Dance Fitness

by the International Association for Dance Medicine and Science
www.DanceScience.org

Introduction

The formal dance class has long been considered the cornerstone of training, providing all the technical, physical and aesthetic requirements of dance. In recent years a considerable amount of research has been carried out regarding the health of dancers. Findings from this research indicate that many dancers are not as fit and healthy as they could be. It has also been found that there is a discrepancy in the physical intensity level between training, rehearsal, and performance. This means that training methods, which are generally based on tradition, are not sufficient to help prepare dancers for the higher, more physically demanding aspects of performance. In light of these studies, and with increased understanding of the artistic and athletic needs of dancers in different genres, it is no longer acceptable to train dancers without preparing them physiologically for the demands of current choreographic work.[1-5]

What is fitness, and why is it beneficial?

For dancers, the whole body (physical and psychological) is their instrument, their means of artistic expression. Dance calls upon all aspects of fitness. Good fitness is key to reducing the risk of injury, enhancing performance, and ensuring longer dancing careers. A healthy dancer is one who is in a state of being 'well' in both body and mind. A physically fit dancer is one who has the ability to meet the demands of a specific physical task at an optimal level. The goal of improving dancers' fitness is to minimize the difference between the dancer's individual maximal abilities and their performance requirements, so that they can become the best dancer possible.[5,6]

What types of fitness are most important for a dancer and why?

While research indicates that some dance styles require certain elements of fitness more explicitly than others, in a well-rounded dance training program, it is necessary to consider all the components of fitness.

The components of fitness are:

- Aerobic fitness – associated with moderate, longer-term levels of activity.
- Anaerobic fitness – associated with high intensity, maximal, short bursts of activity.
- Muscle endurance – the ability of a muscle to produce continuous movement.
- Strength – the ability of a muscle to produce a maximal force on one occasion.
- Power – the explosive (speed-related) aspect of strength.
- Flexibility – the range of motion at a joint in association with the pliability of a muscle.
- Neuromuscular coordination – associated with balance, agility, coordination and skill.
- Body composition – the make-up of body weight by percentage of muscle and fat.
- Rest – a period of no activity, to allow for recovery and regeneration.

While any change in traditional dance training regimens must be approached cautiously to ensure that enhanced artistry and expression remain the primary goals, it may be suggested that unless dancers are physiologically honed to the same extent as they are artistically, their physical conditioning may potentially be the limiting factor in their development. Ignoring the physiological training of today's dancers could eventually hamper the development of the art form. It is the continual responsibility of dance teachers and educators to develop their knowledge and understanding of the physiological demands of dance, and be aware of the options for either integrating physical fitness training into the technique class itself or providing it through supplementation.[7,8]

In a recent study, full time contemporary dance students completed a year of weekly dance fitness classes alongside their regular technique training. Students perceived positive physiological adaptations such as reductions in fatigue, improvement in general energy levels and an improved capacity in their dance classes to sustain technique and jumping ability. The importance of warm up and cool down was also commonly cited and the recognition of the relationship between fitness and injury prevention was highlighted.[9]

More than twenty years ago it was stated that the best dancers have an integrated combination of two talents: knowledge of what is to be expressed and the physical and mental tools to accomplish that expression. A dancer who is able to jump higher, balance longer and create illusions such as floating may not necessarily be a better dancer, but she does have the advantage of a greater range of tools with

which to produce the desired images of dance choreography. Although a topic of continual debate, more recent research has since indicated that a fitter dancer is a better dancer.[10,11]

Which activities improve various types of fitness?

Aerobic Training

The greater a dancer's aerobic capacity, the longer they can work at moderate heart rates before becoming fatigued. Research suggests that dance will only elicit an improvement in aerobic capacity in a very unfit group of people, or if an aerobic dance class is taken. The average dance technique class is too intermittent in nature for any positive aerobic effect to occur. In order to improve aerobic capacity, the body needs to work hard enough to bring about change or adaptation within the body. Specifically, a rise in heart rate to approximately 70–90% of maximum (HRmax) will stress the aerobic energy system. This elevation in heart rate has to be maintained between 20 and 40 minutes, three times a week. Continuous movement activities, such as running, aerobics classes, swimming, cycling, and skipping, are good examples of aerobic exercise.[6,12-18]

Although there are variations among teachers, a primary intention of the technique class is dance skill acquisition. Developing high levels of technical skill and movement economy requires a different focus from developing the aerobic capacity of the dancer. However, technique classes can be modified to involve some degree of aerobic work, using simple repetitive movements. Simple movement repetition helps to stress the aerobic energy system rather than stress skill acquisition. Warm up could be conducted in a continuous manner at a higher intensity than normal, and center or traveling sequences could be longer, with less rest time, allowing an aerobic foundation to develop. Familiar movement combinations might be performed over consecutive classes, purely for the benefit of continuous repetition rather than artistic effect.[6,12,19,20,21]

Anaerobic Training

Anaerobic training utilizes activity that is of a maximal, 'all-out' effort for short periods of time. An exercise-to-rest ratio of 1:3 is recommended for training the threshold at which lactate starts to accumulate in the blood stream, thus hindering muscle function. An exercise-to-rest ratio of 1:5 is recommended for training the source of the fastest muscle actions: high energy phosphates, adenosine triphosphate (ATP) and creatine phosphate (CP). Optimum exercise time for each bout can gradually increase from 10–50 seconds. The intensity of activity for the whole duration should be near maximal heart rate (95–100% HRmax). Rest periods should be at a low intensity exercise, as this promotes faster recovery. Examples of anaerobic exercises include sprints, quick steps, jumps, and fast skipping.[6,13,22]

Strength/Endurance Training

The role of strength training in dance has frequently been misunderstood. There are still concerns in the dance world that increased muscle strength will negatively affect flexibility and aesthetic appearance. Research has demonstrated that supplemental strength training can lead to better dancing and reduced occurrences of injuries, without interfering with key artistic and aesthetic requirements.[6,7,23,24]

For an optimal strength training program, it is suggested that exercises be specific to the desired outcome. Strength training can involve very heavy weights/resistance with minimal repetitions for a relatively short amount of time, or exercises can involve light weights/resistance with many repetitions for a prolonged time. Each program targets a specific goal. A combination of high intensities (70–100% of maximum) and low volumes of work, two to three times a week, aims to increase muscle strength. A full recovery period (5–6 minutes) is essential between sets in this instance. Dancers wanting to increase muscle endurance are prescribed a combination of moderate intensities (60–70% maximum) and high volumes of work, three to four times a week. The rest periods are then shorter (2–4 minutes) so that the next set of exercises begins before full recovery.[22,25,26]

Power Training

Jumping is an integral part of most dance performances and involves the use of both muscular strength and elasticity. Studies report that plyometric (jump) training has been shown to have a positive effect in dancers. However, there are warnings that plyometric training must be approached gradually and systematically to avoid injury. A good starting point is to design exercises in which dancers are encouraged to jump in a neutral position without emphasizing artistic skill, but instead simply focusing on jumping higher. Once the dancers have gained greater understanding of how to elevate themselves, they can bring correct dance technique back into the movements while trying to maintain as much height as possible.[6,27-31]

Flexibility Training

Flexibility is an important element of physical fitness. It is crucial in complimenting muscular strength, building efficiency in movement, coordination, and preventing injuries. Holding muscles in a stretched position for a prolonged amount of time causes the muscle fibers to become accustomed to the new length, therefore increasing flexibility. For it to be beneficial, the specific muscle group being stretched needs to be isolated. For example, when stretching the hamstrings, spinal movement should be reduced. Relaxation is also important. It is advised that stretches happen slowly and gently with coordinated inhalation and exhalation at the moment of maximum stretch (*i.e.*, refrain from holding the breath).[6,32]

There are many different types of stretching including static (holding), dynamic (moving through the stretch), and proprioceptive neuromuscular facilitation (PNF; a method utilizing alternate contraction and relaxation). It is important to be aware of the advantages and disadvantages of each. For example, ballistic (bouncing) stretches are not considered useful and can lead to muscle soreness and injury. Contrary

to the practice of many dancers, stretching to full range should be carried out when the body is warm, preferably after class.[28,29,31,32]

Neuromuscular Coordination

Moving beyond the purely physiological parameters, dance fitness also involves balance, agility, coordination and skill. Out of all the components of fitness, it is likely that neuromuscular coordination is addressed most often in the actual dance technique class. Through the use of imagery and visualization, improved neural pathways can help facilitate and develop efficiency in movement. Neuromuscular coordination can positively affect levels of muscle strength by controlling the recruitment of the right number of muscle fibers at the right time. In others words, dancers can become more skillful in recruiting only the muscles required to produce a certain movement and thus sustain sufficient energy levels and reduce fatigue. Research into motor control and motor learning also offers invaluable information that can enhance neural re-patterning, coordination and muscle relaxation.[20,33]

Body Composition

Body composition plays an important role in dancers' health. Appropriate and healthy ratios of lean muscle mass to fat mass are key factors that can contribute to optimizing physical performance. Body composition is often expressed as a percentage of body fat and healthy recommendations suggest that dancers' body fat be at a certain level in order reach their potential. According to the World Health Organization, healthy body compositions range from 17 to 25% for females and below 15% for males (but not too low as a certain amount of fat is essential for daily healthy function). Optimal body composition is going to vary from activity to activity. These measurements are useful to determine what the best make-up is for dancers so that they can jump higher, turn faster, and physically survive long days of training, rehearsing, and performing. A balance of appropriate energy intake (nutrition) and energy expenditure (physical activity) will help dancers achieve the body composition that is right for them.[6,34]

Rest

The importance of rest in dance training cannot be stressed enough. Proper recovery from physical training has many benefits. Rest helps to accelerate muscle regeneration between training sessions, to decrease fatigue, and to decrease the incidence of injury. It has been appreciated relatively recently that continuous training beyond a certain threshold of physical activity, without sufficient rest, can negatively impact both the health and performance of dancers. This concept refers to overtraining – excessive training that results in no effect or even negative effects on a dancer's performance. When there is an imbalance between habitual exertion (training) and recovery, symptoms such as severe and prolonged fatigue, changes in behavior and a loss of motivation can result. Recommendations to prevent or reverse overtraining include monitoring dance quality versus quantity, diet, hydration, rest, and sleep patterns.[6,35]

General Training Principles

The following variables of exercise t[illegible]ed to be understood in constructing balance[illegible] plans. Depending on the dancer's training/perfor[illegible]t is often necessary to progress to a higher level o[illegible] increasing the intensity, volume and/or frequency over time. Otherwise, the body simply adapts to the and fitness levels plateau. Also fundamental to training is concept of overload, which means that the body must challenged above a certain threshold to provide sufficient stimulus for improvement to occur. Normally encountered stress will maintain but not increase the level of conditioning. For example, if the demands of a dance class are too similar from day to day there will be insufficient overload for desired improvement to take place. Sport literature describes another principle called specificity, and recommends that to develop motor abilities, training exercises should use similar technical patterns and kinematic structure to the particular activity for which it is preparing the athlete/dancer.[5,6,22,36,37]

Summary of fitness training methods

The primary aim for a supplementary dance fitness class is for the structure and content of the class to be responsive to curriculum needs. Intensity and duration of exercises need to be considered. It is also recommended that recovery techniques become a part of the overall training program, alternating between work and rest. The dancers' heart rates and/or perceptions of how hard they feel they are working (rate of perceived exertion) can be monitored regularly to ensure that the intensity level is appropriate to elicit a training response.[38] Functional fitness training should precede more dance-based movement that increasingly replicates vocabulary from technique classes. For example, plyometric training can be introduced, initially using basic parallel foot positions, and later modified to include turned out positions, which more closely mimic the type of jumps seen in dance. Upper body strength exercises can gradually progress to incorporate partner lifting of varying speeds and complexities. During the final phase, a mixture of all fitness parameters can be structured into a circuit-type class, reflecting the variety of activity and speed of succession that would be encountered in a dance class or performance.[21]

How can fitness be measured?

The applicability of laboratory tests and training regimes from sport to dance is questionable and it is becoming increasingly necessary to gather relevant data and qualitative observations (physiological and psychological) in order to develop specific methods of promoting and assessing dance fitness.[14,18]

Heart rate measures are key to assessing aerobic capacity. The fitter a dancer is, the slower the heart needs to beat to pump an adequate volume of blood to the rest of the moving body. The gold standard laboratory test to measure aerobic capacity is the maximal oxygen uptake test (VO2max), which involves running, swimming, or cycling, while the

highest level of oxygen that can be sustained in the body is measured. A more dance specific aerobic fitness test (DAFT) has been developed in recent years, which is a submaximal multistage test that correlates to particular levels of dance fitness capabilities. Rather than running on a treadmill, the dancer's heart rate is measured while they perform simple choreographed movements that gradually increase in intensity.[2,6]

Measuring anaerobic fitness can prove challenging because the anaerobic energy systems are utilized for such a short period of time (*e.g.*, the first 30–60 seconds of maximal intensity exercise). Laboratory tests include the Wingate Anaerobic bike Test (WAnT), which measures lower limb power, while pedaling on a stationary bike as hard as one can for 30 seconds, against a resistance that is proportional to one's own body weight. A test that is more specific to dance is the vertical jump height test, which assesses how high the dancer can jump and therefore evaluates explosive muscular power in the lower extremity. More recently, a high intensity dance specific fitness test has been validated, that provides a means of assessing and monitoring dancers' capacity to dance at near maximal intensities. This test allows dancers to be appraised within an environment to which they are accustomed (the studio), using a mode of exercise that is relevant (dance), and is of adequate intensity to be representative of performance.[6,39,40]

Various isokinetic machines (computerized equipment with speed and resistance capabilities) and dynamometers (*e.g.*, handgrip, back, leg) can measure specific muscular strength and endurance. Flexibility and joint mobility can be assessed using flexometers and goniometers, which measure joint angles in the body.[39]

Body composition can be measured in a variety of ways. Skinfold measurements assess subcutaneous fat at particular areas of the body whereas bioelectrical impedance measures total body water by way of an electrical current that flows through the body, where lean muscle tissue conducts better than fat. While both assessments result in a percentage of adipose tissue (fat tissue) present in the body, bioelectrical impedance is less accurate.[34]

Are there any important considerations teachers need to make?

While technique classes focus on neuromuscular coordination, the length of a traditional class may not be adequate to meet all of the dancer's conditioning needs. The amount of space available, the numbers of students, and the time required for teaching and correcting also have an impact on work rate. Therefore, in order to achieve efficient and optimal development of dance skills, conditioning work over and above daily technique class has been recommended.[6,12,19,20]

Researchers state that regardless of performance level, talent, form of dance, gender, or age, all dancers have to use some or all of the elements of fitness during their daily practice. It is important to remember that partic[illegible]s of dancers may have varying abilities and physi[illegible], so care must be taken to construct safe and ap[illegible]imens. For example, adolescent dancers can exp[illegible]pid decrease in proprioception (internal body[illegible] coordination, and strength due to the growth[illegible] vocational dance students, who have slightly [illegible] training goals than professionals, fatigue can contribu[illegible] injury occurrence, so the emphasis of fitness training shou[illegible] be on aerobic conditioning. However, sessions should also include rest, muscular strength, endurance, and power work.[1,6,8,21]

Conclusion

Assessing, observing and researching the specific characteristics of dance assist dancers and their teachers to improve training techniques, to employ effective injury-prevention strategies and to determine better standards of health and physical conditioning. As we understand and develop more appropriate dance training methodologies, dancers can reap the benefits of enhanced performance, reduced injury and ultimately longevity in their careers.

References

1. Laws H. *Fit to Dance 2: Report of the Second National Inquiry into Dancers' Health and Injury in the UK.* London: Dance UK, 2005.
2. Wyon M, Redding E, Abt G, Head A, Sharp C. Development, reliability and validity of a multi-stage dance specific aerobic fitness test (DAFT). J Dance Med Sci. 2003;7(3):80-4.
3. Wyon M, Head A, Sharp NCC, Redding E. The cardiorespiratory responses to modern dance classes. J Dance Med Sci. 2002;6(2):41-5.
4. Krasnow DH, Chatfield SJ. Dance science and the technique class. Impulse. 1996;4:162-72.
5. Clarkson PM, Skrinar M (eds). *Science of Dance Training*. Champaign, IL: Human Kinetics, 1988.
6. Koutedakis Y, Sharp NCC. *The Fit and Healthy Dancer*. Chichester: Wiley, 1999.
7. Koutedakis Y. Fitness for dance. J Dance Med Sci. 2005;9(1):5-6.
8. Berardi GM. *Finding balance: Fitness, Training and Health for a Lifetime in Dance* (2nd ed). New York: Routledge, 2005.
9. Rafferty S, Redding E, Irvine S, Quin E. The effects of a one-year dance-specific fitness training program on undergraduate modern dance students: an experimental study. Abstract. J Dance Med Sci. 2007;11(1):16.
10. Angioi M, Metsios GS, Twitchett E, Koutedakis Y, Wyon M. Association between selected physical fitness parameters and esthetic competence in contemporary dancers. J Dance Med Sci. 2009;13(4):115-23.

11. Shell CG (ed). *The Dancer as Athlete: the 1984 Olympic Scientific Congress Proceedings*, vol. 8. Champaign, IL: Human Kinetics, 1984.
12. Wyon M, Redding E. Physiological monitoring of cardiorespiratory adaptations during rehearsal and performance of contemporary dance. J Strength Condit Res. 2005;19(3):611-14.
13. Wyon M. Cardiorespiratory training for dancers. J Dance Med Sci. 2005;9(1):7-12.
14. Redding E, Wyon M. Strengths and weaknesses of current methods for evaluating the aerobic power of dancers. J Dance Med Sci. 2003;7(1):10-6.
15. Dahlstrom M, Inasio J, Jansson E, Kaijser L. Physical fitness and physical effort in dancers: a comparison of four major dance styles. Impulse. 1996;4:193-209.
16. Rimmer JH, Jay D, Plowman SA. Physiological characteristics of trained dancers and intensity level of ballet class and rehearsal. Impulse. 1994;2:97-105.
17. Cohen A. Dance – aerobic and anaerobic. JOPERD. 1984 Mar;55:51-3.
18. Schantz PG, Astrand PO. Physiological characteristics of classical ballet. Med Sci Sports Exerc. 1984;16(5):472-6.
19. Grossman G, Wilmerding MV. The effect of conditioning on the height of dancer's extension in à la seconde. J Dance Med Sci. 2000;4(4):117-21.
20. Fitt S. *Dance Kinesiology* (2nd ed). Australia: Schirmer, 1996.
21. Rafferty S. Considerations for integrating fitness into dance training. J Dance Med Sci. 2010;14(2):45-9.
22. Heyward V. *Advanced Fitness Assessment and Exercise Prescription* (6th ed). Champaign IL: Human Kinetics, 2010.
23. Koutedakis Y, Stavropoulos-Kalinoglou A, Metsios G. The significance of muscular strength in dance. J Dance Med Sci. 2005;9(1):29-34.
24. Koutedakis Y, Cross V, Sharp NCC. Strength training in male ballet dancers. Impulse. 1996;4:210-19.
25. Baechle TR, Earle RW (eds). *Essentials of Strength Training and Conditioning* (3rd ed). Champaign IL: Human Kinetics, 2008.
26. Phillips NCC. Stability in dance training. J Dance Med Sci. 2005;9(1):24-8.
27. Brown AC, Wells TJ, Schade ML, Smith DL, Fehling PC. Effects of plyometric training versus traditional weight training on strength, power and aesthetic jumping ability in female collegiate dancers. J Dance Med Sci. 2007;11(2):38-44.
28. Hewett TE, Ford KR, Myer GD. Anterior cruciate ligament injuries in female athletes: part two, a meta-analysis of neuromuscular interventions aimed at injury prevention. Am J Sports Med. 2006;34(3):490-498.
29. Hewett TE, Paterno MV, Myer G[illegible] for enhancing proprioception and neuro[illegible]rol of the knee. Clin Orthop Relat Res. 2002;402[illegible]
30. Harley YX, Gibson ASC, Harley EH, Lam[illegible] Vaughan CL, Noakes TD. Quadriceps streng[illegible] jumping efficiency in dancers. J Dance Med Sci. 2002;6(3):87-94.
31. Hewett TE, Stroupe AL, Nance TA, Noyes FR. Plyom[illegible] training in female athletes: decreased impact forces and increased hamstring torques. Am J Sports Med. 1996;24(6):765-773.
32. Alter MJ. *Science of Flexibility* (3rd ed). Champaign, IL: Human Kinetics, 2004.
33. Franklin E. *Conditioning for Dance.* Champaign, IL: Human Kinetics, 2004.
34. Wilmerding MV, McKinnon MM, Mermier CM. Body Composition in Dancers: A Review. J Dance Med Sci, 2005;9(1):17-22.
35. Batson G. Revisiting overuse injuries in dance in view of motor learning and somatic models of distributed practice. J Dance Med Sci. 2007;11(3):70-5.
36. Bompa TO. *Periodization: Theory and Methodology of Training* (4th ed). Champaign, IL: Human Kinetics, 1999.
37. Anderson O. Things your mother forgot to tell you about the periodisation of your training. Peak Performance. 1997;94:1-10.
38. Borg G. Borg's Perceived Exertion and Pain Scales. Champaign, IL: Human Kinetics, 1998.
39. Winter EM, Jones AM, Davison RRC, Bromley PD, Mercer T (eds). *Sport and Exercise Physiology Testing Guidelines Volume ii: Exercise and Clinical Testing: the British Association of Sport and Exercise Sciences Guide.* New York: Routledge, 2007.
40. Redding E, Weller P, Ehrenberg S, Irvine S, Quin E, Rafferty S, Wyon M, Cox C. The development of a high intensity dance performance fitness test. J Dance Med Sci. 2009;13(1):3-9.

Written by Sarah Irvine, M.Sc., Emma Redding, Ph.D., and Sonia Rafferty, M.Sc. under the auspices of the Education and Media Committees of IADMS.