

# YOGA PRACTICE IS ASSOCIATED WITH ATTENUATED WEIGHT GAIN IN HEALTHY, MIDDLE-AGED MEN AND WOMEN

Alan R. Kristal, DrPH, Alyson J. Littman, PhD, Denise Benitez, BFA, Emily White, PhD

**Background** • Yoga is promoted for weight maintenance, but there is little evidence of its efficacy.

**Objective** • To examine whether yoga practice is associated with lower mean 10-year weight gain after age 45.

**Participants** • Participants included 15,550 adults, aged 53 to 57 years, recruited to the Vitamin and Lifestyle (VITAL) cohort study between 2000 and 2002.

**Measurements** • Physical activity (including yoga) during the past 10 years, diet, height, and weight at recruitment and at ages 30 and 45. All measures were based on self-reporting, and past weight was retrospectively ascertained.

**Methods** • Multiple regression analyses were used to examine covariate-adjusted associations between yoga practice and weight change from age 45 to recruitment, and polychotomous logistic regression was used to examine associations of yoga practice with the relative odds of weight maintenance (within 5%) and weight loss (>5%) compared to weight gain.

**Results** • Yoga practice for four or more years was associated with a 3.1-lb lower weight gain among normal weight (BMI <25) participants [9.5 lbs versus 12.6 lbs] and an 18.5-lb lower weight gain among overweight participants [-5.0 lbs versus 13.5 lbs] (both *P* for trend <.001). Among overweight individuals, 4+ years of yoga practice was associated with a relative odds of 1.85 (95% confidence interval [CI] 0.63-5.42) for weight maintenance (within 5%) and 3.88 (95% CI 1.30-9.88) for weight loss (>5%) compared to weight gain (*P* for trend .026 and .003, respectively).

**Conclusions** • Regular yoga practice was associated with attenuated weight gain, most strongly among individuals who were overweight. Although causal inference from this observational study is not possible, results are consistent with the hypothesis that regular yoga practice can benefit individuals who wish to maintain or lose weight. (*Altern Ther Health Med.* 2005;11(4):28-33.)

**Alan R. Kristal, DrPH**, is a Member in Public Health Sciences in the Division of Public Health Sciences, Fred Hutchinson Cancer Research Center, Seattle, Wash, and a Professor in the Department of Epidemiology, University of Washington, Seattle. **Alyson J. Littman, PhD**, is a Post-doctoral Fellow in the Division of Public Health Sciences, Fred Hutchinson Cancer Research Center, and a Post-doctoral Fellow in the Department of Epidemiology, University of Washington. **Denise Benitez, BFA**, is a Certified Anasara Instructor and Director of Seattle Yoga Arts. **Emily White, PhD**, is a Member in Public Health Sciences in the Division of Public Health Sciences, Fred Hutchinson Cancer Research Center, and a Professor in the Department of Epidemiology at the University of Washington.

Obesity is a major public health concern in the US. Obesity increases one's risk of developing hypertension, diabetes, and breast cancer and may exacerbate other chronic conditions, such as osteoarthritis, gallstones, dyslipidemia, and musculoskeletal problems.<sup>1,2</sup> In 2001, an estimated 21% of American adults (more than 44 million) were considered obese (body mass

index [BMI] >30 kg/m<sup>2</sup>), a 74% increase since 1991.<sup>3</sup> Developing programs to prevent obesity could reduce morbidity and premature mortality for millions of Americans.

Conventional medical therapies are, at best, only moderately effective in treating obesity.<sup>4</sup> Many forms of complementary and alternative medicine, including use of dietary supplements, radical diets, and mind-body therapies, also have been proposed for weight management.<sup>5</sup> Hatha yoga, which emphasizes postures, breathing, and meditation, is an increasingly popular spiritual and physical practice that is widely promoted in books, videotapes, magazine articles, and programs for weight loss and maintenance.<sup>6</sup> A typical hatha yoga session lasts 60 to 90 minutes and is performed in a group led by an experienced teacher. The practice begins with a short period of centering or meditation, followed by a series of yoga poses (*asanas*) that are designed to build flexibility and strength. During the practice, there is an emphasis on the breath to enhance focus and awareness. Sessions generally end with a five-to-10 minute rest, during which a variety of techniques are used to enable deep physical and mental relaxation. Although a 90-minute, vigorous yoga practice would expend more than of 250 kcal<sup>7</sup> and thus meet American College of Sports Medicine guidelines for weight con-

trol,<sup>8</sup> energy expenditure from a less vigorous yoga practice would be too small to substantially influence energy balance.<sup>7,9-11</sup> We hypothesize that yoga's emphasis on developing body awareness and physical discipline supports the adoption of healthful dietary and exercise habits and thus indirectly affects weight control. We know of no published studies that have examined critically whether yoga practice is associated with weight maintenance or weight loss.

This study examines the associations between yoga practice and weight change in healthy, middle-aged adults. Data are from a large study that collected detailed information on weight history, medical history, physical activity over 10 years, and diet. The sample size was sufficiently large to exclude those with serious medical conditions that might lead to weight loss, adjust for potential confounding variables such as other physical activity and dietary patterns, and examine associations within strata defined by BMI, and we have previously published a detailed report on the associations of physical activity with weight history in this cohort.<sup>12</sup> Observational studies such as this one are important because they examine behavior related to weight change in a free-living population over an extended period of time, which is likely different from that in controlled environments during short trials. Results from this study can help scientists and clinicians better understand how practices such as yoga might be helpful for weight control.

## METHODS

This study's participants were drawn from the Vitamins And Lifestyle (VITAL) study. Methods for the VITAL study have been described in detail elsewhere.<sup>13</sup> Briefly, 364,418 baseline questionnaires were mailed between October 2000 and December 2002 to men and women aged 50 to 76 years who lived in western Washington State. Of the 79,300 questionnaires that were returned, 77,738 met eligibility and questionnaire quality control standards.

Participants in this analysis were aged between 53 and 57 years at recruitment (N=18,995). Respondents with a history of diseases that may lead to weight loss (eg, cancer, cirrhosis of the liver, other chronic liver diseases, kidney disease) or self-reported poor health (n=2,308) were excluded. Those with missing or out-of-range values for height, weight, or BMI (n=1,032) or who did not complete the questions on physical activity (n=155) also were excluded, which left 15,500 participants for analysis.

### Weight, Height, Body Mass Index, and Weight Change

Participants reported their height to the nearest inch and their current weight and weights at ages 30 and 45 to the nearest pound. Outliers for height (<4 ft tall for both men and women and >7 ft tall for women and >8 ft tall for men) and weight (<70 lbs for women and <90 lbs for men and >500 pounds for both men and women) were omitted (n=14), as were those with missing values for height or weight (n=806). BMI was calculated as weight in kg divided by height in meters squared. Participants whose BMI at recruitment or age 45 was <18.5 (n=195) or >55

kg/m<sup>2</sup> (n=17) were excluded. Overweight was defined as BMI  $\geq$ 25 based on cut-offs recommended by the National Heart, Lung, and Blood Institute Expert Panel<sup>14</sup> and the World Health Organization Consultation on Obesity.<sup>15</sup> Weight change was calculated as the difference between weight at recruitment and weight at age 45. Depending on age at recruitment, weight change corresponded to an eight-to-12 year period. All statistical models were controlled for age at recruitment to adjust for this variability.

### Assessment of Yoga and Physical Activity

The physical activity questionnaire and a study describing its validity have been described in detail elsewhere.<sup>16</sup> Briefly, the questionnaire asked about three specific recreational physical activities (walking, lifting weights, and practicing yoga) and two broader categories of activity (mild and moderate exercise and strenuous exercise). Respondents were instructed to report only activities done regularly, defined as at least once per week for at least one year in the previous 10 years. Participants reported the number of years in the last 10 years that they did each activity, along with the days per week and the minutes per day. To calculate average metabolic-equivalent task-hours (MET-hours) per week from physical activities during the past 10 years, we assigned an intensity code (MET)<sup>17</sup> to each activity and multiplied this number by the average frequency per week, minutes per session (divided by 60 to get hours), and number of years the activity was done (divided by 10). Yoga practice was grouped into three categories of increasing intensity based on a combination of the usual length of a yoga session and the number of years of maintaining the practice, as follows: "abbreviated" included individuals who reported a practice of less than 30 minutes per session for at least one year; "one to three years" included individuals who reported a practice of 30 or more minutes for one to three years; and "four+ years" included individuals who reported a practice of 30 or more minutes for four or more years.

### Diet and Other Risk Factor Assessment

Diet was assessed using a 122-item food frequency questionnaire (FFQ) that was an adaptation of FFQs developed for the Women's Health Initiative and other studies.<sup>18</sup> The nutrient database was derived from the University of Minnesota Nutrition Coordinating Center,<sup>19</sup> and the algorithms for analysis are described elsewhere.<sup>20</sup> Daily vegetable and fruit intakes were calculated using the "Five-a-Day" method<sup>21</sup> as the sum of the usual daily servings of "vegetables, not including salad or potatoes," "fruit, not including juice," juice, salad, and potatoes (not fried). Participants were excluded from the nutrient calculations if they did not complete all pages of the food frequency section (at least five items per page) or their energy intake was considered improbable (<800 kcal for men or <600 kcal for women; >5000 kcal for men and >4,000 kcal for women) (n=935).

### Statistical Analyses

Linear regression was used to model associations of yoga practice with weight change since age 45, adjusting for con-

founding variables. All models were adjusted for age at recruitment, weight at age 45, change in weight from age 30 to age 45, MET-hours per week of physical activity not including yoga, education, smoking, energy from all macronutrients (carbohydrates, protein, fat and alcohol, each entered separately), and servings per day of fruits and vegetables. All analyses were stratified by BMI at age 45 because weight change and its determinants may differ between normal and overweight individuals.<sup>22</sup>

Polychotomous logistic regression was used to model the association of yoga practice with the relative odds of weight loss or weight maintenance compared to weight gain. Weight change was

categorized based on percent change in body weight into three groups: >5% weight loss, weight maintenance within 5%, and >5% weight gain. We chose 5% because this is considered a clinically significant change, particularly in terms of weight loss.<sup>23</sup>

## RESULTS

Table 1 shows distributions of demographic and health-related characteristics among men and women in the study sample, as well as the associations of these characteristics with categories of yoga practice. Almost 10% of women reported yoga practice, but only 2.4% had maintained their practice for four or

TABLE 1 Yoga Practice Prevalence by Demographic and Health-Related Characteristics Among Men and Women in the Vitamins and Lifestyle Study

Characteristic	Women (N=7,994)				Men (N=7,556)			
	Type and years of regular yoga practice <sup>†</sup>				Type and years of regular yoga practice <sup>†</sup>			
	N	Abbreviated	1-3 years	4+ years	N	Abbreviated	1-3 year	4+ years
	Percentages <sup>‡</sup>				Percentages <sup>‡</sup>			
<b>Overall</b>	7,994	3.8	4.7	1.3	7,556	1.9	1.2	0.4
<b>Race</b>								
White	7,332	3.7	4.8	1.2	6,981	1.8	1.2	0.4
Asian or Pacific Islander	217	4.6	1.4	2.3	184	3.3	1.6	0.5
Other/unknown	395	5.1	4.6	2.0	391	2.8	1.0	0.5
<b>Education (years)</b>								
≤12	1,101	2.1	2.0	0.4	747	0.1	0.0	0.0
13-15	3,336	3.1	3.7	0.7	2,743	1.1	0.5	0.2
16	2,106	4.2	5.7	1.7	2,217	2.3	1.6	0.5
≥17	1,378	5.8	7.8	2.9	1,839	3.3	2.4	0.6
<b>Income (\$)</b>								
<40,000	1,282	3.7	3.8	1.4	758	2.0	0.9	0.4
40,000-79,999	2,967	3.4	4.8	1.2	2,895	1.9	0.9	0.5
80,000+	2,429	4.1	5.4	1.4	3,116	2.1	1.3	0.3
<b>Marital status</b>								
Married	5,623	3.5	4.2	1.2	6,183	1.8	1.1	0.3
Living with partner	326	4.0	5.8	0.9	244	4.1	2.1	1.2
Never married	341	4.1	7.0	1.5	312	2.9	2.2	1.0
Separated/divorced/widowed	1,610	4.4	5.7	1.4	798	1.6	1.3	0.5
<b>BMI</b>								
<25	4,810	4.5	6.1	1.7	2,897	2.6	1.5	0.7
25-<30	2,024	3.1	2.7	0.6	3,581	1.5	1.1	0.3
≥30	1,110	1.7	2.4	0.6	1,078	1.3	0.7	0.1
<b>Smoking status</b>								
Never smoker	4,559	3.7	4.1	1.4	3,370	1.5	1.4	0.4
Current smoker	695	2.9	2.6	0.3	774	1.0	0.5	0.4
FS* (quit>10 years ago)	2,217	4.5	6.7	1.6	2,766	2.8	1.3	0.5
FS* (quit≤10 years ago)	450	2.2	4.2	0.2	596	1.3	1.0	0.0

\* Former smoker

<sup>†</sup> Abbreviated=less than 30 minutes per session at least once a week for at least one year of the past 10 years; 1-3 years=sessions 30 minutes or longer at least once a week for 1-3 years of the previous 10 years; 4+ years=sessions 30 minutes or longer at least once a week for 4 or more of the previous 10 years

<sup>‡</sup> Percentages sum across row, but do not total 100 because "No yoga" category is not presented

**TABLE 2** Physical Activity and Dietary Characteristics Stratified By Type and Years of Regular Yoga Practice

Characteristic	Type and years of regular yoga practice*			
	None	Abbreviated Practice	1-3 years	4+ years
	Mean <sup>†</sup> (95% CI)			
MET-hours from activities other than yoga	10.3 (10.1, 10.5)	14.1 (13.7, 14.6)	17.9 (17.0, 18.8)	21.7 (20.4, 23.1)
MET-hours from high intensity physical activity	3.1 (3.0, 3.2)	4.5 (4.3, 4.8)	6.0 (5.4, 6.5)	7.4 (6.6, 8.2)
Percent energy from fat	34.3 (34.2, 34.5)	33.0 (32.8, 33.3)	31.8 (31.2, 32.3)	30.5 (29.7, 31.3)
Fruit and vegetable intake (servings/day)	3.8 (3.8, 3.9)	4.4 (4.3, 4.5)	4.9 (4.8, 5.1)	5.5 (5.3, 5.7)
Energy intake (kcal/day)	1,889 (1,877, 1,900)	1,916 (1,892, 1,941)	1,944 (1,897, 1,991)	1,972 (1,901, 2,042)

\* Abbreviated=less than 30 minutes per session at least once a week for at least one year of the past 10 years; 1-3 years=sessions 30 minutes or longer at least once a week for 1-3 years of the previous 10 years; 4+ years=sessions 30 minutes or longer at least once a week for 4 or more of the previous 10 years  
<sup>†</sup> Adjusted for sex

more years; in contrast, only 3.5% of men reported yoga practice, and only 1.3% had maintained their practice for four or more years. For both men and women, the percent practicing yoga was positively associated with education, but was not associated with income. Yoga practice was inversely related to BMI and smoking.

Among women, there was little difference in yoga practice by marital status, whereas among men, yoga practice was more common among those who had never married or those who were living with a partner but were not married.

There were significant trends for both increasing physical activity and more healthful diets across categories of yoga practice ( $P<.001$ ) (Table 2). MET-hours of total and high-intensity physical activity (excluding yoga) were more than two-fold higher among those practicing yoga for four or more years than for those not practicing yoga. Similarly, yoga practice for four or more years was associated with an 11% lower percentage of energy from fat and a 45% higher consumption of fruits and vegetables. Energy intake was somewhat higher among individuals who practiced yoga, which is consistent with their higher levels of physical activity.

Table 3 shows the raw and adjusted mean weight gains from age 45 across categories of yoga practice. Among both normal and overweight individuals, there were statistically significant trends for lower weight gain with increasing intensity of yoga practice. However, associations of yoga with weight gain attenuation were substantially larger among those who were overweight. Compared to individuals who did not practice yoga, four or more years of practice was associated with a 3.1-lb lower weight gain among those normal weight at age 45 and an 18.5-lb lower weight gain among those overweight at age 45. We examined alternative statistical models that did not control for diet and MET-hours of physical activity from yoga, as differences in dietary behavior and energy expenditure from yoga likely are mediating factors linking yoga practice to attenuated weight gain. Based on these models, differences in consumption of energy (from each macronutrient independently) and fruits and vegetables explained only 0.4 lbs (normal weight) and 1.2 lbs (overweight) of the total weight gain difference between those not practicing yoga and those practicing for four or more years;

**TABLE 3** Unadjusted and Adjusted\* Mean Weight Change (lbs) From Age 45 to Age 53-57 by Type and Years of Regular Yoga Practice, Stratified by Body Mass Index (BMI) at Age 45

Type and years of yoga practice in past 10 years <sup>†</sup>	BMI<25			BMI≥25		
	N	Mean (SD) Unadjusted	Mean (95% CI) Adjusted	N	Mean (SD) Unadjusted	Mean (95% CI) Adjusted*
Overall	7,707	12.4 (15.1)	—	7,793	13.1 (24.5)	—
None	6,976	12.7 (15.3)	12.6 (12.2, 12.9)	7,485	13.4 (24.4)	13.5 (13.0, 14.1)
Abbreviated practice	293	9.1 (12.9)	10.6 (8.9, 12.3)	149	8.4 (23.1)	10.2 (6.3, 14.0)
1-3 yrs	336	9.4 (12.5)	10.5 (8.9, 12.1)	129	5.3 (25.6)	8.1 (3.9, 12.4)
4+ yrs	102	7.7 (10.4)	9.5 (6.7, 12.4)	30	-6.6 (35.6)	-5.0 (-14.2, 4.2)
P for trend		<.0001	.0002		<.0001	<.0001

\* Adjusted for sex, weight (in pounds) at age 45 (continuous), age at time of questionnaire completion, MET-hours of low-intensity activities other than yoga, MET-hours from moderate-intensity activities, and MET-hours from high-intensity activities, energy (separately from fat, protein, carbohydrates, and alcohol), servings per day of fruits and vegetables, weight change between ages 30 and 45, education, and smoking (former smoker, quit <10 years before baseline vs. never; current; or former smoker, quit >10 years before baseline)

<sup>†</sup> Abbreviated=less than 30 minutes per session at least once a week for at least one year of the past 10 years; 1-3 years=sessions 30 minutes or longer at least once a week for 1-3 years of the previous 10 years; 4+ years=sessions 30 minutes or longer at least once a week for 4 or more of the previous 10 years

**TABLE 4** Relative Odds\* of Body Weight Maintenance and Loss Compared to Weight Gain Associated With Type and Years of Regular Practice Stratified by Body Mass Index (BMI) at Age 45

Type and years of regular yoga practice in past 10 years <sup>†</sup>	BMI < 25		BMI ≥25	
	Maintenance	>5% loss	Maintenance	>5% loss
None	1.0	1.0	1.0	1.0
Abbreviated practice	1.09 (0.83-1.42)	1.74 (1.03-2.92)	1.25 (0.84-1.87)	1.35 (0.82-2.21)
1-3 yrs	1.10 (0.86-1.42)	1.65 (1.02-2.65)	1.46 (0.94-2.27)	1.51 (0.87-2.61)
4+ yrs	1.49 (0.97-2.30)	1.15 (0.40-3.29)	1.85 (0.63-5.42)	3.58 (1.30-9.88)
<i>P</i> for trend	.068	.029	.026	.003

\* Models are adjusted for sex, age at completion of questionnaire, weight (in pounds) at age 45, change in weight from age 30 to age 45, energy intake (separately from fat, protein, carbohydrates, and alcohol), servings per day of fruits and vegetables, smoking (former smoker [quit <10 years before follow-up] versus other), education, and MET-hours of low-intensity activities other than yoga, MET-hours from moderate-intensity activities, and MET-hours from high-intensity activities

<sup>†</sup> "Abbreviated," Less than 30 minutes per session at least once a week for at least one year of the past 10 years; "1-3 years," Sessions 30 minutes or longer at least once a week for 1-3 years of the previous 10 years; "4+ years," Sessions 30 minutes or longer at least once a week for 4 or more of the previous 10 years

comparable differences in weight gain due to MET-hours of physical activity from yoga were 0.5 lbs and 0.6 lbs (data not shown). We also examined associations separately in men and women and found no evidence that the associations of yoga practice with weight gain differed by gender.

Table 4 gives the associations of yoga practice with the relative odds of weight loss (5% or more) or maintenance (within 5%) compared to weight gain. The odds of weight maintenance compared to weight gain increased modestly across categories of intensity of yoga practice, but the trend reached statistical significance only among those who were overweight at age 45. Yoga practice also was associated with a higher relative odds of weight loss versus gain, though there was no trend across yoga practice categories among those normal weight at age 45. In contrast, the trend for increasing odds of weight loss was linear and statistically significant among those overweight at age 45. In this group, four or more years of yoga practice was associated with a 3.58 relative odds of weight loss versus gain.

## DISCUSSION

In this large cohort of women and men aged 53 to 57 years, yoga practice during the previous 10 years was associated with attenuated weight gain after age 45. Mean weight gain among study participants who maintained a regular yoga practice (at least 30 minutes once a week for four or more years) and were normal weight at age 45 was reduced by 3.1 lbs; among those who were overweight, weight gain was reduced by 18.5 lbs. The relative odds of both maintaining weight and losing weight versus gaining weight were higher among individuals who practiced yoga, and these associations were stronger for individuals who were overweight at age 45. Although these results suggest that yoga practice may contribute to long-term weight maintenance, this study has many limitations, and any conclusions regarding associations of yoga and weight control must be made cautiously.

One significant limitation of this study is the small number of individuals who reported that they practice yoga. Although we had data on 1,039 yoga practitioners, 43% of these reported

abbreviated practices of less than 30 minutes' duration. A standard yoga practice is generally 60 to 90 minutes in length, making it difficult to interpret results in this group. Among those with a practice of at least 30 minutes, only 132 had maintained their practice for four or more of the previous 10 years. In addition, respondents could not report the type of yoga they practiced, and yoga types can differ substantially in physical intensity. However, the prevalence of yoga practice was similar to the 7.5% reported in the population-based 2002 National Health Interview Survey (NHIS)<sup>24</sup> and to both the prevalence and demographic characteristics reported in a population-based telephone survey completed in 1998,<sup>25</sup> suggesting that results from this study may be generalizable to other populations.

A second limitation of this study is the research design and self-administered questionnaire. Although our study hypothesis, that yoga practice will affect weight gain, is posed prospectively, the study design is cross-sectional and data are retrospective. We used self-reported weight at study recruitment and recall of weight at age 45 to calculate weight change and retrospectively ascertained physical activity to assess yoga practice. Self-report of weight is generally valid, but people do tend to under-report their current and previous weights, and obese individuals may underreport their weight more than lean individuals.<sup>26-29</sup> We asked how many years individuals practiced yoga during the past 10 years, but could not examine whether the time of reduced weight gain corresponded to the time of yoga practice. There are also many differences between individuals who do and individuals who do not practice yoga and between those who maintain a long-term practice and those who practice occasionally or for a short period, which may confound observed associations between yoga and health outcomes. In the 1998 telephone survey,<sup>25</sup> yoga practitioners were in better overall health than non-practitioners, although they were more likely to report stress-related conditions, such as back and neck pain, anxiety, and depression. In the VITAL cohort, yoga practitioners had substantially more healthful dietary patterns and were far more physically active than non-practitioners. Statistical models did

control for an extensive set of covariates, although there may be residual confounding. For example, individuals who regularly practice yoga may also engage in other physical activities that were not captured by measures of exercise used in this study. For all of these reasons, any inference of causality based on this study is weak. It is not possible to determine whether the yoga practice itself contributed to attenuated weight gain or whether persons who chose to practice yoga were less likely to gain weight for other reasons not related to yoga.

There are also several strengths to this study. Our assessment of physical activity was based on a validated questionnaire that included intensity, frequency, type, and duration of physical activities during a 10-year period.<sup>16</sup> We collected extensive data on diet, previous weight change, and health history, and could thus control for a large set of covariates. Finally, because of the large sample size, we were able to exclude individuals with cancer and other serious illnesses that might lead to weight loss.

If yoga is indeed related to weight loss, there are several possible mechanisms. Yoga does improve exercise capacity,<sup>30</sup> and a vigorous practice maintained for 60 to 90 minutes would expend sufficient energy to contribute directly to weight control.<sup>7,31,32</sup> Most yoga practices, however, would not meet American College of Sports Medicine guidelines for weight management.<sup>8</sup> We speculate, based primarily on observations by experienced yoga teachers, that several indirect mechanisms might better explain an association of yoga with weight control. Yoga practitioners consistently say they feel "more connected" to their bodies. Enhanced awareness of satiety and the discomfort of overeating may lead to reduced food consumption. Yoga also promotes a positive body experience and sense of well-being.<sup>33,34</sup> This positive body experience carries into daily life, and practitioners report wanting to respect their bodies and avoid "junk" food and overeating. Yoga is a physical practice that is accessible to almost anyone, even overweight individuals. It is not competitive and is rarely practiced in front of a mirror. In a sedentary person, yoga can be a gateway to other, more vigorous physical activities. Finally, yoga practitioners tend to maintain a regular yoga practice because of the support of their teacher, the community of the class, and the feeling of well-being that comes from the practice. Yoga cultivates commitment and discipline, which are helpful when making long-term lifestyle changes.

Yoga practice is increasingly popular and accessible in the United States. In 2002, an estimated 18 million Americans practiced yoga, and it was offered by 74% of health clubs.<sup>35</sup> The results of this study suggest that yoga may be helpful for individuals wishing to control or lose weight. Observational studies of yoga and health outcomes are difficult to interpret, however, because of the complex associations of yoga practice with other health behaviors. Only well-designed clinical trials will clarify whether and how yoga practice affects changes in body weight.

#### Acknowledgments

This work was supported by grants R01 CA74846 and R25 CA94880 from the National Cancer Institute. The authors wish to thank the VITAL participants and staff for making this study possible.

#### References

- Field AE, Coakley EH, Must A, et al. Impact of overweight on the risk of developing common chronic diseases during a 10-year period. *Arch Int Med*. 2001;161:1581-1586.
- Physical activity and health: a report of the surgeon general*. US Department of Health and Human Services Center for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion. Atlanta: 1996.
- Mokdad AH, Ford ES, Bowman BA, et al. Prevalence of obesity, diabetes, and obesity-related health risk factors. *JAMA*. 2003;289:76-79.
- Avenell A, Broom J, Brown TJ, et al. Systematic review of the long-term effects and economic consequences of treatments for obesity and implications for health improvement. *Health Tech Assess*. 2004;8:1-182.
- Mulhisen L, and Rogers JZ. Complementary and alternative modes of therapy for the treatment of the obese patient. *J Am Osteopath Assoc*. 1999;99(10 Su Pt 2):S8-12.
- Lamb T. *Yoga and weight management*. International Association of Yoga Therapists, 2004. Available at: www.iayt.org. Accessed May 2005.
- Clay CC, Lloyd LK, Walker JL, Sharp KR, Pankey RB. The metabolic cost of hatha yoga. *J Strength Condi Res*. In press.
- Pollock ML, Gaesser GA, Butcher JD, et al. The recommended quality and quantity of exercise for developing and maintaining cardiorespiratory and muscular fitness, and flexibility in healthy adults. *Med Sci Sports Exerc*. 1998;30:975-991.
- DiCarlo LJ, Sparling PB, Hinson BT, Snow TK, Roskopf LB. Cardiovascular, metabolic, and perceptual responses to hatha yoga standing poses. *Med Exerc Nutr Health*. 1995;4:107-112.
- Rai L, and Ram K. Energy expenditure and ventilatory responses during virasana—a yogic standing posture. *Indian J Physiol Pharmacol*. 1993;37:45-50.
- Rai L, Ram K, Kant U, Madan SK, Sharma SK. Energy expenditure and ventilatory responses during siddhasana—a yogic seated posture. *Indian J Physiol Pharmacol*. 1994;38:29-33.
- Littman A, Kristal AR, White E. Effects of physical activity intensity, frequency, and activity type on 10-y weight change in middle-aged men and women. *Intern J Obesity Related Metabol Dis*. 2005; epub ahead of print.
- White E, Patterson RE, Kristal AR, et al. Vitamins and lifestyle cohort study: study design and characteristics of supplement users. *Am J Epidemiol*. 2004;159:83-93.
- Clinical Guidelines on the Identification, Evaluation, and Treatment of Overweight and Obesity in Adults—The Evidence Report. National Institutes of Health. *Am J Clin Nutr*. 1998;68:899-917.
- World Health Organization. Obesity: preventing and managing the global epidemic: report of a WHO consultation, WHO technical report series, 894. Geneva: World Health Organization, 2000.
- Littman AJ, White E, Kristal AR, et al. Assessment of a one-page questionnaire on long-term recreational physical activity. *Epidemiology*. 2004;15:105-113.
- Ainsworth B, Haskell W, Whitt M. Compendium of physical activities: an update of activity codes and MET intensities. *Med Sci Sports Exerc*. 2000;32:S498-S504.
- Patterson RE, Kristal AR, Carter RA, et al. Measurement characteristics of the Women's Health Initiative food frequency questionnaire. *Ann Epidemiol*. 1999;9:178-187.
- Feshkanish D, Sialaff BH, Chong K. Computerized collection and analysis of dietary intake information. *Comput Methods Programs Biomed*. 1989;30:47-57.
- Kristal AR, Shattuck AL, Williams AE. *Food frequency questionnaires for diet intervention research*. 17th National Nutrient Databank Conference Baltimore, MD: International Life Sciences Institute. 1992:110-125.
- Kristal AR, Vizenor NC, Patterson RE, et al. Precision and bias of food frequency-based measures of fruit and vegetable intakes. *Cancer Epidemiol Biomarkers Prev*. 2000;9:939-944.
- DiPietro L. Physical activity in the prevention of obesity: current evidence and research issues. *Med Sci Sports Exerc*. 1999;31:S542-S546.
- Fogelholm M, Kukkonen-Harjula K. Does physical activity prevent weight gain—a systematic review. *Obes Rev*. 2000;1:95-111.
- Barnes PM, Powell-Griner E, McFann K, Nahin RL. *Complementary and alternative medicine use among adults: United States, 2002*. Advance data from vital and health statistics; no 343. Hyattsville, MD: National Center for Health Statistics, 2004.
- Saper RB, Eisenberg DM, Davis RB, Culpepper L, Phillips RS. Prevalence and patterns of adult yoga use in the United States: results of a national survey. *Altern Ther Health Med*. 2004;10:44-49.
- Engstrom JL, Paterson SA, Doherty A, Trabulsi M, Speer KL. Accuracy of self-reported height and weight in women: an integrative review of the literature. *J Midwifery Women's Health*. 2003;48:338-345.
- Rimm EB, Stampfer MJ, Colditz GA, et al. Validity of self-reported waist and hip circumferences in men and women. *Epidemiology*. 1990;1:466-473.
- Olivarius NF, Andreasen AH, Loken J. Accuracy of 1-, 5- and 10-year body weight recall given in a standard questionnaire. *Int J Obes Relat Metab Disord*. 1997;21:67-71.
- Tamakoshi K, Yatsuya H, Kondo T, et al. The accuracy of long-term recall of past body weight in Japanese adult men. *Int J Obes Relat Metab Disord*. 2003;27:247-252.
- Raub JA. Psychophysiologic effects of hatha yoga on musculoskeletal and cardiopulmonary function: a literature review. *J Alt Comp Med*. 2002;8:797-812.
- Carroll J, Blansit A, Otto RM, Wygand JW. The metabolic requirements of vinyasa yoga. *Med Sci Sports Exerc*. 2003;35:S155.
- Blank SE, Raman K, Chock G, Krieger JW. Heart rate and oxygen cost responses to power yoga asanas in beginning practitioners. *Med Sci Sports Exerc*. 2001;35:S107.
- Wood C. Mood change and perceptions of vitality: a comparison of the effects of relaxation, visualization and yoga. *J R Soc Med*. 1993;86:254-258.
- Woolery A, Myers H, Sternlieb B, Zeltzer L. A yoga intervention for young adults with elevated symptoms of depression. *Altern Ther Health Med*. 2004;10:60-63.
- Kleiner C. Mind-body fitness; Yoga booms in popularity as a way to heighten flexibility, improve breathing, and gain sanity. *US News & World Report*. 2002; 132: 53.