

Dance Science Research and the Modern Dancer

Donna Krasnow, M.S., and Motaz Kabbani

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 in-

jury or both.^{3, 5, 12, 15, 28, 35, 37, 60, 69, 75, 78, 79, 84, 86, 88} 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 Micheli⁷⁹ suggest that there may be different injuries incurred depending on the style or type of modern dance being performed. Garrick²⁸ and Schafle et al.⁶⁹ 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.,⁴⁴ 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 hip³⁵ and ankle problems⁸²; causes and care of injuries^{3, 22, 60, 75}; correlation of injuries to other factors, such as anatomical features^{76, 88}; and a variety of case studies.^{19, 54, 68}

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.^{10, 11, 14, 20, 21, 26} 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.^{27, 30, 51} One study examined combined imagery work with conditioning for strength and flexibility.⁴² 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

Ms. Krasnow and Mr. Kabbani are in the York University Department of Dance, Toronto, Ontario, Canada.

Address correspondence and reprint requests to: Donna Krasnow, M.S., York University, Department of Dance, 106 Howard Park Avenue Upper, Toronto, Ontario, Canada M6R 1V6. E-mail: <dkrasnow@yorku.ca>.

providing evidence of significant changes in strength, hip range of motion, and pelvic alignment,²⁷ 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.^{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. Aust² 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.^{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.⁵⁵ and Mainwaring et al.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 study⁴ 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,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.³⁶ Three of the articles focused on learning issues in the dance class. Gray and Skrinar³¹ looked at differing bases of sup-

ports in ballet and modern dancers. While Poretz⁵⁸ found that bilateral transfer of new material does occur, Welsh et al.⁸⁷ found that forward chaining strategies are more successful than backward chaining strategies. Finally, Woodhull-McNeal et al.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 Cardinal⁶ 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.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.⁸³ Additionally, one study determined that dancers suffering from patellar femoral syndrome (PFS) showed greater quadriceps use than dancers without PFS.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.³⁸ A study comparing dancers and nondancers found that professional training does influence foot mechanics used in the landing phase of jumps.⁵²

Measurement Tools

Four articles discussed the development of measurement tools. Liederbach⁴⁸ and Plastino⁵⁶ 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. Chatfield⁸ and Krasnow et al.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*¹⁶; *Dance Medicine: A Comprehensive Guide*⁶²; *The Dancer as Athlete*⁷²; *Preventing Dance Injuries: An Interdisciplinary Perspective*⁸⁰; and *Epidemiology of Sports Injury*, in the chapter entitled "Dance."⁵

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.^{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

theoretical constructs that dance researchers and educators are examining. Topics include curriculum development, measurement tools, biomechanics, dance medicine overview, descriptive discussion of injuries, pedagogy, and conditioning.

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.

BIBLIOGRAPHY

1. Antonelli F, Tognetti A, Grandonico N, Caputo C, Zenobi L: L'anorexia provocata [Provoked anorexia]. *Movimento* 7(2):95-101, 1991.
2. Aust NZJ: The effect of dance training on menstrual function in collegiate dancing students. *Obstet Gynecol* 35:304-309, 1995.
3. Bowling A: Injuries to dancers: Prevalence, treatment, and perceptions of causes. *Br Med J* 298:731-734, 1989.
4. Bushey SR: Relationship of modern dance performance to agility, balance, flexibility, power, and strength. *Res Q* 37:313-316, 1966.
5. Caine CG, Garrick JG: Dance. In Caine DJ, Caine CG, Lindner KJ (eds): *Epidemiology of Sports Injury*. Windsor, Ontario, Canada, Human Kinetics Publishers, 1996, pp 124-160.
6. Cardinal MK, Cardinal BJ: An analysis of the quadriceps:hamstring ratio among dancers and other cohorts. *Kinesiol Med Dance* 15 (1):36-45, 1992/93.
7. Cardinal MK, Hilsendager SA: A curricular model for dance wellness education in higher education dance programs. *J Dance Med Sci* 1(2):67-72, 1997.
8. Chatfield SJ: Quantification of aesthetic competence in dance. *Impulse: Int J Dance Sci Med Educ* 1:115-125, 1993.
9. Chatfield SJ, Barr S, Woollacott MH, Sveistrup H: Electromyographic and kinematic analysis of movement repatterning in dance. *Impulse Int J Dance Sci Med Educ* 4:220-234, 1996.
10. Chatfield SJ, Byrnes WC, Foster VL: Effects of intermediate modern dance training in select physiologic performance parameters. *Kinesiol Med Dance* 14(2):13-26, 1992.
11. Chatfield SJ, Byrnes WC, Lally DA, Rowe SE: Cross-sectional physiologic profiling of modern dancers. *Dance Res J* 22(1):13-20, 1990.
12. Chmelar RD, Fitt SS, Schultz BB, Ruhling RO, and Zupan MF: A survey of health, training, and injuries in different levels and styles of dancers. *Med Probl Perform Art* 2:61-66, 1987.
13. Chmelar RD, Schultz BB, Ruhling RO, Fitt SS, Johnson M: Isokinetic characteristics of the knee in female, professional and university, ballet and modern dancers. *J Orthop Sports Phys Ther* 9:410-418, 1988.

14. Chmelar RD, Schultz BB, Ruhling RO, Shepherd TA, Zupan ME, Fitt SS: A physiologic profile comparing levels and styles of female dancers. *Physician Sportsmed* 16(7):87-96, 1988.
15. Clanin DR, Davidson DM, and Plastino JG: Injury patterns in university dance students. In Shell CG (Ed): *The Dancer as Athlete*. Champaign, IL, Human Kinetics Publishers, 1986, pp 195-199.
16. Clarkson PM, Skrinar M: *The Science of Dance Training*. Champaign, IL, Human Kinetics, 1988.
17. Clippinger-Robertson K: A unique challenge: Biomechanical considerations in turnout. *J Health Phys Educ Recreat Dance May/June*: 37-40, 1987.
18. Clippinger-Robertson KS, Hutton RS, Miller DI, Nichols TR: Mechanical and anatomical factors relating to the incidence and etiology of patello-femoral pain in dancers. In Shell CG (Ed): *The Dancer as Athlete*. Champaign, IL, Human Kinetics Publishers, 1986, pp 53-72.
19. Daffner RH: Anterior tibial striations. *Am J Roentgenol* 143: 651-653, 1984.
20. Dahlström M: Physical effort during dance training: A comparison between teachers and students. *J Dance Med Sci* 1:143-148, 1997.
21. Dahlström M, Inasio J, Jansson E, Kaijser L: Physical fitness and physical effort in dancers: A comparison of four major dance styles. *Impulse Int J Dance Sci Med Educ* 4:193-209, 1996.
22. Dick F, Bowling A: British dance companies' attitudes toward injuries. *Med Probl Perform Art* 11:127-132, 1996.
23. Dolgener FA, Spasoff TC, St. John WE: Body build and body composition of high ability female dancers. *Res Q Exerc Sport* 51: 599-607, 1980.
24. Dunn J: Dance medicine and science: The state of the art 1993. *Impulse Int J Dance Sci Med Educ* 1:3-9, 1993.
25. Evers CL: Dietary intake and symptoms of anorexia nervosa in female university dancers. *J Am Diet Assoc* 87:66-68, 1987.
26. Fitt S: Conditioning for dancers: Investigating some assumptions. *Dance Res J* 14(1/2):32-38, 1981/1982.
27. Fitt S, Sturman J, McLain-Smith S: Effects of Pilates-based conditioning on strength, alignment, and range of motion in university ballet and modern dance majors. *Kinesiol Med Dance* 16(1):36-51, 1993-94.
28. Garrick JG: Characterization of the patient population in a sports medicine facility. *Physician Sportsmed* 13(10):73-76, 1985.
29. Garrick JG: Dance injuries. In Mellion MB, Walsh WM, Shelton GL (eds): *The Team Physician's Handbook*. Philadelphia, Hanley and Belfus, 1990, pp 655-662.
30. George D, Vetter R, Ludwig K, Smith D, Gench B: Effects of Current Concepts Reformer exercises on abdominal strength, hip flexibility, pelvic girdle alignment, and the vertical jump in modern dancers. *J Interdisc Res Phys Educ* 1(2):63-72, 1996.
31. Gray M, Skrinar MH: Support base use in two dance idioms. *R Q Exerc Sport* 55:184-187, 1984.
32. Greben SE: Consultation and psychotherapy for professional dancers: Overview and general observations. *Med Probl Perform Art* 6:87-89, 1991.
33. Greben SE: Dealing with the stresses of aging in dancers. *Med Probl Perform Art* 7:127-131, 1992.
34. Hays JF: *Modern Dance: A Biomechanical Approach to Teaching*. St. Louis, C. V. Mosby, 1981.
35. Jacobs M, Young R: Snapping hip among dancers." *Am Correct Ther J* 32(3):92-98, 1978.
36. Jette N, Shick J, Stoner LJ: Concentration of modern dancers while performing balancing tasks. *Dance Res J* 17(1): 21-25, 1985.
37. Kerr G, Krasnow D, Mainwaring L: The nature of dance injuries. *Med Probl Perform Art* 7:25-29, 1992.
38. Koutedakis Y, Khloula M, Pacy PJ, Murphy M, Dunbar GMJ: High peak torques and lower-body injuries in dancers. *J Dance Med Sci* 1:12-15, 1997.
39. Koutedakis Y, Pacy PJ, Carson RJ, Dick F: Health and fitness in professional dancers. *Med Probl Perform Art* 12:23-27, 1997.
40. Krasnow D: C-I Training: The merger of conditioning and imagery as an alternative training methodology for dance. *Med Probl Perform Art* 12:3-8, 1997.
41. Krasnow DH, Chatfield SJ: Dance science and the dance technique class. *Impulse Int J Dance Sci Med Educ* 4:162-172, 1996.
42. Krasnow DH, Chatfield SJ, Barr S, Jensen JL, and Dufek JS: Imagery and conditioning practices for dancers. *Dance Res J* 29(1):43-64, 1997.
43. Krasnow D, Kerr G, Mainwaring L: Psychology of dealing with the injured dancer. *Med Probl Perform Art* 9:7-9, 1994.
44. Krasnow D, Mainwaring L, Kerr G: Injury, stress, and perfectionism in young dancers and gymnasts. *Proceedings of the 7th Annual International Association for Dance Medicine and Science Conference*, Tring, England, October 1997.
45. Kravitz SR: Dance medicine. *Clin Podiatry* 1:417-430, 1984.
46. Kurtzman FD, Yager J, Landsverk J, Wiesmeier E, Bodurka DC: Eating disorders and associated symptoms among dancers and other student populations at UCLA. *Kinesiol Med Dance* 13(1):16-32, 1990.
47. Lee SA: The artist as teacher: A psychological perspective. *Med Probl Perform Art* 12:38-41, 1997.
48. Liederbach M: Screening for functional capacity in dancers: Designing standardized, dance-specific injury prevention screening tools. *J Dance Med Sci* 1:93-106, 1997.
49. Mainwaring L, Kerr G, Krasnow D: Psychological correlates of dance injuries. *Med Probl Perform Art* 8:3-6, 1993.
50. Mariani ME: Examination of personality and intellectual characteristics among female participants in selected physical activities. Unpublished master's thesis, University of Colorado, Boulder, 1980.
51. McLain S, Carter CL, Abel J: The effect of a conditioning and alignment program on the measurement of supine jump height and pelvic alignment when using the Current Concepts Reformer. *J Dance Med Sci* 1:159-154, 1997.
52. McNitt-Gray JL, Koff SR, Hall BL: The influence of dance training and foot position on landing mechanics. *Med Probl Perform Art* 7:87-91, 1992.
53. Mittleman KD, Keegan M, Collins CL: Physiological, nutritional, and training profile of university modern dancers. *Med Probl Perform Art* 7:92-96, 1992.
54. Oliver W: Problems in technique: Ankle block—A case study. *Kinesiol Dance* 9(4):18-19, 1987.
55. Pierce EF, Daleng ML, McGowan RW: Scores on exercise dependence among dancers. *Percept Mot Skills* 76:531-535, 1993.
56. Plastino JG: The university dancer: Physical screening. *J Health Phys Educ, Recreat Dance May/June*: 49-50, 1987.
57. Potter AB, Lavery ES, Bell RA. Body fat and body mass index measurements in preprofessional dance students: A comparison of formulas. *Med Probl Perform Art* 11:43-46, 1996.
58. Poretz SL: Bilateral transfer: The effects of practice on the transfer of complex dance movement patterns. *Res Q Exerc Sport* 54(1):48-54, 1983.
59. Poretz SL: Influence of modern dance on body image. In Woodruff DL (Ed): *Dance Research Annual IX: Essays in Dance Research: From the Fifth CORD Conference*, Philadelphia, November 11-14, 1976. New York, Congress on Research in Dance, 1978, pp 213-230.
60. Rovere GD, Webb LX, Gristina AG, Vogel JM: Musculoskeletal injuries in theatrical dance students. *Am J Sports Med* 11:195-198, 1983.
61. Ryan AJ: Early history of dance medicine. *J Dance Med Sci* 1:30-34, 1997.
62. Ryan AJ, Stephens RE: *Dance Medicine: A Comprehensive Guide*. Chicago, Pluribus Press, 1987.
63. Sammarco GJ: The dancer's hip. *Clin Sports Med* 2:485-498, 1983.
64. Sammarco GJ: Diagnosis and treatment in dancers. *Clin Orthop Rel Res* 187:176-187, 1984.
65. Sammarco GJ, Miller EH: Forefoot conditions in dancers, part I. *Foot Ankle* 3(2):85-92, 1982.
66. Sammarco GJ, Miller EH: Forefoot conditions in dancers, part II. *Foot Ankle* 3(2):93-98, 1982.
67. Sammarco GJ, Stephens MM: Neurapraxia of the femoral nerve in a modern dancer. *Am J Sports Med* 19:413-414, 1991.
68. Schafle M, Requa RK, Garrick JG: A comparison of patterns of injury in ballet, modern, and aerobic dance. In Solomon R, Minton SC, Solomon J (eds): *Preventing Dance Injuries: An Interdisciplinary Perspective*. Reston, VA, American Alliance for Health, Physical Education, Recreation, and Dance, 1990, pp 1-14.
69. Schnitt JM, Schnitt D: Psychological issues in a dancer's career. In Ryan AJ, Stephens RE (eds): *Dance Medicine: A Comprehensive Guide*. Chicago, Pluribus Press, 1987, pp 334-349.
70. Schnitt J, Schnitt D, Del A'une W: Anorexia nervosa or thinness in modern dance students: Comparisons with ballerinas. *Annot Sports Med* 3(1):9-13, 1986.
71. Shell CG (ed): *The Dancer as Athlete: The 1984 Olympic Scientific Congress Proceedings*, Vol. 8. Champaign, IL, Human Kinetics Publishers, 1986.
72. Shick J, Stoner LJ, Jette N: Relationship between modern-dance experience and balancing performance. *Res Q Exerc Sport* 54(1):79-82, 1983.
73. Smith DL, Fehling PC, Fernandez DG, McArdle C, Burns S, Healy S:

- Caloric balance in advanced college dancers. *Impulse Int J Dance Sci Med Educ* 2:176–183, 1994.
75. Sohl P, Bowling A: Injuries to dancers: Prevalence, treatment and prevention. *Sports Med* 9:317–322, 1990.
 76. Solomon R: Foot morphology and injury patterns in ballet and modern dancers: Some thoughts on doing research. *Kinesiol Med Dance* 14(1):57–67, 1991–1992.
 77. Solomon R: Training dancers: Anatomy as a master image. *J Phys Educ Recreat Dance* 58(5):30, 1987.
 78. Solomon R, Micheli LJ: Concepts in the prevention of dance injuries: A survey and analysis. In Shell CG (ed): *The Dancer as Athlete: The 1984 Olympic Scientific Congress Proceedings, Vol. 8*. Champaign, IL, Human Kinetics Publishers, 1986, pp 201–212.
 79. Solomon R, Micheli LJ: Technique as a consideration in treating modern dance injuries. *Physician Sportsmed* 14(8):83–92, 1986.
 80. Solomon R, Minton SC, Solomon J (eds): *Preventing Dance Injuries: An Interdisciplinary Perspective*. Reston, VA, American Alliance for Health, Physical Education, Recreation, and Dance, 1990.
 81. Stensland SH, Sobal J: Dietary practices of ballet, jazz, and modern dancers. *J Am Diet Assoc* 92:319–324, 1992.
 82. Stoller SM, Hekmat F, Kleiger B: A comparative study of the frequency of anterior impingement exostoses of the ankle in dancers and nondancers. *Foot Ankle* 4:201–203, 1984.
 83. Trepman E, Gellman RE, Solomon R, Ramesh-Murthy K, Micheli LJ, De-Luca CJ: Electromyographic analysis of standing posture and demi-plié in ballet and modern dancers. *Med Sci Sports Exerc* 26:771–782, 1994.
 84. Washington EL: Musculoskeletal injuries in theatrical dancers. *Am J Sports Med* 6:75–98, 1978.
 85. Washington EL: Musculoskeletal problems in modern, jazz, and “show biz” dancers. In Ryan AJ, Stephens RE (eds): *Dance Medicine: A Comprehensive Guide*. Chicago, Pluribus Press, 1987, pp 274–280.
 86. Washington EL: A survey of dance injuries. In Taplin DT (ed): *New Directions in Dance: Collected Writings from the Seventh Dance in Canada Conference*, University of Waterloo, June, 1979. Toronto, Pergamon Press, 1979, pp 159–166.
 87. Welsh T, Fitt S, Thompson W: A comparison of forward and backward chaining strategies for teaching dance movement sequences. *Impulse Int J Dance Sci Med Educ* 2:262–274, 1994.
 88. Wiesler ER, Hunter DM, Martin DE, Curl WW, Hoen H: Ankle flexibility and injury patterns in dancers. *Am J Sports Med* 24:754–757, 1996.
 89. Woodhull-McNeal AP, Clarkson PM, James R, Watkins A, Barrett S: How linear is dancers’ posture? *Med Probl Perform Art* 5:151–154, 1990.