Dance Science Research and the Modern Dancer

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Abstract—While the literature abounds with studies examining classical dancers, considerably less has been published about modern dancers. The focus of this paper is to review and to compare articles involving research about the modern dancer. The selection process was restricted to articles that employed research methodology involving subjects, testing procedures, and data collection. While there are many articles that involve theoretical discussions of modern dance, this review concentrates on specific results from analytic studies. The limitations to this search include the following: articles written and published in English, articles published in journals or books, and restrictions on source materials available. Finally, a small sample of theoretical articles are included to give an example of the variety of other topics currently found in the literature. Med Probl Perform Art 14:16–20, 1999.

REVIEW OF THE LITERATURE

The articles selected for this analysis of modern dance research have been subdivided into eight categories: injury incidence, conditioning testing, nutrition and body composition, psychological and psychosocial factors, training enhancement, biomechanical mechanisms, measurement tools, and collections. An overview of the literature reveals that the majority of studies in modern dance have been done on students, primarily at the college and university levels. The two exceptions are studies done about injury incidence, in which approximately 50% of the studies used professional dancers, and studies done about biomechanical mechanisms, in which the majority used professionals.

Injury Incidence

The largest number of articles found (22) were based on data gathered about injuries. Most of these involved collecting information about location of injuries, or about rate of injury or both. There was considerable disagreement about the most common site of injury with some studies citing the lower leg as most affected, and other studies emphasizing the back. Solomon and Micheli suggest that there may be different injuries incurred depending on the style or type of modern dance being performed. Garrick and Schall et al. conclude that the data may indicate more about dancers’ concerns and willingness to report to medical personnel, than about actual incidence. This remark is consistent with the observation that self-reporting studies of injury occurrence show a higher rate of injury than those studies with medical reporting. In both instances, however, rates were quite high, ranging from 59% to 97%. A third suggestion is that the location of injury may be related to age. In a study by Krasnow et al., adolescent ballet and modern dancers incurred a higher incidence of hip injuries than reported in adult populations. The hip joints may be particularly vulnerable during growth spurt years. Other articles in this category looked at specific injuries, such as snapping hip and ankle problems, causes and care of injuries, correlation of injuries to other factors, such as anatomical features, and a variety of case studies.

Conditioning Testing

There were ten articles that studied various areas of conditioning, including aerobic and anaerobic capacity, strength levels, and range of motion capabilities. Several of these articles were concerned with physiologic issues. Three of the articles involved using the Reformer from the Pilates method to examine alignment issues and height of jump, along with other areas of conditioning. One study examined combined imagery work with conditioning for strength and flexibility. Results from these articles are inconsistent. In some cases, modern dance training improved aerobic and anaerobic capacity, and in other studies, there were no significant differences. Generally, dance training did not increase strength levels, but had some effect on range of motion at the hip. Since the time period covered by these studies ranged from 1981 to 1997, changes in training methodologies in modern dance classes might account for these differences. The studies using the Reformer were equally contradictory, with one study
providing evidence of significant changes in strength, hip range of motion, and pelvic alignment,\textsuperscript{21} but the other two showing no changes. All three studies, however, showed no improvement in vertical jump height. Studies also compared various dance styles (ballet, modern, aerobic dance) and various training levels (students and teachers), but the results were mixed.

**Nutrition, Body Composition, and Menstrual Dysfunction**

Ten studies examined the eating habits, body composition, and/or menstrual function of modern dancers. All of the articles concerned with eating behaviors concluded that dancers are calorically and nutritionally deficient, and some stated that dancers are at risk for anorexia.\textsuperscript{1, 25, 46, 53, 71, 74, 81} However, several of these studies collapsed the data on ballet and modern dancers. Potter et al. (57) separated the two groups, and found that the modern dancers were older, weighed more, and had a higher body fat composition than the ballet dancers, although the dietary studies on modern dancers still found them to be nutritionally deficient. Aust\textsuperscript{2} found a correlation between menstrual dysfunction and increased incidence of injuries, and proposed that this may be related to hormonal mechanisms. Additionally, the ballet dancers had a higher incidence of menstrual dysfunction than did the modern dancers.

**Psychological and Psychosocial Factors**

Nine articles studied a variety of psychological and psychosocial issues affecting modern dancers.\textsuperscript{32, 33, 43, 47, 49, 50, 55, 59, 70} Topics covered included stress, aging, psychosocial barriers to seeking medical attention for injuries, effects of negative teaching styles, creative characteristics, exercise dependence, and body image. Two of the more conclusive studies were by Pierce et al.\textsuperscript{35} and Mainwaring et al.\textsuperscript{49} Pierce et al. found that dancers have higher scores on exercise dependence than do athletes, and that these high scores often are correlated with tendencies to have eating disorders. The study by Mainwaring et al. found a correlation between stress and increased incidence of injury, and that negative stress correlates with longer duration of healing time.

**Training Enhancement**

Seven articles looked at a variety of issues that involve enhancing or examining aspects of modern dance training, and covered a wide range of topics. The oldest study\textsuperscript{4} found no significant differences between modern dancers and control subjects in a range of tests, including agility, balance, and vertical jump. Two other studies also looked at aspects of balance, finding that skilled modern dancers were better at a new balancing task than the nondancer control subjects,\textsuperscript{83} and that while there was strong concentration across a variety of balance tasks, there was no relationship between direction of concentration and successful performance.\textsuperscript{36} Three of the articles focused on learning issues in the dance class. Gray and Skrinar\textsuperscript{31} looked at differing bases of support in ballet and modern dancers. While Puretz\textsuperscript{58} found that bilateral transfer of new material does occur, Welsh et al.\textsuperscript{87} found that forward chaining strategies are more successful than backward chaining strategies. Finally, Wood-hull-McNeal et al.\textsuperscript{89} found that the alignment of individual dancers varies depending on the dance position assumed.

**Biomechanical Mechanisms**

Six articles reported studies of a wide range of biomechanical issues in dance. The greatest interest in these studies is in muscle use, especially in the legs. Two studies examined hamstring/quadriceps (H/Q) ratios. Cardinal and Cardinal\textsuperscript{6} found that modern dancers tend to have lower H/Q ratios than both nondancer control subjects and the recommended 2:3 ratio. Chmelar et al.\textsuperscript{13} suggested that H/Q ratios in dancers are not homogeneous across styles. In a similar finding, one study found differing muscle uses in the lower legs in plié and stances between ballet and modern dancers, and hypothesized that this may be due to differences between the two groups in genu recurvatum and turnout.\textsuperscript{83} Additionally, one study determined that dancers suffering from patellar femoral syndrome (PFS) showed greater quadriceps use than dancers without PFS.\textsuperscript{18} Another study compared female modern dancers with male ballet dancers, and the data suggested that lower thigh-output power correlated with increased lower extremity injuries, but not back injuries.\textsuperscript{36} A study comparing dancers and nondancers found that professional training does influence foot mechanics used in the landing phase of jumps.\textsuperscript{52}

**Measurement Tools**

Four articles discussed the development of measurement tools. Liederbach\textsuperscript{88} and Plastino\textsuperscript{86} describe physical screening procedures for modern dancers. While there are many excellent articles that describe screening procedures for dancers, these two specifically discussed the modern dancer. Chatfield\textsuperscript{8} and Krasnow et al.\textsuperscript{42} developed measures to quantify aspects of aesthetic competence and performance in modern dance.

**Collections**

Deserving mention are some books that are collections of chapters or articles dealing with dance science, offering valuable information and presenting research studies about the modern dancer. These include *The Science of Dance Training*\textsuperscript{16}; *Dance Medicine: A Comprehensive Guide*\textsuperscript{62}; *The Dancer as Athlete*\textsuperscript{72}; *Preventing Dance Injuries: An Interdisciplinary Perspective*\textsuperscript{80}; and *Epidemiology of Sports Injury*, in the chapter entitled “Dance.”\textsuperscript{95}

**Other Areas of Study**

Included in the bibliography are 12 examples of numerous articles focusing on the modern dancer, but without data gathered from studies.\textsuperscript{7, 9, 17, 24, 29, 34, 40, 41, 61, 63, 66, 67, 77} These are listed to give a sample of the various topics and
CONCLUSIONS

The majority of dance research studies examine the classical dancer, or include other styles (such as modern, jazz, or aerobic dance) but collapse the data so that it is impossible to glean information about the specific problems of modern dancers. The results from articles that do separately discuss ballet and modern dancers suggest that modern dancers should be studied as a separate entity. Specifically, three areas in which ballet and modern dancers seem to differ are injury sites and rates, nutrition and body composition, and biomechanical mechanisms. Another problem with the current research is that generally the sample pools in studies with modern dancers are small, not facilitating sound statistical analysis. This is possibly a reflection of the available funding and accessibility of large numbers of modern dancers. A third observation is that the majority of studies on modern dancers look at student pools, and there is no way of knowing whether the results generalize to the professional population.

There are two main areas in which the research is highly contradictory. The first, mentioned above, is in the area of injury statistics. Both the primary site of injury occurrence and the rate of injury are highly variable from study to study. There are suggestions in the literature about possible causes for these differences, but they remain untested. The second area of conflicting data is in the results from conditioning testing. The efficacies of certain procedures and systems for improving the general fitness levels of modern dancers, and the application of these improvements to dance practice, are unsubstantiated.

The major agreement across studies of similar focus is in nutritional habits of modern dancers. While many of the studies collapsed the data for ballet and modern dancers, there is nevertheless an emerging pattern of deficient caloric intake and deficient nutritional content in modern dancers’ diets. And while the injury rates in different studies vary considerably, there is still the undisputed observation that injury rates are very high in the modern dance population.

RECOMMENDATIONS

The first recommendation arising from this review is that separate studies be conducted on modern dancers, or that data be analyzed separately in studies with mixed pools. Until the modern dancer receives specific attention, there will be no way to determine the applicability of dance science research to this specialized population.

Second, it is important to begin examining the contradictions in the current literature. In particular, different studies report a variance in location and rates of injuries. Is this truly a reflection of actual incidence? Are specific techniques or choreographic styles responsible for causing higher rates of injury in different areas of the body? Or is it that the data are not reflecting actual injury rates, but rather representing only those injuries for which dancers are seeking medical help, and thereby distorting the injury statistics? A second area of contradiction in the current literature lies in the conditioning testing on modern dancers. What additional conditioning do modern dancers actually need? Further, what is effective in improving the conditioning levels of modern dancers, and what is directly transferable to dance practice and performance? Both of these areas of differing results need further research.

Finally, it is crucial that research studies use larger sample pools, and more professional dancers. The question that needs to be answered is why there are so few professional modern dancers included in the research. Is this a reflection of economic problems and limitations, is it a lack of accessibility to available medical resources, or are there psychosocial factors preventing modern dancers from seeking medical help? What other methods can researchers use to include modern dancers in the studies, in addition to seeking information through the medical clinics or institutions? It is imperative that those researchers interested in the modern dancer actively seek a broader pool of subjects in order to generate data that are representative of the general population in this field.

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