Journal of Physical Activity and Health, **(Ahead of Print)**
https://doi.org/10.1123/jpah.2020-0816

Human Kinetics
ORIGINAL RESEARCH

Traditional Lègong Dance Training Is Superior to Moderate Aerobic Training on Physical Fitness Improvement Among Young Girls

I Putu Adiartha Griadhi, I Putu Gede Adiatmika, and I Ketut Tirtayasa

Background: Légong dance is a famous Balinese dance with a dynamic movement. It potentially becomes an exercise of choice to improve young girls' physical fitness. This study aimed to evaluate légong dance training's effect on physical fitness compared with aerobic training. **Methods**: Forty young girls were randomly assigned to the aerobic training (AG) and lègong dance (DG) group and trained with jogging and lègong dancing at moderate-intensity aerobic training. Each was carried out for 30 minutes, 3 times a week, for 6 weeks. **Result**: Aerobic capacity (estimated maximal oxygen consumption) improved significantly in AG and DG, with a mean difference and Cohen *d* effect size of 0.36 mL/kg/min and 0.68. The back- and leg-muscle strength increased significantly in DG and AG, with a mean difference of 5.55 kg and 6.67 kg, and an effect size of 0.69 and 0.77. Balance improved significantly in DG and AG, with a mean difference of 21.26 seconds and an effect size of 1.05. All significant values are reported at $P < .05$. There were no significant improvements in arm muscle strength, body fat percentage, and flexibility in either group ($P > .05$). **Conclusion**: Lègong dance training results in significant physical fitness improvement and better results than aerobic training.

Keywords: cultural dance training, cardiorespiratory fitness, muscular strength, muscular endurance, static balance

Physical activity (PA) recommendations have been given widely, but failed to promote physical fitness effectively.[1] Sports participation of women and girls diminished through ages from 10 to 19 years old, reaching a low point of 4% for ages 15–19 years.[2] This evidence suggested that girls at that age are more prone to low physical fitness and need a specific PA program. Girls 13 years old or older are in recreational years. An enjoyable PA that is challenging and adaptable to their circumstances must be available.[1,3] The PA programs should be easy to do and have no conflict with the existing culture.[4] Furthermore, women and girls also tend to participate in women-only PA, and they tend to drop out from sports where males also participate.[5] Therefore, efforts to develop a cultural-based PA specific for women and girls and are essential.

Bali has a very high quality of culture, including dance. The most popular dance for Balinese girls is the lègong dance. This dance is known as one of the most dynamic Balinese dances, with the upper limb, lower limb, and trunk movement. The lègong dance is performed with a repetitive semisquat movement, trunk hyperextension, arm abduction and adduction, and footsteps throughout the dance. It also has a fine motoric movement of the finger and eye, and many types of facial expressions.[6] Balinese young girls generally dance in groups, both at school and in traditional dance studios.

Research on many cultural dance types has shown that dancing programs could positively benefit emotions, social interactions, sensory stimulation, and motor coordination.[7] Other research elicits that teenagers who participate in dance training have better bone density and body fat percentage.[8,9] Dancing exercises done in groups will also motivate the expected change in sports behavior.[10,11] Meta-analysis has been conducted to evaluate the effect of dance on the VO_2peak of the elderly compared with nonexercise controls or practitioners of other types of exercise. This study elicits that any dancing training (such as traditional folk, ballroom, and aerobic dancing) could improve VO_2peak compared with nonexercising controls. This research also found that dance training was comparable with other exercise types in improving VO_2peak.[12] The potential mechanism for this improvement was cardiac hypertrophy, increased mitochondria density in skeletal muscle, muscle plasticity, and angiogenesis because, all dance interventions have similar kinesiological patterns and were classified into moderate aerobic training.[12,13] Research on the modern Balinese *Baris* dance, a male dance exercise reveals that this type of dance training could improve the serum lipid profile.[14]

Providing girls with a girls-specific PA that has developed from a well-known culture was a challenging task. Légong dance, as a Balinese cultural dance, might have the potential to be developed as a specific PA for girls. A lack of scientific evidence supporting the benefits of légong dance in physical fitness encourages us to conduct this experimental study. This study aimed to evaluate légong dance training's effect on physical fitness compared with aerobic training. Previous scientific research on the benefits of dance training on physical fitness leads us to hypothesize that légong dance could improve physical fitness components, such as aerobic capacity, body fat percentage, flexibility, balance, and muscle strength among young girls, and be comparable with aerobic training.

Methods

Study Design and Research Sample

This research was an experimental study with a randomized pretest and posttest with a control group design. Using a power value of 0.80, a difference value of 20, and an SD value of 10 obtained from a pilot study, the minimal sample size would be 18 for each group. Two additional samples were added into each group, so we then obtained 20 participants for each group. The study's participants came from the same junior high school, selected with a simple

Griadhi and Tirtayasa are with the Physiology Department, Medical School, Udayana University, Denpasar, Indonesia. Adiatmika is with the Ergonomic Post Graduate Program, Udayana University, Denpasar, Indonesia. Griadhi (adiarthagriadhi@gmail.com) is corresponding author.

random sampling method. The inclusion criteria included having a normal body mass index, having the skill to dance, and accepting the informed consent. We expected the subject to have a normal body mass index to prevent injury during the training program. The art and dance teacher confirmed the skill of the participant in traditional dancing. The exclusion criteria included the presence of a history of musculoskeletal injury, being an athlete, or being a professional dancer. The drop-out criteria included musculoskeletal injury during the program and the subject's failure to attend 3 consecutive times.

The participants were randomly assigned to the dance group (DG) and aerobic group (AG). The DG participants were trained by doing lègong dance for 30 minutes, as the complete duration of this dance was 30 minutes. The AG participants were trained by jogging at their normal pace for 30 minutes. These training programs were conducted 3 times a week for 6 weeks, as research shows that 4 weeks would be the minimum period of training that would give results.[15] The participants' training heart rate was recorded in each session with palpation on the radial artery. We found that both training pieces could be classified into moderate-intensity aerobic exercise (60%–80% of the maximal heart rate [MHR]). The intensity of training depends on the dance music's tempo, but it never falls below 60% of the MHR. The tempo leads lègong dance training like interval training, with a minimal intensity of 60% MHR and a maximal of 80% MHR. This intensity was comparable to aerobic training in this research. Both types of training reached steady-state conditions within 3 minutes.[16]

The measurement of physical fitness components before and after the training program was conducted 1 day before and after the training program. This research study has already passed the Medical School of Udayana University/Sanglah Hospital's ethical clearance, with statement letter no. 923/UN 14.2.2/VII.14/LP/2019.

Instruments

Aerobic fitness was measured with a continuous submaximal test known as multistage fitness testing, bleep test, or the 20 m shuttle run.[17] We used the Leger mathematical formula to predict the maximal oxygen consumption (VO_2max), expressed in milliliters per kilogram per minute.[18] This test was considered a reliable test, and the validity of the VO_2max prediction was just on the border of acceptability since the research participant was considered a low performer.[17] The strength of the back and leg muscle groups was measured using the Takei® back and leg dynamometer. The unit of muscle strength measurement was in kilograms. Flexibility was measured with the Takei® sit and reach measurement set, and the unit measurement was centimeters. Body fat percentage was measured with the Omron® bioimpedance analyzer and was expressed in percentage.

Statistical Analysis

The statistical analysis for this research was descriptive and analytic statistics. The descriptive statistic calculated the mean difference and the SD for each variable measured. An analysis of covariance test was conducted to determine a statistically significant difference between DG and AG on the improvement of physical fitness components (aerobic capacity; body fat; flexibility; balance; and arm, back, and leg muscle strength). The factors used within this model were the initial level of the physical fitness components. The Cohen *d* effect sizes were calculated based on the adjusted mean, with an alpha level of .05. This effect size was considered small if the value was below 0.2, medium if it fell between 0.2 and 0.8, and large if the value was above 0.8.

Results

Participant Characteristic

The participants in both groups were found to be similar in age, height, and body weight. The calculated body mass index percentiles (body mass index percentiles) were not significantly different in both groups (Table 1). The adherence to this program was as high as 95%. Only one participant was a dropout from each group, for a reason that was not related to the program; the rest completed the program in 6 weeks.

Analytic Statistic

The data in this study were normally distributed, and there were no outliers. The dependent variables and covariates on the scatter plot show a linear relationship in each group, and there is a homogeneity of the regression slope. Based on these results, the assumptions of covariance statistical test were met in this study.

This research shows that the aerobic capacity, back muscle strength, leg muscle strength, and balance significantly improved in the AG and DG participants. There was no significant improvement in arm muscle strength, body fat, and flexibility (Table 2). There was a higher aerobic capacity improvement in AG than DG, with a mean difference (MD) of 0.36 mL/kg/min. The Cohen *d* effect size for aerobic capacity improvement was medium, with a value of 0.68, and the η^2 value was .17 ($P = .012$). The improvement in back and leg muscle strengths was found to be better in DG than AG. The MD for back muscle was 5.55 kg, with a medium Cohen *d* effect size of 0.69; the MD for leg muscle was 6.67 kg, with a medium Cohen *d* effect size of 0.77. The η^2 value for back and leg muscle was .17 ($P = .013$) and .19 ($P = .009$), respectively. The balance improvement was found to be higher in DG than AG. The MD was 21.26 seconds, with a large Cohen *d* effect size of 1.05, and the value of η^2 was .20 ($P = .005$).

This research found that the initial fitness level as a covariate affected the fitness level after training significantly in both training groups. The initial aerobic capacity has an η^2 value of .41, the initial back and leg muscle strength have η^2 values of .59 and .53, respectively, and the initial balance has an η^2 value of .31 ($P = .001$). These findings showed that the initial fitness level's effect size explained a more significant proportion of the variance not attributable to training. Therefore, the relationship between the initial fitness level and the fitness level after training was strong (Table 3).

Discussion

This study is the first study that investigates the effect of lègong dance training on physical fitness. This study's results could be scientific evidence to provide a scientific point of view of beautiful artistic dancing. It also provides scientific data to promote lègong

Table 1 Characteristics of the Research Participant

Characteristics	AG	DG
Age, y	14.0 (0.2)	13.9 (0.9)
Body weight, kg	45.1 (6.3)	47.3 (10.2)
Body height, cm	153.6 (5.7)	153.1 (3.9)
BMI, percentiles	43.1 (24.6)	44.0 (28.5)

Abbreviations: AG, aerobic group; BMI, body mass index; DG, dance group.

Table 2 Unadjusted and Covariate Adjusted Descriptive Statistic for Fitness Components in Each Group

			Before training		After training (unadjusted)		After training (adjusted)		MD	
No.	Fitness components	Group	Mean	SD	Mean	SD	Mean	SE	Mean	SD
1	Aerobic VO_2max, mL/kg/min	AG	23.05	1.29	24.73	0.94	24.27	0.21	1.60	0.68
		DG	23.01	1.18	23.91	1.42	23.91	0.21	0.85	1.32
						MD	0.36			
2	Body fat, %	AG	23.86	4.27	24.43	4.29	24.78	0.40	0.54	2.39
		DG	24.63	5.65	24.83	5.45	24.47	0.40	0.19	0.59
						MD	0.31			
3	Flexibility, cm	AG	22.72	5.38	23.21	5.51	22.82	0.58	0.47	2.44
		DG	21.83	3.84	22.58	3.96	22.97	0.58	0.72	15.17
						MD	0.15			
4	Balance, s	AG	36.95	18.97	41.33	17.12	44.09	4.97	4.16	15.02
		DG	44.16	17.78	68.11	31.58	65.35	4.97	22.75	26.22
						MD	21.26			
5	Arm strength, rep	AG	16.21	4.08	18.00	5.40	22.13	1.38	1.70	4.55
		DG	24.89	6.40	28.05	8.70	23.92	1.38	3.00	5.46
						MD	1.79			
6	Back strength, kg	AG	39.56	11.26	60.22	9.55	60.78	1.49	20.67	6.56
		DG	41.22	11.14	66.89	9.86	66.33	1.49	25.67	7.90
						MD	5.55			
7	Leg strength, kg	AG	38.06	9.06	57.56	11.72	58.25	1.71	19.50	7.15
		DG	39.72	9.23	65.61	8.94	64.92	1.71	25.89	7.42
						MD	6.67			

Abbreviations: AG, aerobic group; DG, dance group; MD, mean difference; VO_2max, maximal oxygen consumption.

dance in becoming an alternative to physical exercises to improve young girls' physical fitness. Lègong dance that is carried out as a group activity in the community dance center and school potentially increases young girls' motivation to participate in PA.

The improvement in cardiorespiratory fitness in the DG is consistent with the finding by Kautedakis et al.[19] They observed the improvement of cardiorespiratory fitness among participants in the dancer group. This research is comparable to ours in the intensity of the training, but they researched in 12 weeks.[19] Other research also found that a dancer has better cardiorespiratory fitness than a nondancer by 10%, and more extended training could improve it by 25%.[20]

The effect of lègong dance training on the musculoskeletal system is also consistent with previous research. Students who trained in contemporary dance for 12 weeks gained a 6% improvement in leg strength.[19] Other research also elicited a difference in muscle strength among students who were dancers and nondancers.[20] Muscle strength improvement in this research could be caused by neurological adaptation and not by the hypertrophy process. Many lègong dance movements were similar to calisthenic training and could lead to this kind of adaptation.[21] Research shows that the increase in muscle strength in the first few weeks of exercise results from neural adaptations. Hypertrophic adaptation or increased muscle mass can only be achieved with measured weight training accompanied by training periodization.[21] Neural adaptation is the synchronization of specific muscle motor units accompanied by inhibition of the body's defense mechanisms by the Golgi organ in the tendon, which functions to maintain muscle contraction limit.[21,22] Increasing coordination between agonist and antagonist muscle groups and synergistic muscles can also increase muscle strength.[23]

The superior improvement of balance in DG compared with AG was consistent with other research that observes balance as a prominent dance training effect.[14,24,25] The research also concludes that dance training is balance training.[26] Dance training made the dancers become more field independent compared with nondancers. A dancer has a good internal orientation as well as swimmer, wrestler, and sport dance athlete.[27–29] Complex movements in DG train the dancer's internal orientation and awareness of their body position while dancing.[30] It will improve the interaction between visual, vestibular, and somatosensory system.[27]

There was no significant improvement in body fat percentage in AG and DG. Koutedakis et al also found that there is no improvement of body fat after 12 weeks of dance training.[19] Other research also observes no improvement in body fat percentage among contemporary and ballet dancers. Energy expenditure during the study should be considered regarding this result. During exercise, energy expenditure has a linear relationship with the heart rate and is consistent for an individual across a submaximal exercise range.[31,32] On the other hand, body composition is a significant factor in determining resting energy expenditure.[33,34] Since both training pieces have a similar target heart rate (60%–80% MHR) and no significant difference is observed in body fat percentage, we assume that the energy expenditure from exercise in both groups was not different. It should be emphasized that PA and caloric restriction programs improve the chances of weight loss.[35] Utilizing exercise, especially resistance training, was more effective than a program that employed just a hypocaloric diet.[36] In this research, we did not combine exercise with diet intervention, and the 6-week program could not improve the body fat percentage.

Table 3 Analysis of Covariance for Physical Fitness Components by Training Group With Initial Level of Fitness as a Covariate

No.	Fitness components	Source	Sum Square	df	Mean Square	*F*	*P*	η^2
1	Aerobic, VO_2max	Initial VO_2max (covariate)	21.354	1	21.354	24.439	.000	.41
		Training group	6.114	1	6.114	6.997	.012	.17
		Error	30.583	35	0.874			
2	Body fat, %	Initial body fat (covariate)	758.284	1	758.284	245.855	.000	.88
		Training group	0.900	1	0.900	0.292	.592	.01
		Error	107.950	35	3.084			
3	Flexibility, cm	Initial body flexibility (covariate)	606.206	1	606.206	94.896	.000	.73
		Training group	0.208	1	0.208	0.033	.858	.00
		Error	223.583	35	6.388			
4	Balance, s	Initial balance (covariate)	7113.872	1	7113.872	15.449	.000	.31
		Training group	4127.890	1	4127.890	8.965	.005	.20
		Error	16,116.272	35	460.465			
5	Arm strength, rep	Initial arm strength (covariate)	939.659	1	939.659	34.792	.000	.50
		Training group	17.918	1	17.918	0.663	.421	.02
		Error	945.288	35	27.008			
6	Back strength, kg	Initial back strength (covariate)	1888.501	1	1888.501	47.414	0.000	0.59
		Training group	276.372	1	276.372	6.939	0.013	0.17
		Error	1314.388	35	39.830			
7	Leg strength, kg	Initial leg strength (covariate)	1968.507	1	1968.507	37.676	.000	.53
		Training group	396.743	1	396.743	7.593	.009	.19
		Error	1724.215	35	52.249			

Abbreviation: VO_2max, maximal oxygen consumption.

This research found no significant improvement in flexibility. The possible explanation regarding this result was that no movements similar to the stretching exercise were found in both groups. All movements are in the area of the joint's range of movement. Flexibility improvement in this research could be in contrast with the observation of ballet dance training, which improves the dancer's flexibility.[37,38]

The psychosocial factor that affects participation in this study needs further research in the future. Studies show that psychosocial factors play a role in determining the level of participation in a recommended PA.[39,40] In this research, we only focused on the physical effects of regular dance training. We did not evaluate the psychosocial factors since it would need a different sample size and sampling method. In this study, the psychosocial factors could indirectly support the effect of training in the study groups. Research shows that participation rates are positively related to psychosocial factors.[39,40] The high participation rate in this study ensured the effect of a regular 3 times a week training program on the organ systems and ensured sufficient recovery time for physiological adaptations. Physiological adaptations require a regular organ systems overload and sufficient recovery time.[23]

This study has several limitations. The program's short period did not allow us to observe the effect of training on body fat percentage. This study did not combine the training with diet intervention, and therefore, we cannot observe the impact of an ideal program. Another limitation was that this research did not evaluate psychosocial variables (such as enjoyment, self-efficacy, and social support), so we cannot evaluate the benefit of young girls' mental or cognitive health. Furthermore, this study's results should be carefully extrapolated to the population due to the exclusive use of a female group with a proficient skill to do the lègong dance training.

Conclusion

Lègong dance has a dominant effect on the neuromuscular component (muscle strength and balance) compared with aerobic capacity. Dance movements resemble calisthenic exercises that cover both isometric and isotonic contractions. In contrast, aerobic exercise affects aerobic fitness better than the neuromuscular component. Running and jogging in AG was a simple-rhythmic movement that predominantly affects the cardiorespiratory system.

Acknowledgment

The authors thank the study participant, the trainer of the program, and the National Junior High School headmaster in Denpasar for permission to conduct the research. They also thank the Research and Community Services Unit of Udayana University for supporting the research. The authors declared that they have no competing interests. This research was fully funded by the Research and Community Service Unit of Udayana University block grant of 2018/2019. The authors declared no other funding resources.

References

1. World Health Organization. WHO | Why are we failing to promote physical activity globally? https://www.who.int/bulletin/volumes/91/6/13-120790/en/. Updated February 11, 2021. Accessed February 11, 2021.
2. Eime R, Harvey J, Charity M, Westerbeek H. Longitudinal trends in sport participation and retention of women and girls. *Front Sports Act*

Living. 2020;2:39. PubMed ID: 33345031 doi:10.3389/fspor.2020.00039
3. Côté J, Lidor R, Hackfort D. ISSP position stand: to sample or to specialize? Seven postulates about youth sport activities that lead to continued participation and elite performance. *Int J Sport Exerc Psychol*. 2009;7(1):7–17. doi:10.1080/1612197X.2009.9671889.
4. Ransdell L. *Developing Effective Physical Activity Programs*. Physical Activity Intervention Series. Champaign, IL and Leeds, UK: Human Kinetics; 2009.
5. Casey MM, Eime RM, Payne WR, Harvey JT. Using a socioecological approach to examine participation in sport and physical activity among rural adolescent girls. *Qual Health Res*. 2009;19(7):881–893. PubMed ID: 19556398 doi:10.1177/1049732309338198.
6. Bandem I, DeBoer FE. *Kaja and Kelod: Balinese Dance in Transition/I Madé Bandem and Fredrik Eugene deBoer*. Kuala Lumpur, Malaysia and Oxford, UK: Oxford University Press; 1981.
7. Kattenstroth JC, Kalisch T, Kolankowska I, Dinse HR. Balance, sensorimotor, and cognitive performance in long-year expert senior ballroom dancers. *J Aging Res*. 2011;2011:176709. doi:10.4061/2011/176709.
8. Angioi M, Metsios G, Koutedakis Y, Wyon M. Fitness in contemporary dance: a systematic review. *Int. J. Sports Med.* 2009;30(07):475–484. doi:10.1055/s-0029-1202821.
9. Cotman CW, Berchtold NC. Exercise: a behavioral intervention to enhance brain health and plasticity. *Trends Neurosci.* 2002;25(6):295–301. PubMed ID: 12086747
10. Blackman L, Hunter G, Hilyer J, Harrison P. The effects of dance team participation on female adolescent physical fitness and self-concept. *Adolescence*. 1988;23(90):437–448. PubMed ID: 3407504
11. Eyigor S, Karapolat H, Durmaz B, Ibisoglu U, Cakir S. A randomized controlled trial of Turkish folklore dance on the physical performance, balance, depression and quality of life in older women. *Arch Gerontol Geriatr*. 2009;48(1):84–88. PubMed ID: 18068829 doi:10.1016/j.archger.2007.10.008.
12. Rodrigues-Krause J, Farinha JB, Krause M, Reischak-Oliveira Á. Effects of dance interventions on cardiovascular risk with ageing: Systematic review and meta-analysis. *Compl Ther Med*. 2016;29:16–28. PubMed ID: 27912941 doi:10.1016/j.ctim.2016.09.004.
13. Wackerhage H. *Molecular Exercise Physiology*. New York, NY: Routledge; 2014.
14. Adiputra N, Djojonegoro S, Soekarman Manuaba A. The effect of modern Balinese Baris dancing exercise (MBBDE) on serum lipid profiles. *J Hum Ergol*. 1992;21(2):119–124.
15. Fong Yan A, Cobley S, Chan C, et al. The effectiveness of dance interventions on physical health outcomes compared to other forms of physical activity: a systematic review and meta-analysis. *Sports Med*. 2018;48(4):933–951. PubMed ID: 29270864 doi:10.1007/s40279-017-0853-5.
16. Plowman SA, Meredith MD. *Fitnessgram/Activitygram Reference Guide*. 4th ed. Dallas, TX; 2013.
17. Cooper S-M, Baker JS, Tong RJ, Roberts E, Hanford M. The repeatability and criterion related validity of the 20 m multistage fitness test as a predictor of maximal oxygen uptake in active young men. *Br J Sports Med*. 2005;39(4):e19. PubMed ID: 15793077 doi:10.1136/bjsm.2004.013078.
18. Léger LA, Mercier D, Gadoury C, Lambert J. The multistage 20 metre shuttle run test for aerobic fitness. *J Sports Sci*. 1988;6(2):93–101. PubMed ID: 3184250 doi:10.1080/02640418808729800.
19. Koutedakis Y, Hukam H, Metsios G, et al. The effects of three months of aerobic and strength training on selected performance- and fitness-related parameters in modern dance students. *J Strength Cond Res*. 2007;21(3):808–812. PubMed ID: 17685714doi:10.1519/R-20856.1.
20. Chatfield SJ, Byrnes WC, Lally DA, Rowe SE. Cross-sectional physiologic profiling of modern dancers. *Dance Res J*. 1990;22(1):13. doi:10.2307/1477737.
21. Gabriel DA, Kamen G, Frost G. Neural adaptations to resistive exercise: mechanisms and recommendations for training practices. *Sports Med*. 2006;36(2):133–149. PubMed ID: 16464122
22. Kraemer WJ, Fleck SJ, Deschenes MR. *Exercise Physiology: Integrated From Theory to Practical Applications*. 1st ed. Philadelphia, PA: Wolters Kluwer/Lippincott Williams & Wilkins Health; 2012.
23. Plowman SA, Smith DL. *Exercise Physiology for Health, Fitness, and Performance*. 4th ed. London, UK and Philadelphia, PA: Lippincott Williams & Wilkins; 2014.
24. Granacher U, Muehlbauer T, Bridenbaugh SA, et al. Effects of a salsa dance training on balance and strength performance in older adults. *Gerontology*. 2012;58(4):305–312. PubMed ID: 22236951 doi:10.1159/000334814.
25. Shanahan J, Coman L, Ryan F, et al. To dance or not to dance?: A comparison of balance, physical fitness and quality of life in older Irish set dancers and age-matched controls. *Public Health*. 2016;141:56–62. PubMed ID: 27932016 doi:10.1016/j.puhe.2016.07.015.
26. Brown S, Martinez MJ, Parsons LM. The neural basis of human dance. *Cereb Cortex*. 2006;16(8):1157–1167. PubMed ID: 16221923 doi:10.1093/cercor/bhj057.
27. Corsi-Cabrera M, Gutierrez L. Spatial ability in classic dancers and their perceptual style. *Percept Mot Skills*. 1991;72(2):399–402. PubMed ID: 1852551 doi:10.2466/pms.1991.72.2.399.
28. Crotts D, Thompson B, Nahom M, Ryan S, Newton RA. Balance abilities of professional dancers on select balance tests. *J Orthop Sports Phys Ther*. 1996;23(1):12–17. PubMed ID: 8749745 doi:10.2519/jospt.1996.23.1.12.
29. Terelak J. Field dependence/independence and eye-hands-legs coordination. *Percept Mot Skills*. 1990;71(3, pt 1):947–950. PubMed ID: 2293195 doi:10.2466/pms.1990.71.3.947.
30. Dibia IW, Ballinger R, Anello B. *Balinese Dance, Drama & Music: A Guide to the Performing Arts of Bali*. Tokyo, Japan: Tuttle; 2004. http://gbv.eblib.com/patron/FullRecord.aspx?p=1072857.
31. Freedson PS, Miller K. Objective monitoring of physical activity using motion sensors and heart rate. *Res Q Exerc Sport*. 2000;71(2 suppl):S21–S29.
32. Livingstone MB. Heart-rate monitoring: the answer for assessing energy expenditure and physical activity in population studies? *Br J Nutr*. 1997;78(6):869–871. PubMed ID: 9497439 doi:10.1079/bjn19970205.
33. Nelson KM, Weinsier RL, Long CL, Schutz Y. Prediction of resting energy expenditure from fat-free mass and fat mass. *Am J Clin Nutr*. 1992;56(5):848–856. PubMed ID: 1415003 doi:10.1093/ajcn/56.5.848.
34. Weinsier RL, Schutz Y, Bracco D. Reexamination of the relationship of resting metabolic rate to fat-free mass and to the metabolically active components of fat-free mass in humans. *Am J Clin Nutr*. 1992;55(4):790–794. PubMed ID: 1550060 doi:10.1093/ajcn/55.4.790.
35. Swift DL, Johannsen NM, Lavie CJ, Earnest CP, Church TS. The role of exercise and physical activity in weight loss and maintenance. *Prog Cardiovasc Dis*. 2014;56(4):441–447. PubMed ID: 24438736 doi:10.1016/j.pcad.2013.09.012.
36. Clark JE. Diet, exercise or diet with exercise: comparing the effectiveness of treatment options for weight-loss and changes in fitness for adults (18-65 years old) who are overfat, or obese; systematic review

and meta-analysis. *J Diabetes Metab Disord*. 2015;14:31. PubMed ID: 25973403 doi:10.1186/s40200-015-0154-1.

37. Hutt K, Redding E. The effect of an eyes-closed dance-specific training program on dynamic balance in elite pre-professional ballet dancers: a randomized controlled pilot study. *J Dance Med Sci*. 2014;18(1):3–11. PubMed ID: 24568798 doi:10.12678/1089-313X.18.1.3.
38. Twitchett EA, Koutedakis Y, Wyon MA. Physiological fitness and professional classical ballet performance: a brief review. *J Strength Cond Res*. 2009;23(9):2732–2740. PubMed ID: 19910802 doi:10.1519/JSC.0b013e3181bc1749.
39. Mama SK, McNeill LH, McCurdy SA, et al. Psychosocial factors and theory in physical activity studies in minorities. *Am J Health Behav*. 2015;39(1):68–76. PubMed ID: 25290599 doi:10.5993/AJHB.39.1.8.
40. Zhang J, Middlestadt SE, Ji C-Y. Psychosocial factors underlying physical activity. *Int J Behav Nutr Phys Act*. 2007;4:38. PubMed ID: 17880688 doi:10.1186/1479-5868-4-38.