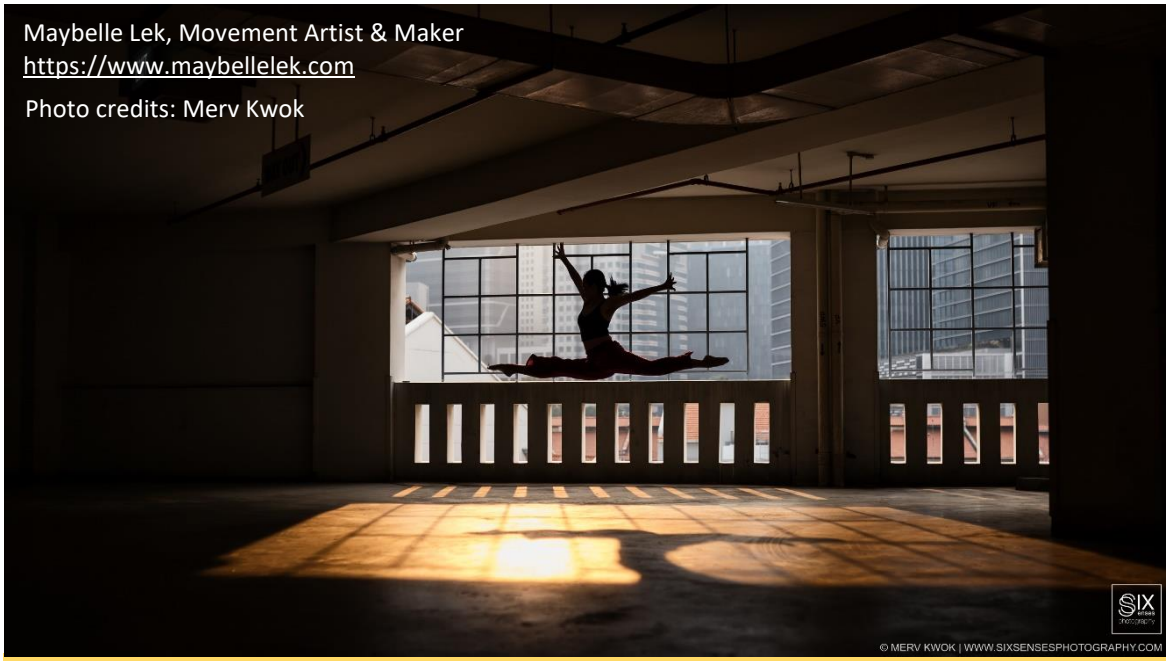


Stamina in Dance

Physiological adaptation to training and rethinking our lesson plans

Charmaine Tay, January 2021

For centuries, we have followed the tradition of how a dance class should be structured, across all genres. However, given the shift in demands on a dancer, do our dance classes still cater to what is required of these 21st century dancers?

Increase in demands of the 21st century dancer

Unlike before, dancers of the present day face an increase in demands[1,4] placed on them, such as:

- **Being able to perform multiple genres of dance style**
- **Longer duration of performances**
- **Increased number of items per dancer**
- **Higher level of acrobatic movements normalised**

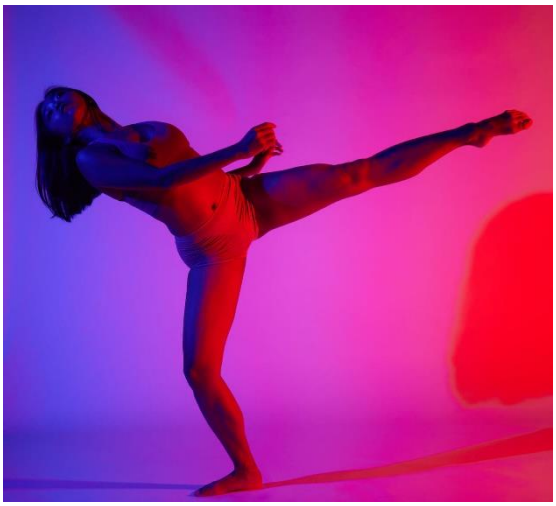
These all require dancers to have a great amount of aerobic capacity and cardiovascular fitness that may not already be trained during a technique class or rehearsal itself due to the start-stop nature of these sessions, but yet, required of the dancer during performance[16,17]. The intermittent format allows us to refine our techniques and pick apart the details of a choreography but does not fully prepare us for performance as it does not replicate the cardiovascular demands of the choreography [9]. Furthermore, when dancers reach the point of fatigue on stage, they will not be able to exemplify

the technical brilliance they have been training for. When leading up to the performance, dancers also risk getting injured from dancing as their body is unable to support the movements in their joints at an adequate capacity. Fatigue is often an unacknowledged cause of injury but is the main cause of injuries in professional dancers[5,6].

Dancers who enter a tough rehearsal or training season without good cardiovascular fitness tend to fatigue faster too, causing to them experiencing load damage to their joints and tendons[7,8,17]. Therefore, technique training is important but cardiovascular endurance is needed to sustain technical precision right to the very end of the performance, as well as to prevent fatigue-related injuries from occurring[14]. However, physiological conditioning takes time as your body needs time to adapt to your routine, in order to help you be more energy efficient.

Let's break down what our cardiovascular system is, its physiological adaptations during exercise and its effects over a long term.

Cardiovascular system



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When you move, your muscles require oxygen, transported via your blood to produce energy. The cardiovascular system composes of the heart, blood vessels and blood, and responds directly proportional to the skeletal muscle oxygen demands at varying intensities. Your oxygen uptake (VO2) also increases linearly with increasing movement intensity. When you start to dance, your heart rate increases and more blood is needed to supply more oxygen for your muscles to move. At a moderate to high intensity, your heart has to work harder to maintain your blood pressure (cardiac output) as the volume of blood your heart is pumping increases. As most of the blood is usually pumped to your brain, you may start feeling giddy when you dance due to the redistribution of blood flow to your muscles. Here's a table on how much redistribution of blood flow there is to the muscles:

Status	% of blood flow to muscles
At rest	18%
Low intensity	47%
Moderate to High intensity	71%
At Maximal	88%

However, when a dancer does not keep up with cardiovascular training, they may find moderate intensity movements to be of higher intensity and fatigue a lot quicker. (i.e. if you do 50 jumping jacks every day for the past month, you will probably find it a lot less intense than someone who has done it inconsistently or not at all)

When you work on your cardiovascular fitness, your body adapts to the greater rate of work you are constantly producing during cardio training and several physical changes occur, helping you produce movements more easily[12]. These changes include:

1. **Increase in heart size (hypertrophy)**
2. **Increase in red blood cell mass (Red blood cell carries oxygen and the body requires a higher level of oxygen as it adapts to higher oxygen demands with increased cardiovascular activity in the long run)**
3. **Increased blood volume**
4. **Reduced resting heart rate**
5. **Increased stroke volume (amount of blood your heart pumps each time it beats)**
6. **Increased maximal heart rate**
7. **Increased oxygen uptake at maximal (VO2 max)**

These changes allow you work at a higher intensity while meeting oxygen demands, placing less strain on the heart, leading to an improvement of stamina.

Training to improve cardiovascular fitness

If you are just starting out on supplementing dance class with cardio training, aim for 20 minutes of low intensity of sustained effort, such as a jog once a day, to improve the endurance in your muscles as well as health of your heart and lungs. Once you have built a base level of stamina at this lower intensity, begin to alternate one of the weekly sessions with a high-intensity interval training (HIIT) workout, followed by lower intensity recovery intervals[7] i.e. switching between sprinting and walking, repeating several sets. Other alternatives such as skipping and cycling is also encouraged.

In addition, during rehearsals, dance instructors should also set aside some time during the rehearsal throughout the training season to run the item full out several times to let the dancers experience the cardiovascular demands of the choreography, rather than only run it in full closer to the performance itself.

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Research on dance aerobic training and testing

A group of dance scientist have also designed a Dance-specific Aerobic Fitness Test (DAFT) consisting of five progressively (physiologically) demanding dance sequence to test whether dancers had the cardiorespiratory capabilities to cope with a dance class[18], along with a high-intensity performance fitness test to test[10] if dancers could handle the demands of a performance. These tests have been used in dance schools as cardio fitness training for dancers[11,12], and has proven to be successful in achieving its goals[14]. Look out for future workshops on aerobic capacity testing for dancers as well as our upcoming webinar with our expert on exercise physiology to learn more!

End

Currently a dance science and anatomy lecturer at the dance department, as well as a body conditioning, advance ballet and jazz at the musical theatre department of LASALLE College of The Arts. Charmaine also provides private coaching for dancers from the Elite programme for local and international dance competitions. Charmaine is the first Singaporean to graduate with a MSc in Dance Science from Trinity Laban Conservatoire of Music and Dance in 2013.

References

1. da Mota, G. R., Neto, O. B., Guimaratilde, A. C., da Silva, L., Lopes, C. R., & Junior, M. M. (2011). Street-dance: Physiological demands and effect of endurance training. Journal of Physical Education and Sport Management, 2(5), 53-57.

2. In *International Symposium on Performance Science* (pp. 91-96).

3. Kirkendall, D. T., & Calabrese, L. H. (1983). Physiological aspects of dance. Clinics in sports medicine, 2(3), 525-537.

4. Koutedakis, Y. (2005). Fitness for dance. *Journal of dance medicine & science*, *9*(1), 5-5.

5. Liederbach, M., Schanfein, L., & Kremenic, I. J. (2013). What is known about the effect of fatigue on injury occurrence among dancers. *J Dance Med Sci*, *17*(3), 101-8.

6. Liederbach, M., & Compagno, J. M. (2001). Psychological aspects of fatigue-related injuries in dancers. *Journal of Dance Medicine & Science*, *5*(4), 116-120.

7. MacInnis, M. J., & Gibala, M. J. (2017). Physiological adaptations to interval training and the role of exercise intensity. *The Journal of physiology*, *595*(9), 2915-2930.

8. Murgia, C. (2013). Overuse, tissue fatigue, and injuries. *Journal of Dance Medicine & Science*, *17*(3), 92-100.

9. McEldowney, K. M., Hopper, L. S., Etlin-Stein, H., & Redding, E. (2013). Fatigue effects on quadriceps and hamstrings activation in dancers performing drop landings. *Journal of Dance Medicine & Science*, *17*(3), 109-114.

10. Rodrigues-Krause, J., Krause, M., & Reischak-Oliveira, Á. (2015). Cardiorespiratory considerations in dance: from classes to performances. *Journal of Dance Medicine & Science*, *19*(3), 91-102.

11. Redding, E., Weller, P., Ehrenberg, S., Irvine, S., Quin, E., Rafferty, S., ... & Cox, C. (2009). The development of a high intensity dance performance fitness test. *Journal of dance medicine & science*, *13*(1), 3-9.

12. Redding, E., Irvine, S., Quin, E., & Rafferty, S. (2009). Dance science: Scientific investigations into the effect of dance specific fitness training and its impact upon pedagogic practices and dance performance.

13. Rivera-Brown, A. M., & Frontera, W. R. (2012). Principles of exercise physiology: responses to acute exercise and long-term adaptations to training. *Pm&r*, *4*(11), 797-804.

14. Tiemens, A., van Rijn, R. M., Wyon, M. A., Redding, E., & Stubbe, J. H. (2018). Influence of Movement Quality on Heart Rate While Performing the Dance-Specific Aerobic Fitness Test (DAFT) in Preprofessional Contemporary Dancers. *Medical problems of performing artists*, *33*(2), 77-81.

References

15. Twitchett, E., Nevill, A., Angioi, M., Koutedakis, Y., & Wyon, M. (2011). Development, validity, and reliability of a ballet-specific aerobic fitness test. *Journal of Dance Medicine & Science*, *15*(3), 123-127.

16. Wyon, M. A., & Koutedakis, Y. (2013). Muscular fatigue: considerations for dance. *Journal of dance medicine & science*, *17*(2), 63-69.

17. Wyon, M. A., & Redding, E. (2005). Physiological monitoring of cardiorespiratory adaptations during rehearsal and performance of contemporary dance.

18. Wyon, M. (2005). Cardiorespiratory training for dancers. *Journal of dance medicine & science*, *9*(1), 7-12.

19. Wyon, M., Redding, E., Abt, G., Head, A., & Sharp, N. C. C. (2003). Development, reliability, and validity of a multistage dance specific aerobic fitness test (DAFT). *Journal of dance medicine & science*, *7*(3), 80-84.