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The Effect of Creative Gymnastics on The Cardiorespiratory Endurance of Sport Science Students at State University of Medan in 2026

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ABSTRACT

Cardiorespiratory endurance is a major component of physical fitness and is important for Sport Science students because it supports sustained physical activity. This study aimed to examine changes in students' cardiorespiratory endurance after participation in a creative gymnastics program. A quantitative one-group pretest–posttest design was employed with 30 male Sport Science students from the 2025 cohort at Universitas Negeri Medan, selected through random sampling. Cardiorespiratory endurance was assessed using the Multistage Fitness Test (MFT), with shuttle level and estimated VO_2max as indicators. The intervention comprised 16 sessions delivered three times per week. Data were analyzed using descriptive statistics, the Shapiro–Wilk test, and the Wilcoxon signed-rank test. Mean shuttle level increased from 6.15 ± 1.12 at pretest to 6.84 ± 1.13 at posttest, while mean estimated VO_2max increased from 37.12 ± 4.01 to 39.60 ± 4.08 $ml \cdot kg^{-1} \cdot min^{-1}$. Based on the displayed means, the increase was 2.48 $ml \cdot kg^{-1} \cdot min^{-1}$, equivalent to approximately 6.68%. All participants showed an increase in estimated VO_2max. The Wilcoxon test indicated a statistically significant pretest–posttest difference ($p < .001$), with an effect size of $r = .87$. These findings indicate an improvement within the participating group following the program; however, the absence of a control group prevents definitive causal conclusions.

Keywords: creative gymnastics, cardiorespiratory endurance, VO2Max, Multistage Fitness Test, university students

INTRODUCTION

Physical fitness is an important foundation for performing daily activities effectively and safely. For university students, fitness is relevant not only to participation in sport but also to health, functional capacity, and the maintenance of an active lifestyle. Evidence syntheses indicate that physical activity provides broad health benefits and that cardiorespiratory fitness is an important marker of health status (Warburton & Bredin, 2017); (Bull et al., 2020). Accordingly, physical fitness interventions in higher education may contribute to students' capacity to sustain regular physical activity.

University students are an important population for physical activity promotion because the transition to higher education may coincide with changes in daily routines and increased sedentary behaviour. Systematic reviews and meta-analyses have reported substantial sedentary time among university students, while other research has identified the university environment as a relevant setting for physical activity promotion (Castro et al., 2018) (Castro et al., 2020); (Moulin et al., 2021). Students' activity patterns may vary according to academic demands, living arrangements, and opportunities for structured exercise. These circumstances support the need to evaluate accessible exercise programs that can be implemented in university settings.

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Sport Science students have a specific educational context because their studies combine theoretical learning with practical sport and physical activity. A systematic review of university students reported variation in physical activity and physical fitness across student populations (Kljajević et al., 2022). Interventions in university settings have also shown potential to increase physical activity, although the characteristics and effects of programs vary (Maselli et al., 2018); (Favieri et al., 2023). Assessing fitness changes in Sport Science students can therefore provide context-specific evidence about structured exercise activities in higher education.

Cardiorespiratory endurance refers to the capacity of the cardiovascular and respiratory systems to support oxygen delivery during sustained physical activity. It is an important component of physical fitness and is associated with health outcomes across populations. The American Heart Association has emphasized the clinical importance of assessing cardiorespiratory fitness, while meta-analytic evidence has linked higher fitness levels with lower risks of mortality and cardiovascular outcomes (Ross et al., 2016); (Kodama et al., 2009); (Han et al., 2022). For this reason, monitoring cardiorespiratory endurance is relevant when evaluating exercise programs.

VO_2max is commonly used to describe maximal aerobic capacity, although field-based tests generally provide an estimate rather than a direct measurement. Regular exercise can improve cardiorespiratory fitness when the training stimulus is appropriate and repeated over time. A meta-analysis of randomized controlled trials found that exercise training improves cardiorespiratory fitness in adults (Lin et al., 2015). Exercise prescription is commonly structured around frequency, intensity, time, and type, while World Health Organization guidelines recommend regular moderate- or vigorous-intensity aerobic activity for adults (Garber et al., 2011); (Bull et al., 2020).

Creative gymnastics may be a practical option for aerobic activity because it combines rhythmic movements into a continuous sequence. Research on aerobic dance has described this form of activity as a potential cardiovascular exercise option when it is designed in accordance with exercise-prescription principles (Williford et al., 1989). A systematic review of cardiorespiratory fitness tests used in dance also highlights the importance of measuring fitness in populations engaged in rhythmic movement activities (Tiemens et al., 2023). Nevertheless, the response to a particular creative gymnastics program depends on its actual exercise dose and implementation.

Music is often a defining feature of rhythmic movement activities. A meta-analytic review reported that music can influence psychological, physiological, psychophysical, and performance responses during exercise and sport (Terry et al., 2020). More recent meta-analytic evidence has also examined the effects of music on affective responses during acute exercise (He et al., 2025). In the present study, however, affective responses and music characteristics were not measured as independent variables; therefore, music is considered a feature of the activity rather than an established mechanism for any observed change.

The Multistage Fitness Test (MFT), also known as the 20-m shuttle run test, estimates VO_2max from the participant's ability to complete progressively faster shuttle runs. The test protocol was developed to predict VO_2max and has been examined in adult populations (Léger & Lambert, 1982); (Léger & Gadoury, 1989). A meta-analysis and a later systematic review support the use of the 20-m shuttle run as a field-based method for estimating cardiorespiratory fitness, while also emphasizing that field tests are not direct measurements of VO_2max (Mayorga-Vega et al., 2015); (Cuenca-García, 2021). Familiarization may also influence performance, which should be considered when interpreting pretest–posttest changes (Lamb & Rogers, 2007).

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Despite the potential relevance of rhythmic exercise, empirical evidence is needed regarding changes in cardiorespiratory endurance following a creative gymnastics program among Sport Science students at Universitas Negeri Medan. This study therefore examined male students from the 2025 cohort who participated in 16 creative gymnastics sessions delivered three times per week. Shuttle level and estimated VO_2max were compared before and after the intervention. Because the study used a one-group pretest–posttest design without a control group, its purpose was to describe and test within-group change rather than to establish definitive causality.

METHOD

Research Design

This study used a quantitative one-group pretest–posttest design. The design can be represented as $O_1 \rightarrow X_{16} \rightarrow O_2$, where O_1 denotes the pretest, X_{16} represents 16 creative gymnastics sessions, and O_2 denotes the posttest. The same participants completed the MFT before and after the intervention. Because no control group was included, the results are interpreted as changes observed within the group and cannot rule out alternative explanations such as concurrent physical activity or test familiarization.

Participants

The study population consisted of students enrolled in the Sport Science Study Program at Universitas Negeri Medan in the 2025 cohort. The sample comprised 30 male students selected through random sampling. Participants were active students who took part in the measurement and intervention sequence. The findings should be generalized cautiously because the sample was limited to male students from one cohort at one university.

Instrument

Cardiorespiratory endurance was assessed using the Multistage Fitness Test (MFT), also known as the 20-m shuttle run test. Participants ran back and forth along a 20-m course in time with an audio signal that increased in speed across stages. The last successfully completed level and shuttle were recorded as performance indicators, and estimated VO_2max was derived using the conversion procedure applied in the study. The MFT was selected because it is practical for group testing and has supporting evidence for estimating cardiorespiratory fitness in adults (Léger & Lambert, 1982); (Léger & Gadoury, 1989); (Mayorga-Vega et al., 2015); (Cuenca-García, 2021).

Creative Gymnastics Intervention

The creative gymnastics program consisted of 16 sessions delivered three times per week. Each session involved a structured sequence of rhythmic movements and continuous physical activity intended to provide an exercise stimulus relevant to cardiorespiratory endurance. The program was implemented consistently throughout the intervention period. The available study record did not report session duration or objective exercise intensity; consequently, these details are not inferred or retrospectively specified in this manuscript.

Data Collection

The procedure began with an MFT pretest to obtain baseline shuttle-level and estimated VO_2max data. Participants then completed the 16-session creative gymnastics intervention at a frequency of three sessions per week. After the intervention was completed, the participants performed a posttest using the same MFT procedure. The use of the same test at both

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measurement points supported a within-participant comparison, although the possibility of test familiarization remains a limitation.

Data Analysis

Descriptive statistics included minimum, maximum, mean, median, and standard deviation. The Shapiro–Wilk test was used to examine normality, including the distribution of the pretest–posttest difference scores. Because the difference scores for estimated VO_2max did not meet the normality assumption, the Wilcoxon signed-rank test was used to compare pretest and posttest results. Effect size was calculated as $r = Z/\sqrt{N}$, and statistical significance was set at $p < .05$.

RESULTS AND DISCUSSION

Descriptive Statistics

Table 1. Descriptive Statistics for Shuttle Level and Estimated VO2max

Variable	N	Minimum	Maximum	Mean ± SD	Median
Pretest shuttle level	30	4.2	8.7	6.15 ± 1.12	6.25
Posttest shuttle level	30	4.7	9.4	6.84 ± 1.13	6.80
Pretest estimated VO2max ($ml \cdot kg^{-1} \cdot min^{-1}$)	30	30.1	46.2	37.12 ± 4.01	37.45
Posttest estimated VO2max ($ml \cdot kg^{-1} \cdot min^{-1}$)	30	31.8	48.8	39.60 ± 4.08	39.40

Mean shuttle level increased by 0.69, from 6.15 at pretest to 6.84 at posttest. Mean estimated VO_2max increased from 37.12 to 39.60 $ml \cdot kg^{-1} \cdot min^{-1}$. Based on the rounded means presented in Table 1, the difference was 2.48 $ml \cdot kg^{-1} \cdot min^{-1}$, equivalent to approximately 6.68% of the pretest mean. The reported percentage may differ slightly from calculations using unrounded participant-level data.

Individual Changes in Estimated VO_2max

Table 2. Summary of Individual Changes in Estimated VO_2Max

Indicator	Result
Number of participants	30
Participants with an increase	30 (100%)
Participants with no change	0 (0%)
Participants with a decrease	0 (0%)
Smallest increase ($ml \cdot kg^{-1} \cdot min^{-1}$)	0.6
Largest increase ($ml \cdot kg^{-1} \cdot min^{-1}$)	4.0
Mean increase based on reported study data ($ml \cdot kg^{-1} \cdot min^{-1}$)	2.47
Reported relative increase	6.66%

All 30 participants had higher estimated VO_2max values at posttest than at pretest. The smallest individual increase was 0.6 $ml \cdot kg^{-1} \cdot min^{-1}$, and the largest was 4.0 $ml \cdot kg^{-1} \cdot min^{-1}$. The original study record reported a mean increase of 2.47 $ml \cdot kg^{-1} \cdot min^{-1}$ and a relative increase of 6.66%; these figures may reflect calculations using unrounded data. The descriptive results indicate a consistent direction of change across participants, but do not by themselves establish that the intervention caused the change.

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Normality Test

Table 3. Shapiro–Wilk Normality Test for Estimated VO_2Max

Data	W	p	Decision
Pretest VO_2max	0.972	0.590	No evidence of non-normality
Posttest VO_2max	0.980	0.837	No evidence of non-normality
VO_2max difference scores	0.924	0.033	Non-normal distribution

The Shapiro–Wilk test did not indicate a significant departure from normality for the pretest or posttest VO_2max values. However, the difference scores were not normally distributed ($p = .033$). Therefore, the Wilcoxon signed-rank test was selected for the pretest–posttest comparison. This decision was based on the distribution of the paired difference scores rather than on the separate distributions of the pretest and posttest values.

Hypothesis Test

Table 4. Wilcoxon Signed-Rank Test for Estimated VO_2Max

Variable	Pretest median	Posttest median	Median difference	Z	p	Effect size r
Estimated VO_2max	37.45	39.40	2.40	4.77	< .001	0.87

The Wilcoxon signed-rank test indicated a statistically significant difference between pretest and posttest estimated VO_2max ($Z = 4.77$, $p < .001$). The effect size was $r = .87$, indicating a large within-group effect according to commonly used benchmarks. The median increased from 37.45 to 39.40 $ml \cdot kg^{-1} \cdot min^{-1}$, with a reported median difference of 2.40 $ml \cdot kg^{-1} \cdot min^{-1}$. Statistical significance and effect size describe the observed paired change, but do not eliminate the limitations associated with the absence of a control group.

Discussion

The findings indicate that estimated cardiorespiratory endurance improved between pretest and posttest among the students who completed 16 creative gymnastics sessions delivered three times per week. Mean estimated VO_2max increased from 37.12 to 39.60 $ml \cdot kg^{-1} \cdot min^{-1}$, while mean shuttle level increased from 6.15 to 6.84. All participants showed an increase in estimated VO_2max, indicating that the direction of change was consistent within this sample. These results should nevertheless be interpreted as a within-group improvement following participation, rather than definitive evidence that creative gymnastics alone caused the change.

From a physiological perspective, repeated aerobic exercise can provide a stimulus for adaptations associated with cardiorespiratory fitness. A meta-analysis of randomized controlled trials found that exercise training improves cardiorespiratory fitness in adults (Lin et al., 2015). Exercise prescription guidance emphasizes frequency, intensity, time, and type as key elements for planning and monitoring exercise (Garber et al., 2011). In the present study, the frequency and number of sessions were documented, but session duration and objective intensity were not available, limiting conclusions about the precise exercise dose.

The repeated schedule of three sessions per week created a regular pattern of physical activity over the intervention period. Regular activity is consistent with public health guidance that recommends aerobic activity throughout the week (Bull et al., 2020). Research on

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university-based interventions suggests that structured programs can support physical activity, although effects vary across interventions and populations (Maselli et al., 2018); (Favieri et al., 2023). The present findings add a context-specific observation for Sport Science students at Universitas Negeri Medan, but further controlled research is needed to determine the size of the intervention-specific effect.

Creative gymnastics combines rhythmic movement sequences that can be performed continuously, making it a plausible option for aerobic exercise. Previous work on aerobic dance has discussed its cardiovascular potential when exercise is designed according to appropriate training principles (Williford et al., 1989). Research reviewing cardiorespiratory fitness tests in dance also emphasizes the value of measuring fitness in populations participating in rhythmic movement activities (Tiemens et al., 2023). However, because the present study did not compare creative gymnastics with another exercise mode, it cannot establish that creative gymnastics is more effective than alternative aerobic activities.

Music may be a relevant contextual feature of rhythmic exercise. A meta-analysis reported that music can influence psychological, physiological, psychophysical, and performance responses during exercise and sport (Terry et al., 2020), and more recent work has examined its effects on affective responses during acute exercise (He et al., 2025). Nevertheless, music-related responses were not measured in this study, and music was not analyzed as an independent variable. It would therefore be inappropriate to attribute the observed increase in estimated VO_2max to music or to a specific psychological mechanism.

The increase in shuttle level was consistent with the increase in estimated VO_2max because the MFT uses progressively faster 20-m shuttle runs to estimate aerobic capacity. The original protocol was developed to predict VO_2max, and subsequent research has examined its validity in adults (Léger & Lambert, 1982); (Léger & Gadoury, 1989). A meta-analysis and a systematic review support the use of the 20-m shuttle run as a field-based estimate of cardiorespiratory fitness (Mayorga-Vega et al., 2015); (Cuenca-García, 2021). Nonetheless, estimated VO_2max is not equivalent to a direct laboratory measurement, and the precision of the estimate depends on the protocol and conversion procedure used.

Familiarization is another possible explanation that should be considered when interpreting the pretest–posttest difference. Previous research has re-examined the reliability of the 20-m multistage shuttle run and highlighted the importance of considering test characteristics (Lamb & Rogers, 2007). Because participants completed the same field test at both time points, some improvement may have reflected greater familiarity with the test procedure or pacing demands. The study design did not allow the contribution of familiarization to be separated from physiological adaptation.

The effect size of $r = .87$ indicates a large paired change in this sample, but a large effect size does not remove the limitations of the design. Without a control group, the observed changes could also be associated with other physical activities, changes in lifestyle, or familiarization with the MFT. The sample included only male students from the 2025 cohort at a single university, limiting generalizability to female students and other populations. Future studies should consider a controlled design, recruit a larger and more diverse sample, record session duration and exercise intensity, and consider direct measurement of VO_2max when feasible.

CONCLUSION

Among 30 male Sport Science students from the 2025 cohort at Universitas Negeri Medan, participation in a 16-session creative gymnastics program delivered three times per week was followed by an increase in estimated cardiorespiratory endurance. Mean shuttle level increased

from 6.15 ± 1.12 to 6.84 ± 1.13, while mean estimated VO_2max increased from 37.12 ± 4.01 to 39.60 ± 4.08 ml·kg^{-1}·min^{-1}. The Wilcoxon signed-rank test showed a statistically significant pretest–posttest difference ($p < .001$), with an effect size of $r = .87$. Creative gymnastics may be considered a potential aerobic activity option in higher education sport settings, but the one-group design does not support definitive causal conclusions.

RECOMMENDATIONS

Future research should include a control group and, where feasible, random allocation to strengthen causal interpretation. Samples should be larger and include participants of different sexes and backgrounds to improve the generalizability of findings. Researchers should document session duration and monitor exercise intensity objectively, for example through heart-rate monitoring or ratings of perceived exertion. Direct measurement of VO_2max may also strengthen measurement accuracy when appropriate equipment and resources are available.

REFERENCES

Ahler, T., Bendiksen, M., Krustrup, P., & Bandholm, T. (2012). Aerobic fitness testing of soccer players: Reliability of the Yo-Yo intermittent recovery test and the 20-m shuttle run test. Journal of Strength and Conditioning Research, 26(12), 3459–3466. https://doi.org/10.1519/JSC.0b013e318248e9e5

Brown, C. E., Richardson, K., Halil-Pizzirani, B., Atkins, L., Yücel, M., & Segrave, R. A. (2024). Key influences on university students' physical activity: A systematic review using the Theoretical Domains Framework and the COM-B model of human behaviour. BMC Public Health, 24, 418. https://doi.org/10.1186/s12889-023-17621-4

Bull, F. C., Al-Ansari, S. S., Biddle, S., Borodulin, K., Buman, M. P., Cardon, G., et al. (2020). World Health Organization 2020 guidelines on physical activity and sedentary behaviour. British Journal of Sports Medicine, 54(24), 1451–1462. https://doi.org/10.1136/bjsports-2020-102955

Castro, O., Bennie, J., Vergeer, I., Bosselut, G., & Biddle, S. J. H. (2018). Correlates of sedentary behaviour in university students: A systematic review. Preventive Medicine, 116, 194–202. https://doi.org/10.1016/j.ypmed.2018.09.016

Castro, O., Bennie, J., Vergeer, I., Bosselut, G., & Biddle, S. J. H. (2020). How sedentary are university students? A systematic review and meta-analysis. Prevention Science, 21(3), 332–343. https://doi.org/10.1007/s11121-020-01093-8

Cuenca-García, M., et al. (2021). Criterion-related validity of field-based fitness tests in adults: A systematic review. Journal of Clinical Medicine, 10(16), 3743. https://doi.org/10.3390/jcm10163743

Favieri, F., French, M. N., Casagrande, M., & Chen, E. Y. (2023). Physical activity interventions have a moderate effect in increasing physical activity in university students—A meta-analysis. Journal of American College Health, 71(9), 2823–2834. https://doi.org/10.1080/07448481.2021.1998070

Garber, C. E., Blissmer, B., Deschenes, M. R., Franklin, B. A., Lamonte, M. J., Lee, I.-M., Nieman, D. C., & Swain, D. P. (2011). Quantity and quality of exercise for developing and maintaining cardiorespiratory, musculoskeletal, and neuromotor fitness in apparently healthy adults. Medicine & Science in Sports & Exercise, 43(7), 1334–1359. https://doi.org/10.1249/MSS.0b013e318213fefb

Gasana, J., O'Keeffe, T., Withers, T. M., & Greaves, C. J. (2023). A systematic review and meta-analysis of the long-term effects of physical activity interventions on objectively measured outcomes. BMC Public Health, 23, 1697. https://doi.org/10.1186/s12889-023-16541-7

Han, M., Qie, R., Shi, X., Yang, Y., Lu, J., Hu, F., Zhang, M., Zhang, Z., Hu, D., & Zhao, Y. (2022). Cardiorespiratory fitness and mortality from all causes, cardiovascular disease and cancer: Dose-

response meta-analysis of cohort studies. British Journal of Sports Medicine, 56(13), 733–739. https://doi.org/10.1136/bjsports-2021-104876

He, X., Zhang, M., Li, S., Jia, J., Xu, B., & Wang, X. (2025). Effects of music on affective responses to acute exercise: A meta-analytic review and multilevel meta-analysis. Applied Psychology: Health and Well-Being, 17(6), e70092. https://doi.org/10.1111/aphw.70092

Kljajević, V., Stanković, M., Đorđević, D., Trkulja-Petković, D., Jovanović, R., Plazibat, K., Oršolić, M., Čurić, M., & Sporiš, G. (2022). Physical activity and physical fitness among university students—A systematic review. International Journal of Environmental Research and Public Health, 19(1), 158. https://doi.org/10.3390/ijerph19010158

Kodama, S., Saito, K., Tanaka, S., Maki, M., Yachi, Y., Asumi, M., Sugawara, A., Totsuka, K., Shimano, H., Ohashi, Y., Yamada, N., & Sone, H. (2009). Cardiorespiratory fitness as a quantitative predictor of all-cause mortality and cardiovascular events. JAMA, 301(19), 2024–2035. https://doi.org/10.1001/jama.2009.681

Lamb, K. L., & Rogers, L. (2007). A re-appraisal of the reliability of the 20 m multi-stage shuttle run test. European Journal of Applied Physiology, 100(3), 287–292. https://doi.org/10.1007/s00421-007-0432-9

Léger, L. A., & Gadoury, C. (1989). Validity of the 20 m shuttle run test with 1 min stages to predict VO_2max in adults. Canadian Journal of Sport Sciences, 14(1), 21–26.

Léger, L. A., & Lambert, J. (1982). A maximal multistage 20-m shuttle run test to predict VO_2max. European Journal of Applied Physiology and Occupational Physiology, 49(1), 1–12. https://doi.org/10.1007/BF00428958

Lin, X., Zhang, X., Guo, J., Roberts, C. K., McKenzie, S., Wu, W.-C., Liu, S., & Song, Y. (2015). Effects of exercise training on cardiorespiratory fitness and biomarkers of cardiometabolic health: A systematic review and meta-analysis of randomized controlled trials. Journal of the American Heart Association, 4(7), e002014. https://doi.org/10.1161/JAHA.115.002014

Maselli, M., Ward, P. B., Gobbi, E., & Carraro, A. (2018). Promoting physical activity among university students: A systematic review of controlled trials. American Journal of Health Promotion, 32(7), 1602–1612. https://doi.org/10.1177/0890117117753798

Mayorga-Vega, D., Aguilar-Soto, P., & Viciana, J. (2015). Criterion-related validity of the 20-M shuttle run test for estimating cardiorespiratory fitness: A meta-analysis. Journal of Sports Science & Medicine, 14(3), 536–547.

Memon, A. R., Gupta, C. C., Crowther, M. E., Ferguson, S. A., Tuckwell, G. A., & Vincent, G. E. (2021). Sleep and physical activity in university students: A systematic review and meta-analysis. Sleep Medicine Reviews, 58, 101482. https://doi.org/10.1016/j.smrv.2021.101482

Moulin, M. S., Truelove, S., Burke, S. M., & Irwin, J. D. (2021). Sedentary time among undergraduate students: A systematic review. Journal of American College Health, 69(3), 237–244. https://doi.org/10.1080/07448481.2019.1661422

Peng, S., Yuan, F., Othman, A. T., Zhou, X., Shen, G., & Liang, J. (2023). The effectiveness of e-health interventions promoting physical activity and reducing sedentary behavior in college students: A systematic review and meta-analysis of randomized controlled trials. International Journal of Environmental Research and Public Health, 20(1), 318. https://doi.org/10.3390/ijerph20010318

Prince, S. A., Dempsey, P. C., Reed, J. L., Rubin, L., Saunders, T. J., Ta, J., Tomkinson, G. R., Merucci, K., & Lang, J. J. (2024). The effect of sedentary behaviour on cardiorespiratory fitness: A systematic review and meta-analysis. Sports Medicine, 54(4), 997–1013. https://doi.org/10.1007/s40279-023-01986-y

Ross, R., Blair, S. N., Arena, R., Church, T. S., Després, J.-P., Franklin, B. A., Haskell, W. L., Kaminsky, L. A., Levine, B. D., Lavie, C. J., Myers, J., Niebauer, J., Sallis, R., Sawada, S. S., Sui, X., & Wisløff, U. (2016). Importance of assessing cardiorespiratory fitness in clinical practice: A case for fitness as a clinical vital sign. Circulation, 134(24), e653–e699. https://doi.org/10.1161/CIR.0000000000000461

Terry, P. C., Karageorghis, C. I., Curran, M. L., Martin, O. V., & Parsons-Smith, R. L. (2020). Effects of music in exercise and sport: A meta-analytic review. Psychological Bulletin, 146(2), 91–117. https://doi.org/10.1037/bul0000216

Tiemens, A., van Rijn, R. M., Koes, B. W., & Stubbe, J. H. (2023). A systematic review of cardiorespiratory fitness tests used in dance. Journal of Dance Medicine & Science, 27(1), 27–40. https://doi.org/10.1177/1089313X231176608

Warburton, D. E. R., & Bredin, S. S. D. (2017). Health benefits of physical activity: A systematic review of current systematic reviews. Current Opinion in Cardiology, 32(5), 541–556. https://doi.org/10.1097/HCO.0000000000000437

Williford, H. N., Scharff-Olson, M., & Blessing, D. L. (1989). The physiological effects of aerobic dance: A review. Sports Medicine, 8(6), 335–345. https://doi.org/10.2165/00007256-198908060-00003