

Does Pilates Training Benefit Dancers?

An Appraisal of Pilates Research Literature

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Abstract

Pilates has been used extensively by dancers since Joseph H. Pilates first developed his method of training over 60 years ago. With the extent to which Pilates has been incorporated into dancers' training and conditioning, the question arises as to the scientific basis for this practice. Our two-fold purpose was to critically appraise published research on Pilates training in dancers and propose future research strategies for this method in dancers. An extensive literature search was conducted, using *Pilates* as the search word. A total of 277 articles were found. Thirty-nine articles and abstracts were published in refereed, professional journals, of which there were 10 clinical trials. Of these clinical trials, only 5 were published with dancers and gymnasts as the population of interest. The strengths of these 5 clinical trials were: 1. the use of Pilates by experienced instructors; 2. well-written hypotheses; and 3. documented need for research in this area. The weaknesses were: 1. lack of true experimental designs; 2. lack of statistical power; and 3. small sample sizes. There is weak support for the effectiveness of Pilates in improving strength and alignment in dancers, primarily due to a lack of sound research methodology

surrounding each study. Utilizing control groups, randomizing subjects, calculating statistical power, and using valid and reliable methods to measure outcomes can enhance the scientific basis for Pilates in the dance profession.

Pilates is a mind-body fitness program that incorporates breathing and movement to achieve balance and body awareness. Named after its founder, Joseph H. Pilates, this fitness program is designed to be used in conjunction with special apparatus under the supervision of capable instructors trained and certified in Pilates.

Dancers, in particular, probably are one of the few groups of professionals consistently exposed to Pilates training throughout their careers, from a young age through performing and beyond. Published anecdotal evidence supports the use of Pilates in dancers sustaining injuries and requiring rehabilitation¹⁻³ or physical therapy.⁴ In addition, the biomechanical forces exerted while performing demi-plié movements on the reformer have been evaluated.⁵

While Pilates writes that he "scientifically tested" his exercises, his only two known published documents discuss his health program of Contrology⁶ and describe his exercise sequence.⁷ While dancers and other professionals support and endorse the effectiveness of Pilates for improving flexibility, muscular strength, and mind-body awareness, the scientific basis for this practice applied to dancers needs to be articulated. To learn more about the scientific basis for Pilates in dancers, we critically appraised the published research to determine the quality of this research and to recommend strategies for future research with Pilates and dancers.

Methods

We conducted an extensive electronic and paper literature search. Articles were obtained from clinical journals identified through online searches using the OVID search engine and from primary sources found in the obtained published reports. Data bases searched were Medline, AMED (Allied and Complementary Medicine), CINAHL (Cumulative Index to Nursing and Allied Health Literature), SportsInfo, and the Cochrane Database of Systematic Reviews. Journal articles published from 1990 to 2005 were searched. The key word searched was *Pilates*. We referenced each journal title using Ulrich's Periodicals Directory to de-

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termine its publication status, such as refereed, professional journal, trade magazine or consumer magazine. Articles were retrieved for appraisal if they were human subjects research published in refereed, professional journals. We appraised the available research by reviewing each study's question, sample, design, methods, and results.

A total of 277 articles and abstracts were identified. No meta-analyses or systematic reviews were found. Seventy one (25.6%) articles were published in journals that had no match in the Ulrich's Periodicals Directory. Two articles were published in German, one in French and one in Swedish (n = 4, 1.4%). Eighty-five (30.7%) articles were printed in trade magazines, while 78 (28.1%) articles were printed in consumer publications, such as magazines, newspapers, and newsletters.

Thirty nine articles and abstracts (14%) were published in refereed, professional journals. Five of these articles discussed the history and principles of Pilates^{8,9,10,11,12}; 5 articles were commentaries¹³⁻¹⁷; and 4 were briefs^{18,19} and non-research abstracts.^{20,21}

Five articles focused on the use of Pilates in rehabilitation^{22,23} and in rehabilitation of the foot and ankle,²⁴ and the knee.^{1,25} Four articles discussed Pilates along with other mind-body interventions in general,²⁶ as manual therapy,²⁷ for osteoporosis prevention and treatment,²⁸ and for treatment for chronic low back pain.²⁹ Three articles were case reports^{2,3,30} and one article was an observational study biomechanical forces with Pilates equipment.⁵ Two articles discussed use application of Pilates in pregnant women³¹ and in older adults.³²

Of these 39 refereed articles, 10 (3.9%) were research studies. Two studies were conducted in special populations^{33,34} and three were conducted in healthy adults.³⁵⁻³⁷ Five research studies were conducted in dancers and gymnasts.³⁸⁻⁴² We appraised these 5 studies because they were human subjects research that

used Pilates as the intervention (independent variable) in dancers and gymnasts.

Results

Pilates-Based Training in Dancers and Gymnasts

Fitt, Sturman, and McClain-Smith³⁸ determined the effects of workouts using the Pilates reformer and mat work exercises on strength, alignment and mobility in college dance majors. A quasi-experimental, pre-test/post-test design was used. Thirty two dance majors (16 modern dance, 16 ballet) were randomly assigned to attend one weekly training session lasting 1.5 hours; reformer work for 2, 30 minute sessions weekly; daily mat work exercises (experimental group) or to continue their usual conditioning (control group). The training lasted 7 weeks. After 7 weeks, subjects in the control group were offered a modification of the experimental group's treatment program. Selected strength, range of motion, alignment, and one complex task were evaluated by the same investigator. The experimental group had statistically significant improvements in alignment, strength and range of motion compared to the control group. There were no differences in the performance of a complex task.

Parrott³⁹ asked the questions: 1. Does aerobic conditioning and/or the Pilates Technique improve dance technique?; 2. Do additional exercise protocols improve some dimensions of dance technique and not others?; and 3. Can gymnastics judging procedures be adapted to effectively evaluate dance technique? Eighteen female university dance majors (age range 19 to 30 years) enrolled in either a level 1 or 2 modern dance technique class and who performed in a winter concert were enrolled into this quasi-experimental, pre-test/post-test study. Group 1 (n = 6) had 80-minute sessions of a scheduled Pilates class 3 days per week plus their regular dance and rehearsal schedules; Group 2 (n = 6) had 80 minute sessions of a scheduled aerobic dance class 3 days

per week plus their regular dance and rehearsal schedules; and Group 3 (n = 6) maintained their regular dance and rehearsal schedules only. Judges, blinded to group assignment, evaluated two modern-dance sequences performed by each subject. Evaluation was based on the Federation for International Gymnastics (FIG) Code of Points. There was a low inter-rater reliability coefficient for the judges. Overall, the subjects receiving the Pilates intervention had a statistically significant improvement from pre-testing to post-testing. The Pilates method subjects had greatest improvement in alignment, intention of movement, and expressivity of the body. The aerobic conditioning group only had statistically significant differences in the expressivity of the body. The investigators concluded that it may be beneficial for dancers and instructors to use conditioning techniques to improve technical and aesthetic performance.

McClain, Carter, and Abel⁴⁰ examined the effects of a conditioning and alignment program using a Pilates reformer to investigate: 1. A dancer's jump height when performing jumps in first position off or using a foot plate on the reformer in a supine position; and 2. Maintenance of pelvic alignment and stability (after raining in a supine position on the reformer) when standing and executing jumps in first and parallel positions. A quasi-experimental, pre-post test design was employed, and non-random group assignment was used. First or second year dance majors (n = 24) enrolled in a college dance program who had no prior reformer training served as the subjects. The experimental group (n = 10) enrolled in a dance conditioning and alignment course, with 8 weeks on the reformer; 2 weekly dance conditioning and alignment classes (1.5 hours, of which 1 hour included reformer work); and unsupervised, independent workouts on the reformer for one hour per week. The control group (n = 14) enrolled in a ballet and/or modern technique class and maintained their regular routine.

Pre-test and post-test jumping ability was measured by supine jump height and pelvic alignment and videotaped, then evaluated by judges blinded to group assignment. Both experimental and control groups improved significantly, but there was no significant difference in improvement of supine jump height between the two groups. Inter-rater reliability fluctuated among the judges. The experimental group had negative changes in alignment and pelvic placement during jumping. The investigators concluded that jump technique may not be correlated with supine jump height.

Hutchinson, Tremain, Christiansen, and Beitzel⁴¹ used a prospective, repeated measures study to improve the leaping ability of athletes in rhythmic gymnastics using a controlled course of jump training. Eight female national gymnasts (mean age: 16 years; and 2.3 years of experience at the national elite level of gymnastics) were enrolled. Using a non-random assignment, six students were assigned to the experimental group, and received pool training and Pilates for one month. Pilates exercises on the reformer, twice a week for the first month and then once a week, were performed. Each subject performed each exercise for a series of three sets of 20 repetitions progressing sequentially through the workout. The control group (n = 2) had no Pilates exercises or pool training. Data were collected at baseline, one month and four months on both groups (floor reaction time, leap height, and explosive power) measured on the Electronic Vertical Jump Measuring System. The experimental group showed improvement in jump height an average of 16.2%, which was maintained at 4 months and one year. Improvement in floor reaction time averaged of 49.8%, which was maintained at 4 months and one year. Improvements in explosive power averaged 220.4% which was slightly less, but still improved, from baseline to 4 months and one year. The control group had no significant changes at 1 and 4 months in jump height,

floor reaction time and explosive power. The investigators concluded that elite rhythmic gymnasts can improve their leaping ability through a course of jump training that includes Pilates exercises.

McMillan, Proteau, and Lebe⁴² conducted a prospective, 14-week pre-test/post-test study to determine if Pilates promotes good posture and body alignment in relatively advanced student dancers. Ten adolescent ballet students were enrolled. Five students who trained 20 to 25 hours per week were assigned to an experimental group consisting of 23 one-hour private Pilates sessions with mat exercises and reformer work with rotator disks. A daily regimen of mat exercises was performed at home. Private Pilates sessions that advanced throughout the study period were included. The control group (n = 5) had no Pilates training. Muscular strength was measured during vertical alignment during a grand plié using the WATSMART system. On the pre-test, both groups performed similarly. At post-test, the experimental group had a reduced sway (distance) between upper body and pelvis (ear to greater trochanter), therefore showing improved alignment. The investigators concluded that Pilates may be useful in promoting dynamic alignment in ballet students

Appraisal

The overall results from these five studies in dancers and gymnasts show mixed outcomes as to the effectiveness of Pilates training. Except for Fitt and colleagues,³⁸ all of the published articles with dancers and athletes used a quasi-experimental design, resulting in a serious lack of consistency in subject assignment. In the study by McMillan and associates,⁴² 10 adolescent ballet students were assigned based on the school director's determination (it is assumed that parental consent and subject assent were obtained). Similarly, the six elite rhythmic gymnasts in the study by Hutchinson and coworkers⁴¹ were assigned to the intervention (n = 4) or control (n =

2) group, and no rationale for this assignment was given. Parrott³⁹ did not randomize the 18 female university dance majors.

Subject characteristics were not clearly defined in these studies. Sample sizes were small, which suggests a lack of statistical power. In the study by McMillan and associates,⁴² it was not known at the time of pre-testing if the students were all female or if their techniques were comparable, which may have contributed to the intra-group variability. Hutchinson and colleagues⁴¹ did not report their subjects' prior training or expertise in Pilates, which may have influenced their execution of the exercises. It was not stated if there was crossover between the experimental and control groups in their enrollment in the ballet and modern technique class. Since all were dance majors, it is assumed that all subjects would be taking dance classes of some type. Students enrolled in the dance conditioning and alignment course may have differed from subjects not enrolled in the course due to the course's placement in the academic curriculum, year in school, or ability and technique. A review of the demographic data between the two groups showed no differences in the proportion of males and females and average height and weight. There was a difference (no statistics were reported) between the average years of previous training, with the control group having 8.95 years and the experimental group having 6.81 years. Whether this difference had an effect on the study's results is not known.

Most investigators were thorough in describing the sequence and type of Pilates exercises performed. Only reformer and mat exercises were utilized in all of the studies. Not all researchers stated if subjects were supervised during instruction or were permitted to exercise on their own. Furthermore, the duration of each study's protocol varied, which does not allow for comparison in effectiveness across studies. For example, subjects in the McMillan and colleagues⁴² study had 23 one-hour

private sessions of mat and reformer work as well as home Pilates for 14 weeks. In contrast, Hutchinson and associates⁴¹ had pool training and Pilates for one month on the reformer, twice a week for the first month, and then weekly. While Parrot's³⁹ subjects had 80-minute sessions of a Pilates class 3 days per week, it is not known if this intervention included mat and apparatus work. Also, the length of Parrot's³⁹ training program was not specifically stated, but speculated to be 8 weeks in duration. McClain and coworkers⁴⁰ had study subjects use the reformer for 8 weeks as well as one hour weekly unsupervised sessions. Fitt and colleagues³⁸ had subjects enrolled in weekly training sessions for 1.5 hours; 2 sessions at 30 minutes per week on the reformer; and daily mat work for a total of 7 weeks. Such variability in session length and protocol length does not permit extrapolations for what would be an appropriate amount of time for changes in study outcomes to be attained in other populations (external validity). Typically, there was no measurement of the subjects' compliance with their at-home Pilates routine, and the hours involved with these exercises were not factored into the overall hours of Pilates training or study outcomes.

The particular "method" of Pilates exercise (e.g., Balanced Body, Stott-Pilates, The Method) was not specified in the research conducted in the early 1990's because such differentiation did not come about until later in the 1990's. Theoretically, there would be similarities in the basic execution and order of the exercises as set forth by Joseph H. Pilates; practically, it is not known if variations and modifications offered by each recognized method of Pilates contributed to the overall generalizability (external validity) of these studies' results.

The study by Hutchinson and colleagues⁴¹ used pool exercises in addition to Pilates. For these workouts, the depth of water, intensity level, and instructor supervision or instruction were not reported. The interaction effect between the Pilates and

pool exercises cannot be discounted, making it difficult to evaluate the effectiveness of Pilates alone.

Even with small sample sizes, where large differences in outcomes would be found, there existed little variation between the treatment and control groups on outcome variables. In the studies conducted with athletes and dancers, these individuals may already have been performing at their peak. Their reported hours of training were quite high (20 to 25 hours per week⁴²) and (34 hours per week⁴¹), suggesting that additional factors may have attributed to performance outcomes. Extrapolating results from high-performance athletes to the general population is not possible, however.

Consistently, each study appeared to use valid and reliable methods for measuring changes in subject and control outcomes. Efforts were taken to detail inter-rater reliability, and instrument validity and reliability. Overall, the outcomes of interest were appropriate to the studies' purpose, questions, methods, and intervention.

Recommendations for Future Research

Despite the plethora of published articles on Pilates in trade and consumer publications, there is a lack of scientific evidence for its effectiveness, particularly in dancers. Ideally, a large number of well-controlled research studies using dance students, professional dancers, and dancers other than those experienced in ballet and modern dance, would have been conducted, published and discovered during a literature review. The reality is that very few research studies rigorously examining Pilates have been published. These studies were all published in the 1990's, and it is not known why there has been very little published with dancers since that time. This lack of published research is disappointing, considering the integration of Pilates into dance curricula, training, and rehabilitation.

Overall, each study's purpose, questions, and hypotheses were well

stated. The rationale for studying Pilates was well conceptualized, and documentation of the need for such study was presented clearly. All investigators were in agreement that Pilates warranted further study in their populations of interest (dancers and gymnasts). All investigators had experience in working with the populations of interest and had knowledge of the application of Pilates as an intervention. The lack of randomization is a concern, leaving room for bias in group allocation. This influence cannot be discounted, despite assumed similarities in physical and other attributes between control and intervention groups. Furthermore, there was no measurement of the subjects' prior training in or skill level with executing each study's Pilates exercises.

A limitation of our appraisal is that we may have missed articles that were not available through our OVID search engine. Unpublished master's theses and doctoral dissertations were not located through our search, and there may be rich sources of data in these documents.

Conclusion

There is weak support for the effectiveness of Pilates, and this weakness is related to the lack of sound research methods employed in the published research. Others have noted the wide variability in the quality and quantity of Pilates research,²⁶ and researchers and practitioners alike agree that there is a lack of, and need for, published research on the effectiveness of Pilates in healthy and injured adults.^{8,17,22,38}

Human subjects research must be conducted with Pilates to establish an evidence-base for its practice. Such an evidence-based can further enhance instructor training, allowing for consistency among certification curricula and practice.^{14,15} Well-designed studies that randomize subjects, use a control group, measure compliance with the study intervention (Pilates), include covariates in the statistical outcomes, calculating power, and using valid and reliable methods

to measure outcomes, would help to determine the efficacy of Pilates. Such research can only enhance the scientific basis of Pilates as taught and practiced in the dance profession.

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