

## How Is the Practice of Yoga Related to Weight Status? Population-Based Findings From Project EAT-IV

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**Background:** Yoga may provide a strategy for healthy weight management in young adults. This study examined prevalence and characteristics of young adults' yoga practice and associations with changes in body mass index. **Methods:** Surveys were completed by 1830 young adults ( $31.1 \pm 1.6$  y) participating in Project EAT-IV. Cross-sectional and 5-year longitudinal analyses were conducted stratified by initial weight status. **Results:** Two-thirds (66.5%) of nonoverweight women and 48.9% of overweight women reported ever doing yoga, while 27.2% of nonoverweight women and 16.4% of overweight women practiced regularly ( $\geq 30$  min/wk). Fewer men practiced yoga. Among young adults practicing regularly ( $n = 294$ ), differences were identified in intensity, type, and location of yoga practice across weight status. Young adults who were overweight and practiced yoga regularly showed a nonsignificant 5-year decrease in their body mass index ( $-0.60$  kg/m<sup>2</sup>;  $P = .49$ ), whereas those not practicing regularly had significant increases in their body mass index ( $+1.37$  kg/m<sup>2</sup>;  $P < .01$ ). Frequency of yoga was inversely associated with weight gain among both overweight and nonoverweight young adults practicing yoga regularly. **Conclusions:** Young adults of different body sizes practice yoga. Yoga was associated with less weight gain over time, particularly in overweight young adults. Practicing yoga on a regular basis may help with weight gain prevention.

**Keywords:** youth, obesity, body weight, epidemiology, intervention study

Obesity in young adults is of public health concern, given its high prevalence and potential adverse health consequences.<sup>1-3</sup> Innovative strategies are needed that are widely acceptable and effective in long-term weight management.<sup>4</sup> Given that some research suggests that overweight individuals are less likely than nonoverweight individuals to enjoy, engage in, and sustain physical activity,<sup>5-9</sup> it is important to consider strategies that are likely to be continued over time. As overweight individuals are at high risk for body dissatisfaction and disordered eating behaviors,<sup>10</sup> which also predict weight gain over time,<sup>11-15</sup> it is also important to encourage activities that may help individuals develop a positive relationship to their bodies. Acceptability and sustainability of weight-related activities may be particularly relevant to young adults. Young adults have shown lower rates of engagement in, and responsiveness to, standard weight management,<sup>4,16</sup> and there are few effective weight gain prevention strategies currently available for young adults.<sup>4</sup>

Yoga is a practice that involves physical movement, strengthening and stretching activities, focused breathing, mindfulness, and meditation.<sup>17-19</sup> Underlying tenets of yoga, including movement in accordance with the ability and needs of one's body, enhanced body awareness, and promotion of self-compassion, suggest that yoga could be helpful for overweight individuals. If taught in a manner that encourages participants to listen to their bodies and modify poses accordingly, yoga has the potential to help people of different shapes and sizes feel comfortable with movement and activities that increase strength and flexibility, which may lead to

sustained physical activity over time. Furthermore, given the social stigma and associated stresses often experienced by overweight individuals,<sup>20</sup> the compassion and self-acceptance that are part of yoga practice may help some people enjoy yoga more than other forms of activity. Several studies have shown that participation in yoga may result in greater capacity to withstand stress and emotional distress<sup>21,22</sup> and may lead to reduced emotional eating and binge eating,<sup>21-24</sup> all of which have the potential to improve the quality of life of overweight individuals and help with healthy weight management. If yoga is to be utilized as a weight management strategy, it is important to learn more about its acceptability among target populations, particularly young adults of higher weight status. To inform the development of yoga-based interventions for populations of different body weights, it is also useful to understand the characteristics of yoga practices and reasons for engaging in yoga among overweight and nonoverweight people.

The practice of yoga appears to be increasingly popular in the United States, although population-based research studies are limited and there is some variation in prevalence estimates across extant studies, probably due to differences in both populations studied and measures used to assess yoga practice.<sup>25-28</sup> A large population-based sample ( $n = 34,525$ ) of adults of all ages in the United States, who participated in the 2012 National Health Interview Survey, found that 8.9% of adults had ever practiced yoga and 8.9% had practiced in the past 12 months.<sup>26</sup> The prevalence tended to be highest among age groups capturing young adulthood (ie, 18-29 and 30-39). The 2016 Yoga in America Study found that 15% of adults in the United States participated in a yoga class in the past 6 months, and 34% indicated an intention to do yoga in the next year.<sup>29</sup> However, little is known about the prevalence of its use and its acceptability among overweight individuals.<sup>30,31</sup> Furthermore, research examining the effectiveness of yoga in weight management has shown mixed results across

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studies, possibly due to small sample sizes and limitations in scientific rigor.<sup>32–37</sup> Although findings from a recent review of randomized, controlled trials suggest that yoga-based interventions for overweight participants can lead to reductions in body mass index (BMI), few studies have focused on young adults.<sup>38</sup> Given the increasing popularity of yoga, an important question is whether yoga, as practiced by young adults in the general population, is associated with lower weight gain over time, particularly among overweight young adults.

The overall aim of the current study is to characterize yoga practices in a population-based young adult sample and assess yoga's suitability and potential relevance for weight management. This study addressed the following research questions: (1) Who is practicing yoga in terms of weight status and sociodemographic characteristics? (2) What factors characterize yoga practice (frequency, type, intensity, location, and reasons for practice) among nonoverweight and overweight young adults practicing yoga regularly? and (3) How is participation and frequency of doing yoga associated with 5-year changes in BMI among nonoverweight and overweight young adults?

## Methods

### Study Overview

Project EAT is a large, population-based study on eating and weight-related outcomes that followed young people from adolescence to young adulthood.<sup>10,39–43</sup> At the original assessment (1998–1999), 4746 adolescents attending public middle and high schools in Minneapolis–St Paul, MN, completed surveys and anthropometric measures. Follow-up mailed and online surveys were completed at 5-year intervals (Projects EAT-II, III, and IV). Data used in the current analysis come primarily from Project EAT-IV; data from Project EAT-III are utilized to examine changes in BMI over a 5-year period.

For Project EAT-IV, participants who responded at EAT-I and to at least one previous follow-up survey were mailed invitation letters to complete the survey. Surveys were completed by 1830 young adults (mean age:  $31.1 \pm 1.6$  y). The University of Minnesota's Institutional Review Board Human Subjects Committee approved all study protocols.

### Survey Development and Measures

The EAT-IV survey assessed topics relevant to weight-related health and was modified from surveys used in previous study waves to assess age-appropriate issues and explore topics of emerging interest. Given the growing interest in yoga across the United States, questions on yoga were added to EAT-IV. The EAT-IV survey was pilot tested among young adults in their late 20s to mid-30s. Two focus groups were conducted to gather feedback on specific survey items. Next, a revised survey was pilot tested with a different sample of 65 young adults to examine test–retest reliability and internal consistency of scales in order to further refine items and reduce survey length. Finally, scale psychometrics were examined in the EAT-IV survey sample and estimates of item test–retest reliability, reported below, were determined in a subgroup of 103 participants who completed the survey twice during a 1- to 4-week period.

**Yoga Practice.** At EAT-IV, young adults indicated if they had *ever done yoga* (yes/no; test–retest agreement = 94%). Young adults who reported they had ever done yoga were asked additional questions. To assess *frequency of practice*, respondents were asked, “On average, how frequently did you do yoga over

the past year?” Seven response options ranged from “less than 30 minutes per week” to “10+ hours per week.” A continuous frequency measure was created with each individual assigned the midpoint of the response category. Respondents indicating they had engaged in yoga  $\geq 30$  minutes per week were identified as having a *regular practice* (test–retest agreement = 92%) and asked to report on the intensity of their practice, the types of yoga they do, where they usually practice, reasons for practicing yoga, and perceived influence of their practice on weight-related outcomes. *Intensity of practice* was assessed by asking “How would you describe your yoga practice?” Response options were “mainly vigorous,” “mainly gentle,” and “mixed vigorous/gentle” (test–retest  $r = .53$ ). Those with a regular practice were asked to indicate the *usual type(s)* of yoga they do with the response options of “hatha,” “vinyasa flow,” “restorative/yin yoga,” “hot yoga,” and “other” (test–retest agreement = 85%–95%). For reporting *usual location(s)* of practice, response options were “gym or fitness center,” “yoga studio,” “home,” and “other” (test–retest agreement = 90%–100%). For usual type of yoga and location of practice, study participants could mark more than one response. Participants who regularly practiced yoga were also provided a list of 9 possible *reasons for practicing yoga* (eg, stress reduction and relaxation, helps me be present in the moment) and asked to indicate the main reasons they choose to practice (test–retest agreement = 55%–95%).

**Weight Status.** Prior weight status was assessed in EAT-III and current weight status was assessed in EAT-IV using self-reported height and weight from which BMI ( $\text{kg}/\text{m}^2$ ) was calculated. Self-report of height and weight (test–retest  $r = .95$  for height and  $r = .98$  weight) were previously validated against objective measurements in an EAT-III subsample ( $n = 125$ ). Results showed high correlations between self-reported and measured BMI in males ( $r = .95$ ) and females ( $r = .98$ ).<sup>14,44</sup> Weight status was defined using current guidelines for adults (overweight or obese:  $\text{BMI} \geq 25 \text{ kg}/\text{m}^2$ ; obese:  $\text{BMI} \geq 30 \text{ kg}/\text{m}^2$ ).<sup>45</sup>

**Covariates.** Prior physical activity (EAT-III) and sociodemographic variables were included as covariates in examining associations between yoga practice and BMI, given their potential role as confounders. Physical activity (h/wk in moderate and vigorous activities) was assessed in EAT-III using 2 questions adapted from the widely used Godin Leisure-Time Exercise Questionnaire (test–retest  $r = .85$ ).<sup>46</sup> Participants reported their *ethnicity/race* (test–retest  $k = 0.70$ – $0.83$ ) on the original school-based survey.<sup>47</sup> On the EAT-IV survey, participants reported *gender* (test–retest agreement = 97%), *educational attainment* (test–retest  $r = .92$ ), and *household income* (test–retest  $r = .96$ ).

### Analysis

Descriptive statistics were used to estimate prevalence of ever practicing yoga and prevalence of regular yoga practice ( $\geq 30$  min/wk in the past year) among the entire EAT-IV sample ( $n = 1830$ ) by sociodemographic characteristics. Analyses were stratified by weight status at EAT-IV (BMI:  $< 25$  vs  $\geq 25$ ). Among those who reported regularly practicing yoga and were not missing BMI at EAT-IV ( $n = 294$ ), descriptive statistics and  $\chi^2$  tests were utilized to examine characteristics of yoga practice.

Linear regression models were used to estimate the association between current regular yoga practice and change in BMI between EAT-III and EAT-IV among the full EAT-IV sample ( $N = 1830$ ) in analyses stratified by weight status. Similar models were used to estimate the association between frequency of yoga and change in BMI among the subset ( $n = 294$ ) who engaged in regular yoga

practice. Change in BMI was included in the regression as the dependent variable. Regular yoga practice (yes/no) and yoga frequency (continuous variable, h/wk) were included as main predictors in separate models. Interaction terms (prior weight status  $\times$  yoga) were added to explore effect modification. *P*-values for these terms were .05 for weight status  $\times$  yoga practice and .07 for weight status  $\times$  yoga frequency; these marginally significant interactions suggest some differences in the associations between yoga and BMI change across previous weight status. Therefore, for each of the main predictors, separate models were fit for overweight and nonoverweight individuals (based on EAT-III BMI) for a total of 4 regression models. There were 166 participants who were in EAT-IV but not EAT-III and were dropped from analyses of BMI change. All models adjusted for physical activity at EAT-III. Additionally, as a sensitivity analysis, regression models were fit adjusted for physical activity at EAT-IV; this additional adjustment did not result in a substantive change in results. All models also adjusted for gender, ethnicity/race, household income, and educational attainment as potential confounders given that these variables could be associated with both yoga practice and changes in

BMI. Women who were pregnant or currently breast feeding at EAT-III or EAT-IV were excluded from these regression models.

Statistical adjustments were made to account for attrition from the original EAT-I sample ( $n=4746$ ) and to help adjust for selection bias. In all analyses, data were weighted using a response propensity method. Response propensities (ie, the probability of responding to the EAT-IV survey) were estimated using a logistic regression of response at 15-year follow-up on predictor variables from the school-based survey. The weighting method resulted in estimates representative of the demographic make-up of the original school-based sample, thereby allowing results to be more fully generalizable to the population of young people in the Minneapolis–St Paul metropolitan area in 2009–2010.

## Results

### Who Is Practicing Yoga?

Yoga practice (ever done yoga and regular practice, ie,  $\geq 30$  min/wk) was examined by sociodemographic characteristics and

**Table 1 Total Project EAT-IV Sample ( $n = 1830$ ): Young Adults (%) Practicing Yoga by Weight Status and Sociodemographic Characteristics<sup>a,b</sup>**

	n	Ever done yoga			Regular yoga practice ( $\geq 30$ min in past year)		
		Total sample, %	BMI < 25, %	BMI $\geq$ 25, %	Total sample, %	BMI < 25, %	BMI $\geq$ 25, %
Total sample	1830	42.4	51.7	37.2	13.1	18.7	10.1
Gender							
Women	1036	56.4	66.5	48.9	20.5	27.2	16.4
Men	787	29.1	34.2	27.4	6.1	8.8	4.8
<i>P</i> -value		<.01	<.01	<.01	<.01	<.01	<.01
Ethnicity/race							
White	1241	50.3	61.3	43.6	15.6	22.9	11
African American	154	36.1	40.9	33.3	8.4	15.4	6.4
Hispanic	63	34.2	35.8	33.3	14	15.7	13.2
Asian American	268	32.9	40.9	28.3	11.5	12.6	10.7
Mixed/other	90	39	44	36.6	13.9	17.9	12.6
<i>P</i> -value		<.01	<.01	.04	.10	.32	.47
Educational attainment							
High school or less	415	26.9	28.1	26.3	8	10.7	7
Vocational	197	29.4	33.3	27.7	11.3	17.1	9
Associate degree	249	37.1	45	34.5	8.8	6.5	9.7
Bachelors	654	56.3	63.2	52	18.2	24.4	13.9
Advanced degree	305	66.3	75.3	55.4	20.4	27.3	13.6
<i>P</i> -value		<.01	<.01	<.01	<.01	<.01	.07
Household income							
<\$20k	133	33.1	39	32	11.6	9.9	13.7
\$20k–\$34.9k	230	32	40.2	25.5	10	17.9	5.9
\$35k–\$49.9k	289	41	48.1	38.5	13.2	14.8	12.7
\$50k–\$74.9k	402	44.5	53.5	38.8	12.2	17.8	9.3
\$75k–\$99.9k	310	40	49.2	35.6	11.5	18.3	7.8
>\$100k	435	57.6	66	51.3	19.8	27.2	13.8
<i>P</i> -value		<.01	<.01	<.01	.02	.06	.13

Abbreviation: BMI, body mass index.

<sup>a</sup>Regular yoga practice defined as  $\geq 30$  minutes per week in past year.

<sup>b</sup>*n* is observed count of people in each category, while percentage (%) is weighted to account for attrition over time and allow for extrapolation to the original population-based sample.

weight status among the EAT-IV population of 1830 young adults (Table 1). High percentages of young adult women reported engaging in yoga compared with young adult men; 56.4% of women and 29.1% of men reported ever doing yoga, whereas 20.5% of women and 6.1% of men practiced regularly in the past year. Young adults from all ethnic/racial backgrounds and socioeconomic levels reported regularly practicing yoga, although percentages tended to be lower among those who were nonwhite and had lower levels of educational attainment and household income.

### What Are the Characteristics of Young Adults' Yoga Practice Across Weight Status?

Characteristics of yoga practice were examined by weight status among those who practiced yoga regularly ( $n=294$ ; Table 2). Among these yoga practitioners, frequency of practice did not significantly differ across weight status. Intensity of yoga did differ across weight status; 28.9% of nonoverweight young adults reported a gentle practice, compared with 48.7% of overweight young adults. In general, type of yoga practiced did not differ across weight status; however, overweight individuals were less likely to report hot yoga than nonoverweight individuals. Regardless of weight status, slightly over half of young adults engaging in regular yoga practice reported practicing at home. Nonoverweight young adults were more likely to practice at yoga studios than overweight individuals. Among those practicing yoga regularly, the most frequently cited reasons for practicing yoga were stress reduction and relaxation and enhanced physical fitness (Figure 1). Reasons for practicing yoga were similar

across weight status with only 2 exceptions. Overweight respondents were more likely than nonoverweight respondents to cite weight control and enhanced spirituality as reasons for their practice.

### How Is Yoga Associated With Change in BMI in Nonoverweight and Overweight Young Adults?

Associations were examined between regular yoga practice and 5-year changes in BMI (from EAT-III to EAT-IV); analyses were stratified by weight status at EAT-III (Table 3). Among those included in this analysis, the unadjusted mean (SD) BMI was 26.1 (5.7) at EAT-III and 27.4 (6.3) at EAT-IV for the total sample. The unadjusted mean BMI among those who were not overweight at EAT-III was 22.1 (1.8) at EAT-III and 23.5 (3.0) at EAT-IV. Among those who were categorized as overweight at EAT-III, the mean BMI was 30.3 (5.3) at EAT-III and 31.6 (6.3) at EAT-IV. Among overweight young adults at EAT-III, in adjusted analyses, those regularly practicing yoga showed a nonsignificant decrease in their BMI ( $-0.60 \text{ kg/m}^2$ ; 95% CI,  $-2.32$  to  $1.12$ ;  $P = .49$ ), whereas those who did not regularly practice yoga had significant increases in BMI ( $+1.37 \text{ kg/m}^2$ ; 95% CI,  $1.00$  to  $1.75$ ;  $P < .01$ ). Among young adults who were overweight at EAT-III, the difference in 5-year BMI change between those practicing yoga regularly and those not practicing yoga regularly was significant ( $P = .03$ ); those who practiced regularly had a change in BMI that was  $1.97 \text{ kg/m}^2$  [ $1.37 \text{ kg/m}^2 - (-0.60 \text{ kg/m}^2)$ ] less than the change in those who did not practice regularly (Table 3). Among nonoverweight young adults at EAT-III, regardless of yoga practice, BMI increased significantly over time: not practicing yoga ( $+1.53$  units; 95%

**Table 2 Regular Yoga Practitioners ( $n = 294$ ): Characteristics of Yoga Practice by Weight Status Among Young Adults Practicing Yoga Regularly<sup>a,b,c</sup>**

	Total n	BMI < 25 ( $n = 160$ ; %)	BMI $\geq 25$ ( $n = 134$ ; %)	P-value
Frequency, h/wk				
1/2–1	101	30.0	39.2	
1–2	123	42.5	43.0	
$\geq 2$	70	27.5	17.9	.17
Intensity				
Mainly vigorous	33	15.0	8.9	
Mainly gentle	104	28.9	48.7	
Mainly vigorous/gentle	156	56.1	42.5	.02
Usual type				
Hatha yoga	76	25.9	25.7	.98
Vinyasa flow	165	57.8	46.0	.09
Restorative/yin	68	24.7	23.9	.89
Hot yoga	75	30.4	19.1	.06
Other <sup>d</sup>	50	15.7	20.0	.42
Usual location				
Gym or fitness center	90	29.0	34.1	.43
Yoga studio	118	42.8	28.9	.03
Home	168	59.4	58.1	.84

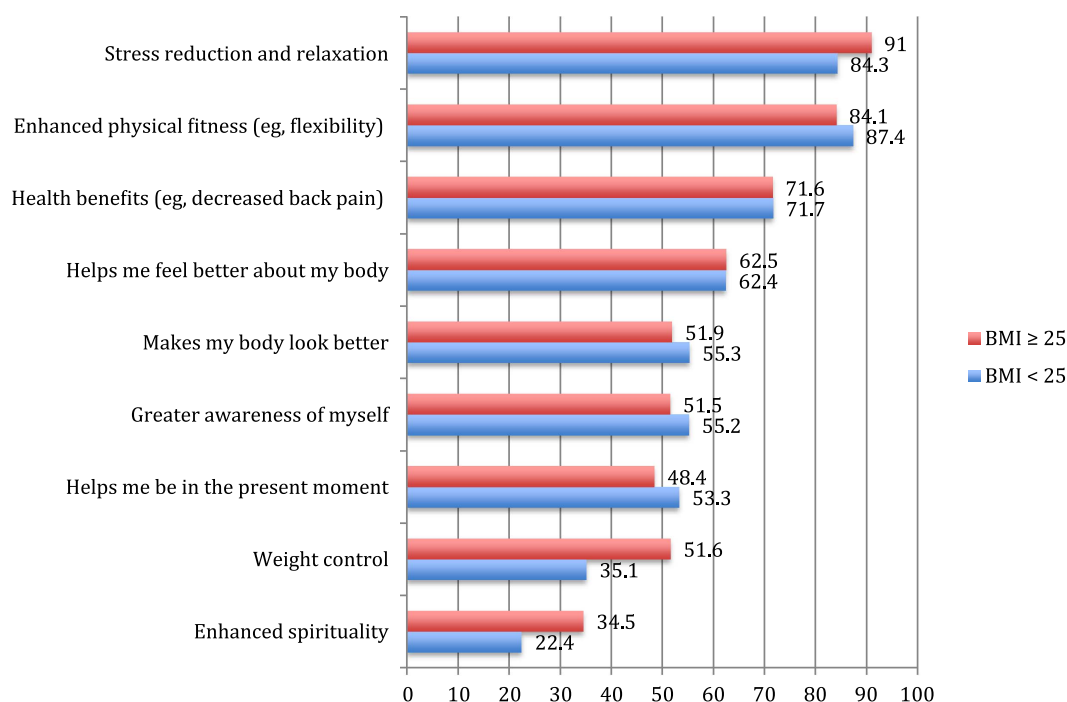
Abbreviation: BMI, body mass index.

<sup>a</sup>Regular yoga practice defined as  $\geq 30$  minutes per week in past year.

<sup>b</sup>For type of yoga usually practiced and usual place of practice, participants could indicate more than one response; therefore, percentages do not add up to 100%.

<sup>c</sup> $n$  is observed count of people in each category, while percentage (%) is weighted to account for attrition over time and allow for extrapolation to the original population-based sample.

<sup>d</sup>Among "other" types of yoga, the most commonly reported were yoga videos/Wii ( $n = 12$ ), sculpt ( $n = 11$ ), general ( $n = 11$ ), or prenatal ( $n = 9$ ).



**Figure 1** — Regular yoga practitioners (n = 294): Main reasons for practicing yoga among young adults practicing yoga regularly ( $\geq 30$  min/wk in past year) by weight status. *Note.* Participants could report more than one response. Main reasons for practicing yoga differed significantly across weight status for weight control ( $P = .01$ ) and enhanced spirituality ( $P = .04$ ).

CI, 1.28 to 1.79;  $P < .01$ ) and practicing yoga (+1.36 units; 95% CI, 0.91 to 1.81;  $P < .01$ ). Among nonoverweight young adults at EAT-III, the difference in BMI increase between those practicing and not practicing yoga was not significantly different ( $-0.17$  kg/m<sup>2</sup>; 95% CI,  $-0.62$  to  $0.28$ ;  $P = .44$ ; Table 3).

Additionally, associations were examined between frequency of yoga practice and 5-year changes in BMI separately by initial weight status among those practicing yoga regularly (data not shown in tables). Among overweight young adults, in adjusted analyses, frequency of yoga (as a continuous measure) was associated with

change in BMI over time; the increase in BMI was 0.93 units less for each additional hour of yoga per week (change  $-0.93$ ; 95% CI,  $-1.55$  to  $-0.31$ ;  $p < .01$ ). Among nonoverweight young adults, the increase in BMI was 0.31 units less for each additional hour of yoga per week (change  $-0.31$ ; 95% CI,  $-0.54$  to  $0.09$ ;  $P = .01$ ).

## Discussion

This study examined yoga practices among young adults, with a focus on learning more about its suitability for young adults who are

**Table 3** Total Project EAT-IV Sample (n = 1830): Associations Between Regular Yoga Practice<sup>a</sup> and Changes in BMI<sup>b</sup> by Weight Status<sup>c</sup>

	Change in BMI <sup>b</sup>	Confidence interval	P-value
Overweight at EAT-III (n = 693)			
Regular yoga practice			
Yes	-0.60	-2.32 to 1.12	.49
No	+1.37	1.00 to 1.75	<.01
Difference <sup>d</sup>	-1.97	-3.73 to -0.22	.03
Nonoverweight at EAT-III (n = 731)			
Regular yoga practice			
Yes	+1.36	0.91 to 1.81	<.01
No	+1.53	1.28 to 1.79	<.01
Difference <sup>d</sup>	-0.17	-0.62 to 0.28	.45

Abbreviation: BMI, body mass index.

<sup>a</sup>Regular yoga practice defined as  $\geq 30$  minutes per week in past year.

<sup>b</sup>Five-year change in BMI from EAT-III to EAT-IV.

<sup>c</sup>Participants were categorized by weight status at EAT-III: nonoverweight (BMI < 25) and overweight (BMI  $\geq 25$ ). Analyses are adjusted for physical activity at EAT-III, gender, ethnicity/race, educational attainment, and household income.

<sup>d</sup>Difference is the estimated change in BMI among those regularly practicing yoga minus the estimated change in BMI among those not regularly practicing yoga.



overweight, and the potential utility of yoga for weight gain prevention. This study shows that yoga is popular, regardless of weight status, particularly among young adult women. Findings further suggest that regular yoga practice is associated with less weight gain over time among overweight young adults. Additionally, among young adults practicing yoga on a regular basis, increased frequency of practice was associated with less weight gain over time in both overweight and nonoverweight yoga practitioners. Results from this large population-based observational study provide initial justification for exploring yoga-based strategies to promote weight management and evaluating the impact of such interventions in young adults in the general population.

Findings from this study indicate that most young adult women have tried yoga; approximately one-half of overweight women and two-thirds of nonoverweight women have done yoga at some point. Furthermore, nearly one-fifth of overweight and one-fourth of nonoverweight women practiced yoga on a regular basis in the past year, suggesting its acceptability among a large sector of young adult women. As expected, the prevalence of yoga was lower among young adult men, particularly those who are overweight, suggesting potential challenges in making yoga an acceptable practice for young adult men. The finding that young adults from different ethnic/racial backgrounds reported practicing yoga suggests yoga's potential suitability for a wide sector of the young adult population. That said, young adults with higher levels of educational attainment, who may be at lowest risk for obesity,<sup>48</sup> were most likely to practice yoga. Furthermore, while a third of overweight African Americans had ever done yoga, a very small percentage practiced on a regular basis. These findings suggest that barriers to yoga among at-risk groups and strategies for overcoming barriers should be explored and addressed. Of note, findings from the current study on young adults are in line with findings reported by Cramer et al<sup>26</sup>; in a large population-based sample of US adults of all ages, the prevalence of yoga practice was highest among women, whites, and those with higher education and income levels.

Study findings further indicate that characteristics of one's regular yoga practice generally do not differ across weight status, although some differences did emerge with potential relevance to the needs of overweight individuals. Stress reduction and fitness enhancement were cited as main reasons for practicing yoga, regardless of weight status. However, overweight yoga practitioners were more likely to indicate weight control as a main reason for practicing compared with nonoverweight yoga practitioners. Overweight individuals were less likely to practice in yoga studios than nonoverweight individuals, suggesting that yoga studios can more effectively reach out to individuals of diverse body sizes. Over half of overweight and nonoverweight individuals reported practicing at home. Although a home yoga practice provides an inexpensive, convenient, and a private place for engaging in yoga, if done without a teacher present, there may be concerns regarding proper alignment that may not be adequately addressed. Studios providing instruction on developing a home practice, or home videos, can address concerns that are likely to be common, particularly for practitioners who are overweight. Additionally, overweight yoga practitioners were more likely than nonoverweight yoga practitioners to report engaging in a gentle practice, suggesting the importance of studying the benefits of gentle classes for this sector. Although gentle classes may not directly result in large energy expenditure, there may be indirect benefits such as changes in eating patterns as a result of greater body awareness, stress management, and self-care, which could lead to lower energy intake. Furthermore, participating in gentle yoga may be a gateway to more active practices.

Importantly, findings indicate the practice of yoga may offer benefits in weight gain prevention, particularly for overweight young adults. Specifically, we examined changes in BMI over a 5-year period. Among study participants who were initially overweight, young adults practicing yoga did not significantly change their BMI over time, while those not practicing yoga increased their BMI over a 5-year period. Similarly, Kristal et al<sup>30</sup> found that regular yoga practice was associated with lower 10-year weight gains in adults over the age of 45, particularly among adults who were overweight. Together, findings from these 2 population-based studies suggest yoga may be helpful in preventing further weight gain among overweight adults. Mechanisms by which yoga may be helpful to overweight individuals are worthy of further exploration. In a large study of Australian women, findings suggested that overweight women practicing yoga or meditation may be more likely than overweight women not engaging in these practices to engage in healthy weight-related behaviors, but findings also suggested an increased risk for unhealthy weight-related behaviors.<sup>25</sup> Ideally, yoga can be used to increase comfort with physical activity and increase healthier eating patterns such as intuitive eating and the consumption of more fruits and vegetables, decrease the consumption of minimally nutritious foods, and provide healthy coping strategies in response to stress as alternatives to binge eating.

Study strengths include the population-based nature, size, diversity, and age of the sample. Given the growing popularity of yoga, population-based studies are important as they can provide information on how yoga is being practiced in the general public. The incorporation of survey items assessing various aspects of yoga into a larger longitudinal study in which BMI has been assessed at various time points is another study strength. A limitation of the study is that we did not include a comprehensive assessment of yoga practice at earlier time points, which would have allowed for stronger longitudinal analyses. Furthermore, we do not know when, during the 5-year period, participants began to engage in yoga and experience changes in BMI. Although frequency of practice was based on the past year, weight changes were examined over 5 years. Additionally, there may be uncontrolled factors (eg, lifestyle behaviors, physical characteristics, personality types, social support networks) that influence the adoption of yoga practice and are related to BMI, resulting in residual confounding. Finally, there was attrition from the original EAT-I sample. We utilized weighting to make generalizations back to the original sample; however, residual bias may exist.

Although findings from the current study provide initial justification for studying yoga-based interventions in young adult populations, further research is needed to inform the development of interventions most likely to be both acceptable and effective and to more rigorously test the impact of yoga on weight status. To guide the development of yoga-based interventions for healthy weight management, it is important to further explore the mechanisms by which yoga may influence weight status. For example, it is of interest to determine if yoga positively influences outcomes like stress, body image, and eating patterns, and then to determine if changes in these factors predict changes in BMI. Given that half of overweight women practicing yoga regularly reported doing gentle yoga, it is also of interest to explore whether a low-intensity activity is more likely to be practiced and sustained than a higher intensity activity, whether individuals who start with a gentle practice are willing to try more physically challenging practices as they gain more strength and confidence, and whether a low-intensity activity is likely to have benefits on eating patterns via the transmission of coping skills, greater awareness of hunger and satiety cues, decreased depression, or other mechanisms. It is also worth noting

that the term “gentle” can be interpreted differently (eg, yin, restorative, meditation, slow flow), and it is worthwhile exploring what young adults mean when they report gentle yoga practices and what it is about such practices that are attractive to them. Further research should also explore associations between different characteristics of yoga practice (eg, intensity) and outcomes such as changes in BMI over time; more comprehensive assessments of intensity, including an assessment of actual intensity, should be utilized in such analyses. We recommend implementation of longitudinal studies to better understand temporality of relationships, mixed-methods studies in which rich qualitative data can complement quantitative data, and intervention trials examining health impacts of different types of yoga-based interventions.

Given the popularity of yoga among young adults, it will be important to further explore how to best ensure that offerings are suitable for persons of different sizes. Some suggested strategies include offering gentle yoga classes; offering mixed-intensity classes with teacher language that encourages students to work at their own level with the “body of the day” (ie, listening to what the body of today is saying with any current injuries or limitations); having teachers who are diverse in terms of gender, ethnicity/race, and body size; providing training opportunities for yoga instructors on various weight-related topics and opportunities for reducing weight stigma and bias<sup>49</sup>; and addressing issues in the physical environment, such as using nonmirrored rooms<sup>50</sup> and/or offering private spaces for changing clothes and showering and possibly offering classes that specifically target students with larger bodies, physical problems that limit movement, and/or body image concerns. A priority should be to develop and evaluate training programs aimed at helping yoga teachers understand common weight-related problems, enhance their weight sensitivity, and be able to teach in a way that works well for students with different weight-related issues.<sup>10</sup>

## Conclusions

Findings from this large population-based study demonstrate the popularity of yoga in young adults and its potential as a tool for weight gain prevention. Having a regular yoga practice was associated with significantly lower weight gain over a 5-year period among overweight young adults. Furthermore, among both overweight and nonoverweight young adults practicing yoga regularly, a greater frequency of practice was associated with lower weight gain over time. Findings are promising and provide insights for next steps with regard to making yoga more acceptable to populations who could potentially benefit from the practice but have low participation (eg, overweight African Americans and overweight men) and conducting research to further explore the impact of yoga on different dimensions of weight-related health including weight status, eating behaviors, physical activity, and body image concerns.

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