Physical Activity and Weight Gain Prevention

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Context The amount of physical activity needed to prevent long-term weight gain is unclear. In 2008, federal guidelines recommended at least 150 minutes per week (7.5 metabolic equivalent [MET] hours per week) of moderate-intensity activity for "substantial health benefits."

Objective To examine the association of different amounts of physical activity with long-term weight changes among women consuming a usual diet.

Design, Setting, and Participants A prospective cohort study involving 34 079 healthy US women (mean age, 54.2 years) from 1992-2007. At baseline and months 36, 72, 96, 120, 144, and 156, women reported their physical activity and body weight. Women were classified as expending less than 7.5, 7.5 to less than 21, and 21 or more MET hours per week of activity at each time. Repeated-measures regression prospectively examined physical activity and weight change over intervals averaging 3 years.

Main Outcome Measure Change in weight.

Results Women gained a mean of 2.6 kg throughout the study. A multivariate analysis comparing women expending 21 or more MET hours per week with those expending from 7.5 to less than 21 MET hours per week showed that the latter group gained a mean (SD) 0.11 kg (0.04 kg; $P=.003$) over a mean interval of 3 years, and those expending less than 7.5 MET hours per week gained 0.12 kg (0.04; $P=.002$). There was a significant interaction with body mass index (BMI), such that there was an inverse dose-response relation between activity levels and weight gain among women with a BMI of less than 25 (P for trend $<.001$) but no relation among women with a BMI from 25 to 29.9 (P for trend $=.56$) or with a BMI of 30.0 or higher (P for trend $=.50$). A total of 4540 women (13.3%) with a BMI lower than 25 at study start successfully maintained their weight by gaining less than 2.3 kg throughout. Their mean activity level over the study was 21.5 MET hours per week (≈60 minutes a day of moderate-intensity activity).

Conclusions Among women consuming a usual diet, physical activity was associated with less weight gain only among women whose BMI was lower than 25. Women successful in maintaining normal weight and gaining fewer than 2.3 kg over 13 years averaged approximately 60 minutes a day of moderate-intensity activity throughout the study.

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THE PREVALENCE OF OVERweight and obesity in the United States has increased dramatically over the past 2 decades, with 1 in 3 adults currently obese.[1] These numbers present a tremendous health care challenge in treatment and cost relating to the many adverse health conditions associated with excess body weight.[2,3]

At a fundamental level, weight gain occurs when caloric intake exceeds caloric expenditure. Many studies have examined physical activity, with or without caloric restriction, and weight loss among those who are overweight or obese.[4] Effective strategies exist for weight loss, but the majority of persons losing weight do not maintain their weight loss.[5,6] Because the average US adult gains weight with age,[7,8] developing ways to prevent unhealthful weight gain would help them avoid having to lose weight and then trying to maintain that loss. Compared with the vast body of research on the treatment of overweight and obese individuals, little research exists on preventing weight gain.[2]

Essential for the prevention of unhealthful weight gain are clear guidelines on the amount of physical activity required. The 2008 federal guidelines currently recommend at least 150 minutes a week of moderate-intensity aerobic physical activity for individuals to obtain "substantial health benefits,"[9,10] but whether this amount of exercise can prevent weight gain is unclear.[11,12] The Institute of Medicine, on the other hand, suggests that 60 minutes a day (420 minutes per week) of moderate-intensity activity may be

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needed to prevent individuals from becoming either overweight or obese,[13] but the basis for this recommendation also has been questioned.[12] Clarifying these divergent recommendations is important because many people may be more likely to engage in 150 minutes per week of exercise than in 420 minutes per week, an almost 3-fold difference.

We therefore examined weight changes associated with different physical activity levels in a large cohort of women who were followed up for 13 years.

METHODS

Study Participants

This prospective cohort study began with the 39 876 women who participated in the Women's Health Study[14-16]—a 1992-2004 randomized trial testing low-dose aspirin and vitamin E for preventing cardiovascular disease and cancer—and continued after the trial ended when 33 796 women (88.0% of those alive) consented to continue in an observational follow-up study. The Women's Health Study initially enrolled women who were free of coronary heart disease, cerebrovascular disease, cancer (except nonmelanoma skin cancer), and other major chronic illnesses. Women provided written consent to participate, and the study was approved by the Brigham and Women's Hospital's institutional review board committee.

During the trial, women completed health questionnaires every 6 months during the first year and annually thereafter. During observational follow-up, they completed questionnaires annually, with cycle 1 beginning in May 2005. Reported cardiovascular disease and cancer were confirmed by checking medical records.

For this study, we excluded women developing cardiovascular disease and cancer (n=5331) prior to the end of the study (cycle 3 of observational follow-up) because these diseases could influence weight and we excluded women with missing physical activity or weight data at baseline (n=466), leaving 34 079 women.

Assessment of Physical Activity

On the baseline health questionnaire, women reported the average amount of time per week that they engaged in 8 groups of recreational activities over the past year: walking or hiking; jogging (>10-minute miles); running (≤10-minute miles); bicycling, including stationary machines; aerobic exercise, aerobic dance, or use of exercise machines; lower-intensity exercise such as yoga, stretching, or toning; tennis, squash, or racquetball; and lap swimming. They also reported their usual walking pace and number of flights of stairs climbed daily. We estimated the energy expended for each group of activities[17] in metabolic equivalent (MET) hours per week and summed this across all activities to estimate weekly energy expenditure.

The physical activity questionnaire was adapted from the College Alumni Health Study physical activity questionnaire, which has been extensively tested for reliability and validity, including validation against doubly labeled water (Spearman $r=0.67$ for recreational activities).[18] The original questionnaire allowed open-ended listing of activities; the adapted questionnaire listed activities most commonly carried out by women. For this adapted questionnaire, in a random sample of nurses, the test-retest correlation coefficient over 2 years was 0.59.[19] Questionnaire estimates, compared with 4 past-week recalls of physical activity spaced over 1 year before questionnaire administration, yielded a correlation of 0.79, and compared with activity diaries kept for 4 weeks spaced over the same year yielded a correlation of 0.62.[19]

Physical activity was updated at months 36, 72, and 96 during the trial, at trial conclusion, and cycle 2 of observational follow-up, referred to as the 36-, 72-, 96-, 120-, and 144-month follow-up.

We classified women into 3 groups of physical activity levels at each assessment: those who engaged in less than 7.5 MET hours per week (equivalent to <150 minutes per week of moderate-intensity physical activity), the minimum recommended by the federal government,[20] American College of Sports Medicine, and American Heart Association[9]; 7.5 to less than 21 MET hours per week; and 21 or more MET hours per week (equivalent to ≥420 minutes per week of moderate-intensity activity), the Institute of Medicine recommendation.[13]

Assessment of Body Weight and Other Variables

Women reported their body weight at baseline and regularly during follow-up. For the present study, we used baseline and 36-, 72-, 96-, 120-, and 156-month follow-up weights. Among nurses, self-reported weight is highly correlated ($r=0.96$) with directly measured weight.[21]

Women also reported information on potential confounders of the association between physical activity and weight change: race (self-declared), educational attainment, height, smoking status, menopausal status, postmenopausal hormone use, diabetes, hypertension, alcohol intake, and diet measured by a 131-item food frequency questionnaire.[22]

Statistical Analyses

We first compared characteristics among the 3 physical activity groups at baseline and examined physical activity and weight trends during the study.

Next, we examined prospective changes in body weight, according to the 3 activity groups, with physical activity updated over time and using repeated measures linear regression to account for the correlation of within-woman repeated observations.[23] For example, physical activity at baseline was related to weight change from baseline to 36 months, physical activity at 36 months was related to weight change from 36 to 72 months, etc. Initial models adjusted for age, baseline weight, height, and time interval between weight assessments (all continuous variables). Fully adjusted models additionally considered race (white, nonwhite); educational attainment (≤2-year associate's degree, 3-year associate's degree, bachelor's degree, ≥master's degree); smoking status

(never, past, current); menopausal status (premenopausal, postmenopausal, uncertain); postmenopausal hormone therapy (never, past, current); diagnosis of diabetes (no, yes); diagnosis of hypertension (no, yes); alcohol intake (never, 1-3 servings per month, 1-4 servings per week, ≥5 servings per week); and quintiles of intakes of total energy, saturated fat, fruits, and vegetables. We also examined changes in body mass index (BMI), calculated as weight in kilograms divided by height in meters squared. Because the findings were very similar (mean height was identical across groups), we present only the findings for weight, a more interpretable measure. We examined interactions between physical activity and age (<55, 55-64, ≥65 years), BMI (normal weight, BMI<25; overweight, 25-<30; obese, ≥30), and smoking and menopausal status with respect to weight change.

In parallel analyses, we examined prospectively the odd ratios (ORs) and 95% confidence intervals (CIs) for meaningful weight gain, defined as at least 2.3 kg (≥5 lb),[24] in the interval between physical activity and weight assessments, according to the 3 physical activity groups and using repeated measures logistic regression. Post hoc power calculations using $\alpha = .05$ and a 2-sided test showed more than 99% power to detect a trend across groups, with an OR of 1.11 comparing extreme groups.

Statistical analyses were conducted using SAS release 9.1.3 (SAS Institute Inc, Cary, North Carolina).

RESULTS

The mean age of women at baseline was 54.2 years. This was similar across physical activity groups (TABLE 1). Body mass index was inversely related to activity level, as was weight, while mean height was identical across groups. Race was similarly distributed across groups, as was the proportion of postmenopausal women. More active women were more likely to have had postgraduate education and use postmenopausal hormones; they also had healthier risk factor and medical history profiles.

The mean follow-up from baseline to month 156 was 13.1 years. At baseline, 49.5% of women expended less than 7.5 MET hours per week on physical activity; 28.8%, 7.5 to less than 21 MET hours per week; and 21.7%, 21 or more MET hours per week (FIGURE 1). The proportion of women in the least active category declined over time, while the proportion in the most active category increased, so that at 144 months, when physical activity was last assessed, 34.2% expended less than 7.5 MET hours per week and 35.5% expended 21 or more MET hours per week. In part, this likely reflected the fact that women who continued in the observational component (120 to 156

Table 1. Baseline Characteristics of Women by Physical Activity Level, Women's Health Study[a]

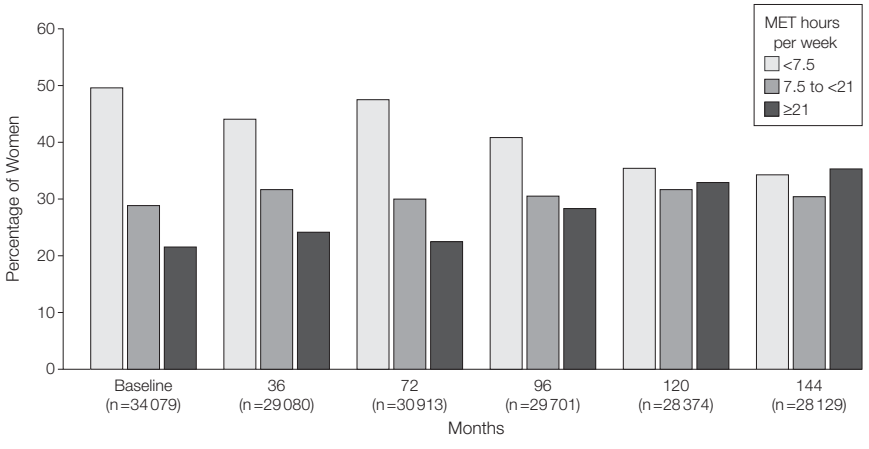
Characteristics	Physical Activity, MET Hours per Week[b] <7.5 (n = 16 856)	7.5 to <21 (n = 9819)	≥21 (n = 7404)
Age, mean (SD), y	54.1 (6.8)	54.3 (6.9)	54.2 (6.9)
BMI, mean (SD)	26.9 (5.5)	25.5 (4.5)	24.5 (4.1)
Weight, mean (SD), kg	72.7 (15.7)	68.8 (13.0)	66.2 (12.0)
Height, mean (SD), cm	164.1 (6.3)	164.1 (6.2)	164.1 (6.3)
White race, No. (%)	15 769 (94.3)	9308 (95.5)	6950 (94.5)
Postgraduate education, No. (%)	2875 (17.4)	2088 (21.6)	1755 (24.1)
Postmenopausal, No. (%)	8746 (52.0)	5147 (52.5)	3869 (52.4)
Postmenopausal hormone therapy use, No. (%)	6630 (39.4)	4077 (41.6)	3181 (43.1)
Current smoking, No. (%)	2622 (15.6)	953 (9.7)	611 (8.3)
Any alcohol intake, No. (%)	8508 (50.5)	5660 (57.7)	4618 (62.4)
Energy intake, mean (SD), kcal/d	1708 (542)	1739 (521)	1755 (537)
Saturated fat, mean (SD), g/d	20.6 (4.8)	19.2 (4.6)	18.1 (4.8)
Fruits and vegetables, mean (SD), servings/d	5.5 (3.4)	6.4 (3.4)	7.2 (4.2)
Hypertension, No. (%)	4553 (27.0)	2289 (23.3)	1494 (20.2)
Diabetes mellitus, No. (%)	397 (2.4)	212 (2.2)	93 (1.3)

Abbreviations: BMI, body mass index, which is calculated as weight in kilograms divided by height in meters squared; MET, metabolic equivalent.

[a] Except for physical activity, weight, and BMI, data for other characteristics were not provided by all women.

[b] An expenditure of 7.5 MET hours per week is equivalent to 150 minutes per week of moderate-intensity physical activity, the minimum recommended by the federal government[20]; 21 MET hours per week is equivalent to 60 minutes per day (420 min/wk) of moderate-intensity physical activity, recommended by the Institute of Medicine.[13]

Figure 1. Physical Activity Levels Throughout Women's Health Study



MET indicates metabolic equivalent. The number of women who provided physical activity information varied during the study.

months) were a somewhat healthier subgroup.

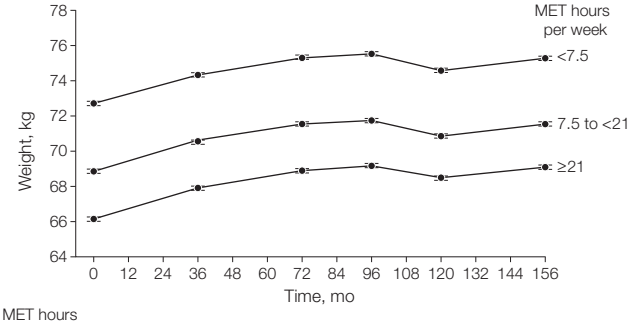
As expected, women gained weight over time. At baseline, the mean weight was 70.2 kg; at the end of the study, 72.8 kg. FIGURE 2 shows the trajectory of weight gain over time by baseline physical activity levels. When classified by this single measure of physical activity, all 3 groups showed similar weight gain patterns over time.

We next examined prospective changes in weight, according to physical activity level and allowing physical activity to be updated over time. The mean (SD) interval during which weight change was assessed was 2.88 (0.41) years. Compared with women expending 21 or more MET hours per week, those expending 7.5 to less than 21 MET hours per week gained 0.11 kg (0.04 kg) in a fully adjusted model (TABLE 2), whereas those expending less than 7.5 MET hours per week gained 0.12 kg (0.04). The difference in weight gain between these 2 groups—0.11 vs 0.12 kg—was not statistically significant ($P=.77$).

We investigated whether the association between physical activity and weight change was modified by age, BMI, smoking status, or menopausal status and found significant interactions with age, BMI (both $P<.001$), and menopausal status ($P=.04$; Table 2). The trend of increasing weight gain with lower levels of activity appeared only among women younger than 65 years and among women with BMI lower than 25, and the magnitude of gain was larger in least active premenopausal women than postmenopausal women.

We then prospectively examined the likelihood of gaining 2.3 kg or more over a mean interval of 2.88 years

Figure 2. Mean Weight, According to Baseline Physical Activity Levels Throughout Study, Women's Health Study



No. by MET hours per week

<7.5	16856	15634	15153	15661	13779	13353
7.5 to <21	9819	9171	9005	9260	8336	8106
≥21	7404	6924	6808	6992	6264	6107

MET indicates metabolic equivalent. Error bars indicate 95% confidence intervals. Except for baseline, numbers of women by follow-up month do not sum to those in Figure 1 because of missing data.

Table 2. Mean (SD) Differences in Weight Over Any 3-Year Period by Physical Activity Level, Women's Health Study, 1992-2007[a]

Group	No. of Women[b]	Physical Activity, MET Hours per Week			*P* Value for Trend	*P* Value for Interaction
		<7.5	7.5 to <21	≥21		
All women						
Analytical model[c]						
1		0.15 (0.04)	0.12 (0.04)	0 [Reference]	<.001	
2		0.12 (0.04)	0.11 (0.04)	0 [Reference]	<.001	
Age, y						
<55	21363	0.12 (0.08)	0.02 (0.08)	0 [Reference]	<.001	<.001
55-64	9699	0.24 (0.06)	0.19 (0.06)	0 [Reference]	<.001	
≥65	3017	–0.09 (0.07)	0.07 (0.07)	0 [Reference]	.13	
BMI						
<25.0	17475	0.21 (0.04)	0.14 (0.04)	0 [Reference]	<.001	<.001
25-29.9	10516	–0.04 (0.06)	–0.04 (0.06)	0 [Reference]	.56	
≥30.0	6088	0.16 (0.14)	0.13 (0.16)	0 [Reference]	.50	
Smoking status						
Never	17692	0.18 (0.05)	0.17 (0.05)	0 [Reference]	<.001	.53
Former	12169	0.06 (0.06)	0.05 (0.06)	0 [Reference]	.04	
Current	4186	0.15 (0.15)	0.12 (0.16)	0 [Reference]	.11	
Menopausal status						
Premenopausal	9821	0.19 (0.13)	0.08 (0.13)	0 [Reference]	.03	.04
Postmenopausal	17762	0.12 (0.04)	0.12 (0.04)	0 [Reference]	<.001	

Abbreviation: BMI, body mass index, which is calculated as weight in kilograms divided by height in meters squared; MET, metabolic equivalent.
[a] The mean (SD) difference in weight in kilograms is compared with the reference group. The mean (SD) interval during which weight change was assessed was 2.88 (0.41) years. See Table 1 footnote for definition of physical activity levels.
[b] Number of women represents those in the group at baseline.
[c] Model 1 was adjusted for age, baseline weight, height, and time interval between weight assessments. Model 2 was additionally adjusted for race; educational attainment; smoking status; menopausal status; hormone replacement therapy use; hypertension; diabetes; alcohol consumption; and quintiles of intakes of total energy, saturated fat, and fruits and vegetables. Analyses according to subgroups of women all used estimates from model 2.

(TABLE 3). Compared with women expending 21 or more MET hours per week, those expending 7.5 to less than 21 were 7% (95% CI, 4%-11%) and those expending less than 7.5 MET hours per week were 11% (7%-14%) more likely to gain 2.3 kg or more in a fully adjusted model. We observed a significant interaction with BMI ($P<.001$) but not age, smoking status, or menopausal status (all $P>.05$). Only among women with BMI less than 25 was there less likelihood of gaining 2.3 kg with higher levels of physical activity (P for trend $<.001$); there was no relation among women with BMIs from 25 to less than 30 (P for trend = .13) or 30 or higher (P for trend = .37).

Finally, we investigated how much physical activity was carried out by women who successfully maintained normal weight. We identified 4540 women (13.3%) with normal BMI at baseline, who remained at normal BMI throughout the study while gaining less than 2.3 kg over baseline weight at any time point assessed. Their mean activity levels at baseline, 36-, 72-, 96-, 120-, and 144-month were 17.6, 19.9, 18.9, 22.1, 24.2, and 26.1 MET hours per week, respectively, for a mean of 21.5 MET hours per week during follow-up.

COMMENT

In this large cohort of middle-aged and older women who were followed up for 13 years, there was an overall weight gain over time. Compared with women who engaged in the equivalent of 420 minutes per week (≈60 minutes per day) of moderate-intensity physical activity, those carrying out 150 to less than 420 minutes per week of such activity, as well as those engaged in less than 150 minutes per week, gained significantly more weight with no difference in weight gain between these 2 lesser active groups. The 2 lesser active groups also were significantly more likely to gain at least 2.3 kg (≥5 lb) over a 3-year period than the most active group. There was an interaction of these associations with BMI, so that physical activity was inversely related to weight gain only among normal-weight women. No relation existed among heavier women. Normal-weight women who gained less than 2.3 kg throughout the 13-year study spent the equivalent of 60 minutes per day in moderate-intensity activity—the level recommended by the Institute of Medicine for the prevention of unhealthful weight gain.[13]

These results highlight 2 important points for weight gain prevention. First, once overweight, it may be too late because physical activity—at least, at levels carried out by study participants—was not associated with less weight gain. Second, sustaining high levels of physical activity (~60 minutes a day) is needed to successfully maintain normal BMI and prevent weight gain: women engaging at this level of physical activity at baseline only (who may not have sustained the level over the study duration) gained weight at a similar trajectory compared with women who were less active (Figure 2).

The rate of weight gain in this study—2.6 kg over 13 years—was very similar to that observed between 1992 and 2000 among nationally representative women aged 51 to 61 years.[8] This

Table 3. Odds Ratio (95% Confidence Interval) for Weight Gain of at Least 2.3 Kilograms Over Any 3-Year Period by Physical Activity Level, Women's Health Study, 1992-2007[a]

Group	No. of Women[c]	Odds Ratio (95% Confidence Interval) of Weight Gain, Physical Activity by MET Hours per Week[b]			*P* Value for Trend	*P* Value for Interaction
		<7.5	7.5 to <21	≥21		
All women	34 079	1.11 (1.07-1.14)	1.07 (1.04-1.11)	1 [Reference]	<.001	
Age, y						
<55	21 363	1.08 (1.02-1.14)	1.05 (0.99-1.11)	1 [Reference]	.005	.51
55-64	9699	1.14 (1.09-1.20)	1.12 (1.07-1.17)	1 [Reference]	<.001	
≥65	3017	1.07 (1.00-1.15)	1.03 (0.96-1.10)	1 [Reference]	.054	
BMI						
<25.0	17 475	1.14 (1.09-1.20)	1.08 (1.03-1.13)	1 [Reference]	<.001	<.001
25-29.9	10 516	1.04 (0.99-1.10)	1.01 (0.96-1.07)	1 [Reference]	.13	
≥30.0	6088	1.04 (0.97-1.12)	1.05 (0.97-1.14)	1 [Reference]	.37	
Smoking status						
Never	17 692	1.13 (1.08-1.18)	1.10 (1.05-1.15)	1 [Reference]	<.001	.69
Former	12 169	1.09 (1.03-1.14)	1.06 (1.01-1.11)	1 [Reference]	<.001	
Current	4186	1.07 (0.96-1.18)	1.04 (0.92-1.17)	1 [Reference]	.23	
Menopausal status						
Premenopausal	9821	1.10 (1.01-1.21)	1.02 (0.93-1.12)	1 [Reference]	.03	.50
Postmenopausal	17 762	1.11 (1.08-1.15)	1.08 (1.05-1.13)	1 [Reference]	<.001	

Abbreviation: BMI, body mass index, which is calculated as weight in kilograms divided by height in meters squared; MET, metabolic equivalent.
[a] Adjusted for age; baseline weight; height; time interval between weight assessments; race; educational attainment; smoking status; menopausal status; hormone replacement therapy; hypertension; diabetes; alcohol consumption; and quintiles of intakes of total energy, saturated fat, and fruits and vegetables. The mean (SD) interval during which weight change was assessed was 2.88 (0.41) years.
[b] See footnote to Table 1 for definition of physical activity levels.
[c] Number of women in the group at baseline.

seemingly small amount of weight gain is sufficient to adversely affect health.[2,3] Preventing weight gain is preferable to treating overweight and obesity because of the limited sustainability of weight loss.[5,6] For example, in a recent randomized trial of weight loss involving overweight and obese women, even with extensive counseling on diet and exercise and the provision of treadmills in participants' homes, the 8% to 10% weight loss at 6 months could not be sustained at 24 months.[25] In another study in which overweight and obese men and women had lost 8.5 kg, weight regain of 4.0 to 5.5 kg over 30 months occurred in all groups randomly assigned to different behavioral interventions designed to maintain weight loss.[26]

Because weight gain results from an imbalance between energy intake and expenditure, an important question for weight gain prevention, among individuals consuming a usual US diet, is the amount of physical activity needed. The available data are unclear, particularly for long-term weight gain prevention. Current national and international recommendations for preventing unhealthful weight gain have variously targeted between 45 and 60 minutes per day of moderate to vigorous activity but acknowledge the limited basis for this amount.[10,12,13,20,27] Cross-sectional studies consistently indicate an inverse, dose-response relation; however, the direction of the relation is unclear with this study design (does physical activity lead to lower body weight, or is higher body weight a deterrent to activity?)[10] Prospective cohort studies with follow-up of 6.5 years or longer show consistent associations between increased physical activity levels, generally assessed at 2 time points only, and less weight gain.[10] It is difficult to infer the amount of physical activity carried out in these studies because studies typically analyzed physical activity as a continuous variable or grouped participants into categories of increase, decrease, or no change in physical activity.[10,28] Several randomized controlled trials testing different amounts of physical activity exist for which the primary outcome was not weight but in which weight was recorded.[10] These trials are short term, lasting 8 to 16 months and suggest that physical activity on the order of 13 to 26 MET hours per week over this short interval results in less than 3% weight change.[10,29-31] The data from our long-term observational study are congruent with this activity range.

Most of the studies discussed above have used self-reported physical activity, as did our study, which may be limited. However, studies with objective measures of physical activity and weight change are sparse. The Institute of Medicine recommendation for the amount of physical activity to maintain weight was based on data from doubly labeled water studies worldwide.[13] The expert panel estimated the activity level among 407 normal-weight men and women to be 60 minutes per day of moderate-intensity activity. However, not examined by the panel were the 360 overweight or obese participants in the doubly labeled water studies, in which physical activity levels were similar to or even higher than those among participants who were normal weight.[12] Thus, these data, in addition to being cross-sectional, do not fully support the Institute of Medicine conclusion that 60 minutes per day of activity is needed for maintaining normal weight. Another study of 74 Pima Indians reported a negative nonsignificant correlation between physical activity, measured using doubly labeled water at baseline and weight change over 4 years; the lack of significance may be due to the small sample.[32]

Strengths of the present study include the large number of women who were followed up prospectively for a long period, with multiple assessments of physical activity and body weight. Women were classified according to clinically relevant groups corresponding to physical activity recommendations. We also adjusted for many variables that could potentially confound the physical activity–weight relation.

Limitations include self-reported recreational physical activity and weight. However, the physical activity questionnaire used has shown good reliability and validity,[18,19] and physical activity in the present study has shown expected associations with chronic disease outcomes.[33-35] Self-reported body weight also is highly correlated (r=0.96) with directly measured weight in health professionals.[21] We did not have detailed information on other measures of body composition nor on medications potentially affecting weight. Furthermore, participants are not representative of the US population; however, their rate of weight gain was similar to that of comparably aged women in the general population.[8] Although we adjusted for baseline diet, we did not have repeated measures of diet over time. We also did not examine activity levels needed for weight management among women restricting caloric intake because our intent was to investigate women consuming a usual diet.

In conclusion, in this large prospective study of women consuming a usual diet, sustained moderate-intensity physical activity for approximately 60 minutes per day was needed to maintain normal weight and prevent weight gain. These data suggest that the 2008 federal recommendation for 150 minutes per week, while clearly sufficient to lower the risks of chronic diseases, is insufficient for weight gain prevention absent caloric restriction. Physical activity was inversely related to weight gain only among normal-weight women; among heavier women, there was no relation, emphasizing the importance of controlling caloric intake for weight maintenance in this group.

Author Contributions: Dr Lee had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.
Study concept and design: Lee.
Acquisition of the data: Lee, Buring.
Analysis and interpretation of data: Lee, Djoussé, Sesso, Wang, Buring.
Drafting of the manuscript: Lee.
Critical revision of the manuscript for important intellectual content: Lee, Djoussé, Sesso, Wang, Buring.

Statistical analysis: Djoussé.
Obtained funding: Lee, Buring, Sesso.
Study supervision: Lee, Buring.
Administrative, technical, or material support: Lee.
Financial Disclosures: Dr Lee reported serving as a consultant to Virgin HealthMiles and sits on its scientific advisory board. No other financial disclosures were reported.
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