

IDENTIFICATION OF TOPOLOGICALLY CHARACTERISTIC MUSCULOSKELETAL PAIN OCCURRENCE AMONG YOUNG FEMALE ATHLETES

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Abstract

The purpose of this study was to identify pain occurrence among young female athletes in aesthetic sports by defining the proportions of pain status of fourteen body regions. Three groups of young female athletes (artistic gymnasts, rhythmic gymnasts and contemporary dancers) were analysed and compared. The sample consisted of overall 99 competitive athletes. Using the “Self-estimated functional inability because of pain” (SEFIP) questionnaire, athletes were asked to assess their current pain status in 14 body regions on a 5-point scale, with 0 being no pain and 4 being pain so severe that they are unable to practice. According to the Wilk’s test there was a significant multivariate effect ($F= 4.60$; $p<0.001$) between artistic gymnasts, rhythmic gymnasts and compulsory dancers in training experience and body status. The most common locations for incidence of pain on the total sample of subjects were in the lower back (44%), knees (35%) and ankles/feet (31%). Artistic gymnasts mostly report pain in the ankles/feet (51.43%), and lower (37.14%) and upper back (34.29%). Rhythmic gymnasts of the same age mostly report pain in lower back area (46.42%), knees (42.86%) shins, ankles and feet (28.57%), while dancers experience pain mostly in lower back (50%), upper back (44%) and knees (38.89%). According to the results of the Chi-square test, artistic gymnasts reported significantly higher pain incidence in ankles/feet region ($p<0.01$). Early detection of even low intensity pain, accompanied with the adjustment of training load and usage of appropriate safety requirements, can prevent the occurrence of injuries among young athletes.

Keywords: artistic gymnastics, rhythmic gymnastics, dance, health care, back pain.

INTRODUCTION

Young female athletes in aesthetic sports are subjected to intensive training very early in life while they master the demanding techniques of performance, which can cause musculoskeletal pain. Due to differences in training content, one could expect different incidence and risk of injury

in aesthetic sports such as artistic gymnastics, rhythmic gymnastics and contemporary dance. Differences are expected even within different types of dance with different topological characteristics and occurrences of pain (Miletić, Kostić, Božanić & Miletić, 2009).

Artistic, as well as rhythmic gymnasts, start with systematic competitions at the age of 7. High level of training demands at an early age can lead to various injuries which become a serious obstacle in development of future competitive career.

Artistic gymnastics is reported to have some of the highest injury rates in sports (Campbell et al. 2019). According to recent studies, most frequently, musculoskeletal pain among gymnasts may occur in lower extremities (Thomas & Thomas, 2019; Kerr, Hayden, Barr, Klossner & Dompier, 2015), wrists (Di Fiori, 2006), lower-back (Cugusi et al. 2020) and shoulder (Gerhardt, Doyscher, Boschert & Scheibel, 2014) regions. Other possible risk factors of musculoskeletal pain among gymnasts are identified as overuse and repetition of the same gestures several times for every type of training (Wyatt, Gittoes & Irwin, 2020), maturity phases of rapid growth (Notarnicola et al. 2019), age, body mass, body size, training duration and life stress (Campbell et al. 2019), and duration of sport practice (Farri et al. 2021). According to Thomas & Thomas (2019), the most common injury types in gymnast Olympians were sprains (35%) followed by tendinopathy/arthritis/impingements 17%), contusions (10%), and fractures (7%). Researches on young gymnasts (ages 6 to 10) show that they are most likely to experience a lower arm fracture, while those over the age of 10 years were most likely to experience an ankle sprain (Albright, Meghani, Lemme, Owens, & Tabaddor, 2022). In order to be able to prevent such injuries caused by training, it is advisable to start with the systematic monitoring of the occurrence of pain of very low intensity as early as possible.

In rhythmic gymnastics, there is a prevailing attitude that reduced body weight

will positively affect performance (Kaur & Koley, 2019), and thus the overall competitive result. Therefore, eating disorders and lower caloric intake are more common in aesthetic sports such as rhythmic gymnastics and figure skating, and endurance sports such as cycling, distance running and swimming (Coelho, Gomes, Ribeiro & Soares, 2014). In order to achieve the desired external appearance, which includes a below-average body weight, female athletes often do not have adequate nutrition, optimal for the heavy, multi-hour training sessions they carry out on a daily basis (Amorim, 2019). An additional problem is that rhythmic gymnasts enter the competition system very early, and the high requirements of physical appearance with below-average body weight, especially for girls in the developmental phase, can negatively affect the physical and mental health of young athletes. The higher the competitive level, the greater is the prevalence of eating disorders and risky dietary behaviors (Francisco, Alarcão, & Narciso, 2012). Some authors (de Oliveira et al., 2021) indicate the need for action by the main gymnastics institution (FIG) in order to prevent training methods that include inadequate nutrition of athletes, which will negatively affect the health of gymnasts. It is all the more important for rhythmic gymnasts to frequently monitor the appearance of pain caused by training, which can be directly related to exhaustion, overtraining and caloric deficit. The most common injuries among rhythmic gymnasts, according to previous research, are in the area of the lower extremities and back (Gulati, Rychlik, Wild, & LaBella, 2022; Oltean, Rusu, Copoiu, & Calin, 2017.). Overuse injuries are mostly seen in the knees, lower back and hip/groin (Gram,

Clarsen, & Bø, 2021). Some authors (Gulati, Rychlik, Wild, & LaBella, 2022) report that the most common injury types were strain (20.7%), nonspecific pain (15.5%), and tendinitis/tenosynovitis (10.36%); and the most common injured body parts were foot (24.9%), ankle (15.5%), knee (15.0%), lower back (14.0%), and hip (13.0%).

Generally, dance is an activity that causes intense pain, especially in the lower back (Miletic, Miletic, & Milavic, 2015; Henn, Smith, Ambegaonkar, & Wyon, 2020; Miletic, Miletic, Lujan, Kezic, & Erceg, 2015). McMeeken reported that 52% of Australian dancers suffer from back pain injuries before they are 18 and 75% by the time they are 25.

Contemporary dance, according to research so far, causes pain predominantly in the lower extremities due to specific dance techniques, especially intense jumps. Most pain in contemporary dancers is in the area of knees, ankles, and shin (Van Winden, Van Rijn, Richardson, Savelsbergh, Oudejans, & Stubbe, 2019) and contemporary dancers are at high risk for lower-extremity injuries (van Seters, van Rijn, van Middelkoop, & Stubbe, 2020). In modern dance, it is important to regularly monitor the occurrence of pain because the occurrence of a higher incidence of characteristic painful areas is possibly related to physical fitness, incomplete mastery of mechanical movements and incorrect movements (Sun, 2020). According to Angioi, Metsios, Koutedakis, Twitchett, & Wyon (2009) a reduced level of lower body muscular power is associated with increased severity of injuries in female contemporary dancers. Injury rates in contemporary dance are high; notably, 89% of dancers reported one or more injuries. This problem is particularly

evident in the lower limb (Baker, Scott, Watkins, Keegan-Turcotte, & Wyon, 2010). Research on the incidence of pain in contemporary dancers is still insufficient (Fuller, Moyle, Hunt, & Minett, 2019).

Generally, frequent monitoring of the occurrence of pain in young female athletes needs to be carried out in order to: (1) determine the characteristic critical points of occurrence of pain in certain sports activities, (2) prevent the occurrence of more serious chronic injuries related to the training content, (3) extended the careers of young female athletes. In this paper, we analyze and compare the incidence of pain in female athletes who actively train in different aesthetic sports, in order to be able to relate the characteristic topological pain occurrence in each special group to the training content. Knowing the characteristics of topologically defined occurrence of pain for each of the analyzed sports is the first step to the complex process of protecting young female athletes from sports injuries caused by training. Namely, the characteristic occurrences of pain in some sports lead to acute ones, and if they are ignored, it is possible that they become serious chronic injuries that seriously threaten the careers of young female athletes. Prevention of the occurrence of characteristic injuries in female athletes is a complex process that, in addition to the female athletes and coaches, also encompasses the wider environment. It is especially important for young athletes that their parents, coaches, doctors and therapists, choreographers, fitness trainers and everyone involved in the training and education processes are educated and informed in this sense.

The purpose of this study was to identify pain experience among young female athletes by defining the proportions

of pain status of fourteen body regions. Accordingly, three groups of young female athletes (artistic gymnasts, rhythmic gymnasts and contemporary dancers), defined by type of athletic training were analyzed and compared.

METHODS

The sample of subjects for the investigation consisted of 99 young female athletes who participated in aesthetic sports. Their mean age was 12.3 years (range 8 to 18). The coaches and parents were thoroughly familiar with aims and methods of this research. The study was performed following standard ethical guidelines of the University of Split, Croatia, and was approved by the Faculty of Kinesiology's Ethics Committee. The subjects were divided into three groups according to their training programs: artistic gymnasts (AG), rhythmic gymnasts (RG) and dancers (D). The artistic gymnasts (N=35) are competitors in compulsory and free programs, who have participated in national competitions and have a training load of approximately 10 hours per week of training. The rhythmic gymnasts (N=28) have participated in national and international competitions and have approximately 12 hours per week of training. The dancers (N=36) have participated in national compulsory dance competitions and have approximately 18 hours per week of training.

The experiment was conducted in two phases. In the first phase, coaches and parents were introduced to the methods and objectives of the research, and the athletes, with the assistance of the coaches, filled out a questionnaire about their sports status, which included; a) previous training experience; b) training characteristics; c)

hours of training per week; d) number of years of current sports participation; e) competition level and sport success. Then, subjects who changed training activities in the past three years, and who trained less than 7 hours a week in the past 6 months, were excluded from the research. Out of a total of 251 female athletes included in the first phase of the research, 99 of them met the conditions for inclusion in the second phase of the experiment.

In the second phase, the subjects were asked to complete a questionnaire, and anthropometric measurements were taken. "Self-estimated functional inability because of pain" (SEFIP) questionnaire is a simple and valuable tool in defining the pain status in certain regions, approved to be of high applicability among young athletes involved in aesthetic activities (Ramel, Moritz & Jarnlo 1999; Miletić, Kostic, Bozanic & Miletić, 2009). SEFIP is an instrument that asks the subjects to assess their current pain on a 5-point scale. The questionnaire covers 14 body regions (neck, shoulders, elbows, wrists/hands, upper back, lower back, hips, thighs (front), thighs (back), knees, shins, calves, ankles/feet, and toes). A sum score (range, 0-56) can be achieved where 0 represents no pain and 4 represents maximal pain. Everything above zero is regarded as a positive finding. Subject reports pain intensity on the five-point scale as follows: 0 – if they report no pain at all; 1 – if they report some pain but not much problem; 2 – if they report some pain but can handle it; 3 – if they report much pain and must avoid some movements; 4 – if the absence of practice is reported because of pain. The 99 subjects from three aesthetic sports were asked to answer the questions of the questionnaire sincerely, based on their own observations and experience. An online questionnaire

was posted on a specialized server *SurveyMonkey* with permission of the Faculty of Kinesiology, University of Split. *SurveyMonkey* is specialized for collecting and analyzing data electronically on a global level. The server and the application enabled a password level of access security and automatic identification of subjects when filling out the questionnaire from a computer identified by the IP address and personal information. Data collection was conducted in the period from April to June, 2022. The anthropometric measurements included body height and body weight. Body mass index (BMI) was calculated as $BMI = \text{body weight (kg)} / \text{body height (m)}^2$.

The basic parameters of the distribution of variables were calculated (mean value and standard deviation) for the three groups of athletes: (1) number of years of training; (2) body height (BH); (3) body weight (BW); and (4) body mass index (BMI). A multivariate analysis of variance (one-way MANOVA) with the post-hoc Tukey's test was used to test the differences between the three groups of subjects in the mentioned variables. Pearson's Chi-square test was applied for the comparison of the proportions of pain experience in the 14 body regions between the groups of athletes. The statistical level of significance of 95% ($p < 0.05$) was applied.

RESULTS

Basic data of body status and years of training, separately for each group, are presented in Table 1. One-way MANOVA was calculated in order to determine the differences between the groups in these six variables.

According to Wilks' test, there was a significant multivariate effect ($F = 4.60$; $p < 0.001$) meaning that the whole set of

composites could significantly discriminate the groups. In order to define which of the analyzed dependent variables contributes the most to the defined differences, a post-hoc Tukey's HSD test was calculated. The results show that there are no significant differences between the groups if we analyze the total sum of the results achieved by applying the SEFIP questionnaire and the occurrence of pain in young female athletes. Furthermore, the post-hoc Tukey test determined that there are significant differences in the years of training between sports gymnasts and dancers and between rhythmic gymnasts and dancers. Differences in body height and weight were determined between artistic gymnasts and dancers and between rhythmic gymnasts and dancers, which was also reflected in significant differences in BMI between rhythmic gymnasts and dancers.

Percentages of reported intensity of pain or absence of pain for each body region separately and for total sample of athletes are presented in Table 2. According to these results, young female athletes in aesthetic sports most often report the appearance of pain of low intensity in the knees (as many as 29 of them), followed by the upper and lower back (26 athletes) and in the area of the ankle joints and feet (20 athletes). When it comes to the occurrence of pain of greater intensity that young athletes feel but can still exercise and correctly follow the training requirements and correctly perform the given elements, such pain most often appears in the upper and lower back and in the area of the ankle joints and feet. It is characteristic that the pain of high intensity, due to which female athletes' proper performance is impaired in training and they avoid performing some elements, most often occurs in ankle joints and feet.

Table 1.

Descriptive statistics for groups of artistic gymnasts (AG), rhythmic gymnasts (RG), and dancers (D) and results of One-way MANOVA (Post-hoc Tukey's Test)

Sports	SEFIP (Σ)	Yrs (t)	Age (yrs)	Height (cm)	Weight (kg)	BMI
AG (n = 35)	4.09±4.66	5.46±2.74 ²	11.86±2.64	145.69±14.74 ²	39.20±12.90 ²	17.95±2.81
RG (n = 28)	2.57±2.59	5.61±2.94 ³	11.85±2.58	149.53±12.86 ³	37.89±10.99 ³	16.54±2.12 ³
D (n = 36)	3.75±3.14	7.67±2.96	13.08±1.25	162.03±11.73	49.56±10.58	18.67±2.63

¹differences between AG and RG, ²differences between AG and D, ³differences between RG and D

Table 2.

Percentages of reported intensity of pain (1, 2, 3 or 4) or reported absence of pain (0) for total sample of athletes (N=99) for each body region separately

Body region	No pain (0)	Some pain but not much problem (1)	Pretty much pain but can handle it (2)	Much pain, must avoid some movements (3)	Cannot practice because of pain (4)
Neck	85.9% 85	12.1% 12	2% 2	0.0% 0	0.0% 0
Shoulders	82.8% 82	13.2% 13	4% 4	0.0% 0	0.0% 0
Elbow	93.9% 93	4.1% 4	1% 1	0.0% 0	1% 1
Wrists/hands	85.9% 85	10.1% 10	4% 4	0.0% 0	0.0% 0
Upper back	64.6% 64	26.3% 26	9.1% 9	0.0% 0	0.0% 0
Lower back	55.6% 55	26.3% 26	15.1% 15	3% 3	0.0% 0
Hips	89.9% 89	9.1% 9	1% 1	0.0% 0	0.0% 0
Thighs (front)	86.9% 86	8.1% 8	5% 5	0.0% 0	0.0% 0
Thighs (back)	90.9% 90	8.1% 8	1% 1	0.0% 0	0.0% 0
Knees	64.7% 64	29.3% 29	4% 4	2% 2	0.0% 0
Shins	89.9% 89	10.1% 10	0.0% 0	0.0% 0	0.0% 0
Calves	70.7% 70	24.3% 24	4% 4	1% 1	0.0% 0
Ankles/feet	68.6% 68	20.2% 20	6.1% 6	5.1% 5	0.0% 0
Toes	98% 97	2% 2	0.0% 0	0.0% 0	0.0% 0

For a better insight into the occurrence of pain of low, medium and high intensity in the area of ankle joints and feet by research groups, the results are shown in Figure 1.

The results in the category (4) *Cannot practice because of pain* are not shown in the figure because the highest level of pain in the total sample of young female athletes was not identified by the SEFIP questionnaire. However, the most frequently reported occurrences of pain by subsamples of female athletes are identified. In the sub-sample of artistic gymnasts, only 48.60% of them do not report any occurrence of pain. This means that every other gymnast at the age of 12 reports some musculoskeletal pain caused by training, regardless of its intensity. A total of 71.40% of rhythmic dancers at the age of 12 do not report any occurrence of pain, and 86.10% of female dancers at the age of 13.

The results of the Chi square test for each body region between the three groups of athletes are presented in Table 3. According to the results, young female athletes in aesthetic sports most often report the occurrence of characteristic musculoskeletal pain in the lower back area (44.44 %) followed by the upper back and knees (35.35%), while in third place is the occurrence of pain in the area of the ankle joints and feet (31.31%). By analyzing the appearance of characteristic musculoskeletal pain for each research group separately, we see how the characteristic appearance of topological pain in young female athletes differs depending on the type of training activity. Thus, in artistic gymnasts, the occurrence of pain is most common in the area of the ankle joints (up to 51.43%), followed by the area of the lower back (37.14%) and upper back (34.29%).

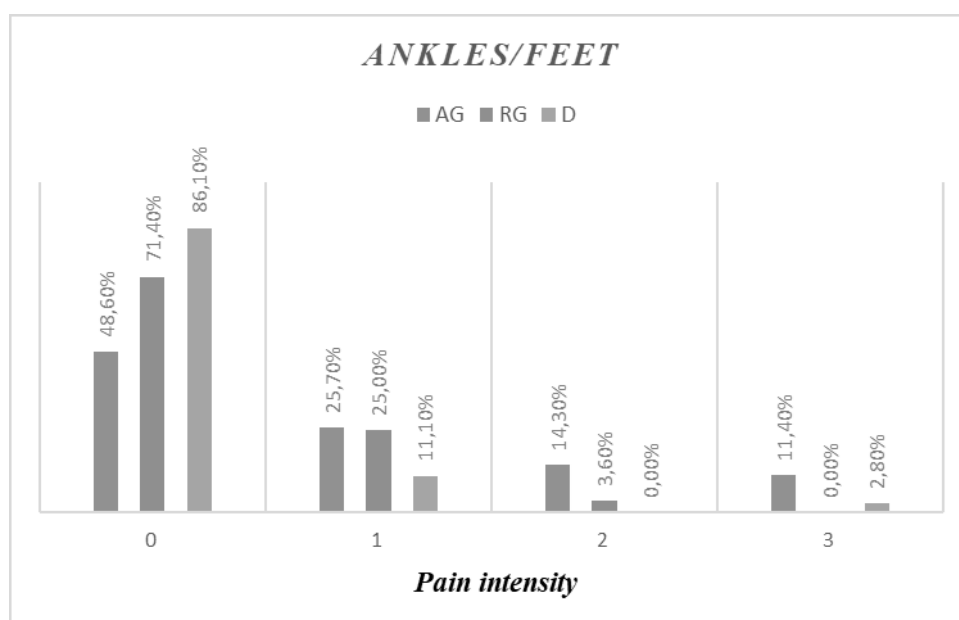


Figure 1. Intensity of pain prevalence among groups of artistic gymnasts (AG), rhythmic gymnasts (RG) and dancers (D) in ankles/feet region: (0) *No pain*; (1) *Some pain but not much problem*; (2) *Pretty much pain but can handle it*; (3) *Much pain, must avoid some movements*.

Table 3.

Differences between groups of artistic gymnasts, rhythmic gymnasts and dancers in pain incidence: Chi square test results (χ^2) for each body region between three groups

<i>Body region</i>	<i>AG</i> <i>N= 35</i>	<i>RG</i> <i>N=28</i>	<i>D</i> <i>N=36</i>	<i>TOTAL</i> <i>N=99</i>	χ^2	<i>df</i>
Neck	7 20%	2 7.14%	5 13.89%	14.14% 14	4.76	4
Shoulders	7 20%	3 10.71%	7 19.44%	17.17% 17	1.95	4
Elbow	2 5.71%	1 3.57%	3 8.33%	6.06% 6	3.96	6
Wrists/hands	8 22.86%	2 7.14%	4 11.11%	14.14% 14	8.16	4
Upper back	12 34.29%	7 25%	16 44.44%	35.35% 35	5.03	4
Lower back	13 37.14%	13 46.42%	18 50%	44.44% 44	3.48	6
Hips	1 2.86%	4 14.28%	5 13.89%	10.10% 10	4.55	4
Thighs (front)	4 11.43%	1 3.57%	8 22.22%	13.13% 13	5.31	4
Thighs (back)	4 11.43%	1 3.57%	4 11.11%	9.09% 9	3.07	4
Knees	9 25.71%	12 42.86%	14 38.89%	35.35% 35	7.93	6
Shins	3 8.57%	2 7.14%	5 13.89%	10.10% 10	.93	2
Calves	10 28.57%	8 28.57%	11 30.56%	29.29% 29	5.04	6
Ankles/feet	18 51.43%	8 28.57%	5 13.89%	31.31% 31	16.98**	6
Toes	2 5.71%	0 0.0%	0 0.0%	2.02% 2	3.73	2

*Denotes significant coefficients on the level $p < 0.05$;

**Denotes significant coefficients on the level $p < 0.01$.

In rhythmic gymnasts, the occurrence of characteristic musculoskeletal pain is most common in the lower back (46.42%), followed by the knees (42.86%) and in the area of ankles and feet (28.57%). In female dancers, the occurrence of characteristic musculoskeletal pain is most common in the lower back (50%), upper back (44%) and in the area of the knees (38.89%). According to the results of the Pearsons Chi-square test, we found significant differences

between the three investigated groups in the occurrence of characteristic musculoskeletal pain in the area of the ankle joints and feet. Artistic gymnasts most often report pain in the area of the ankle joints and feet (51.43%), followed by rhythmic gymnasts (28.57%) and dancers (13.89%).

DISCUSSION

Results have shown that there are differences in training experience between artistic gymnasts and dancers. Respondents in the sub-sample of female dancers, with an average age of 13.8 years, are slightly older than the gymnasts (11.8 years), which is expected because gymnasts enter the competition system earlier and therefore start systematic training very early, already at the age of 5. In relation to their age, it is expected that there are more dancers than gymnasts because they are already in the phase of accelerated growth. The differences in weight and BMI, which show that rhythmic gymnasts have the lowest BMI values and below average body weight, are in accordance with previous research (Purenović-Ivanović, Popović, Bubanj, & Stanković, 2019; Batista, Garganta, & Ávila-Carvalho, 2019) according to which we expect a characteristic physique from female competitors in rhythmic gymnastics: lean body, long limbs, and low body weight. It is a common opinion that in female rhythmic gymnasts, reduced body weight is a prerequisite for better performance of body elements (Kaur & Koley, 2019) and already at an early competitive age, girls with such a physique and below-average BMI will be positively selected. In recent scientific literature (Oliviera, Costa, Antualpa, & Nunomura, 2021) the question is increasingly being asked how justified this is, i.e., whether such a physique really promotes good performance and whether it justifies dietary restrictions that can have a bad effect on the overall mental and physical health of young female athletes. We can assume that insufficient nutrition will make it more difficult to cope with the great training demands of this sport, and

that the problems of rhythmic gymnasts will also be reflected in the appearance of musculoskeletal pain. That is why it is necessary to react seriously to the appearance of musculoskeletal pain even of the smallest intensity and to adjust the training loads and diet.

According to the obtained results, young female athletes in aesthetic sports most often report the appearance of pain in the area of the upper and lower back and knees, followed by ankles and feet in third place. The results are in line with previous research and the general occurrence of pain in young athletes in the phase of growth and development (Müller, Müller, Stoll, Fröhlich, Otto, & Mayer, 2017; Schmidt et al. 2014; Hall, Foss, Hewett, & Myer, 2015).

By analyzing the occurrence of characteristic musculoskeletal pain in subgroups of artistic gymnasts, rhythmic gymnasts and dancers in this research, we come to more detailed information regarding pain caused by specific sports training. In artistic gymnasts, a characteristic occurrence of musculoskeletal pain was identified, most often in the area of the ankle joints and feet, as well as the upper and lower back. Artistic gymnastics is a physically demanding sport that requires flexibility, agility, and extreme upper and lower body strength. The specific biomechanics of the sport leads to a unique injury profile (Desai, Vance, Rosenwasser, & Ahmad, 2019). According to Edouard, Steffen, Junge, Leglise, Soligard, & Engebretsen (2018), the most common injury in female artistic gymnasts is ankle sprain, which is in line with the results of this research. Understanding the aetiology, prevention and treatment protocol by coaches and athletes is a necessary prerequisite for injured athletes to return to

training under full load. This is why it is important to frequently monitor the occurrence of musculoskeletal pain and identify the intensity of the occurrence of pain in order to be able to adjust training contents and loads. This can be done by, for example, reducing intensive training of explosive strength such as jumps and flexibility, especially in the back area, after the identification of characteristic pain.

In a sub-sample of female rhythmic gymnasts, a characteristic occurrence of musculoskeletal pain in the area of the lower back, knees, lower legs, ankles and feet was identified. For rhythmic gymnasts, the training is based on the intensive development of extreme flexibility, mobility, while the body elements of balances mainly contain elements related to back flexibility, which can be the cause of significant pain in the back. The obtained results are in accordance with previous research (Gulati, Rychlik, Wild, & LaBella, 2022; Oltean, Rusu, Copoiu, & Calin, 2017), and it is recommended to adjust the training in order to reduce the execution of high-risk elements to a minimum (Oltean, Rusu, Copoiu, & Calin, 2017).

In a subsample of female dancers, a characteristic occurrence of musculoskeletal pain in the back and knee area was identified. Dancers in the contemporary dance style, when compared to gymnasts and rhythmic gymnasts, do not have pronounced jumping training, and there is no intense pain in the area of the ankle joints, while the dominant pain appears in the back and knees. The results of the Pearsons Chi-square test show significant differences in the occurrence of musculoskeletal pain in the area of the ankle joints, which can be directly related to the content of the training, especially when it comes to intensive training during which

the take-off is practiced, whether it is a group of jumps or acrobatic elements. It is clear that such trainings in artistic gymnastics are the most intense due to its acrobatic elements.

The most common causes of chronic injuries in female gymnasts are poor technique, improper training methodology for learning gymnastic elements and overtraining (Kolar, Pavletić, Smrdu, & Atiković, 2016). Possible prevention of acute painful conditions that progress to chronic ones include better education of coaches, athletes, parents, physiotherapists, doctors and others involved in the training protocol of young female athletes. Better education also includes recent knowledge such as the identification of the characteristic occurrence of pain in certain sports disciplines, and a more effective transfer of knowledge between conducted research and coaches who directly affect the health status of young female athletes.

This paper once again proved that there is a clear need for adoption of universal standards for injury prevention screens and injury reporting (Liederbach, 1997) and, therefore, scientists and experts are making great efforts to develop these standards in their sports. However, as the results of this research show, the main problem in most aesthetic sports are the back, knees, feet and ankles areas. Fortunately, the importance of injury prevention for these body areas is well researched and includes core and knee stability exercises, as well as strengthening the feet & ankle muscles (Thacker et al., 2003; Huxel Bliven & Anderson, 2013; van Der Merwe, Shultz, Colborne & Fink, 2021). Coaches and experts need to realize that injury prevention exercises are crucial for athlete's development and their long-term wellbeing and that they are to be practised on a daily basis. Also, to minimize

the injury risk, all the professionals working with athletes need to be devoted to improving training facilities, as well as training equipment and apparatus that athletes use.

CONCLUSIONS

According to the results presented and discussed in this research, it can be concluded:

- The most common occurrence of musculoskeletal pain in young female athletes in aesthetic disciplines is in the lower back, followed by the upper back and knees, and in the ankles and feet.
- Characteristic musculoskeletal pain caused by training in artistic gymnasts is mainly in the area of the ankle joints, then in the lower and upper back; in rhythmic gymnasts in the lower back, knees and shins, ankles and feet; and in dancers in the area of the lower and upper back and in knees.
- It is recommended to monitor the occurrence of musculoskeletal pain in young female athletes and to modify training in accordance with the obtained results, so that the acute occurrence of pain does not have chronic consequences and thus directly negatively affect the careers of young female athletes.
- The use of the SEFIP questionnaire is recommended for monitoring the occurrence of musculoskeletal pain in young female athletes.
- Injury prevention program should be an integral part of every sport-related activity, since it not only helps in achieving training goals but also keeps athletes healthy.

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