

EFFECTS OF AEROBIC ENDURANCE, MUSCLE STRENGTH, AND MOTOR CONTROL EXERCISE ON PHYSICAL FITNESS AND MUSCULOSKELETAL INJURY RATE IN PREPROFESSIONAL DANCERS: AN UNCONTROLLED TRIAL

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ABSTRACT

Objective: The purpose of this study was to evaluate musculoskeletal injury rate and physical fitness before and 6 months after an endurance, strength, and motor control exercise program in preprofessional dancers.

Methods: This uncontrolled trial was completed at a college offering a professional bachelor degree in dance. Forty preprofessional dancers underwent a test battery before and after a 6-month lasting exercise program in addition to their regular dance lessons. Physical fitness was evaluated by means of a submaximal exercise test with continuous physiological monitoring and by a field test for explosive strength. Anthropometric measurements were taken to analyze the influence of fitness training on body composition. Musculoskeletal injury incidence and quality of life were recorded during the 6-month lasting intervention. An intention-to-treat analysis ("last observation carried forward" method) was used with a Student *t* test for normally distributed variables. The Wilcoxon signed rank and Mann-Whitney *U* tests were used as nonparametric tests.

Results: Physical fitness improved after the 6 months of additional training program ($P < .05$). The waist:hip ratio ($P = .036$) and the sum of the measured subcutaneous skin thickness ($P = .001$) significantly decreased. Twelve dancers developed musculoskeletal complaints, requiring temporary interruption of dancing.

Conclusions: The combination of regular dance lessons with an additional exercise program resulted in improved physical fitness in preprofessional dancers, without affecting the aesthetical appearance. A relatively high injury rate was observed during the intervention period. These results suggest that a randomized, controlled trial should be performed to examine the effectiveness of additional exercise in dancers on physical fitness and musculoskeletal injury rate. (*J Manipulative Physiol Ther* 2012;35:381-389)

Key Indexing Terms: *Dancing; Athletic Injuries; Resistance Training; Physical Fitness; Physical Endurance; Athletic Performance; Exercise*

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To be able to fulfil the physical demands imposed by the choreography, professional dancers need an adequate aerobic endurance capacity and muscular strength as well as flexibility and motor control in addition to their technical skills.¹⁻⁵ One could compare these requirements with those of an athlete.¹ In contrast to athletes, little attention has been paid to the prevention of injuries in dancers. Prevalence estimates for musculoskeletal injury in professional dancers are high and range between 40% and 84%.² Several potential risk factors for injury have been suggested, such as a reduced level of aerobic fitness,³ lack of muscular strength,⁴⁻⁶ joint hypermobility,⁷ and altered motor control of the lumbo-pelvic region,⁸ but no conclusive evidence exists for any of these items separately.²

Applying sports science principles to dance training may improve the performances of the dancers.⁹ Dancers demonstrate relative low aerobic fitness and muscle strength, considering the high demands of choreographies. Aerobic endurance of dancers is comparable with that of healthy adults with a sedentary lifestyle or nonendurance athletes.^{1,10} Several researchers determined that the intensity during dance lessons is too low to reach the level of an aerobic training.^{10,11} Only 30% to 50% of the maximal oxygen consumption is reached during “warming up” isometric exercises or stretching.¹⁰ These values may increase to 50% to 80% of the maximal oxygen consumption during training, acquisition of dancing skills, or public performance, but the periods of high intensity are very short.¹¹ Similar results are observed when the heart rate is used to evaluate the intensity of dance lessons instead of the maximal oxygen consumption.¹²

Despite intensive dance classes, muscle strength is rather low in dancers. Isokinetic measurements of the lower limbs of professional dancers reveal lower peak values compared with other athletes or nondancers.^{6,13} Choreographers and dancers consider themselves as artists and are afraid of a negative influence of power training on aesthetical aspects,¹ for example, increased muscle mass leading to an increase in limb circumference. Nevertheless, power training recently became a component of dancing classes.⁹

Advantages of additional training have been often suggested by researchers,^{1,9,12,14} but few studies investigated the effects of additional training in dancers. Most of them were performed in very small samples or analyze only 1 specific component of training. We were interested in physical fitness as well as musculoskeletal injury risk in preprofessional dancers. Because a low level of physical fitness and altered motor control have been associated with an increased injury risk,^{5,8} an endurance-, strength-, and motor control-targeted exercise program was presented to preprofessional dancers. We hypothesized that physical fitness improves after a 6-month lasting endurance-, strength-, and motor control-targeted exercise program without affecting body composition. The purpose of this

study was to evaluate the incidence and location of musculoskeletal injury during this intervention program.

METHODS

Design

An uncontrolled trial was conducted among students enrolled in a full-time Bachelor degree in Dance at the Royal Conservatoire in Belgium. Before participation, all subjects received verbal and written information addressing the nature of the study. The Human Research Ethics Committee of the University Hospital of Antwerp approved the study (no. 7/31/174), and written informed consent was obtained from all participants before testing. A flowchart of the study is presented in [Figure 1](#).

The sample size was predetermined by the number of students who were full-time enrolled in the Royal Conservatoire during the academic year 2008 to 2009. Expanding the sample size was not possible because this is the only professional bachelor for dance in Belgium. Moreover, dropouts were expected because some first-year students stop their studies and because some students from the second and third year perform a stay abroad and miss training or assessments. Therefore, an uncontrolled trial seemed to be the best design. Indeed, subdividing the preprofessional dancers into 2 different training groups (intervention vs control group) could lead to an underpowered study because of small sample sizes within each group. For this reason, no control group was defined because all dancers received the same intervention program in addition to their dance lessons.

Study Participants

Participants were recruited among dancers (N = 41) enrolled at the Department of Dance of the Royal Conservatoire, Artesis University College of Antwerp. At the start of the academic year, all subjects received verbal information addressing the study because they all were eligible for inclusion. Next, an information booklet was handed out to the participants. The participants were instructed to read it vigilantly and to ask for additional explanation if necessary. Inclusion criterion was full-time enrolment. Forty dancers (2 men and 38 women) agreed to participate at the study and signed the informed consent form. One student performed a stay abroad during the whole academic year and was excluded from the study. The age of the participants varied between 17 and 26 years, with a mean age of 20.3 (2.4) years. The study flow is presented in [Figure 1](#).

Outcome Measures

Data collection was performed at the Royal Conservatoire. Baseline assessment included an evaluation of aerobic

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