The development of a multi-stage ballet-specific aerobic fitness test: Initial reliability and validity analysis

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Introduction

Researchers investigating the demands of classical ballet have concluded that classical ballet is a high-intensity intermittent form of exercise [1-4]. This form of exercise requires a good aerobic foundation[5], however studies have found that dancers have poor aerobic capacities compared to athletes taking part in other high-intensity, intermittent activities [2],3,6-8]. Furthermore, it has been found that the work that classical ballet dancers carry out in class, rehearsal and performance places little stress on the cardiovascular system, and is insufficient to further develop aerobic fitness [2, 3].

It has been hypothesised that this aerobic weakness may be a causative factor in many injuries associated with classical ballet. It has been documented that many dancers perceived that fatigue was directly related to their injuries [6]. Classical ballet requires high skill, and fatigue can result in poor alignment and the consequent misplacement of forces [5].

Therefore, physiologists and physiotherapists may be seeking ways to improve, and consequently assess the aerobic fitness of dancers.

Simple aerobic activities such as running or cycling are not ideal for a dancing population as they are not representative of a dance performance where dancers are required to produce maximal effort [7]. The use of these tests is also limited in dance, as dancers experience mechanical problems when walking or running, due to external rotation of the lower limbs, limited dorsiflexion at the ankle, and the tendency to land 'toes-first' as if performing a '*jeté*'. These tests also require laboratory or gymnasium equipment such as treadmills, exercise bicycles or elliptical cross-trainers, that many dance companies are unable to access.

A multi-stage dance aerobic fitness test (DAFT) was developed in 2003 [7] which has enabled the aerobic fitness of contemporary dancers to be monitored in a field setting. However this test utilises parallel lower limb alignment, and upper body movements which are not representative of the repertoire of classical ballet. Therefore, the aim of the current study was to develop the DAFT [7] further to enable its' use within a classical ballet company or school setting.

Method

The development of the test

A 16-bar sequence was designed in a similar way to the DAFT [7], with a basic sequence which increased in intensity by one or two changes per level. This ensured that learning of the test did not affect its function. Intensity increased at each stage in terms of both tempo of the accompaniment, and the size of movements. The sequence was choreographed to minimize the need for advanced

skill, to allow both intermediate novice and elite dancers to use the same test, and reducing the affect of movement economy. The test was terminated when a dancer was unable to keep in time with the accompaniment, or if technique became compromised, for example arm lines not held properly, turn-out diminished.

Reliability and validity analysis

15 dancers undertook the test wearing a portable gas analyser (Metamax 3B, Cortex, Leipzig, Germany), with 7 days between the tests. Each subject signed an informed consent form and undertook a familiarisation trial to learn the sequences before the test. Mean relative oxygen uptake and heart rate were calculated for the last 30 seconds of each stage.

Statistical analysis

Logical validity was provided by the termination criteria of the test; an inability of the dancer to keep in time with the tempo of the accompaniment, and when secure classical technique (arms placed well in specific positions, turnout maintained) could not be sustained. The choreography for the test included commonly used classical ballet vocabulary, to ensure validity for use within a ballet population. Reliability was assessed using methodology as described by Bland and Altman [8].

Results, Discussion and Conclusion.

Data collection is still underway, due to equipment failure at the time of writing. It is hypothesised that due to insufficient time between tests for any training effect to have occurred, there will be no significant differences between tests one and two, and that the test will be proved reliable.

References

1. Cohen, J.L., Segal K. R., McArdle W. D., *Heart rate response to ballet stage performance.* 1982.
2. Cohen, J.L., et al., *Cardiorespiratory responses to ballet exercise and the VO2max of elite ballet dancers.* Med Sci Sports Exerc, 1982. **14**(3): p. 212-7.
3. Schantz, P.G. and P.O. Astrand, *Physiological characteristics of classical ballet.* Med Sci Sports Exerc, 1984. **16**(5): p. 472-6.
4. Twitchett, E. *Video Analysis of Classical Ballet*. in *17 Annual meeting of the International Association for Dance Medicine and Science*. 2007. Canberra, Australia.
5. Allen, N. and M. Wyon, *Dance Medicine: Artist or Athlete?* SportEX medicine, 2008. **35**(Jan): p. 6-9.
6. Laws, H., *Fit to dance 2*. 2005, London: Dance UK.
7. Wyon, M., et al., *Development, Reliability, and Validity of a Multistage Dance Specific Aerobic Fitness Test (DAFT).* JOURNAL OF DANCE MEDICINE AND SCIENCE, 2003. **7**(3): p. 80-84.
8. Bland, J.M. and D.G. Altman, *Statistical methods for assessing agreement between two methods of clinical measurement.* Lancet, 1986. **1**(8476): p. 307-10.