticity and described in various textbooks and methodical recommendations as well as compared with State tests and norms were used to study the motor fitness of students (Apanasenko, 2004; Samokish, 2018; Seluyanov, Dimova, 2002; State program of physical culture and sport development in Ukraine, 1994).

Numerous experts (Hirtz, Vilkner, 1985; Mekota, Blahus, 1983; Schnabel, 1994; Sergienko, 2001) believe that the question of criteria for evaluating physical state of athletes, creation of authentic methods and elaboration of the tests is the most significant in the problem of 'coordination technique'.

Study protocol was approved by University Ethics Committee. The research was fulfilled in compliance with WMA Declaration of Helsinki – Ethical Principles for Medical Research Involving Human Subjects (2013).

General motor fitness of athletes was assessed by means of control exercises, which provided information about the level of manifesting the major human physical capacities (endurance, strength and speed-strength capacities, speed, agility and flexibility) and were envisaged by the requirements of the educational program in physical education of students.

The level of endurance manifestation was determined by the results of 3,000 m run; that of strength – according to the number of pull-ups and push-ups, that of speed – according to the time of covering 100 m distance; that of agility – by the results of 4 × 9 m shuttle run; that of flexibility – by the results of trunk forward bending in sitting position (cm), and that of speed-strength capacities – according to the result of standing long jump (cm).

Proceeding from the above, a comparative analysis of the physical fitness and physiometric indices of experimental group students (EG – 34 persons), whose movements of different coordination structures were

developed by means of Alish belt wrestling and the control group of students (CG – 30 persons) that were engaged in the traditional physical education program and attended elective classes by choice, was conducted.

Initial values of physical development indices (body length and mass, height-mass index, Quetelet index), those of cardiovascular system functional state (HR, systolic BP, diastolic BP, circulation efficiency), indices of external respiration system (VC, MPV, timed inspiratory capacity, timed expiratory capacity), those of physical development and endurance (3,000 m run), speed data (100 m run), agility data (4 × 9 m shuttle run), speed-strength indices (standing long jump), strength indices (strength of right and left hand, strength index, pull-ups, right/left leg squats), data of functional tests (Martine-Kushelevsky's test, Harvard step-test index, Kerdo index), agility and other data of complex examining both groups of students were presented. The studies were conducted before and at the end of the experiment (after three years of training according to special methods for motion coordination formation by means of Alish belt wrestling). The presented results are a starting point for evaluation of the students' physical preparation structure and comparing those results with literary data in order to establish the influence of physical education means on morphofunctional development and manifestation of movements of different coordination structure in the dynamics of pedagogical experiment (Novytskyi, 2010; Seluyanov, Dimova, 2002; Sergienko, 2001).

STATISTICA 13.3 (StatSoft) software was used for statistical processing of experimental material.

Results

Anthropometric, physiometric and strength indices of both student groups were similar before the experiment: the difference in body mass, Quetelet index, height-mass index, VC, vital and strength indices differed by no more than 8.5% ($p > 0.05$). However, after the implementation of the program of special physical education by means of Alish belt wrestling, the data at the end of the experiment showed significant differences.

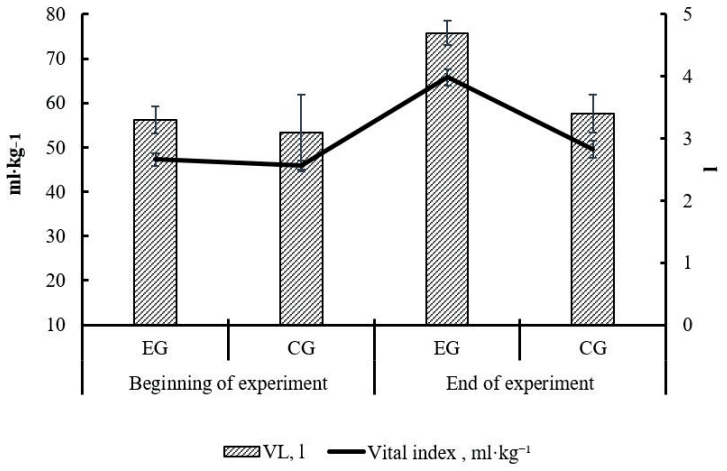


Figure 1. VC and vital index at the beginning and at the end of the experiment. EG – experimental group; CG – control group

The main changes that characterized the improvement of the EG students' physical state were: an increase of the vital index (by 34.3% at $p \leq 0.05$) and VC (by 42.4%, $p < 0.05$) (Figure 1), the strength of right and left hand (respectively 33.5%, $p \leq 0.05$ and 30.2%, $p \leq 0.05$). This resulted in an increase of the strength index (by 30.5%, $p < 0.05$). At the same time, indices of CG students changed insignificantly ($p > 0.05$).

The analysis of individual aspects of functional fitness and physical work capacity of both student groups before and after pedagogical experiment demonstrated that the most significant changes of functional state occurred in students of the EG in: indices of arterial blood pressure, HR during the recovery period after testing physical loads, Harvard step-test, Martine-Kushelevsky's test and data of circulation efficiency.

Changes in the indices of cardiovascular system functional state indicate that the regular engagement in single combats tends to improve the student's physical state significantly (Table 1).

Table 1. Indices of cardiovascular system functional state and physical work capacity of students in pedagogical experiment

Index	Groups: EG (n = 34), CG (n = 30)	Beginning of experiment M ± m	End of experiment M ± m	p
Pulse, bt/min., (HR)	EG	76.2 ±1.52	71.4 ±1.39	<0.050
	CG	77.4 ±1.28	73.5 ±1.64	>0.050
Systolic BP, mm. Hg.	EG	112.5 ±1.45	110.1 ±1.58	>0.020
	CG	120.7 ±1.28	118.8 ±2.10	>0.020
Diastolic BP, mm. Hg.	EG	72.8 ±1.02	70.1 ±1.10	>0.050
	CG	73.1 ±1.41	72.3 ±1.81	>0.050
Circulation efficiency coefficient, un	EG	3,025.1 ±112.7	2,856.0 ±127.1	<0.050
	CG	3,684.2 ±122.5	3,417.8 ±130.2	>0.050
Martine-Kushelevsky's test, min	EG	2.2 ±0.47	1.4 ±0.27	<0.005
	CG	2.3 ±0.51	2.0 ±0.42	>0.050
Kerdo index, %	EG	4.47 ±2.21	1.82 ±1.17	<0.005
	CG	5.56 ±2.84	1.63 ±1.58	<0.005
Harvard step-test index, un	EG	80.5 ±2.81	92.1 ±2.14	<0.050
	CG	78.9 ±1.98	83.8 ±2.52	>0.050

An increase of physical work capacity level (by 14.4% at $p \leq 0.05$) and the reduction of recovery time after physical loads during performance of Harvard step-test were noted in EG along with the improvement of physical work capacity indices according to Martine-Kushelevsky's test (by 36.4%) and circulation efficiency coefficient from 3,025.1 ±112.7 un. to 2,856.0 ±127.1 un. The decrease of the given coefficient indices indicates the processes of reduced fatigue under high physical loads. The difference in circulation efficiency coefficient indices at the end of the experiment was 19.6% higher in the experimental group as compared to the control one.

The analysis of experimental material demonstrated a significant decrease of pulse in students of EG during the recovery period after testing loads, as well as less expressed response to physical loads and faster HR decrease during the recovery period as compared to data of CG students and those before pedagogical experiment. This is indicative of enhanced reserve functional capacities of the body of EG students.

Only in CG the tendency for physical work capacity increase (by 6.2% at >0.05) and the decrease of HR recovery time after physical load during Harvard step-test execution ($p > 0.05$) was observed.

The difference in the Kerdo index between subjects of EG and CG is negligible, although it is evident that the excitation processes in both groups exceed those of inhibition in the activity of the autonomic nervous system. However, at the end of the pedagogical experiment there was a clear approximation of the data to the functional equilibrium ($p < 0.005$) in both groups.

The results of assessing general physical fitness of students according to control standards demonstrated positive changes in the development of motor qualities in both groups (Table 2).

At the end of the experiment the following indices increased significantly in students of EG: endurance (20.3% increment, $p \leq 0.05$), speed (12.9% increment, $p \leq 0.05$), agility (21.8% increment, $p \leq 0.05$), arm strength (47.7% increment, $p \leq 0.05$), speed-strength capacities (12.7% increment, $p \leq 0.05$) and leg strength (44.3% and 40.6% increase of the number of right and left leg squats, respectively, $p < 0.05$). In CG the following increments were noted: endurance – 3.2%, speed – 8.2%, agility – 6.9%, arm strength – 4.8%, speed-strength capacities – 2.5% and right and left leg strength 8.5% and 9.2%, respectively. These changes, however, were statistically insignificant ($p > 0.05$).

Slightly lower results were observed in endurance motor tests (3,000 m running), speed (100 m running), speed-strength capacities (standing long jump) and agility (4 × 9 m shuttle run), whereas much better indices were noted in strength tests (pull-ups and right and left leg squats) (Table 2).

Table 2. Physical fitness indices of students in pedagogical experiment

Types of testing	Groups: EG (n = 34), CG (n = 30)	Beginning of experiment M ± m	End of experiment M ± m	p
3,000 m running, min, s	EG	16.0 ±1.3	13.3 ±1.8	≤0.05
	CG	16.1 ±1.8	15.6 ±1.3	>0.05
100 m running, s	EG	15.7 ±0.8	13.9 ±0.4	≤0.05
	CG	15.8 ±0.7	14.6 ±0.5	>0.05
Pull-ups, number	EG	23.5 ±1.29	34.7 ±1.74	≤0.05
	CG	22.8 ±1.23	23.9 ±1.25	≤0.05
Standing long jump, cm	EG	212.2 ±2.26	239.5 ±2.16	≤0.05
	CG	218.3 ±2.21	223.8 ±2.18	>0.05
4 × 9 m shuttle run, s	EG	10.6 ±1.2	8.7 ±0.5	≤0.05
	CG	10.8 ±1.0	10.1 ±1.0	>0.05
Right leg squats, number	EG	11.5 ±1.01	16.6 ±0.88	<0.05
	CG	10.8 ±0.87	11.5 ±1.12	>0.05
Left leg squats, number	EG	10.6 ±1.35	14.9 ±1.26	<0.05
	CG	9.8 ±0.79	10.7 ±1.30	>0.05

The results presented in Table 3 show that the level of special motor fitness of EG students in Alish belt wrestling has increased significantly in the dynamics of pedagogical experiment (Table 3).

Table 3. Indices of student special motor fitness under conditions of pedagogical experiment

Types of testing	Groups: EG(n=34), CG(n=30)	Beginning of experiment M±m	End of experiment M±m	p
Push-ups, number	EG	17.5 ±2.51	24.4 ±1.84	<0.05
	CG	16.9 ±1.78	18.6 ±2.21	>0.05
Standing high jump, cm	EG	42.2 ±1.81	48.0 ±1.59	<0.05
	CG	40.1 ±2.01	42.3 ±2.20	>0.05
Trunk forward bending in sitting position, cm	EG	15.8 ±1.23	19.5 ±2.14	<0.05
	CG	13.2 ±2.02	14.2 ±1.98	>0.05
Sit-ups in 1 min, number	EG	27.6 ±1.03	39.4 ±0.98	<0.05
	CG	26.5 ±1.14	29.6 ±1.28	>0.05

In students of the EG the following parameters increased: the dynamic strength endurance of the upper extremities – by 39.4% ($p < 0.05$); the explosive power of legs – by 13.7% ($p < 0.05$); spine mobility (flexibility) – by 23.4% ($p < 0.05$), strength of abdominal muscles – by 42.8% ($p < 0.05$). At the same time, the CG students demonstrated insignificant improvement of the indices of special motor capacity development ($p > 0.05$).

During three years of the experiment, the students enhanced their physical development and physical fitness significantly through the improvement of motion coordination by means of Alish belt wrestling, which was reflected in their motor abilities and strength data, indices of agility, speed-strength tests and spine flexibility. These differences may be explained by more qualitative rearrangements in the motor system of the students, which has been influenced by engagement in belt wrestling, and is indicative of the higher functional reserves of their motor system, including coordination abilities.

This gave impetus to the increase of technical capacities of wrestlers, which is clearly reflected in the analysis of temporal characteristics and the study of phase structures of the technique of throw execution at the beginning and at the end of the pedagogical experiment conducted in EG (Table 4).

Table 4. Results of analysis of throw execution time by belt wrestlers during pedagogical experiment

Index of throw execution time (n – 34)		Beginning of experiment		End of experiment		Percent of changes	t	p
		M	±m	M	±m			
Duration of throw preparation, s	Hip-roll, lateral	1.86	0.1	1.16	0.25	60.3	2.60	<0.01
	Valley drop throw	1.87	0.16	1.19	0.71	57.1	0.93	>0.05
	Lateral drop sweep	1.89	0.15	1.2	0.15	57.5	3.25	<0.01
	Two-leg pick-up	1.93	0.1	1.22	0.28	58.2	2.39	<0.02
Duration of of phase of throw itself, s	Hip-roll, lateral	1.74	0.28	1.14	0.58	52.6	0.93	>0.05
	Valley drop throw	1.52	0.1	1.08	0.15	40.7	2.44	<0.02
	Lateral drop sweep	1.34	0.18	1.06	21	26.4	0.01	>0.05
	Two-leg pick-up	1.58	0.18	1.11	0.15	42.3	2.01	<0.05
Duration of throw phase on the whole, s	Hip-roll, lateral	3.6	0.18	2.3	0.47	56.5	2.58	<0.01
	Valley drop throw	3.39	0.21	2.27	0.13	49.3	4.53	<0.01
	Lateral drop sweep	3.23	0.19	2.26	0.14	42.9	4.11	<0.01
	Two-leg pick-up	3.51	0.23	2.33	0.21	50.6	3.79	<0.01

While comparing the duration of hold execution during pedagogical experiment, one should state that the given changes in belt wrestlers' preparation significantly improve technical parameters of throw execution at the end of the conducted experiment.

For instance, the duration of lateral hip-roll decreased from 3.60 ±0.18 s at the beginning of experiment to 2.12 ±0.14 s ($p < 0.05$) at the end.

The reduction of the duration of action initial phases is especially noteworthy.

For instance, the duration of preparation for throw execution decreased from 1.86 ±0.12 s at the beginning of experiment to 1.12 ±0.16 s at the end ($p \leq 0.05$). Similar data were obtained during the study of duration of performing other holds/actions by wrestlers.

In addition to the analysis of temporal characteristics and the study of the phase structures of throw execution technique, an expert evaluation method was used for more objective assessment of Alish belt wrestling efficiency.

This method is based on an expert assessment of throws on a five-point system before and after the experiment (Table 5).

Table 5. Expert estimates of performing throws of different coordination structure before and after experiment, points

Number of subjects (n – 34)	Before experiment				After experiment			
	1	2	3	4	1	2	3	4
M	2.45	2.40	2.80	2.32	4.19	3.91	4.79	3.84
±m	0.27	0.34	0.29	0.31	0.37	0.42	0.44	0.47
p	<0.001	<0.005	<0.005	<0.001	<0.001	<0.001	<0.001	<0.005

Note: **1** – lateral hip-roll; **2 –** valley drop throw; **3 –** lateral drop sweep; **4 –** two-leg pick-up.

As shown in Table 5, the experimental methods of training resulted in an increased value of average points of throws. Increment of average value of lateral hip-roll constituted 71.3%; that of valley drop throw – 65.5%; that of lateral drop sweep – 71.7% and that of two-leg pick-up – 65.9% ($p < 0.001$).

At the end of the experiment, in spite of the overall increase in the quality of throw performance, significant difficulties remained in the execution of the valley drop throw and two-leg pick-up, which had the lowest average scores and the lowest increment of the indices of performance quality. As opposed to the above-mentioned situation, at the end of the experiment, the belt wrestlers showed excellent mastery of the technique of hip-roll and lateral drop sweep, received high average scores and experienced a significant increase in the indices of the quality of the above techniques performance.

In our opinion, this training's effect was mainly due to the usage of specialized motions of various coordination structure peculiar for Alish belt wrestling, which helped to develop qualities and skills necessary for mastering the given technique by the wrestlers. Therefore, the most efficient specialized holds and actions – lateral hip-roll and lateral drop sweep – were further used to improve motion coordination of students.

Discussion

The findings demonstrate that the level of student physical fitness is determined by their motor activity mode. The most efficient in this regard are those motor modes that were developed for EG. They are mainly focused

on the complex enhancement of the level of physical capacity development, formation and improvement of student motion coordination by using regular and extended exercises of acyclic character in the form of Alish belt wrestling in extracurricular physical culture and sports activities.

Despite numerous works dealing with the problem of student physical fitness under modern conditions of physical education organization at higher education institutions (Pryimakov, Dotsenko, 2006; Novytskyi, 2010; Seluyanov, Dimova, 2002; Samokysh, 2018), most of them fail to take into account the ratio and interrelations of different preparation system constituents. In particular, the importance of coordination preparation for increasing motor skills of students, reserve capabilities of their motor system, including those necessary to enhance functional capacities and the level of development of motor qualities, are not sufficiently accounted for.

The analysis of indices of student physical and technical fitness during the experiment (100 m and 3,000 m running, standing long jumps, shuttle running, expert estimate of the quality of executing hip-rolls, leg trips and sweeps and the duration of performing their separate phases) allowed to reveal certain interrelations between motions of various coordination structure and to formulate more accurately general notions about the level of their development and functioning of the system of motion control under different conditions.

Positive associations were noted between the results in shuttle running and long jump, on the one hand, and those in 100 m and 3,000 m running – on the other.

These dependencies may be interpreted in such a way that the improvement of the quality of coordination changes in standing long jump and shuttle run occurs in parallel with the improvement of the result in short and long distance running. That is, there is a certain interdependence of the level of development of individual motor qualities and coordination of movements both in the process of ontogenetic development, and in the process of special physical preparation (aimed at the development of speed, endurance, speed-strength qualities and a number of coordination abilities).

The results allow to assume that the enhancement of specialized motions of various coordination structure in the process of Alish belt wrestling not only improves the phase temporal structure of these motions (duration of separate phases of throw execution is reduced along with the improvement of the motor control quality according to the results of expert estimate) but also contributes to the improvement of results in non-specialized motions with different character of energy supply and various structure of movements, which details and supplements the findings of other authors.

Statistically significant positive associations between the result in sprint running (100 m and 3,000 m) and the data of shuttle run, standing long jumps and pull-ups indicate an availability of positive crossed transfer between speed and general endurance, speed and strength endurance, speed and agility.

Short distance running represents a fast and coordination-wise complex movement. Time of the run-up, high speed at the distance are provided not only by the morphological structure of the motor system, the power and capacity of the corresponding energy sources (phosphagens), the activity of enzymes, but also by the coordination changes in the motion control system – improvement of intramuscular and intermuscular coordination, that of nervous processes and sensory systems. Intermuscular coordination is based on the mechanisms of reciprocal innervation of leg antagonist muscles, has an innate character, but is improved in the process of long-term adaptation to physical loads (Pryimakov, Monogarov, 2000).

Based on the above, it can be affirmed that there exists an interrelation of several major indices of speed, speed-strength and coordination capacities of the EG students:

- increased speed of 100 m running is associated with improved speed-strength capacities (standing long jumps), coordination abilities (shuttle run), general endurance (3,000 m run),
- improved coordination in shuttle run is associated with increased speed-strength (results in standing long jump) and speed (100 m run) capacities, general (3,000 m run) and strength endurance (pull-ups),
- improved result in speed-strength and complex coordinated test – standing long jump is associated with increased strength (pull-ups), dynamic (sit-ups in 1 min) and general endurance (3,000 m run), as well as improved coordination reorganizations of agility (shuttle run) and speed (100 m run).

Regular engagement in Alish belt wrestling leads to significant improvement of physical and functional state indices:

- strength of the right and the left hand increases (by 33.5% and 30.2%, respectively),
- duration of hip-rolls and the initial phases of action reduces, whereas the quality of motor control tends to improve (according to expert estimate),
- vital index increases by 34.3%, VC – by 42.4%, endurance – by 20.3%, speed – by 12.9%, agility – by 21.8%, speed-strength capacities – by 12.7%,
- time of recovery after physical loads reduces and the indices of physical work capacity and circulation efficiency show significant improvement.

Therefore, generalization of the above-analyzed material allows to conclude that among the indices that determine physical fitness of the EG students, those which reflect their motor capacities in strength data, indices of agility, speed-strength tests and spine flexibility tend to prevail unlike indices of the CG students.

These differences may be explained by more qualitative rearrangements in the motor system of the EG students that occurred both in the process of their ontogenetic development, and under the influence of Alish belt wrestling, thus indicating higher functional reserves of their motor system, including coordination capacities.

Comprehensiveness of wrestlers' motor preparation, founded on the principles of a systematic approach in pedagogics, is the basis and criterion for studying the functional reserves of student motor system.

The findings supplement the results of studies of a number of authors, who dealt with the problem of functional reserves of student motor system (Pryimakov, Dotsenko, 2006; Pryimakov, Dotsenko, Prysyazhnyuk, 2014; Samokysh, 2016; Samokish, Bosenko, Pryimakov, Biletskaya, 2017).

Conclusions

Variety of student motor activity while practicing Alish belt wrestling during non-school hours and the performance of skills of different coordination structures contribute to development of various, including special, motor capacities of wrestlers, reduce the duration of realization of separate phases of executed motions, increase the quality of their performance and extend students' motor reserve capacities.

The improvement of specialized motions of different coordination structures while practicing Alish belt wrestling contributes to enhancement of the results in both specialized and non-specialized movements with different character of energy supply and different motion structure, improves functional state indices, reduces the time of recovery after physical loads and increases the level of general work capacity.

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COMPARISON OF THE GENERAL FITNESS LEVEL IN JUNIOR KAYAKERS WITH DIFFERENT SPORTS LEVEL

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Abstract The objectives of this study were to see if the general performance of kayakers depends on the level of their specific preparation and to identify the parameters of general preparedness that determine specific preparation. The subjects were divided into 3 groups on the basis of the result of a specific test: paddling over a 2,000-m distance. Group 2 included kayakers whose paddling time did not exceed ±1 SD for the whole sample, while group 1 included the best athletes with paddling times shorter than –1 SD and group 3 individuals who needed more than +1 SD to cover the 2,000-m distance. The study included 55 junior flatwater kayakers, represented various sports classes. All athletes manifested a similar level of endurance running, power and endurance pull and push barbell, 30 m running tests. The only differing characteristic between all groups was the level of asymmetry in distance of ball throw from sitting position of at 29, 45 and 66% in each group and paddling for 2,000 m time. All athletes manifested a similar level of general fitness preparation. The only differing characteristic between all groups was the level of asymmetry in distance of ball throw from a sitting position.

Key words kayaking, determination of sports results, motor abilities, power, endurance, asymmetry

Introduction

Kayaking is a very popular type of physical activity, both in its recreational form and as a sports discipline. The latter has been included in the Olympic program since 1936. Currently, there are two types of kayaking in Olympic competition: flatwater kayaking and kayak slalom.

Athletes who practice flatwater kayaking should have high levels of general preparation in terms of both aerobic (Van Someren, Phyllips, Palmer, 1999) and anaerobic (Bishop, 2000; Van Someren Oliver, 2001) capacity as well as adequate muscle strength. The latter should refer not only to maximum strength but also to strength endurance and power (Akca, Muniroglu, 2008; Rynkiewicz, Rynkiewicz, Żurek, 2014), primarily for the upper body (Tesch, 1993), but also for the trunk and core (Fekete, Coach, 1998; Fry, Morton, 1991). Furthermore, the athletes should master a specific paddling technique (Begon, Colloud, 2007; Fleming, Donne, Fletcher, 2012; Fleming, Donne, Fletcher, Mathony, 2012), also under unstable conditions (Rynkiewicz, Starosta, 2011), this may be particularly challenging, especially in the case of extreme fatigue. Therefore, improvement of body balance is another vital component of kayakers training (Rynkiewicz et al., 2014).

Such complex preparation is not possible without identifying the key determinants of successful performance. Analysis of our preceding research findings (in press), showed that the results of most general fitness tests conducted in 14- to 18-year-old kayakers correlated significantly with the time they required to cover a race distance. This observation prompted the study of the characteristics that distinguish elite kayakers from other athletes.

A number of papers dealing with general preparation of kayakers have been published to date (Akca, Muniroglu, 2008; Rynkiewicz et al., 2014, Van Someren, Palmer, 2003; Mckean, Burkett, 2010), however, aside from morphological structure (Ackland, Ong, Kerr, Ridge, 2003), no other factors that distinguish the preparation of high-level kayakers from that of other athletes have been identified. Moreover, many published studies included solely young kayakers (Rynkiewicz et al., 2014), or only individuals with low levels of specific preparation (Akca, Muniroglu, 2008).

Comparison of general preparation shown by kayakers from various performance categories would help their coaches to identify appropriate training objectives and could facilitate the development of multi-year training plans. However, such research may be challenging owing to limited availability and the generally low number of athletes being eligible for testing. Furthermore, such athletes devote most of their time to specific training especially paddling, and therefore, their coaches are reluctant to subject them to additional tests. On the basis of published data and our own research findings, the following were identified as the objectives of this study:

1. To see if general performance, power and endurance barbell pull and push, 30 m run test, 1,500 m run test and ball throw distance, of kayakers depends on the level of their 2,000 m kayak paddling preparation.
2. To identify the parameters of general preparedness that determine good specific preparation.

Methods

Participants

The study included 55 junior flatwater kayakers with a mean age of 17.49 ±0.5 years, mean body height of 178.1 ±6.8 cm, mean body weight of 76.3 ±6.8 kg and body mass index of 24.0 ±1.7 kg/m^2. The participants represented various sports classes, from II to master national class, including members of the National Junior Team. All procedures of this study were approved by the Local Ethics Committee at the Karol Marcinkowski University of Medical Sciences in Poznań, Poland. The experiments reported in the manuscript were performed in accordance with the ethical standards of the Helsinki Declaration. The legal guardians of the participants signed an informed consent form.

The subjects were divided into 3 groups on the basis of the result of a specific test: paddling over a 2,000-m distance. Group 2 included kayakers whose paddling time did not exceed ±1 SD for the whole sample, while group

1 included the best athletes with paddling times shorter than –1 SD and group 3 individuals who needed more than +1 SD to cover the 2,000-m distance. The study subjects represented ca. 80% of all actively training Polish kayakers aged 16–17 years. All athletes included in group 1 were members of the Polish national team, and most of them participated in world and European championships during the competitive season covered by the study.

Procedures

The study was conducted in April 2013, and included a nationwide training camp. The results of a competition held during the camp constituted the basis for qualifying for the National Junior Team, which guaranteed us both a high level of motivation and optimal disposition of the athletes.

Measures

The first test was paddling in a kayak for a distance of 2,000 m (P2000). The athletes started one at a time, with a one-minute interval between the athletes. The first kayaker was the athlete who achieved the best score during a previous training camp. Competitors paddled in sports kayaks (K-1) in accordance with the rules of the International Canoe Federation. The weather was calm on the day of the competition and the wind speed was 1.5 m/s parallel to the direction of the test.

Three hours after paddling, the athletes completed a series of general fitness tests. Athletes had at least 10 minutes of individual warm up, and a minimum of 5 minutes of rest between tests. The tests were conducted in a gym. The first test was the distance of a ball throw. The test was performed in two positions: first, in a sitting position, facing the area to which the ball was to be thrown, separately for the right (TSR) and left hand (TSL), and then in a standing position, also separately for the right (TRR) and left hand (TRL). The athletes were allowed to use a 3-m run-up during the second test. We measured the distance of the throw and recorded the ability to throw the ball forward within the boundaries of a 2-m wide track. The throw tests were used to determine the level of dynamic power. The exercise was performed twice and the better result was recorded. In analysing the result of throws, we calculated the asymmetry coefficient.

Next, athletes performed a 30-m run (R30). The test was performed to determine general dynamic speed potential. Time was measured using a Witty timing system (Microgate, Italy). Athletes started from a steady position 50 cm behind the timing gate. The athletes were allowed to start the run at a freely selected time point. The recorded running time was used to calculate mean running velocity. Moreover, momentum was calculated as the product of the athlete's body weight and mean running velocity (PR30).

After a series of ball throw and running speed tests, athletes went to a gym and prepared to perform a test to determine maximal velocity of movement during weightlifting exercise. We used the Tendo Weightlifting Analyzer (Slovakia) to determine the movement velocity of a barbell during the bench Press (Push P) and the bench Pull (Pull P). Exercises were performed with 2-minute intervals. Each participant performed a series of six repetitions of each exercise in the shortest possible time; the load corresponded to one-half of the athlete's body weight ±2.5 kg. We recorded the maximal average power of the one best repetition from series of six.

After the power test, the athletes performed the bench Pull (Pull E) and the bench Press (Push E) exercises for strength endurance determination (Akca, Muniroglu, 2008). We used a device which measures the distance of barbell, based on the movement of a cord connected to the rotary encoder. The results were displayed with an accuracy of 0.1 cm. They performed the bench pull first, followed by a 30-min break, and then the bench press.

The test involved a load corresponding to one-half of the athlete's body weight ±2.5 kg. The athletes repeated the exercise as many times as possible for up to 120 s. To determine the amount of work performed, a recording device registered the distance covered by the barbell during each repetition with 0.01 m precision.

After the strength test, competitors had a 2-hour break and then started the running test (R1500) at a track and field stadium**.** The athletes ran a distance of 1,500 m in the shortest time possible. The competitors ran in groups of 15, and a standard chronometer was used to measure the time. This test was conducted to measure the general level of endurance. Momentum was calculated as the product of the athlete's body weight and mean running velocity (PR1500).

Statistical methods

The study hypothesis was verified with a number of statistical methods. First, the mean and standard deviation were calculated. The Kolmogorov-Smirnov test was used to check the normal distribution of data. The asymmetry coefficient were calculated using the following formula:

$$WA = \frac{X_p - X_l}{\frac{(X_p + X_l)}{2}} \times 100\%$$

where:

WA – asymmetry coefficient,

X_p – right side throw distance,

X_l – left side throw distance.

In the analysis, we used only the absolute values of the coefficients of asymmetry. We use the level of asymmetry in the distance of the alternate hand seated ball throw (ATS) and stand ball throw (ATR). Tukey Post-Hoc one-way ANOVA test for different group size was used to compare differences between groups. All the statistical analyses were conducted with a Statistica 9.0 package (StatSoft Inc. 1984–2011, license no. AXAP012D837210AR-7).

Results

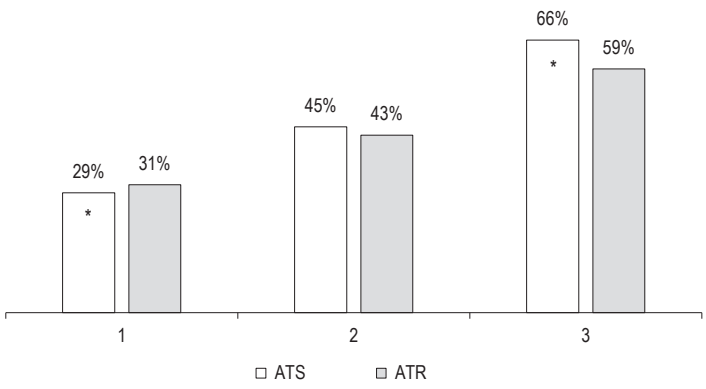
The times, needed to cover the 2,000-m distance, achieved by subjects in group 1 (502.5 s), were significantly shorter that those of athletes in groups 2 and 3 (respectively 532.1 s and 571.8 s). Also, the paddling times of kayakers in group 2 were significantly shorter than those of athletes in group 3. These results confirmed the accuracy of the criterion we used to stratify the athletes into 3 groups showing different levels of performance.

Subsequently, we checked for potential differences in the levels of general preparation shown by athletes in the different groups (Table 1). We did not find any significant intergroup differences in the results of general preparation tests except in (ATS), which was significantly different between athletes in groups 1 and 3. The lowest values for ATS and ATR were achieved by subjects in group 1 (29 and 31%, respectively), followed by individuals in group 2 (45 and 43%, respectively) and group 3 (66 and 59%, respectively) (Figure 1).

Table 1. The results of performed tests

	Mean, ±SD, min–max					
	number of group					
	1		2		3	
	M ±SD	min–max	M ±SD	min–max	M ±SD	min–max
Weight (kg)	78.3 ±4.5	73.0–85.0	75.5 ±7.4	64.3–91.0	77.3 ±6.2	67.0–85.0
Height (cm)	180.6 ±2.2	177–184	177.8 ±6.1	167.0–184.0	176.4 ±5.4	169.0–183.0
BMI (kg/m^2)	24.0 ±1.0	22.0–25.0	23.9 ±1.8	20.6–25.0	24.8 ±1.7	22.0–28.0
P2000 (s)	502.5 ±8.9 *£	484.0–510.0	532.1 ±11.8 * ¥	513.2–510.0	571.8 ±13.5 £ ¥	556.0–592.0
Pull E (kgm)	989.3 ±335.9	553.0–1435.0	972.4 ±238.6	580.0–1435.0	892.3 ±225.3	502.0–1240.0
Push E (kgm)	938.1 ±275.1	474.0–1220.0	988.0 ±276.4	458.0–1220.0	994.4 ±242.8	694.0–1320.0
Push P (W)	465.0 ±49.1	361.0–510.0	469.7 ±60.8	353.0–627.0	505.6 ±57.3	426.0–585.0
Pull P (W)	518.0 ±73.9	409.0–636.0	525.3 ±57.7	427.0–636.0	539.6 ±59.9	474.0–627.0
PR30 (kgm/s)	510.2 ±43.7	457.0–587.0	480.8 ±48.7	387.0–595.0	505.0 ±47.8	418.0–561.0
TSR (m)	10.9 ±2.7	6.0–14.0	11.3 ±2.2	6.0–16.0	12.7 ±2.8	9.0–17.0
TSL (m)	8.2 ±2.6	5.0–13.0	7.2 ±2.0	3.0–13.0	6.4 ±1.5	5.0–8.0
ATS (%)	29.0 ±50.0 £	–50.0–70.0	45.0 ±28.0	–40.0–110.0	66.0 ±15.0 £	40.0–82.0
TRR (m)	19.9 ±5.1	12.0–28.0	21.0 ±3.8	14.0–28.0	22.6 ±3.1	18.0–26.0
TRL (m)	14.4 ±4.1	9.0–21.0	13.5 ±2.4	10.0–22.0	12.4 ±3.0	9.0–17.0
ATR (%)	31.0 ±36.0	–20.0–70.0	43.0 ±23.0	–30.0–80.0	59.0 ±24.0	30.0–97.0
PR1500 (kgm/s)	378.8 ±35.0	327.0–424.0	358.1 ±35.59	271.7–454.0	340.8 ±61.6	231.0–406.0

* – statistically significant difference between group 1 and group 2 $p < 0.05$.
£ – statistically significant difference between group 1 and group 3 $p < 0.05$.
¥ – statistically significant difference between group 2 and group 3 $p < 0.05$.



* – statistically significant difference between group 1 and group 3, $p < 0.05$.

Figure 1. The mean level of ATS and ATR in a group of kayakers

Discussion

The study objectives were to see if general performance, power and endurance barbell pull and push, 30 m run test, 1,500 m run test and ball throw distance, of kayakers depends on the level of their 2,000 m kayak paddling preparation, and also to identify the parameters of general preparedness that determine good specific preparation.

Athletes in the three groups differed in terms of their performance in the 2,000-m paddling. However, we did not find any significant differences in the other parameters for the athletes examined. Kayakers in group 1 were nearly 4 cm taller and 1 kg heavier than subjects in group 3. Morphological characteristics of the athletes participating in this study were slightly different from those reported by other authors (Ackland et al., 2003; Mišigoj-Dyraković, Heimer, 1992), perhaps due to the relatively young age of our subjects.

Kayakers should have a high level of general preparation K.A. Van Someren et al. (1999), D. Bishop (2000), K.A. Van Someren, J.E. Oliver (2001), F. Akca, S. Muniroglu (2008), M. Rynkiewicz et al. (2014). The overall preparation level of our junior kayakers could be considered good and similar to reported by F. Akca, S. Muniroglu (2008), M. Rynkiewicz et al. (2014). Interestingly, contrary to our expectations, we did not find significant intergroup differences in terms of general preparation.

We observed some differences in the level of asymmetry in the distance of the alternate hand seated ball throw (Figure 1). Flatwater kayaking requires the involvement of the upper body, namely alternating right and left rotation of the trunk (Mann, Kearney, 1980). Therefore, kayakers should have an adequate upper body (Tesch, 1993), and trunk (Fekete, Coach, 1998) strength, and a high level of bilateral symmetry as well (Rynkiewicz, Starosta, 2011). Consequently, there is an apparent association between the upper trunk strength and athlete's performance (McKean, Burkett, 2010). According to McKean, Burkett (2010), kayakers have a limited range of motion in the shoulder joint. Limited shoulder flexibility and other differences in arm function are risk factors for injury in some disciplines, e.g., baseball (Donatelli et al., 2000) and volleyball (Kugler, 1996). Shoulder injuries are also the most common problem in kayaking (Edwards, 1993). The level of asymmetry in the distance of the alternate hand seated ball throw turned out to be the principal parameter contributing to the different performance of our kayakers in groups 1, 2 and 3. This is consistent with the data published by other authors who emphasized the pivotal role of the upper body (Tesch, 1993; Mckean, Burkett, 2010; Mann, Kearney, 1980) and high symmetry level (Rynkiewicz, Starosta, 2011).

Most of the Polish population is characterised by the dominance of one body side over the other (Starosta, 2008). Movements performed with a dominant side are generally faster (Bryden, Key, 2002) and more precise (Hausmann, Kirk, Corballis, 2004). However, kayakers should have high levels of symmetry (Rynkiewicz, Starosta, 2011), which can be tested with the alternate hand seated ball throw. An athlete starts the test in a position similar to that during paddling in a kayak, and the throw requires appropriate rotation of the trunk combined with a dynamic movement of the arm. According to M. Rynkiewicz et al. (2014), a high level of motor coordination in stable body position is a determinant of paddling performance. Asymmetry results from poor communication between the two cerebral hemispheres (Sainburg, 2005) and biomechanical differences in the structures of the right and left body (Carey, Otto de Haart, 2001). Consequently, it can be concluded that the difference in performance of junior kayakers results from the variable development of their motor coordination.

K.A. Ericsson, R.T. Krampe, C. Tesch-Römer (1993) proposed a theory of deliberate practice where they assumed the necessity to use specific forms of training to the attainment of expertise. J. Baker, J. Côté, B. Abernethy (2003) and T. Hodge, J. Deakin (1998) reported a strong positive correlation between the hour of high

quality training and sports achievement. However, researchers examining the early stages of development in elite athletes (Carlson, 1988; Côté, 1999; Hill, 1993), have reported that early specialisation as a child does not seem to be an essential ingredient for exceptional sports performance as an adult. According to P. Ward, N.J. Hodges, J.L. Starker, A.M. Williams (2002) elite soccer players did not specialise until after the age of 16. In sports practice, specific training stimuli are often implemented too early to achieve high performance of an athlete still at initial stages of his/her training. However, such approach may prevent further progress in the long term, which results in preterm stabilisation of an athlete's performance and his/her inability to develop (Barynina, Vaitsekhovskii, 1992). Excessive training without adequate recovery can lead to staleness and burnout (Henschen, 1998). This points to the pivotal role of a comprehensive training, especially aimed at the development of motor coordination and symmetry. According to L.D. Wiersman (2000), limited range of skills performed during early sports specialisation can limit overall motor skills development. An athlete subjected to such training will eventually show an appropriate level of strength and endurance under the demanding and unstable conditions of paddling in a kayak.

Unsurprisingly, the level of preparation demonstrated by our kayakers differed from that of the general population. Our study included elite junior kayakers who competed for positions on the Polish national team. All subjects were in their post-pubertal years; this period is characterised by stabilisation of motor skills and body structure. This may explain the lack of statistically significant differences in motor preparation between our athletes. In turn, the significant intergroup differences in symmetry level likely corresponded to the variable preparation of kayakers in terms of their coordination. Therefore, the level of symmetry and indirectly also motor coordination are crucial parameters determining the different performance of junior kayakers.

Conclusions

All athletes manifested a similar level of general fitness preparation. The only differing characteristic between all groups was the level of asymmetry in distance of ball throw from a sitting position.

It seems that the leading characteristic providing a high level of performance was the level of symmetrization and motor coordination.

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STUDENTS OF THE UNIVERSITY OF SZCZECIN AS CANDIDATES FOR THE OLYMPIC OR PARALYMPIC GAMES TOKYO 2020*

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Abstract Balancing sports practice at the highest world level with university education is a difficult – but feasible – task. An example of such skilful balance are some graduates of the Higher Pedagogical School in Szczecin, University of Szczecin, majoring in Physical Education, who graduated from the university with a successfully defended Master's thesis while being active athletes.

The aim of this paper is: to present current students of the Faculty of Physical Culture and Health Promotion of the University of Szczecin (WKFiPZ US) and a graduate of the Institute of Physical Culture of the Faculty of Natural Sciences at the University of Szczecin (IKF WNP US) as potential candidates of various disciplines for the 32nd Summer Olympic or 16th Paralympic Games Tokyo 2020; to show their sports achievements in previous Olympic and Paralympic Games; to present the indicators and qualification rules that the analysed athletes must follow to represent Poland in the Olympic and Paralympic Games Tokyo 2020. The study involved a group of seven athletes, current students of the University of Szczecin, Faculty of Physical Culture and Health Promotion: Patryk Dobek, Michał Gadowski, Marcin Lewandowski, Piotr Lisek, Katarzyna Mądrowska, Paulina Woźniak, Krystian Zalewski and one graduate of the Institute of Physical Culture of the Faculty of Natural Sciences of the University of Szczecin, Anna Harkowska. All of them are members of the national Polish team in their respective sport disciplines.

They compete in their respective sports disciplines in which they strive for qualifying standards which guarantee a start in the 32nd Summer Olympic or the 16th Paralympic Games Tokyo 2020. Piotr Lisek has the best chance of winning a medal in Tokyo in pole vault, as well as the following disabled athletes: Anna Harkowska in cycling, Michał Gadowski in rowing, and Paulina Woźniak in swimming. Marcin Lewandowski – a titled European medallist in the 800 m race will probably compete in his fourth Summer Olympics Tokyo 2020 (he participated in 2008, 2012, and 2016) and this time will fight for the best place amongst the finalist in the 1,500 m race.

Key words students, graduates, Olympic athletes, Paralympic athletes, Olympic Games, Paralympics, University of Szczecin, Faculty of Physical Culture and Health Promotion

* as of 15 May 2019.

Introduction

The Olympic idea had been known in Poland many years before the Polish Olympic Committee was established, and Polish athletes made their debut at the Olympic Games as a national team. Poland's historical circumstances and national captivity prevented Polish athletes from participating in the first Olympic Games of the modern era (in 1896, 1900 and 1904), but already in 1908 and in each subsequent Games, names of Polish athletes appeared amongst the participants of this most important competition in the world, although they did not always represent national colours. An analysis of the available literature showed that among the Olympic participants, there were many university students who successfully balanced sports and university education (Pawlak, 1983; Pawlak, 1988; Woltmann, Urban, 2007).

During the 125th Session of the International Olympic Committee (IOC) in Buenos Aires, on September 7, 2013, members of the Committee considered three potential host cities: Tokyo (Japan), Istanbul (Turkey), and Madrid (Spain); they chose the Japanese capital – Tokyo – as the host of the Summer Olympics in 2020. The 32nd Olympic Games will be held from July 24 to August 9, 2020, while the 16th Paralympic Games will take place from August 25 to September 6, 2020 (www.olimpjski.pl).

The dream of every sportsman is to participate in the largest international sports competitions, such as the Olympic Games organized every four years by the International Olympic Committee, the International Paralympic Committee in cooperation with the National Committees of the hosts of the next Games. 'In order to qualify for the Polish national team, certain qualification requirements in individual sports disciplines must be met (e.g. metric values, ranks at championships, ranking, as well as discretionary factors – the so-called 'wild card'), which enable participation in the Olympic and Paralympic Games' (Eider, Eider, 2012, p. 5).

Balancing sports activities at the highest world level with university education is a difficult – yet feasible – task. An example of this skilful balance are some graduates of the Higher Pedagogical School in Szczecin, University of Szczecin, majoring in Physical Education, who successfully graduated from the university with a defended Master's thesis while being active athletes. Among them are (chronologically listed) Olympians: Ireneusz Omięcki – rowing, Marek Gawkowski – rowing, Marek Kolbowicz – rowing, Przemysław Stańczyk – swimming, Łukasz Chyła – athletics, Damian Zieliński – track cycling, Przemysław Czerwiński – athletics, Marcin Lewandowski – athletics, Konrad Wasielewski – rowing, Małgorzata Wojtyra – track cycling, Oskar Krupecki – swimming, Patryk Dobek – athletics (Bachelor) and Paralympian Piotr Majka (Eider, Eider, 2015a; Eider, Eider, 2017; Tuszyński, Kurzyński, 2014).

The Faculty of Physical Culture and Health Promotion of the University of Szczecin (WKFiPZ US) is an entity whose dean's office, research, didactic and dean's staff are very favourable to students-athletes, including Olympians and Paralympians. Each of these athletes has an Individual Organization of Studies (IOS) or an Individual Plan and Program of Studies (IPPS), as determined by the Faculty Council' (Eider, 2017, pp. 136–137). This form of studying makes it possible to fulfil student duties to a large extent.

It should be emphasized that the IT techniques implemented at WKFiPZ US give employees and students a quick and modern access to national and world-wide databases of scientific information (Nadobnik, 2016). The systems operating at the department, e.g. intranet (internal university network) ensure efficient exchange of e-mails, and synchronizing meeting and consultations calendars. Modern information technology enables students – including athletes – to remotely use resources (via the Internet) made available by academic teachers in the form of teaching materials, lectures, multimedia presentations, etc. The computer network and individual

employee accounts allow permanent contact with the department, which is used by the students-athletes to send final assignments and have individual consultations. Currently, studying athletes have better opportunities and conditions to obtain higher education compared to their peers from over a dozen years ago, when computer techniques were at the stage of development.

The purpose of this paper is:

a) to present current students of the Faculty of Physical Culture and Health Promotion of the University of Szczecin and a graduate of the Institute of Physical Culture of the Faculty of Natural Sciences at the University of Szczecin as potential candidates in their respective disciplines for the 32nd Summer Olympic or 16th Paralympic Games Tokyo 2020;
b) to show their sports achievements in previous Olympic and Paralympic Games;
c) to present indicators and qualification rules that the analysed athletes must follow to represent Poland in the Olympic and Paralympic Games Tokyo 2020;
d) to continue research in the field of broadly defined Olympism and Paralympism, including the participation of students and graduates of the University of Szczecin in the Summer Olympic or Paralympic Games.

Materials and Methods

The study involved a group of seven athletes, current students at the University of Szczecin, Faculty of Physical Culture and Health Promotion: Patryk Dobek, Michał Gadowski, Marcin Lewandowski, Piotr Lisek, Katarzyna Mądrowska, Paulina Woźniak, Krystian Zalewski and one graduate of the Institute of Physical Culture of the Faculty of Natural Sciences of the University of Szczecin, Anna Harkowska (Dokumentacja, 2019), (Table 1). Among subjects, there is Marcin Lewandowski, who graduated from the above-mentioned faculty in 2011, having received a master's degree in Physical Education (Eider, Eider, 2015a); currently, he is a first-cycle student of Public Health. In 2018, Patryk Dobek and Katarzyna Mądrowska completed first-cycle (Bachelor's) studies in Physical Education. They are currently continuing their studies at the second (Master's) level. The other athletes listed in Table 1 are: Michał Gadowski, Piotr Lisek, and Krystian Zalewski are first-cycle students of Physical Education, while Paulina Woźniak is a second-cycle student of Public Health (Dokumentacja, 2019). All of them are members of the national Polish team in their respective sport disciplines. The majority (62.5%) are fully able (Patryk Dobek, Marcin Lewandowski, Piotr Lisek, Katarzyna Mądrowska, Krystian Zalewski), while the remaining 37.5% are disabled athletes (Michał Gadowski, Anna Harkowska, Paulina Woźniak).

Table 1. Research material: students-athletes from the University of Szczecin

First name and last name	Age	Major of studies	Sports		Currently represented sports club
			discipline	competition	
1	2	3	4	5	6
Patryk Dobek	25	Physical Education	Athletics	400 metres hurdles	MKL Szczecin
Michał Gadowski	29	Physical Education	Rowing (disabled)	mixed doubles TAMix2x, PR2 Mix	KSI 'Start' Szczecin
Anna Harkowska	39	Physical Education	Cycling (disabled)	– individual timed trial – mass start race – 3,000 on the track	OKS 'Warmia i Mazury'
Marcin Lewandowski	32	Public Health	Athletics	– 800 m – 1,500 m	WKS Zawisza Bydgoszcz
Piotr Lisek	27	Physical Education	Athletics	pole vault	OSOT Szczecin

1	2	3	4	5	6
Katarzyna Mądrowska	24	Physical Education	wrestling	62 kg	LKS Feniks Pesta Stargard
Paulina Woźniak	27	Public Health	Swimming (disabled)	- 100 m breaststroke - 100 m butterfly stroke - 100 m freestyle - 200 m medley stroke	KSI 'Start' Szczecin
Krystian Zalewski	30	Physical Education	Athletics	3,000-meter steeplechase	UKS Barnim Goleniów

Source: *Dokumentacja* (2019); Eider, Eider (2012); Szaj (2016); Kaźmieraczak (2019a, 2019b); Mądrowska (2019).

The analysed research material was obtained from previous author's and co-author's papers, archival documentation of WKFiPZ US, written and oral reports of trainers, sports activists in Szczecin and employees of WKFiPZ US, www.wikipedia.pl. www.olimpijski.pl, www.paralympic.org.pl, and www.pzla.pl.

Results

Amongst the analysed athletes, only Katarzyna Mądrowska (wrestling) was not a participant of the Summer Games (Table 2). She has a chance to make her debut at the 32nd Olympic Games Tokyo 2020. All the other athletes have already competed in the Olympic or Paralympic Games. The following athletes competed three times: Marcin Lewandowski, Paulina Woźniak (in 2008, 2012, 2016), (Eider, Eider, 2015b; www.wikipedia.pl).

In the group of athletes in question, the disabled sportswomen have won medal. Anna Harkowska has won a total of five silver medals at 14th and 15th Paralympic Games, in three Paralympic competitions: mass start race, individual timed trial, and 3000 m track race (Szaj, 2012, 2016). She won the Paralympic medals in 2012 and 2016, having already graduated from the IKF WNP US, as she had defended her Master's thesis on 'Trends of cross-country cycling in Poland and in the world' in 2005 (Dokumentacja, 2019). Paulina Woźniak has so far won two medals: silver and bronze in the 100 m competition in breaststroke at the 13th and 14th Paralympics Games (Woźniak, 2019).

It should be emphasized that two other athletes participated in the final competition (except for the mentioned: Anna Harkowska and Paulina Woźniak): Piotr Lisek, Marcin Lewandowski, as well as a disabled rower, Michał Gadowski (Table 2). In the 31st Summer Olympic Games in Rio de Janeiro 2016, a member of Ośrodek Szkolenia o Tyczce Szczecin , Piotr Lisek, took fourth place in the pole vault, while Marcin Lewandowski from the Wojskowy Klub Sportowy Zawisza Bydgoszcz had a 6th place in the 800 m race. Michał Gadowski from the Klub Sportowy Inwalidów 'Start' Szczecin also won in Rio de Janeiro sixth place in mixed doubles.

Year 2019 and the first half of 2020 is very important in the training and preparation process of the analysed athletes, who represent a high level of sport skills, which allows them to obtain the qualification standards in their disciplines to guarantee their start in the 32nd Summer Olympic Games or 16th Paralympic Games Tokyo 2020. Every sportsman's dream is to be selected for the Polish Olympic or Paralympic team and successfully representing their country in the largest sports competition organized every four years.

Table 2. Participation of current students-athletes of WKFiPZ US and a graduate of the IKF WNP US in the Summer Olympic or Paralympic Games

First name and last name	Discipline	Beijing 2008			London 2012			Rio de Janerio 2016		
		represented sports club	start in a competition	rank	represented sports club	start in a competition	rank	represented sports club	start in a competition	rank
Patryk Dobek	Athletics	–	–	–	SKLA Sopot	4 × 400 m relay	reserve athlete fo 4 × 400 m relay team	SKLA Sopot	400 metres hurdles	XLI
Michał Gadowski	Rowing (disabled)	–	–	–	KSI „Start" Szczecin	mixed doubles TAMix2x (Jolanta Pawlak)	10th	KSI „Start" Szczecin	mixed doubles TAMix2x (Jolanta Majka)	6th
Anna Harkowska	Cycling (disabled)	–	–	–	OKS Warmia i Mazury	– mass start race – individual timed trial – 3000 m track race	2nd 2nd 2nd	OKS Warmia i Mazury	– mass start race – individual timed trial	2nd 2nd
Marcin Lewandowski	Athletics	UKL 'Ósemka' Police	800 m	20th	WKS Zawisza Bydgoszcz	800 m	9th	WKS Zawisza Bydgoszcz	800 m	6th
Piotr Lisek	Athletics	–	–	–	–	–	–	OSOT Szczecin	Pole vault	4th
Mądrowska Katarzyna	Wrestling	–	–	–	–	–	–	–	–	–
Paulina Woźniak	Swimming (disabled)	KSI „Start" Szczecin	– 100 m breaststroke – 100 m butterfly stroke – 100 m freestyle – 200 m medley stroke	2nd 16th 20th 7th	KSI „Start" Szczecin	– 100 m breaststroke – 100 m butterfly stroke – 200 m medley stroke	3rd 6th 8th	KSI „Start" Szczecin	100 m breaststroke	4th
Krystian Zalewski	Athletics	–	–	–	–	–	–	UKS Barnim Goleniów	3,000-meter steeplechase	27th

Source: Eider (2009); Eider, Eider (2012); Szaj (2012, 2016); Lewandowski (2019); www.wikipedia.pl.

Table 3. Qualification standards for the Summer Olympic or Paralympic Games Tokyo 2020

First name and last name	Discipline	Sport competition	Current personal record	Qualification standard
Patryk Dobek	Athletics	400 metres hurdles	48.40 s (stadium 2015)	48.90
Michał Gadowski	Rowing (disabled)	mixed doubles TAMix2x	officially no life records are registered, as the competition takes place in various weather conditions	– place in top eight at the world championships in Linz – Austria (August 25–September 1, 2019) – the first two teams from the continental qualifications in Varese – Italy (7–10 May 2020)
Anna Harkowska	Cycling (disabled)	– individual timed trial – mass start race – 3,000 m track race	life records are not recorded	high ranking at the world list from certain competitions and a limit of places awarded to Poland by the International Olympic Committee
Marcin Lewandowski	Athletics	– 800 m	1 : 43.72 (stadium 2015) 1 : 45.40 (indoors 2012)	1 : 45.20
		– 1,500 m *	3 : 34.04 (stadium 2017) 3 : 36.50 (indoors 2019)	3 : 35.00
Piotr Lisek	Athletics	Pole vault	5.94 m (stadium 2018) 6.00 m (indoors 2017)	5.80 m
Katarzyna Mądrowska	Wrestling	weight category 62 kg	there are no life records	place in the top six at the world championships in Kazakhstan in Nur – Sultan (14–22 September 2019)
Paulina Woźniak	Swimming (disabled)	– 100 m breaststroke – 100 m butterfly stroke – 100 m freestyle – 200 m medley stroke	1 : 21.47 1 : 12.52 1 : 09.39 2 : 38.12	obtaining the qualification standard, high ranking at the world list from certain competitions and a limit of places awarded to Poland by IPC Swimming
Krystian Zalewski	Athletics	3,000-meter steeplechase	8 : 16.20 (stadium 2014)	8:22.00

* Marcin Lewandowski in Tokyo 2020 is going to compete in the 1,500 m race (Lewandowski 2019).

Source: Ciochoń (2019); Hady-Bartkowiak et al. (edition information not available); Kaźmierczak (2019a); Krupecki (2019b); Mądrowska (2019); www.paralympic.org.pl; www.pzla.pl.

Table 3 lists the qualification standards which the analysed sportsmen must achieve in order to participate in the Tokyo sports competition. For athletics, the requirements are precisely defined by time results, while for pole vault by meters. The current life records of the analysed athletes are better than the applicable qualifying standards (Table 3), but worse than the results of the medallists of the 31st Olympic Games in Rio de Janeiro in 2016 (www.pzla.pl). In cycling, swimming and rowing of the disabled, as well as in wrestling, the sportsmen in question must first of all participate in the world championship and take one of top six or top eight ranks, as well as meet other qualifying standards (Ciochoń, 2019; Kaźmierczak, 2019a, Krupecki, 2019a).

It should be pointed out that Olympic and Paralympic teams are ultimately assigned by the Management Board of the Polish Olympic Committee and the Polish Paralympic Committee (following motions of the management boards of Polish sports associations); the teams include athletes, team leaders, members of the Olympic and Paralympic missions, medical mission, and guests of the team).

The analysed sportsmen in 2017–2019 (until May 15) competed in numerous competitions of various levels. Among others, they took places in top six, they won medals at national, European, and world championships (both at the stadium and indoors). Some of them are among the candidates to take a scored place, and even a medal during the planned Olympic or Paralympic Games Tokyo 2020.

Discussion

Qualifying for the Polish Olympic or Paralympic team, and then participating in the largest sports competition held every four years, is a great sports achievement for every sportsman. Majority of the national team members compete in their disciplines for a place in the finals, and a chance to win a medal.

In order to become an Olympian, or in the case of the disabled – a Paralympian – often many years of hard work are necessary, as well as subduing one's lifestyle completely to rigorous training, to be able to achieve a sports level which guarantees satisfying rivalry with the best sportsmen in the world. This aim is achieved only by few of the many athletes practicing Olympic disciplines (and less numerous group of Paralympic athletes).

Balancing studies with professional sports practice by students-athletes who are members of the national team, Olympic or Paralympic squad is often difficult – yet possible – to achieve. An example of this are previous graduates of Physical Education in Szczecin who, as students, participated in the largest sporting events, including the Summer Olympic and Paralympic Games (Eider, Eider, 2015b; Eider, Eider, 2017), as well as from other universities (Łuczak, 2015).

In 2007, an analysis was carried out related to a possibility of participation of eleven students-athletes from the IKF WNP US and one employee-athlete of the institute in the 29th Summer Olympic Games and 13th Paralympic Games Beijing 2008 (Eider, Eider, 2010). It turned out that as many as nine athletes obtained qualifying standards in their disciplines and were chosen for the Polish Olympic and Paralympic national team for Beijing. Among the team members of the IKF were Marek Kolbowicz and Konrad Wasielewski, who won gold medals in rowing quadruple sculls (with their mates, Michał Jeliński and Adam Korol), (Eider, 2009).

After the 30th Olympic Games and 14th Paralympic Games in London 2012, a study entitled 'Olympians and Paralympians of the West Pomeranian Voivodeship, London 2012' [Olimpijczycy i paraolimpijczycy województwa zachodniopomorskiego Londyn 2012] was published (Eider, Eider, 2012). The authors of this paper discussed, inter alia, sports achievements of the employee, students, and graduates of the University of Szczecin (Physical

Education), who competed in London Olympics. Among the participants, there were five students, one employee and two graduates of WKFiPZ US.

In 2015, another scientific paper was published, in which the authors (Eider, Eider, 2015a) presented eight students-athletes from WKFiPZ US who worked on qualifying standards needed for their participation in the 31st Olympic Games in Rio de Janeiro 2016. Ultimately, only three of them achieved the required sports results, and were able to participate in the Brazilian Olympic competition.

Sports achievements so far (including 2017–2019, unlit May 15) of current students-athletes and graduates indicate that all of them have a chance to obtain qualifying standards and participate in the 32nd Olympic Games and the 16th Paralympic Games in Tokyo. They are members of the national team. They participate in numerous national and foreign sports events. They work with the best trainers who carry out a long-term training process with them.

The presented research analyses on participation of students-athletes in the Summer Olympic or Paralympic Games confirm that many top-class sportsman also skilfully balance education with competitive sports. Through intense work, self-discipline, and enormous physical and intellectual effort, they achieve their sports and educational goals. It is advisable that after many hours of weekly and monthly training, the athlete's body be subjected to mental effort. It should be emphasized that an important supportive role is played by trainers who support them in their studies.

The management of the former IKF WNP US (currently WKFiPZ US), its academic teachers, and employees of the dean's office are very favourable to students-athletes, especially national team members, preparing for Olympic or Paralympic qualifications, participation in Summer Games or world/European championships. Every athlete has a so-called Individual Plan and Program of Studies, so that they can organize classes in a part-time mode, but they must demonstrate theoretical knowledge of subjects from the curriculum (Regulamin, 2019). Most of them fulfil their student duties and skilfully balance education with competitive sports. This is confirmed by the analysis of the number of IKF WNP US and WKFiPZ US student participation of in the 28th–31st Summer Olympic Games and 12th–15th Paralympic Games (Eider, 2004, 2009; Eider, Eider, 2012, 2015a, 2016b, 2017).

Conclusions

1. Among current WKFiPZ US students, there are seven students and one graduate of IKF WNP US who participate in certain sports competitions in which they obtain qualifying standards to guarantee their start in the 32nd Summer Olympic Games or the 16th Paralympic Games Tokyo 2020.

2. Piotr Lisek has the best chance of winning a medal in Tokyo in the pole vault, as well as the following disabled athletes: Michał Gadowski in rowing, Anna Harkowska in cycling, and Paulina Woźniak in swimming.

3. Marcin Lewandowski and Paulina Woźniak – these titled athletes will probably compete in their fourth Summer Olympic Games Tokyo 2020 (they participated in 2008, 2012, and 2016).

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NORDIC WALKING AS A FORM OF RECREATION

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Abstract Recently introduced on the Polish market, the Finnish product under the name of Nordic Walking gains more and more supporters and followers. When trying to determine the essence of Nordic Walking we should first define the term "physical activity" and "recreation". Nordic Walking belongs to a general motor activity. Physical activity is the amount of exercise or physical activity needed to develop and maintain one's health. Quite a simple technique of motion while walking with poles, the possibility of maintaining control of exercise intensity and relatively inexpensive (compared to other disciplines) sports equipment contribute positively to the versatility of Nordic Walking and its availability to any person interested in this sport. The march with the poles is one of the most commonly undertaken, and the most natural form of exercise in everyday life, especially for people in middle and old age, as these particular age groups dominate in Nordic Walking. It does not require large financial outlays or specific time and place, as opposed to practicing fitness or bodybuilding. One can just go out for a daily walk and simply take the poles with them.

Key words recreation, nordic walking, sport, physical education

Recently introduced on the Polish market, the Finnish product under the name of Nordic Walking gains more and more supporters and followers. Quite a simple technique of motion while walking with poles, the possibility of maintaining control of exercise intensity and relatively inexpensive (compared to other disciplines) sports equipment contribute positively to the versatility of Nordic Walking and its availability to any person interested in this sport. It also appears (as shown by a number of studies), it is a safe form of exercise in terms of health, as, to some extent, this specific march protects joints that are the most vulnerable to injuries, so now Nordic Walking is not only recommended by instructors who promote an active lifestyle, but also by physiotherapists and doctors who care for patients' rehabilitation and their recovery after diseases and treatments or surgeries.

Nordic Walking has been a big hit in many European countries and in North America. This sport is mostly practiced by people over 30 years old who choose a moderate activity, and most importantly – a systematic one. There is great hope that Nordic Walking will settle on for longer in Poland. So far, conducted research and

promotional activities indicate that the active part of Polish society is open and willing to accept this new form of exercise (Antosiewicz, 2016). Participation in practical classes under the supervision of qualified instructors gives practitioners the opportunity to learn about Nordic Walking from the practical and theoretical side as well as acquire technical skills of "walking with poles", which can be used by any active person in their free time.

When trying to determine the essence of Nordic Walking we should first define the term "physical activity" and 'recreation'. Nordic Walking belongs to a general motor activity. Physical activity is the amount of exercise or physical activity needed to develop and maintain one's health. The correct course of physiological and metabolic processes is conditioned by the need to ensure the optimal amount of activity for a human body, or at least a minimum amount of exercise. In short, physical activity is essential to the health and balance of the psycho-physical organism (Bielski, 1996).

Dudziak writes that "human physical activity is one of the most important factors stimulating its development. Participation in various forms of physical activity develops human health capabilities, it is also an excellent means of forming interpersonal relationships, as well as an important element of the socio-cultural development of our civilization" (Dzudziak, 2011). The range of physical activity is very wide. In making the physical effort we should pay attention to the individual capabilities of the organism.

Appropriate amount of physical activity has a beneficial effect on lipid and carbohydrate metabolism, blood clotting, biochemical changes of the myocardium and the walls of blood vessels, endocrine system, nervous system, restoring mental balance, respiratory system, increasing efficiency, and motor system, improving their structure and functions (Szwarc, 1979). R. Oleksy believes that "systematic physical exercise influences the increase of somatic development, which is widely presented in numerous Polish and foreign experiments. They prove that a training group of young people reach a significant advantage over their peers who did not train in such growth characteristics as height, weight, chest and limbs girths" (Oleksy, 2012).

Physical activity improves the health in various ways. It is the cheapest and easiest way to prevent many diseases. Doctors report that the current sedentary lifestyle, 'compulsive' leisure time in front of a TV or computer monitor, and hence the general lack of habit of exercises, in a decidedly negative manner impact not only the well-being, but above all – the human health.

Training, especially aerobics, causes an expansion of vital capacity; the maximum ventilation increases, enhancing the overall body strength. Regular exercising increases the volume of blood circulating in the body which results in faster removal of harmful substances and waste products from the body, resulting in faster biological restoration (Oleksy, 2012).

Lack of exercise causes metabolic processes' disorders and negatively affects the psyche and the ability to cope with stress. The natural need for movement, which manifests itself in early childhood, decreases with age, but still remains an important factor in maintaining health, youth and immunity to all diseases of civilization, arising from metabolic disorders –(diabetes, atherosclerosis, heart disease and cardiovascular diseases). The factors responsible for the lack of adequate physical activity are due to education and the lack of habits of participating in recreational sports. The reason for the lack of movement is the overload of professional work, financial and organizational limitations, spending free time in front of the TV or the computer, lack of universal fashion to practice physical exercises, etc. (Maszczak, 1995).

The term "physical recreation" refers to activities of the sports and movement content, such as: sports games, dancing, hiking, walking., which one participates in willingly in their free time, which otherwise could be meant for rest, renewal of strength, pleasure, creation of health and personal development.

The objectives of recreation are:

– motion necessary to meet the needs of health-terms of prevention of metabolic diseases (obesity, diabetes, atherosclerosis, heart and vascular diseases, musculoskeletal system, anxiety, lack of immune capacity of the organism),
– daily energy balance of the human body – maintaining a healthy weight,
– the improvement, maintenance and construction of fitness and physical efficiency,

and indirectly psychological stability

– the achievement of pleasure and satisfaction with physical activity (Toczek-Werner, 2008).

Physical activity becomes fashionable again, and alongside the traditional disciplines cultivated unprofessionally, it becomes apparent that the Poles assimilate innovative forms of healthy exercise, such as Nordic Walking, which has "conquered" the urban population of both sexes and across the age span.

To define the type of physical activity that Nordic Walking represents, one can use the definition of the Polish Federation of Nordic Walking, which says that it is a combination of the march of technology repulsion from the substrate using a specially designed poles, which involves the skillful use to work the muscles of the upper half our body. Unlike trekking, where the poles are mainly used to support, (http://www.podkarpacie.pfnw.eu).

Nordic Walking's roots date back to ancient times, when the shepherds and the pilgrims used sticks to support themselves while walking in difficult terrain. Another source of Nordic Walking can be found in the summer ski training. People participating in the above-mentioned discipline have used sticks for decades to make their summer workouts more effective. Nordic Walking originated in Finland and now it becomes more and more popular around the world and also – slowly – in Poland (Figurski, Figurska, 2010). The first Nordic Walking center in Poland was established in Barlinek.

While walking with poles with proper technique, about 90% of the muscles of the human body is working. The poles relieve the bottom, often overloaded parts of the body (knees, hips and lumbar spine cutter) and activate the upper body (cervical spine and shoulders).

Nordic Walking can also be defined as a form of physical activity in the field, consisting of walking and using poles adapted from the cross-country skiing. Invented by experts from the world of sport and medicine, Nordic Walking is a variant of fitness walking technique which makes use of repulsion from the substrate by means of specially designed poles, which involves the skillful use of the upper half of the body during a brisk walk (Mittermaier, Neureuther, 2010).

Currently, it is estimated that this form of physical activity is practiced by about 7 million people around the world. Nowadays, where free time is occupied mostly by computers or television and fast food is the most common meal, it is difficult to encourage people to any physical activity. This is caused by a sedentary lifestyle, which is substantially the cause of obesity and various systemic diseases, diabetes, dysfunctions of locomotor system.

Walking is the most natural and healthy form of exercise; brisk walking or cross-country marches support fitness and help get in shape. Nordic Walking is a combination of march and a technique of pushing back from

the ground by using sticks. Nordic Walking does not make many demands, one does not need to learn any complicated skills. It is relatively simple to master, just two sticks and a bit of self-denial (Burger, 2010).

The technique of Nordic Walking is a combination of traditional marching and pushing back from the ground by using sticks, which is inspired by cross-country skiing. The simplicity and ease of such activity, and also its safety, allows people at different ages and in different physical condition participate in training. Nordic Walking can be practiced in any area on all surfaces, throughout the year and by everyone.

Nordic Walking training should start with walking with poles hanging loosely at one's sides, hands outstretched, looking for a suitable rhythm of the march. After finding that rhythm, the next stage is to connect the step with pushing the sticks back with the opposite hand. Based on the stick handle, one should loosen the fingers, grip the handle and the upper part of the trunk by rotating in the opposite direction to straighten the joins of the hand. One should not extend the bottom of the stick to the front (Burger, 2010).

At first glance, Nordic Walking resembles cross country skiing. Correctly handling the sticks is crucial for a proper technique. The tip of the stick is always directed slightly to the back. The right stick is to be put down when the right foot touches the ground. The longer the stick is in contact with the ground, the more effective the training is. The process of movement – if it is done correctly – is dynamic and harmonious (Mittermaier, Neureuther, 2010).

Each Nordic Walking training consists of several of the following steps:

- a warm-up – in which a special set of stretching and warm-up exercises is performed,
- proper training – that is march with sticks – from leisurely pace to progressively more vigorous one,
- short pause – during which one stretches the back muscles,
- training after the break – calmer, relaxant form of march.

The effects of Nordic Walking on health are probably undisputed. This 'magical' walk for health in the footsteps of the Finns', the pioneers of Nordic Walking in the world, combines all that is important in the promotion of health and prevention. Nordic Walking has three levels of activity – health, fitness and sports (Schwanbeck, 2013).

We can specify the following health benefits:

1. Strengthens the cardiovascular system.
2. Reduces high blood pressure, blood sugar and blood cholesterol.
3. It lowers resting blood pressure.
4. Involves large muscle groups throughout the body, activates 90% of the body muscles.
5. It activates the upper part of the spine and relaxes tension in the neck and shoulder area.
6. increases oxygen consumption by an average of 20–58% depending on the intensity of the driving poles.
7. Relieves the locomotor system up to 30%, especially all the knee joints and the lower spine section.

It is also important, next to the relax, what is also most commonly expected from a sport that is burning calories, Nordic Walking is extremely effective. It is more intense than during walking without poles (by about 40%), wherein the strain on joints and the spine (in case of equality of the substrate) is much less – the use of the poles during the hour training is compared for example with the passage of the load reduction about a dozen tons, while coaching endurance, strength and flexibility.

Good mastery of Nordic Walking is relatively easy, but it requires professional instruction in order to fully reap the benefits of health and not cause oneself harm. If we add to this the undeniable social values during training in a group, the benefits of outdoor exercise in direct contact with nature during the long 'ordered' marches with biomechanically upright silhouette, we obtain an effective way to year-round health-promoting training, possible

to serve in any area without having to search fitness centers and special clubs. One can also mention the health effects when having a rehabilitation (correcting bad posture or orthopedic injuries).

Nordic Walking is a pro-health and suitable for all regardless of age, gender or fitness level, especially for those who:

- need to lose weight for health purposes, as it effectively 'eats' calories by involving large muscle groups,
- want to effectively strengthen almost every muscle in their body – in Nordic Walking energetic work of the arms increases the speed, adding sticks and good technique creates the upper limbs resistance which leads to engaging the muscles of the abdomen, chest, back and shoulders,
- have orthopedic problems, balance disorders, and cannot burden the joints – Nordic Walking reduces the load on the knee joints of obese people, and well-chosen poles allow to maintain correct posture and stability while walking,
- have problems with mobility of the upper spine and muscle tension around the shoulders and neck – Nordic Walking relieves the pain surrounding neck and shoulders, it improves their mobility and increases the mobility of the chest,
- cardiac patients who seek a safe form of physical activity – Nordic Walking lowers resting blood pressure decreases cholesterol (HDL increasing) and activates the mobility, and hence the weight loss,
- are elderly and want to practice a healthy physical activity – Nordic Walking is a safe form of exercise, regardless of age when walking pace is properly adjusted,
- need motivation to increase their physical activity – Nordic Walking is 40% more efficient than regular walking and less strenuous than running (http://www.nordicwalking.com.pl).

Marching with poles improves the mood and has a positive effect on reducing depression, stress and psycho-physical fatigue. This is a new, amazingly fun, very addictive and gradually improving the condition form of walking.

Unlike ordinary walking, Nordic Walking involves the use of force put upon the poles on both sides. Therefore, Nordic Walkers use more parts of their body (though with less intensity), and thus stimulate the chest muscles, triceps, biceps, shoulders, abs and other muscles in a manner that is different from the stimulation caused by regular walking. This muscle involvement leads to higher reinforcement than that obtained by means of ordinary walking or jogging.

In summary, one can say that recently more and more is said in Poland about the validity of the promotion of a healthy lifestyle, maintaining good form through physical exercise for health rather than for extraordinary sportsmanship and physical fitness. Today's life is manifested by daily rush and stress of work, and what is worse – an unhealthy diet filled with irregular and hastily consumed meals. Many people spend their working day in a highly non-ergonomic position leading to stiffness and pain in the spine, neck and shoulder girdle. Insufficient physical exercise during leisure time causes the heart muscle atrophy as a general weakness of all muscles. An increasingly busy person, submitting an unhealthy diet rather than motor activity, begins to gain weight and so their cholesterol level increases. As a result of all these factors, diseases become a serious threat.

Therefore, the march with poles is undoubtedly the most commonly undertaken, and the most natural form of exercise in everyday life, especially for people in middle and old age, as these particular age groups dominate in Nordic Walking. It does not require large financial outlays or specific time and place, as opposed to practicing fitness or bodybuilding. One can just go out for a daily walk and simply take the poles with them.

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Guide for Authors

Authors are encouraged to submit high quality, original works which have not appeared, nor are under consideration in other journals.
Contributors are invited to submit their manuscripts electronically to e-mail: joanna.latka@usz.edu.pl and cejssm@gmail.com. Central European Journal of Sport Sciences and Medicine considers for publication manuscripts in the categories of Original Research, Review Article and Short Communication. The manuscripts should be in one of the following sub-disciplines: exercise physiology and biology, sports nutrition, sports science, biomechanics, coaching and training, sports medicine, sports injury and rehabilitation, physical activity and health, public health, physical education and health promotion as well as methodology of sport and history of physical culture and sport. Manuscripts with an interdisciplinary perspective with specific applications to sport and exercise and its interaction with health will also be considered. Papers are published only in English.

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Include the following information on the first page of the manuscript: the full title; a running title of no more than 75 characters and spaces. List all authors by first name, all initials and family name. List departmental affiliations of each author affiliated with institutions where the study described was carried out. Connect authors to departments using numbers superscripts. Contributions of the author and each co-author considering the following categories: A – Study Design; B – Data Collection; C – Statistical Analysis; D – Manuscript Preparation; E – Funds Collection. No names of co-authors will be published unless their contributions are indicated. Connect authors to contributions using alphabetic superscripts.
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