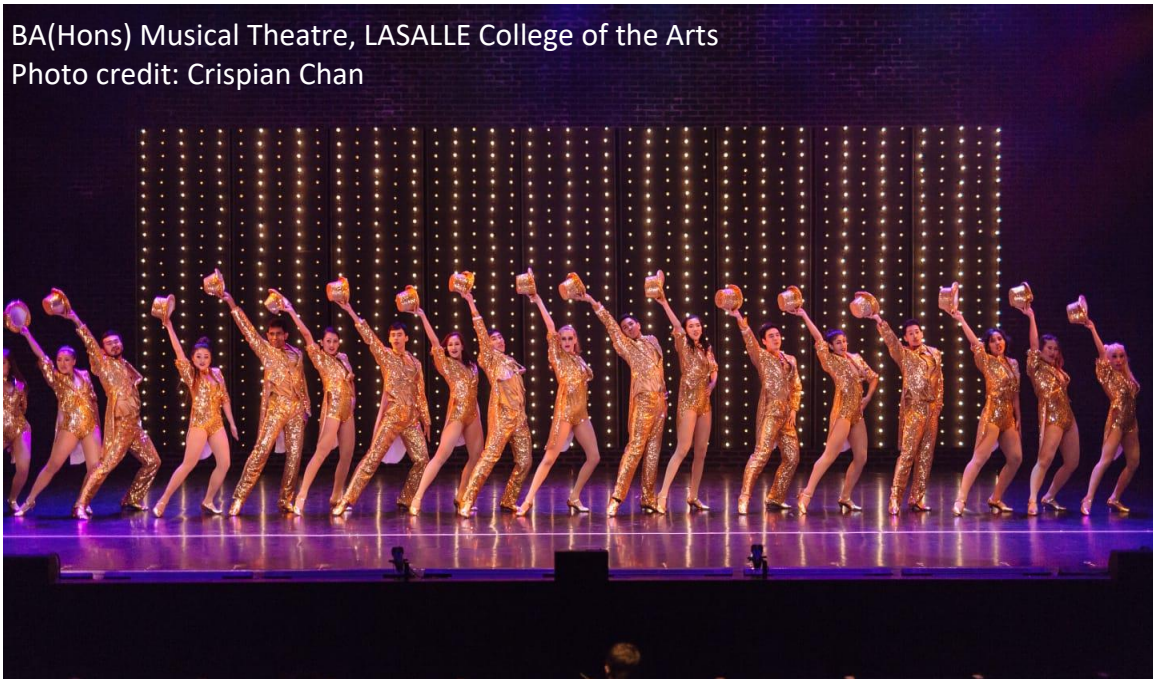


BA(Hons) Musical Theatre, LASALLE College of the Arts
Photo credit: Crispian Chan



Physiological Demands of Musical Theatre Performers: Singing, Dancing and Acting

Charmaine Tay, August 2021

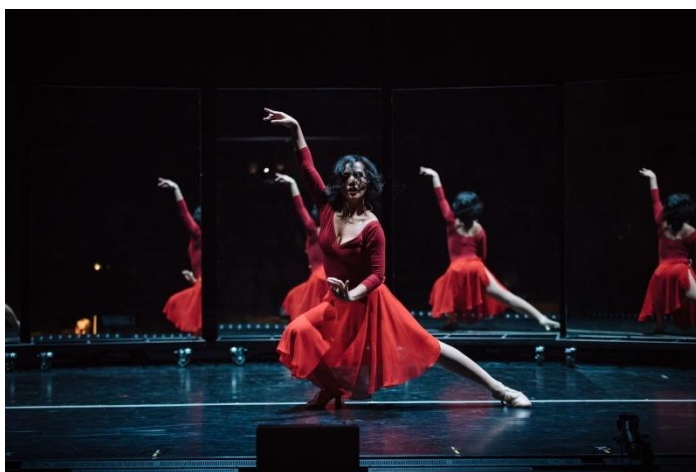
Musical theatre - a genre of theatrical performance combining acting, singing and dancing, is a growing area in the performing arts scene in Singapore. Worldwide, the genre has gone beyond the confines of a theatre, diversifying itself into the industries of films and cruise lines, employing more dancers than ballet and contemporary dance. Given its growing popularity locally and the need for musical theatre performers to be a triple-threat, one would wonder what are the physiological demands like when entering the field. This article will cover research on cardiorespiratory fitness, vocal mechanisms, efficient singing posture, acquired injuries from dancing, potential time-loss from training due to injury, and nutrition among musical theatre performers.

Cardiorespiratory Fitness

The physiological demands of dancing, compared to singing and dancing in a performance, are similar except that singing and dancing combined significantly reduced breathing

frequency and increased lactate production⁸. Musical theatre performers are required to sing while dancing or during breaks between the dancing.

Solely looking at the cardiorespiratory demands of dance, research suggests that dance is mostly intermittent in nature^{1,4,12}, although the work to rest ratio between genres may differ. Data found that dancers are exercising close to their maximal cardiorespiratory capacities during performances with greater stress on the lactate system as compared to class or rehearsal. This is due to the fact that performances generally have shorter rest periods accompanied by higher work intensities¹³.



BA(Hons) Musical Theatre, LASALLE College of the Arts
Photo credit: Crispian Chan

The cardiorespiratory requirements of musical theatre performers suggest that a higher level of aerobic fitness is needed¹⁸ compared to other dance genres, but similar to hip hop dancers¹⁸. The anaerobic (high intensity exercise) threshold for musical theatre dancers were reported to be similar to classical ballet principal and artist dancers due to longer work rest ratio during performance⁸.

Consequently, reduced breathing frequency between dance break affects the recovery mechanics reducing oxygen delivery to recovering muscles. This means that the replenishment of ATP (Adenosine triphosphate is the main molecule for storing and transferring energy in cells) in the muscle cell is reduced, potentially leading to greater use of the anaerobic glycolysis system during performance. This, in turn, increases level of blood lactate in the body, causing soreness and fatigue to the muscles. The combination of singing and dancing can compromise metabolic recovery dynamics and can negatively affect the quality of subsequent dance sequences or singing especially in longer-duration performances.

Voice Production

Singing and speaking during acting scenes play a large role in musical theatre performances. Breathing is an integral part of voice production - without it, the vocal cords are unable to vibrate. There are three interdependent subsystems in voice production - respiratory system (lungs), phonatory system (larynx) and resonatory system (vocal tract).

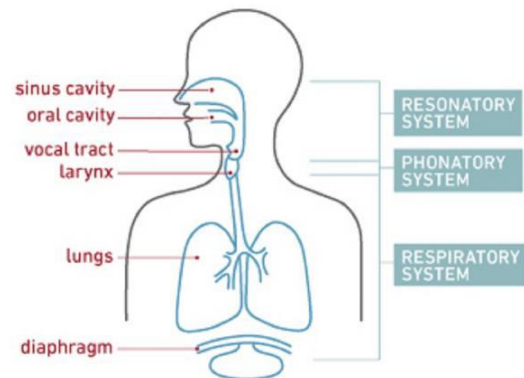


Figure 1. Subsystems in voice production

The respiratory system: Practicing vocal breathing exercises can help to project the sound more efficiently and extend a singer's range. It also helps to protect the vocal health by ensuring the correct amount of pressure is placed on the larynx and vocal cords². By breathing lower in the body, a singer is able to better control the exhalation for singing by using the abdominal muscles. Breathing strategies for dancing are quite different from those needed for legato (a type of singing method) singing. Although tidal volume (amount/volume of air moving in and out of the lungs during each ventilation cycle) was found to be constant for singing and dancing, maximum phonation time (the maximum time in seconds for which a person can sustain a vowel sound when produced on one deep breath at a relatively comfortable pitch and loudness) was reduced by 65.2% for singing while dancing⁸.

The phonatory system: The larynx is made up of separate cartilaginous structures that are held together with muscle and covered with tissue. It sits right on top of the airway (trachea). The back of the larynx is formed by the arytenoids. Muscles that control your arytenoids determine the degree of vocal cord closure. When the vocal cords are brought together and air is exhaled through them, the vocal cords vibrate and voice occurs. This process of valving air with the vocal cords is known as phonation.

The resonatory system: Resonance refers to a sound that is full and rich. Using resonance helps improve their vocal access, comfort and quality. The vocal tract, consisting of the throat, mouth and nose, filters the sound created by the vibration of the vocal cord. The



BA(Hons) Musical Theatre, LASALLE College of the Arts

Photo credit: Crispian Chan

combination of vocal cord vibration and vocal tract produces a unique voice quality to a singer. The size and shape of the vocal tract determines the sound of the voice. It is made up of a tube of muscle called the pharynx, articulators and nose. The articulators are the tongue, lower jaw, teeth, lips, roof of the mouth and alveolar arch. The difference between sounds is the placement of your tongue in your mouth that changes the shape of the vocal tract.

Singing Posture

Voice quality and ease is closely linked to posture and muscle tension². The slouching posture or tension in the shoulders, neck, throat and jaws can create several negative repercussions for voice quality and comfort. The common misalignment of the head and neck (by jutting chin forward) can create tension in the jaw, which negatively affects the voice by constricting the channel through which the voice flows². Furthermore, the “chin-jut” posture can also distort the vocal tract’s shape in a way that is disadvantageous for voice. The vocal tract is the tube that runs from the larynx to the lips and includes the throat, mouth and nose. It acts as a built-in amplifier that makes your voice louder and resonant, if not constricted by bad posture. Proper head alignment can not only reduce laryngeal tension but can also optimise projection of the voice, while reducing vocal effort, giving you the acoustic benefits of the vocal tract.

Injuries

Apart from singing, musical theatre performers are expected to dance at medium to high-intensity during shows, with females mostly dancing on chorus heels/character shoes. A study done on West End performers revealed that 65% suffering at least one injury in the previous year⁵. The lower limb accounted for 50% of injuries, and muscle strains were the diagnosis in 37% of cases. Males sustained 53% of all injuries and 72% percent of injuries were said to have occurred during performance with



BA(Hons) Musical Theatre, LASALLE College of the Arts
Photo credit: Crispian Chan

one-third of the total injuries having a gradual onset. Lower extremity injuries were the most common for dancers (52.2%), while 43.2 % of actors sustained a neck and/or back injuries.

High-heeled shoes were implicated in 30% of lower limb injuries and 40% of spine-related injuries, all of which were in the lumbar spine⁵. For foot and ankle injuries, high-heeled shoes were implicated in 33% of cases. A third of all injuries occurred while performing on a raked stage. Of those, 35% of performers were wearing heeled shoes at the time of onset, whereas of the injuries occurring on flat stages 33% of performers were wearing heeled shoes. Upper limb injuries were the most common on raked stages (40%), followed by lower limb (35%), trunk (15%), and head or neck (10%)⁸.

Disrupted training / shows due to injuries

Injuries cost performers time away from training and shows. 12% of injured performers were required to miss training or performance for more than a week⁵. Of the injuries requiring performances to be missed, muscle strains and tendon-related diagnoses ranged between one and eight performances missed while ligament injuries and “other” diagnoses ranged up to 15 shows. The injuries that required the greatest time loss from performances were ligament injuries and lower limb fractures that ranges up to 15 missed shows. This is in line with reports from multiple populations and is due to the extended healing time of these traumatic injuries¹⁰. Schools and production companies are strongly encouraged to invest in strength and conditioning coaches, as well as healthcare professionals, to provide better management of potential injuries and to mitigate the risk of injuries.

Nutrition

In 2013, a study on eating behaviours revealed that musical theatre students had poor nutritional knowledge although majority did not have an eating disorder, unlike the statistics found in certain dance genres¹¹. However, it is important to address and educate musical theatre students on proper nutrition as their training and performance schedule is equally, if not more hectic than dancers. Due to the singing and dancing nature of musical theatre, performers should hydrate



BA(Hons) Musical Theatre, LASALLE College of the Arts
Photo credit: Crispian Chan

themselves adequately, and limit the consumption of caffeine and alcohol as they may cause drying effects on the vocal mechanism³. Singers are also recommended to avoid cough drops

that contain menthol, eucalyptus, or benzocaine prior to singing as these substances are may numb the vocal tract too much⁷.

Medical Care

Musical theatre performers are advised to be promptly examined by an ENT (Ear, Nose and Throat doctor) specialist when they experience a sudden onset of hoarseness, huskiness, volume disturbances, etc. in their voice⁶, and consult a physiotherapist for dance related injuries⁹.

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. Cohen, J.L., K.R. Segal, I. Witriol, and W.D. McArdle, Cardiorespiratory responses to ballet exercise and VO2max of elite ballet dancers. *Med Sci Sports Exerc*, 1982. 14(3): p. 212-217.
2. DeVore, K., & Cookman, S. (2009). *The voice book: Caring for, protecting, and improving your voice*. Chicago Review Press.
3. Gaskill, C., & Hetzel, A. (2017). Managing “Vocal Dose” and the acting voice: how much is too much?. *Voice and Speech Review*, 11(3), 262-278.
4. Galanti, A., M. Holland, G. Shafranski, P. Loy, S. Vincent, W. Heng, and M. K., Physiological Effects of Training for a Jazz Dance Performance. *The Journal of Strength & Conditioning Research*, 1993. 7(4): p. 206-210.
5. James, A. S., & Lazarczuk, S. L. (2019). Epidemiology of injuries in West End performers. *Journal of Dance Medicine & Science*, 23(4), 139-144.
6. Johnson, A. (1994). The care and prevention of professional voice disorders. *Vocal arts medicine*. New York: Thieme Medical Publishers, Inc, 155.
7. Koziara, A. M., & Scherer, D. (2019). Vocal Hygiene for Musical Theatre Performers.
8. Sliiden, T., Beck, S., & MacDonald, I. (2017). An evaluation of the breathing strategies and maximum phonation time in musical theater performers during controlled performance tasks. *Journal of Voice*, 31(2), 253-e1.
9. Skwiot, M., Śliwiński, Z., Żurawski, A., & Śliwiński, G. (2021). Effectiveness of physiotherapy interventions for injury in ballet dancers: A systematic review. *PLoS one*, 16(6), e0253437.
10. Stephens, N., & Wyon, M. (2020). Physiological characteristics of musical theatre Performers and the effect on cardiorespiratory demand whilst singing and dancing. *Medical problems of performing artists*, 35(1), 54-58.
11. Vitzthum, K., Endres, E., Koch, F., Groneberg, D. A., Quarcoo, D., Wanke, E., & Mache, S. (2013). Eating behavior and nutrition knowledge among musical theatre

Disclaimer: * students. *Medical problems of performing artists*, 28(1), 19–23. Information contained within this article is for educational and informational purposes only while authors draw on their professional expertise and research available. In the event that you use the information provided through our website and or article, *SCAPE and the authors assume no responsibility.

12. Wyon, M.A., G. Abt, E. Redding, A. Head, N. Craig, and C. Sharp, Oxygen uptake during modern dance class, rehearsal, and performance. *J Strength Cond Res*, 2004
13. Wyon, M., E. Twitchett, M. Angioi, F. Clarke, G. Metsios, and Y. Koutedakis, Time motion and video analysis of classical ballet and contemporary dance performance. *Int J Sports Med*, 2011. 32(11): p. 851-855. 10.1055/s-0031-1279718
14. Wyon, M. A., Harris, J., Adams, F., Cloak, R., Clarke, F. A., & Bryant, J. (2018). Cardiorespiratory profile and performance demands of elite hip-hop dancers: breaking and new style. *Medical problems of performing artists*, 33(3), 198-204.