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The effect of classical ballet and contemporary dance training on hip extensor flexibility and strength in novice dancers: A pilot study☆

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ABSTRACT

The purpose of this study was to investigate the effect of an 11-week intervention of classical ballet and contemporary dance training on hip extensor flexibility and strength in college-aged students with no prior dance experience. An experimental group of college students enrolled in an introductory college dance course (n = 22) were compared to a control group of college students (n = 7). Measurements of flexibility and strength were taken at baseline and after the 11-week intervention, which consisted of 160 min of classical ballet or contemporary dance technique training per week. A one-way repeated measures analysis of variance (ANOVA) revealed statistically significant changes in bilateral hip extensor flexibility in the experimental group ($p < 0.001$ bilaterally) and in right hip extensor strength ($p < 0.05$). The current findings suggest that participating in classical ballet and contemporary training may increase bilateral hip extensor flexibility and right sided hip extensor strength in college-aged students, which could potentially be beneficial for athletic and fitness training. Additionally, the atmosphere of live music, social support uniquely found in a dance class, may be useful for athletes in training in their respective sport.

1. Introduction

As the trend toward leaner bodies is increasingly embraced in our social climate, the physical aesthetic of classically trained dancers has become a highly valued physique (Pickard, 2013; Ritenburg, 2010). Although these elite dancers are, in part, genetically selected for this art-form (Liederbach, 2000), the conditioning required to achieve and maintain this physique is quite extraordinary (Franklin, 2003; Stracciolini, Hanson, Kiefer, Myer, & Faigenbaum, 2016; Welsh, 2009). Classical dance requires a subtle balance of strength, physical fitness, and extreme joint mobility/muscle flexibility (Koutedakis & Jamurtas, 2004). While some may argue that dance is specifically an artistic visual medium, recent research has demonstrated the viewpoint of the dancer as a performing athlete (Koutedakis & Jamurtas, 2004; Liederbach, 2000).

Strength and flexibility are essential aspects of physical and athletic fitness (Hansen, Rønnestad, Vegge, & Raastad, 2012; Leite et al., 2015). The extremes of these very attributes are fundamental to the physical beauty and technical expectations synonymous with dance (Bronner & Ojofeitimi, 2011). Although methods for flexibility and strength training are highly published in the sports science literature (Berg, 2006; Hadjicharalambous, 2015; Junker & Stöggl, 2015; Leite et al., 2015), dance is rarely utilized in these conditioning programs despite the undeniable parallels (Koutedakis & Jamurtas, 2004).

Hip extensor strength specifically is an important aspect of physical fitness and athletics. The hip extensors work in conjunction with the hip abductors to stabilize the trunk and assist to transfer forces through the kinetic chain during gait (Lyons, Perry, Gronley, Barnes, & Antonelli, 1983; Nadler et al., 2002). Previous research has also explored the concept of hip extension strength in relation to athletic function. Hollman et al. (2013) found an inverse relationship between hip extension strength and knee valgus. More recently, Teng and Powers (2016) report that 'diminished hip-extensor strength may contribute to an overreliance on the knee extensors during dynamic activities' (p. 522) and additionally suggest that the hip extensor strength can influence the hip and knee extensor demands while running (Teng & Powers, 2016). Ambegaonkar et al. (Ambegaonkar, Mettinger, Caswell, Burtt, & Cortes, 2014, p. 614) suggests that hip strength measures, including hip extensor strength, are related to improved star excursion balance

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Fig. 1. The five basic positions of the feet and arms in classical ballet.

scores which may be, in turn, associated with decreased risk of injury to the lower extremity in female athletes.

Hip extensor flexibility also appears to be an important aspect of athletic movement patterns and risk of injury. Hartig and Henderson (1999) suggest a lower incidence of overuse injuries in military basic trainees with increased hamstring flexibility. Hreljac et al. (2000) report that lack of hip extensor flexibility may to lead to overuse injuries in runners. Furthermore, García-Pinillos et al. (2015) suggest that hip extensor flexibility is an essential aspect of the completion of football skills including sprinting, jumping and kicking. The flexibility and strength on the hip extensor complex appear to play an important role in both functional and athletic movement patterning. As both classical ballet and contemporary dance movements place a strong emphasis on lower extremity movements (Bowerman, Whatman, Harris, & Bradshaw, 2015; Bronner & Ojofeitimi, 2011) the question of whether dance movement itself can alter strength and flexibility with its practice appears to be warranted.

The five basic positions of ballet (Kirstein, Stuart, & Dyer, 1952) are the foundation of classical ballet, and additionally, informs the movement profile of many contemporary dance disciplines (Reynolds & McCormick, 2003) (Fig. 1). One essential aspect of both ballet technique and many contemporary dance techniques, is the extreme use of external rotation in the hip, also known as turnout (Sherman, Mayall, & Tasker, 2014; Wilmerding & Krasnow, 2011). While typical human movement patterns maintain neutral alignment of the femoral head in the acetabulum (DonTigny, 1985), classical dance movements are primarily patterned with the hip in external rotation, with a 'perfect' turnout described as 180° across both legs in a *first position* (Pata, Welsh, Bailey, & Range, 2014) (Fig. 1).

As athletic endeavours and conditioning programs work to enhance overall fitness and performance through multi-joint movement patterns, Bronner (2012) suggests that the 'intention of dance movement is the shape and timing of the movement itself' (p. 26–27). The physicality, complexity and artistry of dance may draw people to its practice. While the positioning of dance movements is foreign to most, both novice and elite dancers strive toward perfecting these extreme postures in their training. Classical ballet and contemporary dance techniques are clearly outside of our typical human movement patterns. One may ask, therefore, whether this meticulous movement discipline could be utilized for athletic and fitness enhancement.

Previous research has demonstrated that dance can indeed improve some physical function within different populations. Most relevant to the field of performance enhancement, Alricsson et al. (2003), found that general dance training positively affected the speed, agility, joint and muscle flexibility after an experimental intervention on cross-country skiers. Additionally, Kaltsatou et al. (2011) found that Greek traditional dancing improved the strength of breast cancer survivors while Ferrufino et al. (2011) found that contemporary dance increased postural control in older adults. These findings beg the question whether the adaptation of classical dance training into conditioning regimens be appropriate in the healthy athletic population.

In popular culture, there has been an influx of video clips and articles regarding athletes participating in classical ballet (Bouchette, 2013; Jones, 2015). Ballet based fitness programs have also emerged claiming improved flexibility, strength and agility (Bowers, 2016; Martins, 1997). Although convincing at first glance, these programs and media appear to be predominantly anecdotal and rarely have citations that definitively endorse these views.

The purpose of this study was to investigate the effect of an 11-week intervention of classical ballet and contemporary dance training on the hip extensor flexibility and strength in college-aged students. Although typically utilized as an expressive artistic medium, we hypothesized that this intervention would improve both variables of physical conditioning. In turn, this work could have implications in the way dance is used as a mainstream flexibility and strength training tool.

2. Methodology

2.1. Participants

A convenience sample of 25 dancers were recruited as the experimental group (EG) from the Skidmore College campus in Saratoga Springs, NY. Participants were recruited via invitation emails and announcements in the first class of the semester. Inclusion criteria were current registration in an introductory, two-credit dance course offered within the Skidmore Dance Department and a self-report of being 'healthy' with the absence of any lower extremity dysfunction. Exclusion criteria were previous classical dance experience, missing >3 class periods over the course of the semester, and an age of under 18 years. An additional convenience sample of 10 students not enrolled in a dance course were recruited via invitation emails as a control group (CG). As in the EG, CG participants required a self-report of being 'healthy' with the absence of any lower extremity dysfunction. Additionally, a score on a Lower Extremity Functional Scale (Binkley, Stratford, Lott, & Riddle, 1999) of <2 on any category on this screening tool excluded participants from the study (EG or CG), although none were excluded because of this criteria. Three participants from the CG and three participants from the EG did not complete the study, and were not included in statistical analyses. Two participants left the college on medical leave prior to post-testing, while four participants did not complete post-testing because of scheduling conflicts. The EG therefore included a total of 22 students (7 male, 15 female) and the CG included 7 students (1 male, 6 female) (Table 1).

Table 1
Participant demographics (mean ± SD).

	Experimental group (n = 22)	Control group (n = 7)
Age (yr)	19.8 ± 1.1	20.4 ± 0.8
Height (cm)	168.4 ± 9.4	168.4 ± 8.9
Weight (kg)	68.9 ± 24.4	80.0 ± 40.5

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