EFFECT OF PILATES METHOD ON 6–10-YEAR-OLD DANCESPORT DANCERS' PHYSIOLOGICAL RESPONSES

Gerda Tumonytė, Roma Aleksandravičienė, Kristina Zaičenkovienė
Lithuanian Sports University, Kaunas, Lithuania

ABSTRACT

Background. Dancesport dancers were investigated aiming at improving their physical qualities, posture, balance, flexibility and endurance. Undoubtedly, the Pilates method is one of the best ways for exercising one's core muscles and flexibility. However, there is a lack of data in the academic literature concerning the influence of Pilates exercises on dancers' fitness levels depending on different age groups and ranking. Based on this, the aim of our study was to evaluate the 16-week Pilates exercise effects on 6–10-year-old Dancesport dancers' physiological responses.

Methods. The static deep trunk muscle endurance was tested with pressure measuring device "Stabilizer", flexibility was assessed using "Sit and Reach" test, static balance – "Flamingo" test and dynamic balance – "Star" excursion test. Research participants were Dancesport dancers ($n = 38$) who had been practising Pilates (13 girls and 7 boys) and attending a usual dance program (11 girls and 7 boys).

Results. After 16 weeks, dancers who had been practicing Pilates method significantly improved static and dynamic deep trunk muscle endurance in all positions, static and dynamic balance and flexibility. The dancers that practiced a usual dance program significantly improved static deep muscle endurance only in the prone position, dynamic in the supine position, but their dynamic balance, static balance and flexibility did not change significantly.

Conclusion. Better improvement in 6–10-year-old Dancesport dancers of deep trunk muscle endurance, balance and flexibility was found after 16 weeks of Pilates exercises compared to dancers who practised a usual dance program.

Keywords: Pilates method, Dancesport dancers, deep muscular endurance, balance, flexibility.

INTRODUCTION

There are long lasting debates in modern scientific discourse whether dance should be regarded a sport or an art. Homer considered dance a pleasure, Socrates construed dances as a form of healthy physical exercises, Shamans used to heal applying dances. Aborigines had dance rituals to cause rain; Irokese solved conflicts with the help of dance. Today dance is a unique combination of both: art and sport which cannot be treated equally.

Today sport is not only a pleasure or excitement, sports are means of developing self-identity or "real identity". It can be achieved with the help of yoga, Tai chi, other techniques of relaxation, body fitness and other activities creating happiness through disciplining the body (Grupe, 1994). In this context, dance undoubtedly corresponds to the definition of sport as a part of cultural life.

Dancesport is an aesthetic sport where the body shape of the dancer is related to the choreography and the competition results depend on the beauty of the performance (Liiv, 2014). Dancesport dancers perform synchronous, dynamic movements of different intensity within the couple. Core stabilization, balance, muscle strength, flexibility and endurance are the key factors for a good dance performance (Watson et al., 2017). There are studies which have demonstrated that extended core stabilization training program will improve specific measures of dance performance (Watson et al., 2017). Therefore, strengthening and stretching exercises should be incorporated into dance technique classes in order to achieve the main goal (Ahearn, 2006). Previous studies proved that Pilates was an effective tool for improving posture, body flexibility and increasing muscular strength and balance (Ahearn, 2006; Di Lorenzo, 2011; Zaičenkovienė, 2016).

Endurance of trunk muscles and lumbar core stability are necessary for maintaining spinal stability (Javadian, Akbari, Talebi, Taghipour-Darzi, & Janmohammadi, 2015). That is particularly important in Dancesport as a strong stabilizer of spine muscles which improves body balance and deep muscular endurance. However, there is lack of data in scientific literature about the effects of Pilates exercises on Dancesport dancers' physiological responses, prevention of injuries and sport results (Bernardo & Nagle, 2006).

The number of dancers suffering from low back pain, scoliosis, spondydolosis, etc. is constantly increasing (Fraser, 2017). For that reason, it is important and useful to learn how different correctly performed exercises can affect dancers' physical condition and help to achieve the desired results. Pilates exercises help people to feel the joy of life without pain, to develop harmony of body, mind and spirit (Mętel, Milert, & Szczygieł, 2012).

Numerous published studies have demonstrated the increased balance instability, spinal curvatures, muscle misbalances, and low back injuries in dancers (Koutedakis & Jamurtas, 2004; Kruusamäe et al., 2015; Watson et al., 2017). This study aim was to establish whether Pilates exercises have an impact on static and dynamic balance, flexibility and the change of static and dynamic deep muscle endurance.

METHODS

Participants. The study was conducted in Kaunas, the Dancesport club "Dance 4 Fun". The subjects were 38 dancers randomly assigned to the experimental group (EG) and the control group (CG). The EG included 20 young dancers (13 girls and 7 boys, age: 8.6 ± 1.3 years old, experience of dance training: 2.1 ± 0.7 years) and the CG – 18 dancers (11 girls and 7 boys; age: 8.1 ± 1.5 years old, experience of dance training: 2.2 ± 0.8 years). Duration of the study was 16 weeks. EG subjects had two sessions per week which lasted 30 min. They had supervised Pilates sessions on a mat and 60 min usual dance practice; CG subjects had two sessions per week: 60 min usual dance practice. A week before the study experimental and control groups passed static and dynamic deep trunk muscle endurance tests, static and dynamic balance tests and flexibility test (pre- testing). The same tests were applied after the study (post-testing).

Mathematical statistical analysis. The arithmetic mean (x) and the average standard deviation (*SD*) were determined for comparison. Differences between different groups were estimated using one-factor dispersion analysis (ANOVA). The following reliability levels were used for statistical calculations: $p > .05$ – insignificant; $p < .05$ – significant. All calculations were performed using *MS Excel* program.

Static and dynamic deep trunk muscle endurance tests were performed with the help of a stabilizer which allowed detecting and monitoring trunk muscle endurance. The data were measured in seconds. Static deep trunk muscle endurance test results in prone position were measured when the pressure cell was placed under the abdomen, in supine position the pressure cell was placed under the lumbar spine and inflated to the baseline of 70 mmHg. The subjects were asked to breathe normally, to draw abdominal wall up without moving pelvis and spine, and he pressure had to decrease by 6–10 mmHg. Dynamic deep trunk muscle endurance test results in prone and supine positions were measured the same as static but with lifting the hip of the supporting surface. The pressure had to remain constant.

Flamingo static balance test. The subjects were asked to stand on the wooden beam (50 cm long, 4 cm high, 3 cm wide) on the tested leg and bend the free leg at the knee, and the foot of this leg was held close to the buttocks with both hands on the iliac crests, standing like a Flamingo. The subjects were instructed to maintain this position as long as they could. Stopwatch was used to note each time the person lost balance either by falling off the beam or letting the foot being held go of or hands removed of the body. The number of falls was counted in 1 minute of balancing. The test was terminated if a person reached the ground with the free leg more than 15 times during the first 30 seconds.

The star excursion dynamic balance test was performed in posteromedial, posterolateral and anteromedial directions. Three sticky tapes, each one 150 cm long, were stuck on to the floor intersecting in the middle, and with the lines placed at 45° angles. While performing the test, the subjects were asked to keep their hand on the pelvis, to stand on one leg on the intersection of the lines and to move the indicator along the line with the toes of another leg. The test was performed barefoot. Each subject was allowed 3 trials in each direction and on each leg. A trial was classified as invalid if the participant did not return to the starting position, stepped on the top of the reach indicator for support, failed to keep balance on one leg and the reaching foot failed to remain at the indicator. The best result was recorded.

Sit and reach flexibility test was performed with a 35 cm length, 45 cm width and 32 cm height box. The lid of the box was 55 cm length and 45 cm width, 15 cm outgoing the side plane for subject's foot support. In the middle of the upper plane, there was a measurement scale from 0 to 50 cm. The subjects sat on the floor with the legs stretched out in front of them with the knees straight and the feet flat against the front end of the test box. Then they lent forward at the hips, keeping their knees straight and slid their hands up the ruler. The test was repeated twice and the best result was recorded.

RESULTS

Static deep trunk muscle endurance results in a prone position. Comparing pre-post test results of the experimental group, the difference was statistically significant ($p < .001$). Pre-test result of static deep trunk muscle endurance in a prone position was 0.44 ± 0.71 s, whereas post-test result of static deep trunk muscle endurance increased to 15.48 ± 0.63 s. The change of indicators of the control group was found to be statistically significant ($p = .002$). Pre-test result was 9.83 ± 0.77 s, post-test result reached 12.74 ± 0.53 s. Significant changes were found comparing static deep trunk muscle endurance result in a prone position of both groups: EG and CG (Figure 1).

Static deep trunk muscle endurance results in a supine position. Comparing pre-post test results of the experimental group, the difference was statistically significant ($p = .0012$). Pre-test result of static deep trunk muscle endurance in a supine position was 16.81 ± 1.37 s, while post-test result of static deep trunk muscle endurance increased to 23.25 ± 1.44 s, the difference was statistically significant ($p = .0012$).

The change of indicators of the control group was found to be statistically insignificant ($p = .36$). Pre-test result was 16.86 ± 1.32 s, post-test result reached 17.56 ± 4.25 s. Comparing the results of static deep trunk muscle endurance in a supine position of both groups (CG and EG), it appeared that the results of EG were statistically significant higher than those of CG (Figure 2).

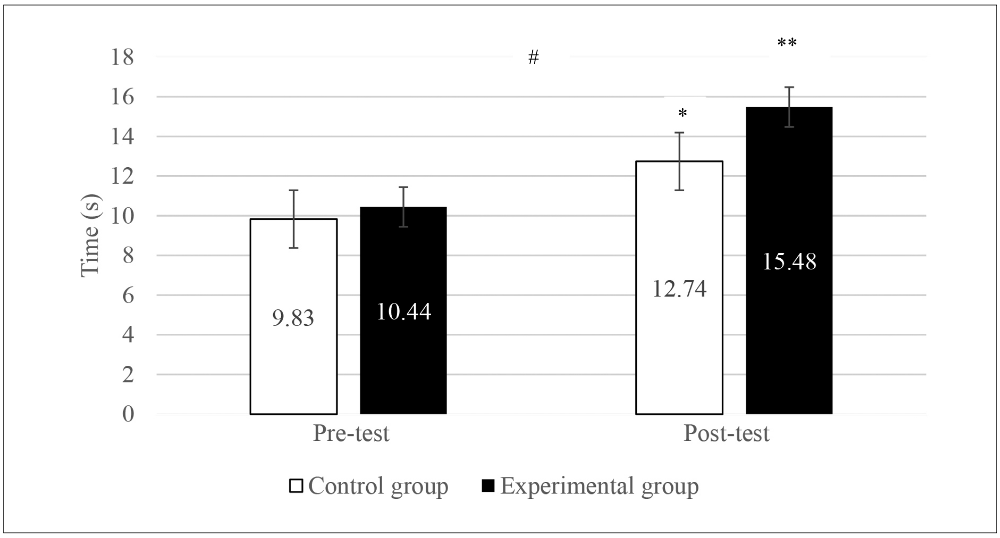
Dynamic deep trunk muscle endurance results in a prone position. The results of the experimental group in a prone position changed statistically significant ($p < .001$). Pre-test result of the experimental group was 8.79 ± 1.20 s, post-test result increased to 13.17 ± 1.46 s Pre-test result of the control group was 8.68 ± 0.87 s, post – 9.83 ± 0.77 s and did not change significantly ($p = .146$). Comparing the results of dynamic deep trunk muscle endurance in a prone position of both groups (CG and EG), it appeared that the results of EG were statistically significantly higher than those of CG (Figure 3).

Dynamic deep trunk muscle endurance results in a supine position. Pre-test result of the experimental group was 9.38 ± 0.50 s, post-test result increased to 14.61 ± 0.68 s. The change of experimental group in a supine position was statistically significant ($p < .001$). Pre-test result of the control group was 8.81 ± 0.65 s, post-test result increased to 10.04 ± 0.70 s The change of the control group in a supine position was statistically significant ($p = .01$). Significant changes were found comparing dynamic deep trunk muscle endurance results in supine position of both groups: EG and CG (Figure 4).

Static balance results (Flamingo test). Comparing pre-post test results of the experimental group, the difference was statistically significant ($p < .001$). Before the study, the average number of falls in EG reached 18.55 ± 2.52 times per min., whereas after the study, the average number of falls decreased to 13.05 ± 2.18 times per min. The change of indicators of the control group was found to be statistically insignificant ($p = .131$). Before the study, the average number of falls of CG reached 15.35 ± 1.87 times per min., after the study, the average number of falls decreased to 14.94 ± 1.65 times per min. No significant changes were found comparing the results of static balance of both groups (CG and EG), it appeared that more statistically significant results were in EG than in CG (Figure 5).

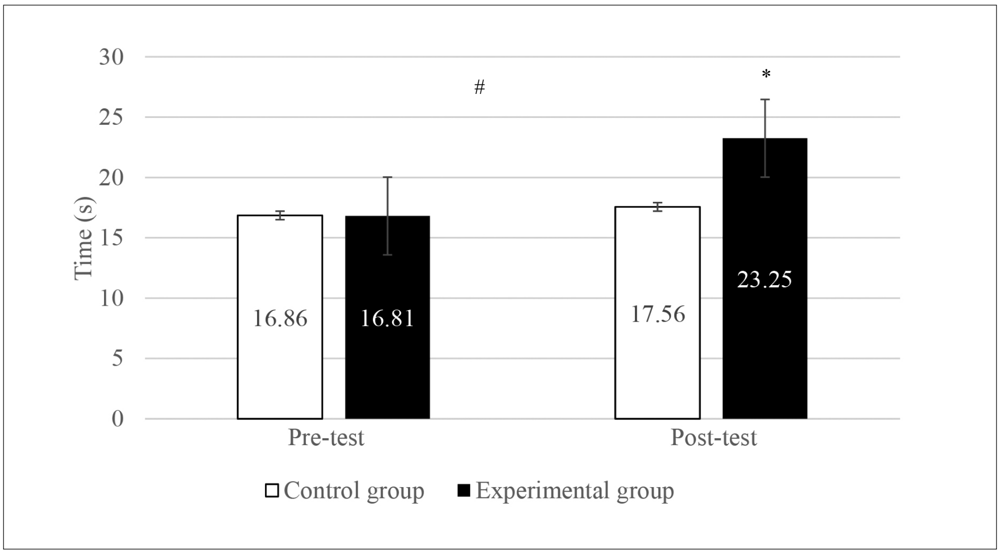
Dynamic balance results (the star excursion balance test). Left anterior reach results. Comparing pre-post test results of the experimental group, the difference were statistically significant

Figure 1. **Static deep trunk muscle test results of experimental and control groups in a prone position**



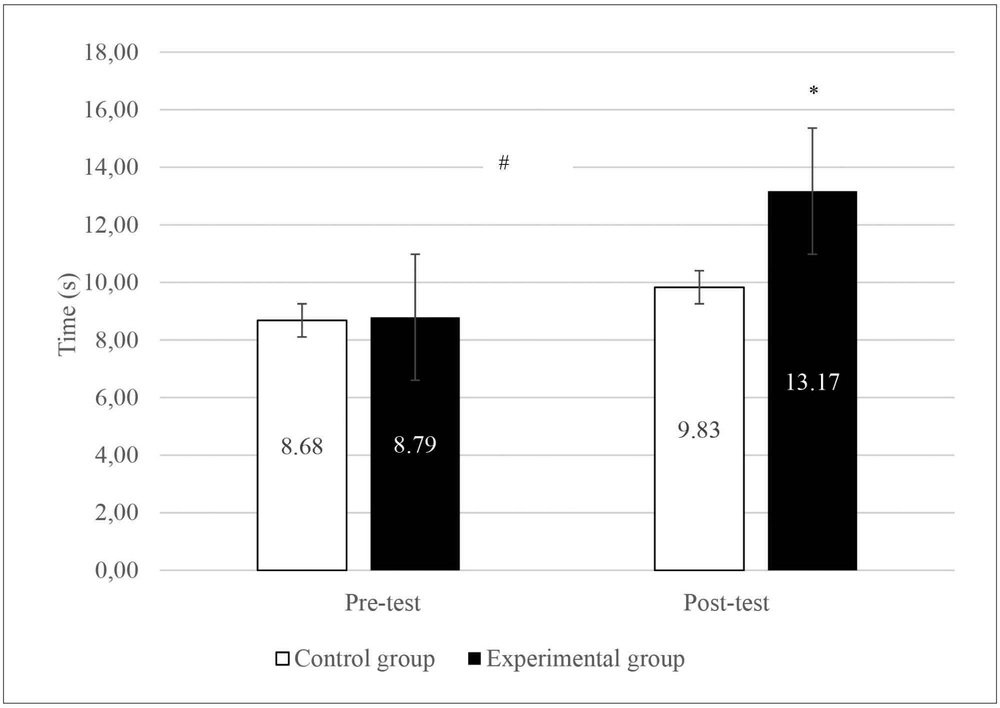
Notes. *$p < .05$ comparing pre-post test results of CG; **$p < .05$ comparing pre-post test results of EG; #$p < .05$ comparing post test results of both groups.

Figure 2. **Static deep trunk muscle test results of experimental and control groups in a supine position**



Notes.*$p < .05$ comparing pre-post test results of EG; #$p < .05$ comparing post test results of both groups.

Figure 3. **Dynamic deep trunk muscle test results in a prone position of experimental and control groups**



Notes. *$p < .05$ comparing pre-post test results of EG; #$p < .05$ comparing post test results of both groups.

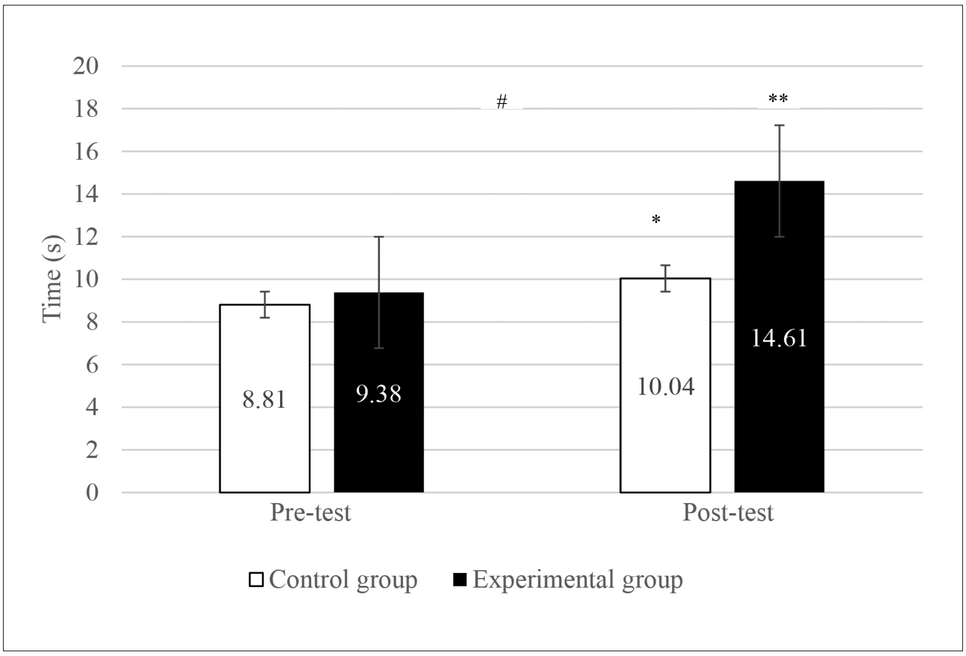


Figure 4. **Dynamic deep trunk muscle test results of experimental and control groups in a supine position**

Notes. *$p < .05$ comparing pre-post test results of CG; **$p < .05$ comparing pre-post test results of EG; #$p < .05$ comparing post test results of both groups.

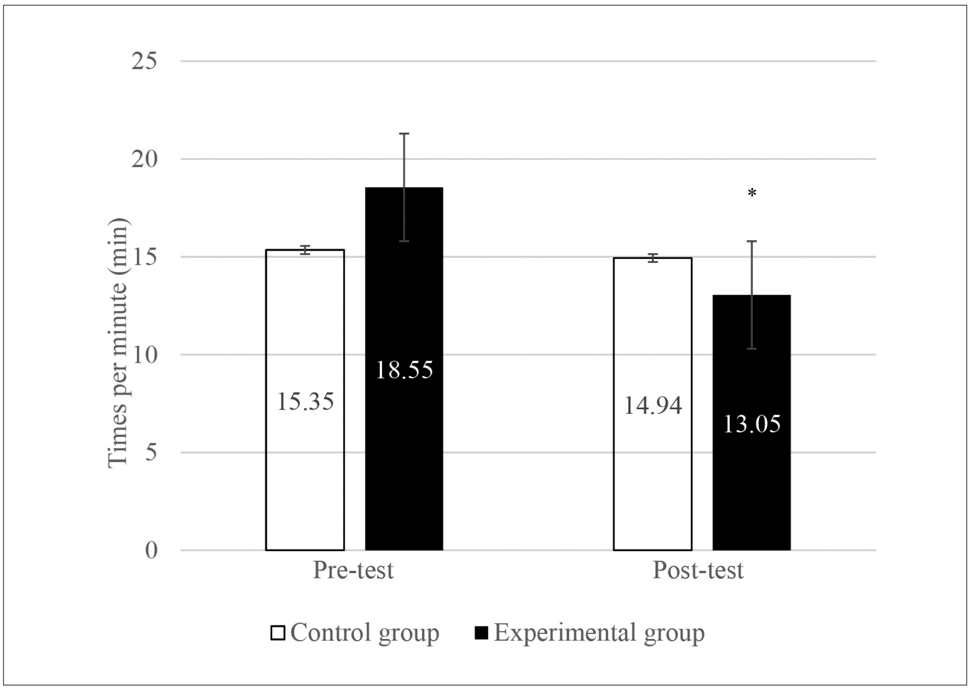


Figure 5. **Static balance (Flamingo test) results of experimental and control groups**

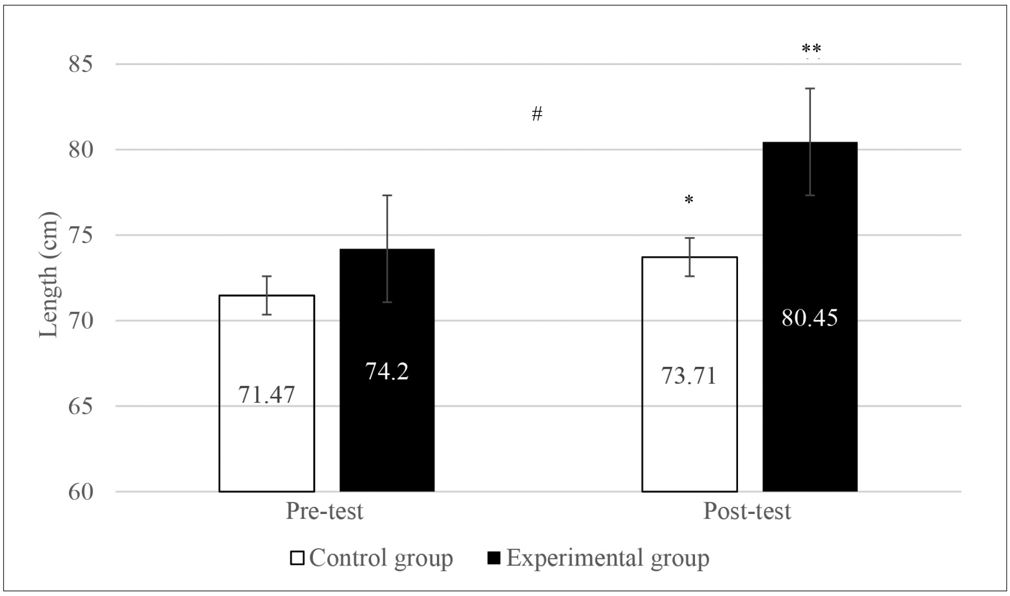
Note. *$p < .05$ comparing pre-post test results of EG.

($p < .001$). Pre-test result of EG reached 74.20 ± 2.67 cm, whereas post-test result increased to 80.45 ± 2.46 cm. Comparing pre-post test results of the control group, the difference was statistically significant ($p < .001$). Pre-test result of CG reached 71.47 ± 2.33 cm, whereas post-test result increased to 73.71 ± 2.33 cm. Significant changes were found comparing dynamic balance (left anterior reach) results of both groups, EG and CG (Figure 6).

Right anterior reach results. Comparing pre-post test results of the experimental group, the difference appeared to be statistically significant ($p < .001$). Pre-test result of EG reached 75.60 ± 2.53 cm, whereas post-test result increased to 81.90 ± 2.61 cm. Comparing pre-post test results of the control group, the difference was statistically significant ($p < .001$). Pre-test result of CG reached 75.11 ± 2.65 cm, whereas post-test result increased to 77.17 ± 2.65 cm. There was no significant change comparing dynamic balance (right anterior reach) results of both groups: EG and CG (Figure 7).

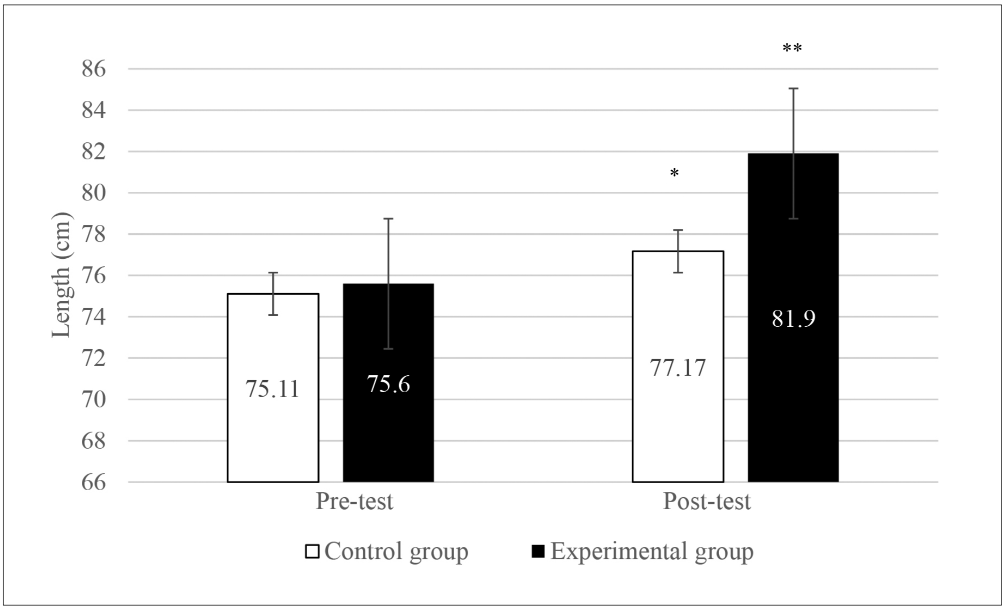
Right posterolateral and right posteromedial reach results. Pre-test right posterolateral reach result of EG reached 80.40 ± 2.95 cm, post-test

Figure 6. **Dynamic balance left anterior reach results of experimental and control groups**



Notes. *$p < .05$ comparing pre-post test results of CG; **$p < .05$ comparing pre-ost test results of EG; #$p < .05$ comparing post test results of both groups.

Figure 7. **Dynamic balance right anterior reach results of experimental and control groups**



Notes. *$p < .05$ comparing pre-post test results of CG; **$p < .05$ comparing pre-post test results of EG.

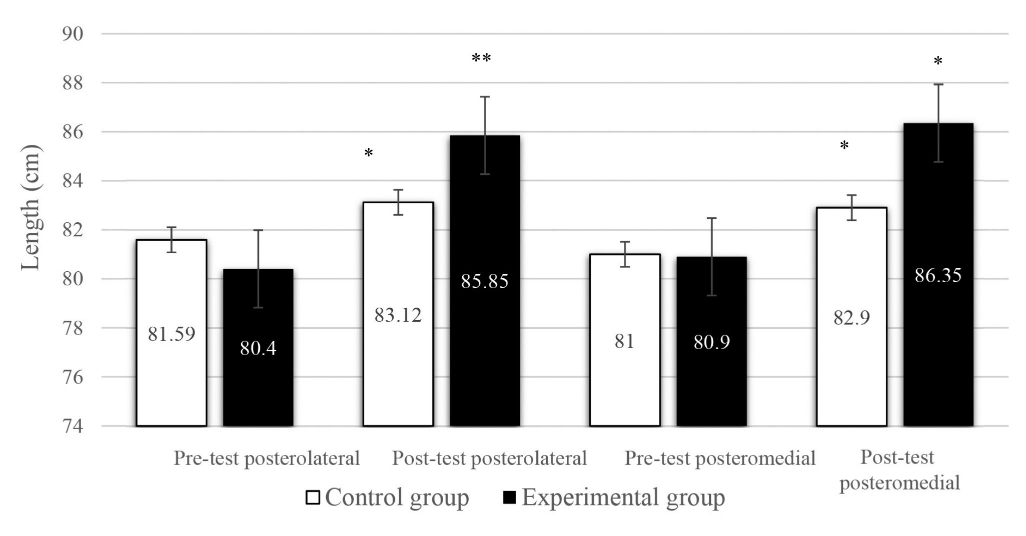
result increased to 85.85 ± 3.05 cm. Pre-test right posteromedial reach result of EG reached 80.90 ± 2.70 cm, post-test result increased to 86.35 ± 2.74 cm. The change of indicators of the experimental group was found to be statistically significant ($p < .001$). Pre-test right posterolateral reach result of CG reached 81.59 ± 3.03 cm, post-test result increased to 83.12 ± 2.95 cm.

Pre-test right posteromedial reach result of CG reached 81.00 ± 2.64 cm, post-test result increased to 82.94 ± 2.79 cm. The change of indicators of the control group was found to be statistically significant ($p < .001$). There was no significant change comparing dynamic balance (right posterolateral and right posteromedial reach) results of both groups: EG and CG (Figure 8).

Left posteromedial and left posterolateral reach results. Pre-test left posteromedial reach result of EG reached 77.85 ± 2.23 cm, post-test result increased to 83.50 ± 2.33 cm. Pre-test left posterolateral reach result of EG reached 79.65 ± 2.70 cm, post-test result increased to 85.35 ± 2.87 cm. The change of indicators of the experimental group was found to be statistically significant ($p < .001$). Pre-test left posteromedial reach result of CG reached 78.25 ± 2.34 cm, post-test result increased to 79.65 ± 2.26 cm.

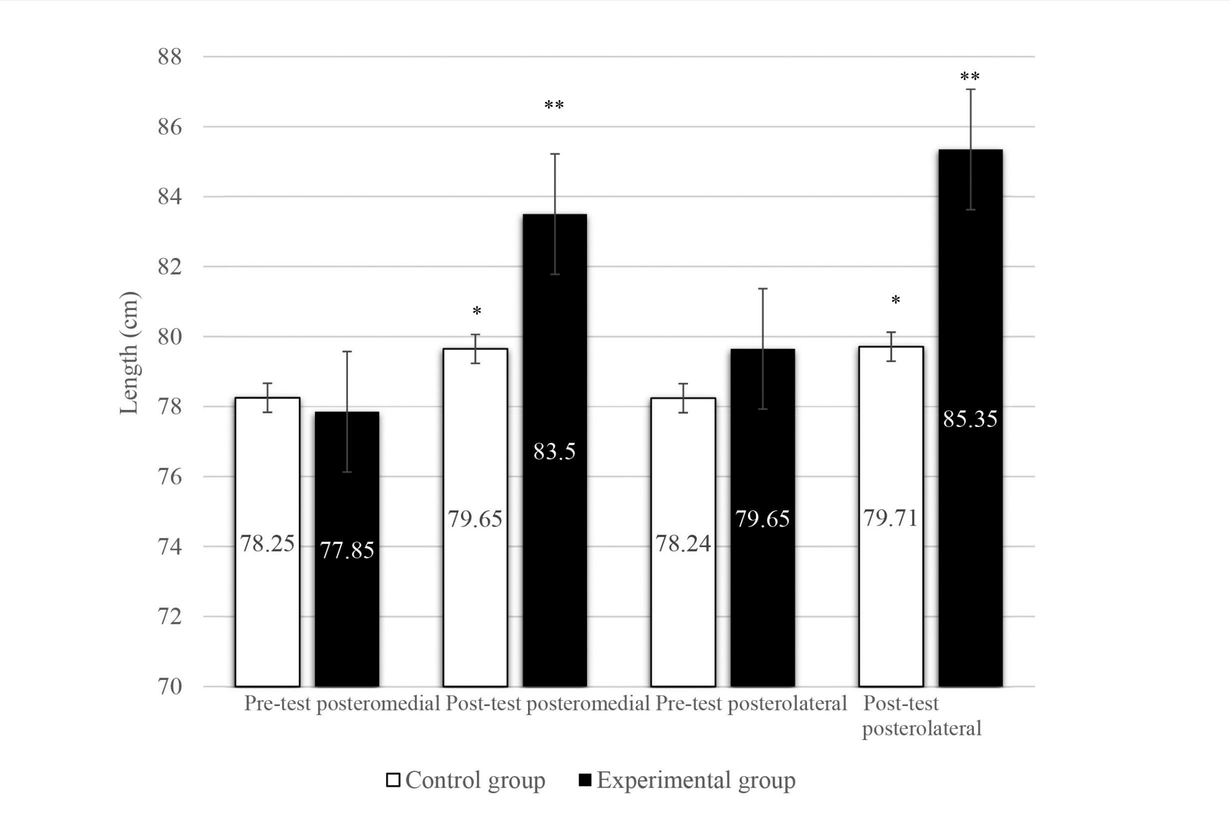
Pre-test left posterolateral reach result of CG reached 78.24 ± 2.50 cm, post-test result increased to 79.71 ± 2.55 cm. The change of indicators of the control group was found to be statistically significant ($p < .001$). There was no significant change comparing dynamic balance (left posterolateral and left posteromedial reach) results of both groups: EG and CG (Figure 9).

Figure 8. **Dynamic balance right posterolateral and right posteromedial reach results of experimental and control groups**



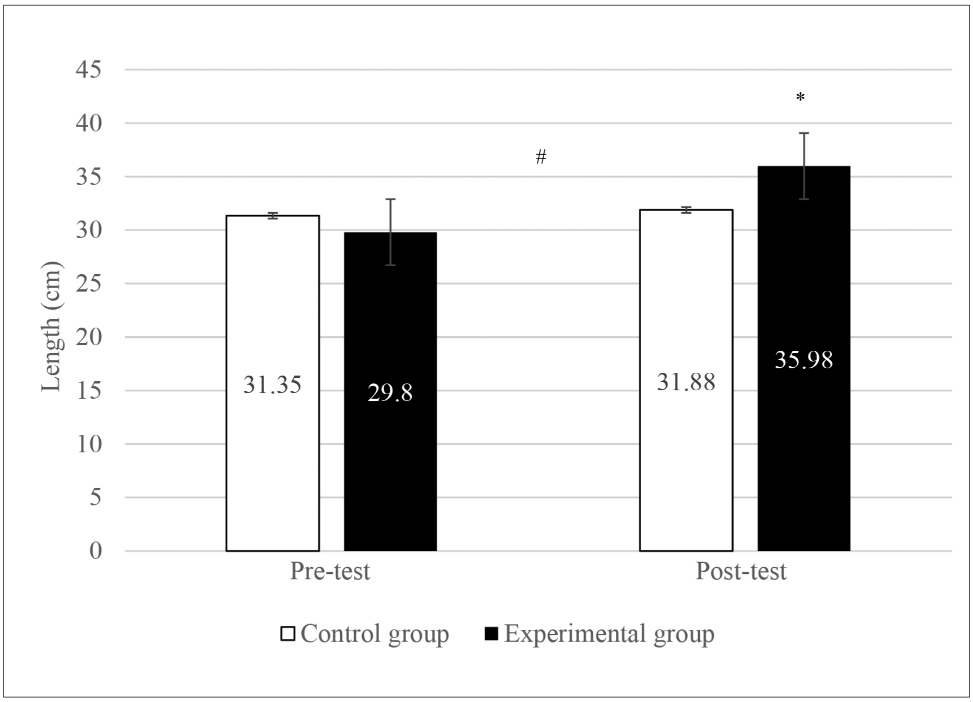
Notes. *$p < .05$ comparing pre-post test results of CG; **$p < .05$ comparing pre-post test results of EG.

Figure 9. **Dynamic balance left posterolateral and left posteromedial reach results of experimental and control groups**



Notes. *$p < .05$ comparing pre-post test results of CG; **$p < .05$ comparing pre-post test results of EG.

Figure 10. **Flexibility test results of experimental and control groups**



Notes. *p < .05 comparing pre-post test results of EG; #p < .05 comparing post test results of both groups.

Flexibility results. Comparing pre-post test results of the experimental group, the difference was found to be statistically significant (p < .001). Pre-test flexibility result of the experimental group was 29.8 ± 1.13 cm, while post-test results of EG increased to 35.9 ± 0.96 cm. The change of indicators of the control group was found to be statistically insignificant (p = .142). Pre-test flexibility result of the control group was 31.35 ± 1.10 cm, post-test results of CG increased insignificantly to 31.88 ± 1.18 cm. Comparing the results of flexibility of both groups (CG and EG), it appeared that more results of EG were statistically significant higher than those of CG (Figure 10).

DISCUSSION

The main aim of this study was to investigate the effect of Pilates exercises on 6–10-year-old Dancesport dancers' physiological responses. The results showed that after 16 weeks of the study 6–10-year-old Dancesport dancers who had been practicing Pilates method (EG), significantly improved static and dynamic deep trunk muscle endurance in a prone and a supine position. The dancers that used to practice usual dance program (CG), significantly improved static deep muscle endurance in a prone position, but there was no significant change in a supine position. Dynamic deep trunk muscle endurance in a prone position did not change significantly in the group that used to practice usual dance program (CG), but in supine position, it showed significant improvements. Sekendiz, Altun, Korkusuz and Akin (2007) used Pilates method intervention and increased abdominal and lower back strength, abdominal muscular endurance, and posterior trunk flexibility in his subjects. Another investigation established that Pilates improved body composition, flexibility (low back, hamstrings, and upper body), and muscular endurance (abdominal and lower back) (Rodgers & Gibson, 2009).

Moreover, after 16 weeks of the study, the static and dynamic balance of 6–10-year-old Dancesport dancers changed significantly, however, the group, that used to practice usual dance program, improved dynamic balance only. Besides, after 16 weeks of the study, the flexibility of 6–10 year old Dancesport dancers improved significantly, but the group, that used to practice usual dance program, did not changed flexibility significantly. A study showed that muscular strength was significantly higher after Pilates training, besides subjets had significantly greater flexibility increases in some dance technical skills (Amorim, Sousa, Rodrigues dos Santos, 2011). The effect of regular Pilates exercises on flexibility was proved by Segal, Hein and Basford (2004). We can recommend Pilates exercises for young Dancesport dancers as means for physiological characteristics improvement.

REFERENCES

Ahearn, L. E. (2006). The Pilates method and ballet technique. Applications in the Dance Studio. *Journal of Dance Education, 6*(3), 92–99. Retrieved from https://flamencodance. wikispaces.com/file/view/Pilates+method+and+ballet+technique+applications+in+the+dance+studio.pdf

Amorim, P. T., Sousa, F. M., & Rodrigues dos Santos, J. A. (2011). Influence of Pilates training on muscular strength and flexibility in dancers. *Motriz. Revista de Educação Física 17*(4), 660–666. doi: 10.1590/S1980-65742011000400010

Bernardo, L. M, & Nagle, F. E. (2006). Does Pilates training benefit dancers? An appraisal of Pilates research literature. *Journal of Dance Medicine, 10*(1), 46–50. Retrieved from https://www.researchgate. net/publication/233622917_Does_Pilates_Training_Benefit_Dancers_An_Appraisal_of_Pilates_Research_Literature

Di Lorenzo, C. E. (2011). Pilates: What is it? Should it be used in rehabilitation? *Sports Health, 3*(4), 352–361. doi: 10.1177/1941738111410285

Fraser, L. J. (2017). Spine conditions in the young dancer. In R. Solomon, J. Solomon, L. J. Micheli (Ed.). *Prevention of Injuries in the Young Dancer* (pp. 95–113). Springer, Cham.

Grupe, O. (1994). Sport and culture – the culture of sport. *Journal of Japan Society of Sports Industry, 4*(1), 39-53. https://doi.org/10.5997/sposun.4.55

Javadian, Y., Akbari, M., Talebi, G., Taghipour-Darzi, M., & Janmohammadi, N. (2015). Influence of core stability exercise on lumbar vertebral instability in patients presented with chronic low back pain: A randomized clinical trial. *Caspian Journal of Internal Medicine, 6*(2), 98–102. Retrieved from www.ncbi.nlm.nih.gov/pmc/articles/PMC4478459/pdf/cjim-6-098.pdf

Koutedakis, Y., & Jamurtas, A., (2004). The Dancer as a performing athlete. *Physiological Considerations. Sports Medicine, 24*(10), 651–661. Retrieved from https://www.researchgate.net/publication/8377670_The_dancer_as_a_performing_athlete_Physiological_considerations

Kruusamäe, H., Maasalu, K., Wyon, M., Jürimäe, T., Mäestu, J., Mooses, M., & Jürimäe, J., (2015). Spinal posture in different Dancesport dance styles compared with track and field athletes. *Medicina, 51*(5), 307–311. Retrieved from https://www.sciencedirect.com/ science/article/pii/S1010660X15000841

Liiv, H. (2014). *Anthropometry, body composition anaerobic capacity in elite Dancesport*

athletes compared with ballet and contemporary dancers (Doctoral dissertation). Tartu: University of Tartu

Mętel, S., Milert, A., & Szczygieł, E. (2012). Pilates based exercise in muscle misbalances prevention and treatment of sports injuries. In K. R. Zaslav (Ed.) *An international perspective on topics in sports medicine and sports injury* (pp. 381–402). doi: 10.5772/1503

Rodgers, K., & Gibson, A. L. (2009). Eight-week traditional mat pilates training-program effects on adult fitness characteristics. *Research Quarterly for Exercise and Sport, 80*(3) 569–574. doi: 10.1080/02701367.2009.10599595

Segal, N. A., Hein, J., & Baford, J. R. (2004). The effects of Pilates training on flexibility and body composition: An observational study. *Archives of Physical Medicine and Rehabilitation, 85*(12), 1977–1981. doi: https://doi.org/10.1016/j.apmr.2004.01.036

Sekendiz, B., Altun ,O., Korkusuz, F., & Akın, S. (2007). Effects of Pilates exercise on trunk strength, endurance and flexibility in sedentary adult females. *Journal of Bodywork and Movement Therapies, 11*(4), 318–326. doi: https://doi.org/10.1016/j.jbmt.2006.12.002

Watson, T., Graning, J., McPherson, S., Carter, E., Edwards, J., Melcher, I., & Burgess, T. (2017). Dance, balance and core muscle performance measures are improved following 9- week core stabilization training program among competitive collegiate dancers. *The International Journal of Sports Physical Therapy, 12*(1), 25.

Zaičenkovienė, K. (2016). *Pilateso Mankšta*: Vadovelis. Kaunas: Lietuvos sporto universitetas.

Received on May 21, 2018
Accepted on June 11, 2018

Corresponding author **Kristina Zaičenkovienė**
Lithuanian Sports University
Sporto str. 6, Kaunas LT-44221
Lithuania
Tel. +37061620238
Email kristina.zaicenkoviene@lsu.lt