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Anaerobic endurance of dance sport athletes

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Summary

Study aim: To assess the impact of an ordinary training week cycle lasting 6 months on the anaerobic endurance of dance sport athletes.

Material and methods: Two couples of standard style and six couples of ten dance style, aged 14–26 years, of diverse competitive categories (E, D, B, A, S), were subjected to maximum runs 8 × 50 m spaced by 15-s intermissions, before and after half-year training. Running time of every run and post-run heart rate (HR) were measured. The results were expressed as running velocities (m/s) and R-R intervals for heart rates.

Results: Velocities were significantly higher in the post-test (5.21 ± 0.21 m/s and 5.57 ± 0.34 m/s for women and men, respectively) than in the pre-test (5.13 ± 0.13 m/s and 5.39 ± 0.24 m/s, for women and men, respectively) ($F_{1,14} = 14.70$, $p = 0.0018$, $\eta^2 = 0.51$) despite the fact that a significant decrease of speed in each successive run was noted ($F_{7,98} = 82.19$, $p < 0.001$, $\eta^2 = 0.85$) for all of the participants in the pre-test and post-test.

Conclusions: The half-year training cycle of dance sport couples had no significant impact on their anaerobic endurance. It seems that individual training plans should include dancing interval exercises and interval training. The performance index is a useful tool in monitoring the training process and can be used as an accurate method for evaluating the anaerobic predispositions of athletes. It is recommended to develop specific, test-suitable dancing exercises.

Key words: Dance sport – Performance index – Endurance – Ballroom dancing

Introduction

Anaerobic endurance is the capacity to perform repeated, short maximal exertions at the highest possible level. This is increasingly important in contemporary sports, thus becoming a desirable part of the preparation of athletes [4, 8, 10, 14], e.g. in dance sport [1, 2, 7, 13]. The type and nature of dance sport competitions are highly demanding, regarding the cardiovascular system of dancers [13, 14, 15]. Physical preparation of dancers is an essential element of their training structure. To achieve and exhibit the excellent technique and the character of each dance, a high level of endurance is required [1, 7, 9, 15]. Today, many couples participating in dance sport competitions in the world face the problem of high-quality movement on the dance floor through all rounds of their competitions [4, 7]. The best dance sport couples participating in the most prestigious world tournaments often perform approx. 35 dances daily, each dance lasting, on average, from 1.30 to 2.10 min according to the rules of competition provided by the World Dance Sport Federation.

In previous studies [1, 5, 14, 15] the heart rate was investigated and it has been found that the effort performed by the dancers can be defined as submaximal [1, 3, 13, 15]. It has been shown that during one dance the pulse rate of the dancer ranges from 60% to 95% of the maximum heart rate (HR max). Short breaks between dances of high intensity make phosphocreatine resynthesis insufficient for energy that is demanded and it will be produced by anaerobic glycolysis, resulting in increased fatigue and reduced work efficiency [3, 12]. In the final round from the six couples that are at a similar level of technical skills anaerobic endurance may appear to be one of the factors determining the order of occupied places in the final. Unfortunately, in the training process of numerous dance sport clubs, the training structure is not based on measurable facts or a planned microcycle, but on the intuition or habits of coaches and dancers. Dancers train 2–3 hours daily, 3–5 days per week, with a focus on the improvement of dance technique. The most common method of building endurance in dance is consistently repeated simulation of the final round of the dance sport competition [13, 15]. Attention in general is paid almost entirely to the improvement

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of technical skills. In many dance sport clubs and studios, a regular training unit does not contain specific fitness and endurance program performance applied on an everyday basis. The number of publications pertaining to research on endurance of dance athletes is still very low.

In today's sports anaerobic endurance, the ability to repeat short term maximal work without lowering the efficiency is an increasingly important and desirable part of preparation of athletes [4, 7, 10, 12]. This is also true in dance sport [1, 2, 7]. Both the type and the nature of the dance sport competitions require from dancers' cardiovascular system aerobic and anaerobic types of work [5, 6]. Physical preparation of dancers constitutes an essential element of their training structure. To obtain and present excellent technique and characteristics of each dance, a dance couple must have a high level of endurance [1, 6, 8]. Today, many couples participating in dance sport competitions around the world face the problem of high-quality movement on the dance floor during all rounds of competitions [6]. The best dance sport couples participating in the most prestigious tournaments around the world often perform approx. 35 dances daily, each dance lasting on average from 1.30 to 2.10 min (WDSF).

In previous studies [4, 6, 7, 9], the heart rate was investigated and it has been found that the effort performed by the dancers can be defined as submaximal [1, 3, 6, 9, 15]. It has been proved that during one dance, dancers' pulse rates ranged from 60% to 95% of the maximum heart rate (HR max). Short intermissions between dances of high intensity make phosphocreatine resynthesis insufficient for the demanded energy and thus the energy must be produced by anaerobic glycolysis, which will result in increased fatigue and reduced work efficiency [6, 8, 12].

Among many factors which may impact a sports result, endurance begins to play a more and more significant role. In the final round of the competition, out of six selected couples at a similar level of technical skills, anaerobic endurance may appear to be one of the factors determining the order of occupied places. Unfortunately, in the training process in numerous dance sport clubs, training structure is not based on measurable facts or planned microcycles, but on the intuition or habits of both trainers and competitors. Dancers train 2–3 hours daily, 3–5 days per week with a focus on the improvement of their dancing technique. The leading method of developing endurance in dance is consistently repeated simulation of the final round of the dance sport competition [6], specifically performing the entire choreography of each dance with a few seconds intermissions between them. During an average dance training session, attention is paid almost entirely to the improvement of technical skills. Development of overall endurance performance is not very common. The number of academic studies researching endurance of dance athletes in dance sport is still marginal. In my previous studies [6] it has been proven that systematic versatile interval training (intensive and extensive) develops anaerobic and aerobic endurance of dancers, which directly influences the quality of the performed dance. It shows that there is a need to draw up additional specialised and versatile training methods aiming to allow trainers to conduct the training process based not only on their intuition. Therefore the aim of this study is to evaluate the influence of the classical one week cycle dance sport training conducted over 6 consecutive months on the dancers' anaerobic endurance.

Material and methods

Sixteen dancers from a sport dance club aged 14–25 volunteered to participate in the research and all of them provided written informed consent prior to testing. The study was approved by the university research ethics committee. Body mass ranged from 48 to 84 kg and body height ranged from 161 to 187 cm. Competing experience ranged from 3 to 19 years. Data declared by the competitors concerning age, height, body mass and competing experience are presented in Table 1. Three couples with class "E" (sport IV – the lowest class), one couple with class "D" (sport III), one couple with class "B" (sport I), two couples with class "A" (master national class) and one couple with class "S" (master international – the highest class) participated in the research.

The study group consisted of 16 competitors (8 females and 8 males) from a dance sport club. The couples were in the process of preparation for the dancing competitions season. Their endurance was researched in two stages and it was performed at the athletic track. The first stage of examination was carried out in September. After completing a 7-minute warm-up, each of the participants performed repeated runs 8x50 m spaced by 15-second intermissions. Each of the subjects had their pulse measured using a heart rate monitor (Polar FT 40). The time of each run was measured and recorded. The results were converted to velocity (m/s). Heart rates (HR) were converted to periods between cardiac contractions (60/HR), that is so-called R-R (s) intermissions. From the results of the velocity of the runs and the R-R intermissions, the index PI was calculated [3, 10] as the relation of the average value from the series of results and maximum value in the series. The second stage of the research was conducted in February.

During the half-year period between the tests, the competitors were subjected to the usual week cycle training which contained 2 training sessions each consisting in 1.5 hours of technical group lessons, two training sessions of 2 × 45 min technical individual lessons and one 1.5-hour competition simulation training session. Dancers were

participating in competitions as usual, on average twice a month [6].

The data obtained were submitted to statistical analysis.

Statistical methods

The analysis of variance for repeated measures was used in order to compare values of velocity. SEX as a fixed factor and TIME (PRE, POST) as well as RUN (1 to 8) as repeated factors were analysed. The post-test R-R intervals were analysed taking into consideration SEX and TIME. The significance level was set at $\alpha = 0.05$. The statistical analysis was conducted using STATISTICA 13.0 software.

Results

Declared age, body height, body mass and BMI of the dance sport competitors are presented in Table 1. Average values (±SD) related to endurance recorded in the study group are presented in Table 2.

Higher average and maximum velocities were achieved during the post-test, in the case of both female and male subjects. Average velocity of runs in the case of males was higher by 0.15 m/s and in the case of females by 0.08 m/s. Higher maximum velocities were achieved in the second test by 0.14 m/s in the case of males, and in the case of

Table 1. Average values (±SD) of age, body height, body mass and BMI of dance sport competitors

Variable	Women (n = 8)	Men (n = 8)
Age [years]	20.25 ± 3.56 (15–24)	21,0 ± 3.9 (14–26)
Body height [cm]	168.25 ± 4.12 (161–174)	179.7 ± 4.5 (174–187)
Body mass [kg]	53.88 ± 4.54 (48–63)	67.9 ± 8.0 (55–84)
BMI	19.04 ± 1.24 (17.2–21)	21.1 ± 2.7 (17.4–26.8)

Table 2. Average values (±SD) of run velocities and of the Performance Index (PI) attained by dance sport competitors

	Women (n = 8)		Men (n = 8)	
	Pre-test	Post-test	Pre-test	Post-test
Mean V [m/s]	5.13 ± 0.13 (4.97–5.32)	5.21 ± 0.21 (4.91–5.58)	5.39 ± 0.24 (5.10–5.82)	5.57 ± 0.34 (5.19–6.30)
Max V [m/s]	5.69 ± 0.26 (5.35–6.05)	5.80 ± 0.28 (5.23–6.15)	6.10 ± 0.29 (5.80–6.76)	6.24 ± 0.50 (5.77–7.41)
PI	0.902 ± 0.020 (0.877–0.928)	0.900 ± 0.020 (0.882–0.940)	0.885 ± 0.018 (0.862–0.920)	0.894 ± 0.023 (0.851–0.936)

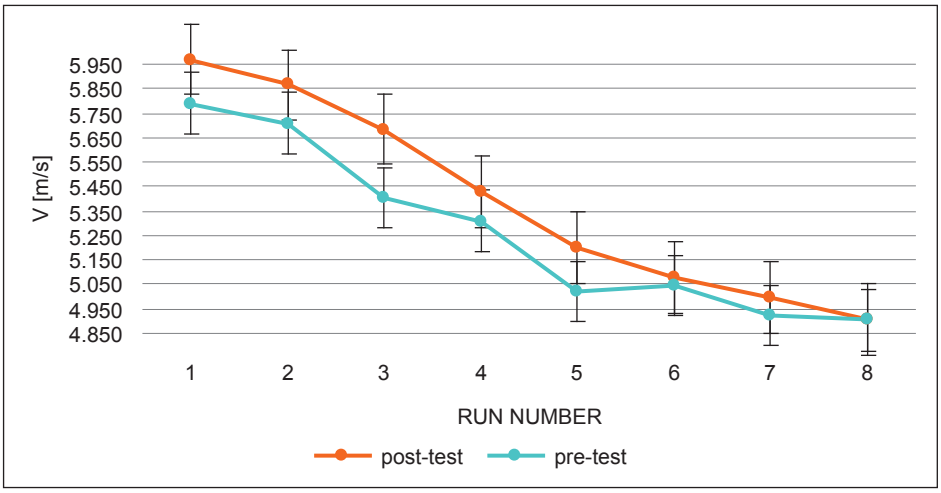

Fig. 1. Average (±SE) velocities in a series of 8 × 50 m runs spaced by 15 s-intermissions achieved by male and female dance sport competitors (n = 16)

females by 0.10 m/s. Females obtained lower maximum velocities (by 0.41 m/s w in the first test, and by 0.44 m/s in the post-test) and average velocities (by 0.26 m/s in the first test, 0.33 m/s in the post-test). The PI index was higher for females by 0.017 in the first test and by 0.01 in the second test. In the case of males, a slight improvement of PI index by 0.005 was noted and for females the PI index was lowered by 0.002. There was a significant difference in velocities between males and females ($F_{1,14} = 6.06$, $p = 0.0275$, $\eta^2 = 0.30$). Velocities were significantly higher in the post-test than in the pre-test ($F_{1,14} = 14.70$, $p = 0.0018$, $\eta^2 = 0.51$) despite the fact that significant reduction of speed in each successive run was observed ($F_{7,98} = 82.19$, $p < 0.001$, $\eta^2 = 0.85$) for all of the participants in the pre-test and post-test.

The difference in pre- and post-test PI was of borderline significance ($F_{1,14} = 4.54$, $p = 0.0512$, $\eta^2 = 0.24$). The competitor who achieved the highest maximum velocity achieved the lowest value of PI index at the same time (Fig. 4). No statistically significant difference was observed between men and women in PI ($F_{1,14} = 0.12$, $p = 0.7356$, $\eta^2 = 0.01$).

At the same time, it can be observed from the second test that 13 competitors achieved average values of PI and average maximum velocities in comparison to only 9 subjects in the first test (Fig. 4 and 5). What is more, in the second test as well as in the first one, the competitor with the maximum velocity is at the same time the competitor with the lowest PI index value. In the second test, only one

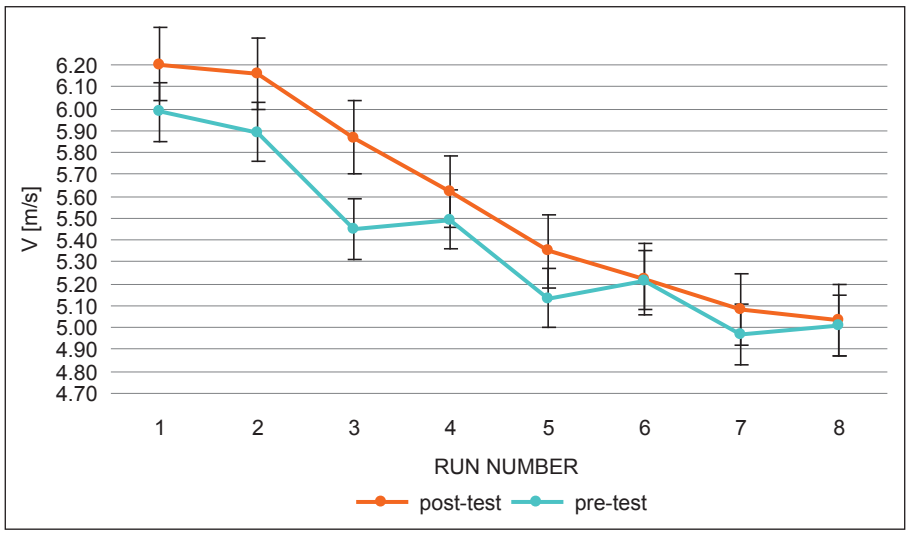

Fig. 2. Average (±SE) velocities in a series of 8 × 50 m runs spaced by 15 s-intermissions achieved by male dance sport competitors (n = 8)

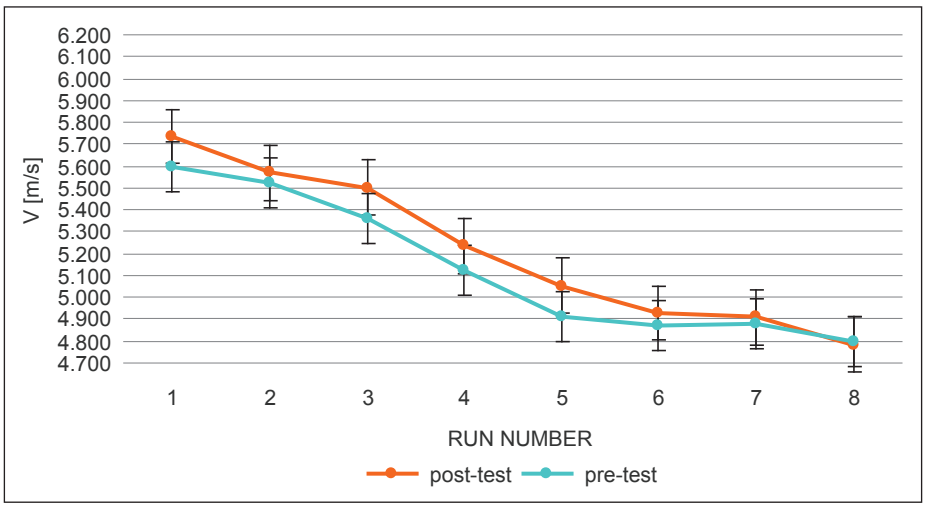

Fig. 3. Average (±SE) velocities in a series of 8 × 50 m runs spaced by 15 s-intermissions achieved by female dance sport competitors (n = 8)

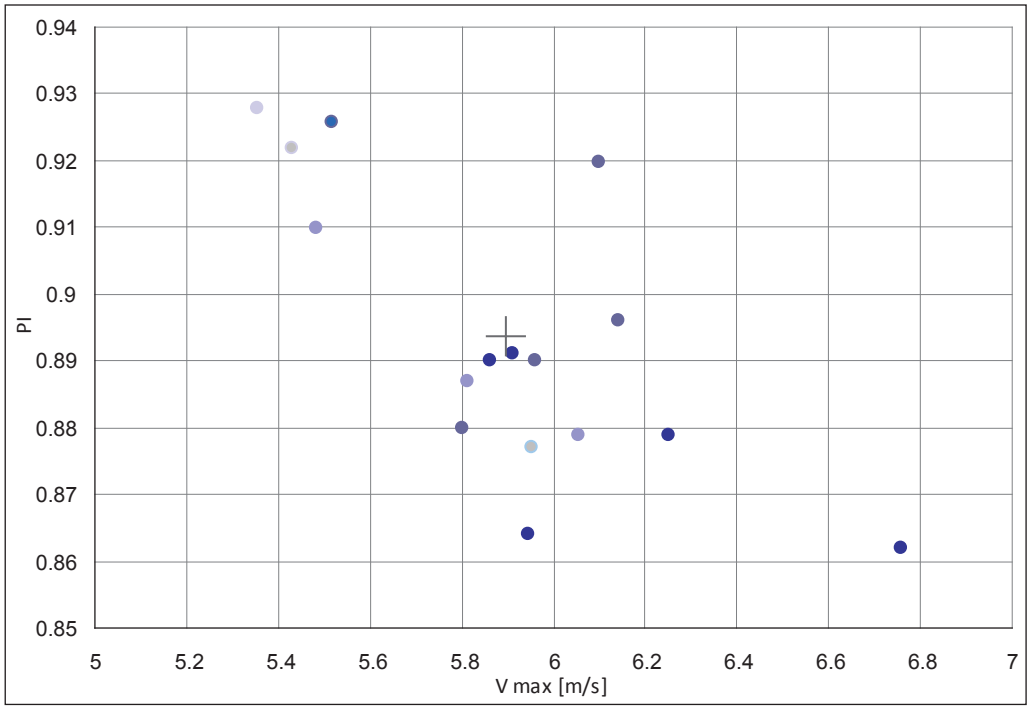

Fig. 4. Relation between PI index and maximum velocity of dance sport competitors – males (n = 8) and females (n = 8) during the pre-test

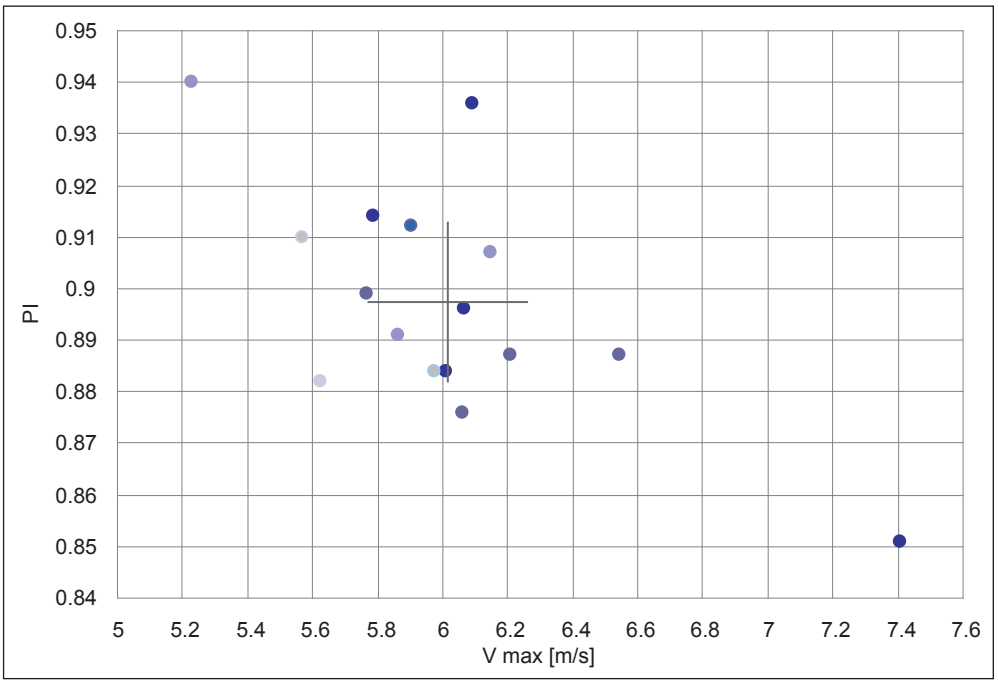

Fig. 5. Relation between PI index and maximum velocity of dance sport competitors – males (n = 8) and females (n = 8) during the post-test

person achieved a remarkably low maximum velocity and high PI index (Fig. 5).

During the pre-test 9 competitors had shorter average maximum R-R intermissions and higher average PI index values, while 7 competitors had lower PI values and longer maximum R-R intermissions. In the post-test more competitors achieved average maximum R-R intermissions and PI index values than in the pre-test. In both tests, the competitor who achieved the longest R-R intermission achieved the lowest PI index.

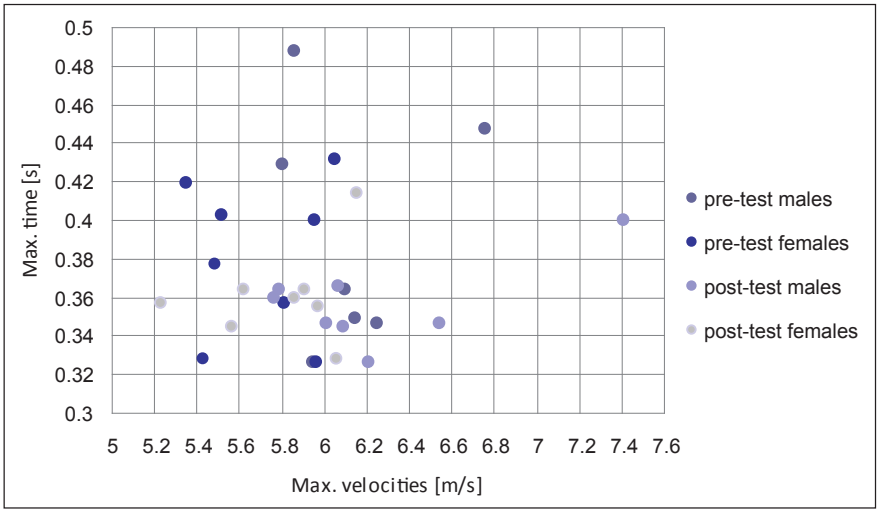

Fig. 6. Maximum velocities and maximum R-R intermissions of the competitors during both tests

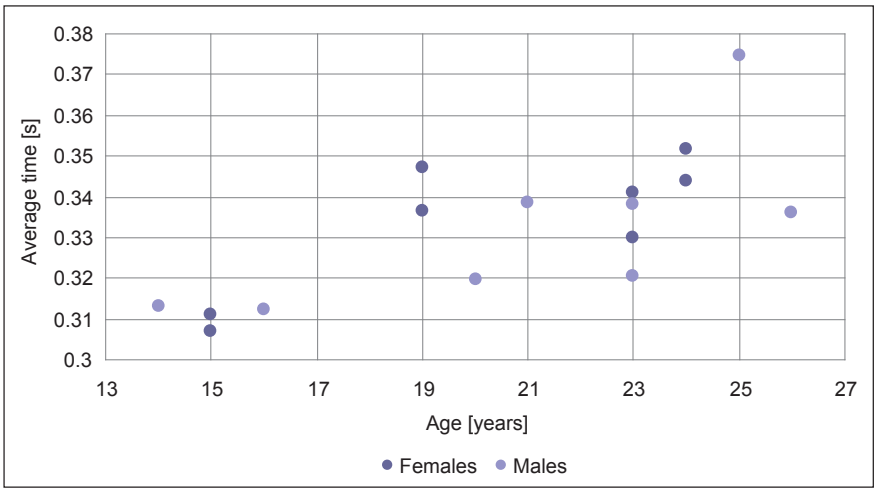

Fig. 7. Relation between average R-R values and age of the competitors (n = 16)

It can be observed that average R-R values were significantly ($p < 0.01$) correlated with age. The correlation rate for all competitors equalled 0.734.

The longest R-R intermissions and the highest velocities during the pre-test were found in the case of 3 competitors. Similar results were obtained in the post-test – also 3 competitors achieved longer average R-R intermissions and maximum velocities (Fig. 6). In the post-test most competitors achieved average results in comparison to the pre-test, in which the difference between the competitors was more significant.

Discussion

On the basis of the conducted research high PI index values and low maximum velocities of four subjects in the first test can be observed. It may prove that the level of their motivation and engagement were lower during the running tests. More attention should be paid to completing a proper warm-up preceding the test. Performing 8 × 50 m runs spaced by 15-second intermissions with maximum intensity is very demanding for contestants. Proper warm up could positively affect the PI index value. Perhaps this could explain why female contestants achieved higher values of PI. Furthermore, poor warm up, or lack of it, may result in short R-R intermissions and low maximum velocity. The competitor who achieved the highest maximum velocity at the same time achieved the lowest value of the PI index. On the other hand, another subject achieved a high PI value and relatively high velocity. The oldest person from the group also achieved the lowest average velocity, but it cannot be proved that the age factor played a crucial role in this particular group.

In dance sport, dancers obtain the highest scores when presenting high quality of movement on the dance floor

in the dance couple, not during one single dance but during the whole dance competition [6]. Endurance in dance plays a crucial role and a well-applied PI index allows one to specify which of the dancers in the training process requires special attention and general training of endurance. PI can also be a great tool to assess the endurance level of the person and, what is more, it can help in the preliminary selection of competitors. So far, in the available literature, the number of works pertaining to studies on endurance in the dance sport is very small. The present study is the first one in which overall endurance of dancers was measured with the application of the performance index.

In comparison to other sport disciplines such as rugby, football or volleyball, in dance, especially in ballroom, it is not running that constitutes the base but coordination of two bodies dancing to the music in close contact. The PI index was applied to examine anaerobic endurance of competitors in team games [4, 5, 10]. In these disciplines, running is used to move on the sports field; thus it is a specialised run for them. Unfortunately, in dance sport it is not like that. Sprint in dance sport is a task and exercise helping to develop overall efficiency and endurance. In this study, by subjecting dancers to runs, the overall endurance was evaluated, but not specific dance effort. A perfect solution would be researching efforts or exercises characteristic for dance sport, from which the PI index could be calculated. With the data obtained from the series of efforts of dancing type, an index of special endurance of sport dancers would be obtained.

However, overall endurance plays a crucial role in the final sport result. A dancer's body is typically exposed to high physiological workload during performing the final round, in which there is an aerobic-anaerobic kind of effort. Couples at a similar technical level are assessed on the basis of their presentation from the beginning to the end [6], and the winner is the one that can demonstrate better endurance. The PI index in this research is an appropriate tool of measurement and systematic assessment of overall endurance of dancers. The data obtained constitute a helpful material supporting trainers' work. Thanks to the running test (8 × 50 m with 15-second intermissions) they are able to evaluate the dancer's overall endurance index, which can help in preparation of individual training plans.

It is necessary to conduct additional research on a larger number of subjects of the same dancing class. The studied group was quite variable: different age, different level of proficiency and experience. The studied subjects did not make any changes in their daily life functioning, so some of them, apart from dance training, also attended the gym, swimming pool, etc. Thus it cannot be clearly stated that the improvement of endurance and maximum velocity is the sole effect of dance training. Subsequent research must be focused on subjecting a special group to a strict training plan.

It can be observed that average R-R values were dependent on age. Older subjects achieved longer R-R intermissions, which can be related to physiological difference of teenagers' and adults' bodies on the one hand, and greater sports experience of older persons on the other.

Taking the first test into consideration, most of the dancers achieved average results in relation to maximum velocities and PI. It was observed that in the case of most of the subjects the anaerobic endurance did not improve significantly. In the first test, most of the subjects had a deficit of PI index, maximum velocity and R-R intermission. The difference may be the result of inadequate engagement of the subjects in the performed test. In the second test, the results show improvement of most of the subjects despite low values being obtained by one subject. It may stem from the fact that running is not a specialised type of movement in dance sport. Proposing typical dance exercises of anaerobic kind of work would engage the subjected dancers to a greater extent. PI is considered to be an extremely useful and important index in team games [3, 12] because it helps to measure the endurance and maximum result at the same time. Dance sport is not a typical team sport because a dancing couple consists of a man and a woman. However, thanks to this indicator, with the full engagement of the subjects, their predispositions to the anaerobic work which is performed by the dancers can be measured.

In previous studies it was demonstrated that a high level of physical endurance is required from dancers [1]. Based on the results of this study, it can be concluded that dancers who achieve the highest velocities and the longest R-R intermissions may be considered to have the best predispositions to this sport. Those who achieve low maximum velocity and short R-R intermissions should be subjected to endurance training.

Conclusions

The classical training cycle of dance sport athletes did not have a significant influence on anaerobic endurance of dance sport athletes. It is advised to prepare an individual training plan for each athlete on the basis of PI test results. This training should combine dancing exercises (including dance finals simulations) as well as interval training (for example running intervals), which increase the anaerobic endurance of dancers.

The performance index is a useful tool to evaluate the training process of dance sport athletes and is an effective method of preselection and evaluation of anaerobic endurance predispositions of dancers. It is advised to create a combination of dance-specific exercises which would be possible to do during the test; it will ensure greater engagement of dancers during tests.

Conflict of interest: Authors state no conflict of interest.

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