Yoga for Women With Hyperkyphosis: Results of a Pilot Study

Gail A. Greendale, MD, Anna McDivit, BS, Annie Carpenter, MS, Leanne Seeger, MD, and Mei-Hua Huang, DrPH

The thoracic region of the spine is normally kyphotic, or anteriorly concave. Hyperkyphosis, colloquially called "dowager's hump," refers to excessive kyphotic curvature; however, there is no criterion standard, nor are there any outcome-based definitions of the condition. A kyphosis angle 40°—the 95th percentile value for young adults—is currently used to define hyperkyphosis.[1,2]

Hyperkyphosis may be associated with physical and emotional limitations[3–11] and may have multiple precipitants.[4,12–14] Yoga could be an optimal intervention for hyperkyphosis in that it may improve physical and emotional functioning as well as combat some of the underlying muscular and biomechanical causes. We conducted a single-arm, nonmasked intervention trial to assess the effects on anthropometric and physical function of yoga among women with hyperkyphosis.

METHODS

To be included in the study, which was conducted in Los Angeles during September 2000 to September 2001, women had to meet the following criteria: presence of physician-diagnosed hyperkyphosis, age 60 years or older, absence of angina and uncontrolled lung disease, cleared for participation by primary care physician, and able to pass physical safety tests (e.g., able to rise from the floor to a standing position safely and independently). The intervention involved hatha yoga, a type of yoga incorporating a combination of breathing and movement.

As a means of ensuring the safety of the participants, the study took place in a closely monitored environment involving one-on-one supervision and hands-on adjustments and corrections. The women were divided into 2 separate small classes (n = 11 and n = 10), each of which involved 12 weeks of yoga consisting of twice-weekly 1-hour sessions.

The program included 4 series of poses modified from the classical forms of yoga to accommodate the physical constraints of kyphotic women. More challenging poses were introduced every 3 weeks, and muscles and joints particularly affected by hyperkyphosis (shoulders, spinal erectors, abdominals, neck) were targeted. Figure 1 briefly summarizes the 4 series and illustrates an example of 1 pose from each.

Anthropometric outcomes, assessed at baseline and follow-up by 1 of the investigators (A.M.) by means of standard protocols, were (1) height without shoes (measured with a stadiometer), (2) distance from tragus to wall (a measure of forward curvature), and (3) Debrunner kyphometer angle (an estimate of degree of thoracic spinal curvature; higher values indicate more curvature).[15] At baseline, this investigator performed same-day repeated measurements of each anthropometric characteristic for 6 of the participants. Intraclass correlation coefficients were .98, .61, and .34, respectively.

Timed physical performance measures were chair stands (standing up and sitting down, with arms folded across chest, using an armless chair),[16] functional reach,[17] the "penny test" (picking up a penny from the floor),[18] the "book test" (placing a book on a high shelf),[18] and an 8-ft (2.4-m) walk.[19] At baseline, all participants underwent spinal radiographs; radiographs were read by a skeletal radiologist.[20]

We used pretest–posttest scores to compute changes in each anthropometric and performance outcome. Because our sample size

(a) Recumbent upper extremity stretch.

(b) Hands and knees.

(c) Prone backbend.

(d) Standing pose.

Note. The program contained 4 progressive series of poses that built on one another. One example from each series is shown. (a) The first series was recumbent, which precluded falling. Yoga breathing was taught, and movements included “rolling the shoulders back” and isolated movements of the arms, legs, and abdomen. (b) In the second series, work on hands and knees was aimed at building balance (safely, close to the floor), core strength, and coordinated movements of extremities. (c) In the third series, women began back bends in the prone position on the floor to strengthen the spinal erectors and to stretch the shoulder and hip girdles. (d) The fourth series introduced standing poses, involving all muscle groups, that trained for strength, flexibility, and balance.

FIGURE 1—Overview of yoga series and examples of poses.

was small, we computed mean change scores (matched *t* tests) as well as median scores (Wilcoxon tests). We also conducted analyses that stratified by presence or absence of vertebral fracture (n = 12 women) and by yoga class. Results were not substantively different; thus, we present pooled results.

Participants completed daily diaries that were independently coded by 2 of the researchers. In making entries in their diaries, the women provided responses to semistructured questions and added comments regarding the program. We conducted content analyses of diary entries.[21]

RESULTS

At baseline, the mean age of the 21 participants was 75.0 years (range: 63.3–86.0 years). Mean height and mean weight were 156.9 cm and 61.5 kg, respectively. Nine women (43%) had no thoracic or lumbar vertebral fracture, 7 (33%) had at least 1 thoracic fracture (median = 2), and 5 (24%) had both thoracic and lumbar fractures (all of the women with lumbar fractures had at least 1 thoracic fracture).

Nineteen women (90%) completed the study; losses were due to unrelated medical problems. Among those who completed the study, session attendance averaged 80% (range: 52%–96%), and the daily diary completion rate was 100%. There were no adverse events.

Measured height increased and distance from tragus to wall diminished; no changes in

TABLE 1—Baseline and Follow-Up Physical Characteristics and Physical Performance Measures

	Baseline Mean Value	Follow-Up Mean Value	Mean Change	t	Median Change	Wilcoxon test
Physical characteristic						
Height, cm	156.28	156.81	0.52	0.039	0.30	0.058
Tragus to wall, cm	17.43	15.41	–2.02	0.000	–2.00	0.001
Kyphometer angle, degree	60.89	59.79	–1.11	0.748	–2.00	0.111
Physical performance						
Chair stand, s	16.54	15.23	–1.317	0.034	–1.32	0.033
Penny test, s	2.78	2.47	-0.350	0.037	–0.46	0.039
Functional reach, cm	28.23	33.09	4.863	0.002	5.60	0.005
Book test, s	3.24	2.87	–0.345	0.129	–0.52	0.102
8-ft walk, s	2.60	2.38	–0.222	0.116	–0.21	0.073

Note. Five participants were missing data on one test each; results were unaltered when the analysis exlcuded these 5 individuals.

kyphometer angle were apparent. Improvements were evident in the case of timed chair stands (faster), the penny test (faster), and functional reach (longer) (Table 1).

In terms of diary entries, 63% of the women reported increased postural awareness/improvement (e.g., "I feel I am standing straighter; because I'm more aware of my posture the more I do yoga, the more I remember to stand and sit correctly" and "I still bend over, but I am catching it more often"), 63% reported improved well-being (e.g., "After class I feel relaxed and peaceful" and "I find [the classes] making me feel better in every way"), and 58% perceived improvements in their physical functioning (e.g., "I really think all the classes that I have attended have helped me with my balance" and "I am feeling more energy, I believe, because of the class").

DISCUSSION

Some clinicians perceive hyperkyphosis as the irreversible product of vertebral fractures, leading to greater anterior convexity. However, in 1 study involving 500 participants, only 42% of variance in kyphosis was explained by vertebral wedging.[13] Similarly, another study showed that only 50% of 132 women with hyperkyphosis had vertebral fractures,[3] about the same percentage as in the present pilot study. Postulated causes of "nonfracture" hyperkyphosis include poor posture and muscular weakness, factors targeted by the yoga intervention.[4,14]

The present intervention was not randomized, and investigators assessing outcomes were aware of the study hypotheses, limitations that must be acknowledged. Nonetheless, this pilot study suggests that the use of yoga among women with hyperkyphosis is safe and acceptable and may produce better posture. The mechanisms by which postural improvements occurred among our participants may have included increased strength and flexibility (attested to by improvements in physical function measures) and heightened attention to alignment (as reflected in women's diary entries). The contemplative state encouraged by yoga's mind–body approach may also lead to enhanced well-being,[22] a benefit noted by the majority of our participants. ■

About the Authors

The authors are with the School of Medicine, University of California at Los Angeles.

Requests for reprints should be sent to Gail A. Greendale, MD, UCLA School of Medicine, Division of Geriatrics, 10945 Le Conte Ave, Suite 2339, Los Angeles, CA 90095-1687 (e-mail: ggreenda@mednet.ucla.edu).

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Contributors

G.A. Greendale designed the study, obtained funding, developed the study procedures, and supervised the data analysis. A. McDivit was responsible for enrollment of participants, conducted baseline and follow-up visits, and contributed to the data analysis. A. Carpenter designed the yoga intervention and taught all of the classes. L. Seeger was responsible for the x-ray protocol, reading of spine films, and interpretation of kyphosis angles. M. Huang performed the data analyses.

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Human Participant Protection

Ethical clearance for the study was obtained from the institutional review board of the University of California, Los Angeles.

References

1. Fon GT, Pitt MJ, Thies AC. Thoracic kyphosis: range in normal subjects. *Am J Roentgenol.* 1980;134:979–983.

2. Voutsinas SA, MacEwan GD. Sagittal profiles of the spine. *Clin Orthop.* 1986;210:235–242.

3. Leech JA, Dulberg C, Kellie S, et al. Relationship of lung function to severity of osteoporosis in women. *Am Rev Respir Dis.* 1990;141:68–71.

4. Chow RK, Harrison JE. Relationship of kyphosis to physical fitness and bone mass in post-menopausal women. *Am J Phys Med.* 1987;66:219–227.

5. Ross PD, Ettinger B, Davis JW, et al. Evaluation of adverse health outcomes associated with vertebral fractures. *Osteoporos Int.* 1991;1:134–140.

6. Ettinger B, Black DM, Nevitt MC, et al. Contribution of vertebral deformities to chronic back pain and disability. *J Bone Miner Res.* 1992;7:449–456.

7. Ettinger B, Black DM, Palermo L, et al. Kyphosis in older women and its relation to back pain, disability and osteopenia: the Study of Osteoporotic Fractures. *Osteoporos Int.* 1994;4:55–60.

8. Cook DJ, Guyatt GH, Adachi JD, et al. Quality of life issues in women with vertebral fractures due to osteoporosis. *Arthritis Rheum.* 1993;36:750–756.

9. Lyles KW, Gold DT, Shipp KM, et al. Association of osteoporotic vertebral compression fractures with impaired functional status. *Am J Med.* 1993;94:595–601.

10. Greendale GA, Barrett-Connor E, Ingles S, et al. Late physical and functional effects of osteoporotic fractures in women: the Rancho Bernardo Study. *J Am Geriatr Soc.* 1995;43:955–961.

11. Ryan SD, Fried LP. The impact of kyphosis on daily functioning. *J Am Geriatr Soc.* 1997;45:1479–1486.

12. Hendry NG. The hydration of the nucleus pulposus and its relation to intervertebral disc hydration. *J Bone Joint Surg.* 1958;40:132–144.

13. Milne JS, Lauder IJ. The relationship of kyphosis to the shape of vertebral bodies. *Ann Hum Biol.* 1976;3:173–179.

14. Sinaki M, Itoi E, Rogers JW, et al. Correlation of

back extensor strength with thoracic kyphosis and lumbar lordosis in estrogen-deficient women. *Am J Phys Med Rehabil.* 1996;75:370–374.

15. Ensrud KE, Black DM, Harris F, et al. Correlates of kyphosis in older women. *J Am Geriatr Soc.* 1997; 45:682–687.

16. Csuka M, McCarty DJ. Simple method for measurement of lower extremity muscle strength. *Am J Med.* 1985;78:77–81.

17. Duncan PW, Studenski S, Chandler J, Prescott B. Functional reach: predictive validity in a sample of elderly male veterans. *J Gerontol.* 1992;47:M93–M98.

18. Reuben DB, Sui AL. An objective measure of physical function of elderly outpatients: the physical performance test. *J Am Geriatr Soc.* 1990;38: 1113–1119.

19. Guralnik JM, Simonsick EM, Ferrucci L, et al. A short physical performance battery assessing lower extremity function: association with self-reported disability and prediction of mortality and nursing home admission. *J Gerontol.* 1994;49:M85–M94.

20. Nelson DA, Kleerkoper M. What is a vertebral fracture? In: Marcus R, Feldman D, Kelsey J, eds. *Osteoporosis.* San Diego, Calif: Academic Press Inc; 1996: 613–633.

21. Willms DG, Best JA, Taylor DW, et al. A systematic approach for using qualitative methods in primary prevention research. *Med Anthropol Q.* 1990;4: 391–409.

22. La Forge R. Mind-body fitness: encouraging prospects for primary and secondary prevention. *J Cardiovasc Nurs.* 1997;11:53–65.