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Effect of Weight Change on Natural History of Pelvic Organ Prolapse

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Abstract

OBJECTIVE—To evaluate the relationship between change in weight and pelvic organ prolapse (POP) progression/regression in women during a 5-year period.

METHODS—Postmenopausal women with uteri (N=16,608), ages 50 to 79, who were enrolled in the Women's Health Initiative (WHI) Estrogen plus Progestin Clinical Trial between 1993 and 1998 were included in this secondary analysis. Baseline pelvic examination, repeated annually, assessed uterine prolapse, cystocele, and rectocele using the WHI Prolapse Classification System. Statistical analyses included univariate and multiple logistic regression methods.

RESULTS—During the 5-year time period, the majority of women (9,251, 55.7%) gained weight (mean 4.43 kg, ± 5.95 kg), and the overall rate of prolapse (WHI Prolapse Classification System: grades 1-3) increased from 40.9% at baseline to 43.8% at year 5 of evaluation. Controlling for age, parity, race, and other health/physical variables, being overweight (body mass index [BMI] between 25 and 29.9) or obese (BMI of at least 30) at baseline was associated with progression in cystocele, rectocele, and uterine prolapse compared with women with healthy BMIs (BMI is calculated as weight (kg)/[height (m)]^2). Specifically, the risk of prolapse progression in overweight and obese women as compared with the participants with healthy BMIs increased by 32% and 48% for cystocele, by 37% and 58% for rectocele, and by 43% and 69% for uterine prolapse, respectively. Adjusting for women with prolapse at baseline and baseline BMI, a 10% weight change was associated with minimal change in overall POP. Specifically, a 10% weight loss was associated with a borderline worsening of uterine prolapse (odds ratio [OR] 0.93, 95% confidence interval [CI] 0.88-0.97) and a minimal regression of cystocele (OR 1.03, 95% CI 1.00-1.05) and rectocele (OR 1.04, 95% CI 1.01-1.07).

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CONCLUSION—Being overweight or obese is associated with progression of POP. Weight loss does not appear to be significantly associated with regression of POP, suggesting that damage to the pelvic floor related to weight gain might be irreversible.

According to the National Center for Health Statistics, an estimated 68% of U.S. adults are either overweight or obese, the majority being female.[1] The effect of weight gain on female health is pervasive and is linked to such prevalent diseases as diabetes, arthritis, cardiovascular disease, and pelvic organ prolapse (POP).

Pelvic organ prolapse, consisting of anterior, apical, and posterior support defects, affects, on average, up to 50% of the female population in the United States, with prevalence rates varying among different populations from 30% to 93%.[2,3] The estimated lifetime risk of surgery for POP and/or urinary incontinence by age 80 years is approximately 11%.[4] In 1997, almost 226,000 (22.7 per 10,000) inpatient surgical procedures were performed in the United States to correct this condition,[5] costing more than 1 billion dollars. Indeed, POP is one of the three most common reasons for hysterectomy in the United States, accounting for 15-18% of procedures in all age groups, and is the leading indication for hysterectomy in postmenopausal women.[6,7] Further, an estimated 13-30% of women who have prolapse surgeries will need a reoperation within 5 years.[4,8] Numerous factors, including age, ethnicity, parity, obesity, and history of hysterectomy, have been found to be associated with POP.[9,10] One recent study demonstrated that hysterectomy, particularly performed vaginally, nearly quadrupled the risk for subsequent prolapse surgery.[11]

Despite our knowledge of the natural history of POP disorders, little is known about the effect of weight change on prolapse progression or regression. In a cross-sectional study of postmenopausal women who enrolled in the Women's Health Initiative (WHI) Hormone Therapy Clinical Trial, the risk of having uterine prolapse, rectocele, or cystocele was 30-50% higher in women with body mass indexes (BMIs) of 25 or higher than in those with BMIs of 24.9 or lower (BMI is calculated as weight (kg)/[height (m)]^2).[9] However, longitudinal effects of being overweight or obese on prolapse development are less well studied. Of particular interest to clinicians is the question of whether being overweight or obese is a modifiable risk factor for POP. The purpose of this secondary analysis of the WHI Estrogen plus Progestin (E+P) Clinical Trial was to evaluate the relationship between change in weight and POP progression/regression in postmenopausal women during a 5-year period.

MATERIALS AND METHODS

This secondary analysis study was approved by the Human Subjects Review Committee at Wayne State University. Postmenopausal women with uteri (N=16,608), ages 50 to 79, who were enrolled in the WHI E+P Clinical Trial between 1993 and 1998 were included in the study. The WHI E+P trial was a randomized, double-blinded trial of the effects of E+P on coronary heart disease, fractures, and malignancies in postmenopausal women. Sixteen percent of the study participants were from racial/ethnic minority groups. Women were eligible to participate in the E+P study if they were postmenopausal, not currently using hormone therapy (or willing to stop), not currently participating in any other clinical trial, and were unlikely to move or die within 3 years. At baseline, women completed screening and enrollment questionnaires by interview and self-report, a physical examination, and blood specimen collection. Information ascertained at baseline included age, age at last delivery, race/ethnicity, education, occupation, overall quality of life (rated 1-10), chronic medical morbidities, time since menopause, parity, duration of prior hormone use, hysterectomy status, constipation, current and past smoking, and physical activity (episodes per week). Additionally, weight (kg), height (cm), and waist and hip circumferences (cm) were recorded. Route of child birth (vaginal or cesarean) was not recorded.

A baseline pelvic examination was required for eligibility in the WHI E+P Clinical Trial. This examination was performed using standardized procedures detailed in the WHI manuals and included an assessment of uterine prolapse, cystocele, and rectocele using the WHI Prolapse Classification System (grades: 0, no prolapse; 1, prolapse in vagina; 2, prolapse to introitus; and 3, prolapse outside vagina); this was repeated annually along with follow-up standardized physical examinations, with each participant having between 1 and 10 visits. A gynecologist, experienced nurse, or physician assistant performed the pelvic examination, with the woman in the supine lithotomy position without a speculum during Valsalva maneuver. Status of bladder or rectal fullness was not recorded. Centralized training provided a review of the examination procedure, the definitions of prolapse, and how to record the results on standardized forms. A WHI clinic gynecologist certified and oversaw all midlevel providers to ensure proper performance of the examination. Medical history updates were completed semiannually, and medical records for hospitalizations were obtained to adjudicate WHI outcomes.

Descriptive analyses were performed and recorded in the form of frequencies and corresponding percentages by BMI category. Associations between BMI and categorical covariates were evaluated with χ^2 tests. Of note, waist circumference was categorized based on the cutoff point of more than 88 cm, which has been shown to correctly identify 88.5% of women who are obese and is a risk factor for hypertention.[12,13] Explanatory variables, including E+P treatment assignment, found to be clinically and statistically significant ($P>.1$) were included as adjustment covariates in logistic regression modeling for each of the three prolapse types (cystocele, rectocele, and uterine prolapse) as a function of BMI. Because a 5% to 10% weight loss has been found to be as efficacious as nonsurgical treatment for urinary incontinence in overweight and obese women,[14] we constructed additional models (one for each type of prolapse) looking at the effect of a 10% weight loss and adjusting for baseline BMI, baseline prolapse status, and the same set of covariates as for the original models. Finally, a series of logistic models were run to estimate whether there was a significant interaction effect of BMI and both age and waist circumference on the various prolapse outcomes.

Missing data were treated in the following manner. We started with the original E+P trial population of 16,608, with each participant having between 1 and 10 visits. Baseline prolapse totals (Table 1) included all baseline data for each individual condition (15,129 for uterine prolapse, 16,585 for cystocele, and 16,573 for rectocele). At year 5, the numbers were 6,890 for uterine prolapse, 8,483 for cystocele, and 8,458 for rectocele. Results, looking at the distribution of the combination of prolapse types (Table 2), were based only on those participants with known data of all prolapse types at each time point presented. Baseline descriptive data by BMI (Table 3) were limited to those participants with known BMI data at baseline (n=16,536). Because repeated-measures logistic regression is a complete case analysis, participants who were still alive at a given time point but missing prolapse data were classified based on their previous examination, whereas those with missing covariates were excluded from the analysis. In the case of Table 4, which encompasses the whole study group, 2,049 (12.4%) of the participants were excluded. In the case of Table 5, in which we examine the effect of weight change on prolapse, only those participants with prolapse data after baseline (n=15,997) were included, with subsequent exclusion of 3,163 (19.8%) participants who were missing covariates. The latter number was lower in the cystocele and rectocele models, which had fewer missing data at baseline than the uterine prolapse variable. Of note, women who underwent hysterectomy during the study period were excluded from the analysis. All statistical analyses were completed with SAS 9.1 (SAS Institute, Cary, NC).

RESULTS

From the initial 16,608 WHI E+P study participants, POP examination data were known for 13,845 women at year 1 and 8,508 women at year 5 of evaluation; 7,094 participants had known values for year 1, year 2, and year 5 of evaluation (Fig. 1). Baseline characteristics of the WHI E+P participants have been described elsewhere.[15] At baseline, mean age was 63.3 years (standard deviation 7.12, range 50-79 years), mean BMI was 28.5 (standard deviation 5.7, range 15.4-58.5), and the majority of women had three deliveries. At baseline, 40.9% of women had POP (grades 1-3); 34.8% had cystocele, 18.4% rectocele, and 13.4% uterine prolapse (Table 1). Prevalence of isolated and combined pelvic support defects at baseline, year 1, and year 5 of evaluation in WHI E+P participants is presented in Table 2. During the 5-year time period, the majority of women (9,251, 55.7%) gained weight (mean 4.43 kg, ±5.95 kg). The overall rate of prolapse (grades 1-3) increased by 4%, from 40.9% at baseline to 43.8% by year 5 of evaluation (Fig. 1). Among those 5,595 participants (45.5% of the sample with known prolapse examination data at year 1), 23.7% had resolution by year 2, with about 26.7% of them having a recurrence by year 5. These trends were observed for each of the three types of prolapse, with lower rates of recurrence for uterine prolapse. Conversely, among 8,250 women who did not have prolapse at year 1 of evaluation (67.14% of those with examination data at year 1), 20.6% developed POP at year 2, with about 42.5% of them having resolution by year 5. Similarly, these trends were observed for each of the three types of prolapse, with higher resolution rates for uterine prolapse.

Demographic and other clinical data for women in the three BMI strata as well as univariate associations between BMI categories and potential covariates are presented in Table 3. Each type of prolapse was classified based on WHI Prolapse Classification System grades (0, 1, 2, 3) and dichotomized into grade 0 compared with grades 1, 2, or 3. In the analysis, baseline explanatory variables or covariates considered included age (younger than 50 to 59, 60-69, 70 to 79 or older), age at last delivery, ethnicity, parity, BMI group (healthy, BMI 24.9 or less; overweight, BMI between 25 and 29.9; and obese, BMI 30 or higher), waist circumference at baseline (88 cm or less and more than 88 cm),[12] physical activity (10 metabolic units above resting/week increments), reported total hormone therapy use, E+P treatment arm, constipation, and tobacco use. We did not include data on women's present or past occupations because the information on occupations involving heavy labor was not available.

We found significant associations between POP and age, ethnicity/race, parity, waist circumference, smoking, total hormone usage, urinary incontinence ($P<.001$). Each type of prolapse was dichotomized into WHI grade 0 compared with grades 1, 2, or 3 for the logistic regression models (Table 4). After controlling for age, parity, race, E+P treatment assignment, and other health/physical variables, being overweight (BMI between 25 and 29.9) or obese (BMI 30 or higher) at baseline was associated with progression in cystocele, rectocele, and uterine prolapse (Table 4) compared with women with healthy BMIs of less than 25 during the average follow-up of 5 years. The risk of prolapse progression in overweight and obese women as compared with the participants with healthy BMIs increased by 32% and 48% for cystocele, 37% and 58% for rectocele, and 43% and 69% for uterine prolapse, respectively. In comparison with uterine prolapse, waist circumference of more than 88 cm was a risk factor for prolapse progression for both cystocele (odds ratio [OR] 1.20, 95% confidence interval [CI] 1.11-1.29) and rectocele (OR 1.31, 95% CI 1.20-1.43). Of interest, when age at last delivery was introduced into the baseline cystocele, rectocele, and uterine prolapse models, it was not found to be significantly associated with prolapse ($P=.29$ compared with 0.42 compared with 0.75, respectively).

Additionally, we evaluated the effect of a 10% weight change on progression, stabilization, or regression of POP after adjusting for women with prolapse at baseline, baseline BMI, and the

previously mentioned explanatory variables. A 10% weight change was associated with minimal change in POP (Table 5). Specifically, a 10% weight loss was associated with a borderline worsening of uterine prolapse (OR 0.93, 95% CI 0.88-0.97) and a minimal regression of cystocele (OR 1.03, 95% CI 1.00-1.05) and rectocele (OR 1.04, 95% CI 1.01-1.07). Interestingly, a change in waist-to-hip ratio, evaluated in 0.1 increment decreases, was found to be associated with regression of both cystocele (OR 1.07, 95% CI 1.03-1.12) and rectocele (OR 1.14, 95% CI 1.08-1.20) but not of uterine prolapse (OR 0.98, 95% CI 0.92-1.05). There was no effect of a 10% weight loss when the same models were fit to evaluate more severe (WHI Prolapse Classification System grades 2 and 3) prolapse. Finally, we did not find a statistically significant interaction effect of BMI with either age or waist circumference on the various prolapse outcomes.

DISCUSSION

The key finding of this study is that, when compared with a healthy BMI, being overweight or obese is highly associated with progression of POP. However, regression of POP did not appear to be significantly associated with weight loss. A 10% weight loss resulted in an overall 3% reduction in cystocele, a 4% reduction in rectocele, and an 8% worsening of uterine prolapse (Table 5) but had no effect on severe grades of prolapse.

This study adds valuable new information to the paucity of existing literature on the natural history of POP in postmenopausal women. Through our search of the PubMed database using various combinations of the search terms “prolapse,” “natural history of prolapse,“ “regression,” “progression,” “cystocele,” “rectocele,” and “uterine prolapse,” we found only two longitudinal studies evaluating the mode and risk factors for progression/regression of prolapse, neither of which addressed the effect of weight change on prolapse.[16,17] Both of these studies were smaller ancillary WHI studies that described POP as a fluctuating state. Similar to our findings, Bradley et al found overall 1- and 3-year prolapse incidences to be 26% and 1- and 3-year prolapse resolution rates to be 21% among 270 women with a mean age of 68 years. Risk factors for prolapse progression included severity of baseline prolapse, BMI, waist circumference, and multiparity.[17] Of particular interest to clinicians are the risk factors of waist circumference and waist-to-hip ratio, surrogate measures of visceral obesity, which also have been linked previously to preeclampsia and cardiovascular disease. In our study, a waist circumference of more than 88 cm was associated with a 20% worsening in cystocele and a 31% worsening in rectocele (Table 4), whereas a reduction in waist-to-hip ratio was associated with an improvement in both cystocele and rectocele (Table 5). One might speculate that these measures are a reflection of larger mechanical forces directed toward the pelvic floor at rest or during cough or Valsalva maneuver, contributing to its dysfunction. Additionally, aging of the study participants during the 5-year study period might have contributed to prolapse progression despite weight loss.

There are important strengths to this study. The observations were made on a large sample size that was followed prospectively, allowing for longitudinal repetitive observations. There was an extended follow-up period of 5 years, and the observations were done in a standardized fashion. Finally, the proportion of racial/ethnic minority participants in this study was similar to that in the general population, making the results generalizable.[15]

Limitations included that the study was designed primarily to examine the effects of hormone therapy on incidence and death from coronary heart disease in women and not to evaluate natural history of prolapse as a function of BMI or weight change. Therefore, the measure (WHI Prolapse Classification) chosen to quantify the prolapse might not have been optimal as compared with the International Continence Society-recommended use of the Pelvic Organ Prolapse Quantification system,[18] but it was perhaps significantly more user-friendly for the

generalists participating in this study. Although the prolapse assessment was done during Valsalva maneuver, the participants were examined without the use of a split or Sims speculum and in a supine position rather than in a birthing chair at a 45° angle that allows for a significantly higher detection rate of stage 2 or greater prolapse.[19] Furthermore, this type of examination might have decreased identification of uterine prolapse as a whole and of less severe prolapse grade 1 and some of grade 2. Different examiners performed the standardized pelvic examinations, raising concerns about the reproducibility and reliability of observations; however, there was standardized training. Information that was collected on any surgical procedures performed to correct POP at baseline and throughout the WHI study period was limited by the participant's response rate on the study forms. More than half of the forms did not have the *Current Procedural Terminology* codes corresponding to the prolapse surgery. In combination, these factors hypothetically might have allowed for underestimation of the presence of prolapse and might have been responsible for a less accurate picture of the natural history of prolapse. Finally, our findings are restricted to women with uteri in situ and might not apply to women with prior hysterectomy.

Despite these limitations, this study adds new and important information to the understanding of the natural history of POP, in particular to the effect of weight change on prolapse. We chose a 10% weight change because a 5-10% weight loss has been shown not only to positively affect diabetes and hypertension but also to improve urinary incontinence by more than 50% in moderately overweight and obese women.[14,20] Unfortunately, the findings of our study did not show that this type of weight change significantly affects regression of POP. For example, a weight loss of 20 lb, or 10% in a woman who weighs 200 lb, might only amount to minimal regression of a cystocele or rectocele and a surprising borderline worsening of uterine prolapse, probably without any significant effect on prolapse-related symptoms. Perhaps the latter is a spurious observation, or it may be due to the uncertain role of fatty tissue in pelvic-floor support. Furthermore, and most importantly, when evaluating women with more severe and potentially more symptomatic prolapse at or beyond the hymen, there is no effect of 10% weight loss on prolapse. This finding suggests that damage to the pelvic floor, related to weight gain, might take more time to regress or is irreversible. Therefore, it might be prudent to counsel our patients to avoid weight gain to prevent additional damage to the pelvic floor associated with childbearing. It is unclear, however, whether further weight loss makes a difference. Additional longitudinal studies are needed to elucidate the role of weight change on prolapse before and after menopause as well as during the postpartum period.

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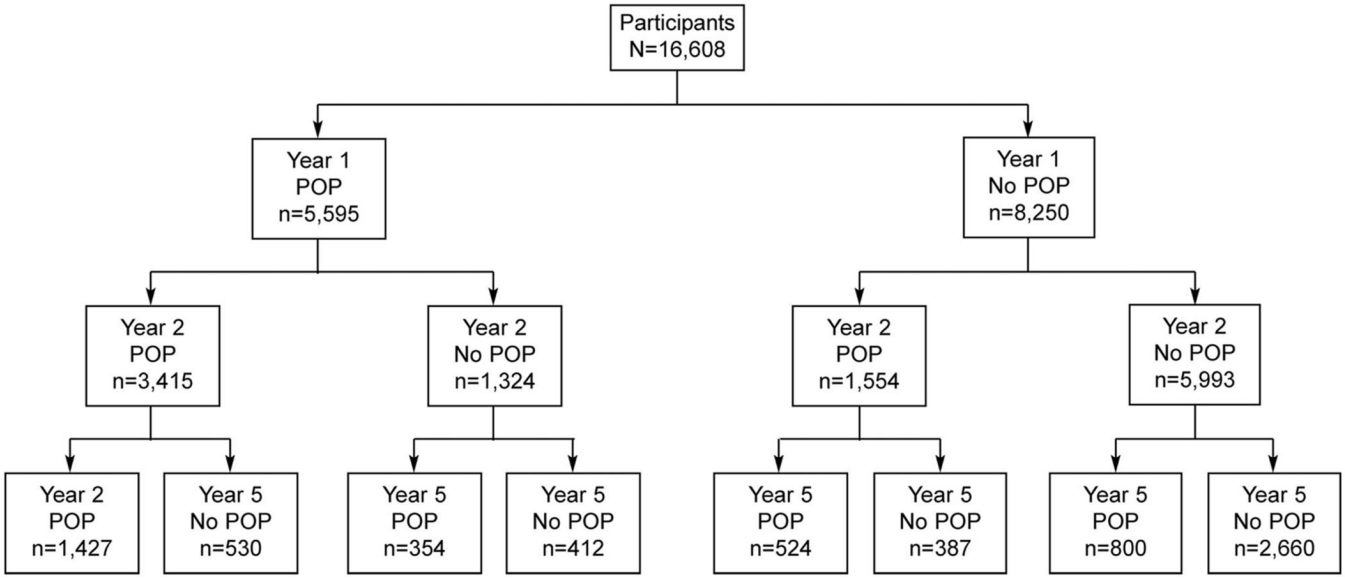

Fig. 1.

Prevalence of pelvic organ prolapse (POP, Women's Health Initiative [WHI] Prolapse Classification grades 1, 2, 3) in WHI Estrogen plus Progestin participants during the 5-year follow-up period: trend in prolapse progression and regression. At each time point, this figure includes all participants with known values for all previous time points. Thus, a participant with a value at year 5 also would have known values at year 2 and year 1. Women who underwent hysterectomy during the study period were excluded from the analysis.

Table 1

Prevalence of WHI Prolapse Classification Grades 0-3 of Cystocele, Rectocele, and Uterine Prolapse at Baseline in Women's Health Initiative Estrogen Plus Progestin Participants

WHI Prolapse Classification Grades	Cystocele (n=16,585*)	Rectocele (n=16,573*)	Uterine Prolapse (n=15,129*)
0 (none)	10,883 (65.6)	13,479 (81.3)	12,772 (84.4)
1 (in vagina)	4,809 (29.0)	2,643 (16)	2,177 (14.4)
2 (to introitus)	839 (5.1)	423 (2.5)	150 (1.0)
3 (beyond introitus)	54 (0.3)	28 (0.2)	30 (0.2)

WHI, Women's Health Initiative.

Data are n (%).

Baseline prolapse totals used all known baseline data for each type of prolapse (n=15,129-16,585).

*Total number of observations for each type of prolapse.

Table 2

Prevalence of Isolated and Combined Pelvic Support Defects at Baseline, Year 1, and Year 5 of Evaluation in Women's Health Initiative Estrogen Plus Progestin Participants

Type of Prolapse	Baseline (n=15,088*)	Year 1 (n=12,078*)	Year 5 (n=6,849*)
Uterine prolapse	510 (3.4)	340 (2.8)	164 (2.4)
Cystocele	2,178 (14.4)	1,867 (15.5)	1,281 (18.7)
Rectocele	487 (3.2)	390 (3.2)	198 (2.9)
Uterine prolapse and cystocele	727 (4.8)	533 (4.4)	238 (3.5)
Uterine prolapse and rectocele	82 (0.5)	51 (0.4)	23 (0.3)
Cystocele and rectocele	1,294 (8.6)	1,160 (9.6)	781 (11.4)
Uterine prolapse and cystocele and rectocele	1,031 (6.8)	670 (5.6)	392 (5.7)

Data are n† (%).

All frequencies at each time point include only those women with known uterine, cystocele, and rectocele examination values.

* Number of study participants at each time point with known examination values.

† Known observations for specified type of prolapse at each time point.

Table 3

Baseline Characteristics of the Women's Health Initiative Estrogen Plus Progestin Participants

Characteristic, Baseline	BMI Category (kg/m^2)			*P*
	Less Than 25	25 to Less Than 30	30 or Higher	
Age				<.001
Younger than 50 to 59	1,645 (32.5)	1,823 (31.3)	2,025 (35.9)	
60-69	2,139 (42.3)	2,706 (46.4)	2,632 (46.6)	
70-79 or older	1,277 (25.2)	1,303 (22.3)	986 (17.5)	
Ethnicity				<.001
White	4,394 (86.8)	4,932 (84.6)	4,555 (80.7)	
African American	196 (3.9)	348 (6.0)	576 (10.2)	
Hispanic	185 (3.7)	340 (5.8)	360 (6.4)	
Native American	12 (0.2)	22 (0.4)	22 (0.4)	
Asian/Pacific Islander	208 (4.1)	109 (1.9)	46 (0.8)	
Unknown	66 (1.3)	81 (1.4)	84 (1.5)	
Parity				<.001
Missing	23 (0.5)	24 (0.4)	31 (0.5)	
Never pregnant	432 (8.5)	441 (7.6)	408 (7.2)	
Never had term pregnancy	133 (2.6)	133 (2.3)	130 (2.3)	
1	441 (8.7)	465 (8.0)	443 (7.9)	
2	1,212 (23.9)	1,254 (21.5)	1,130 (20.0)	
3	1,255 (24.8)	1,412 (24.2)	1,290 (22.9)	
4	822 (16.2)	967 (16.6)	1,031 (18.3)	
5 or more	743 (14.7)	1,136 (19.5)	1,180 (20.9)	
Waist circumference 88 cm or less				<.001
Missing	18 (0.4)	19 (0.3)	13 (0.2)	
No	4,899 (96.8)	3,718 (63.8)	514 (9.1)	
Yes	144 (2.8)	2,095 (35.9)	5,116 (90.7)	
Smoking				<.001
Missing	63 (1.2)	52 (0.9)	74 (1.3)	
Never smoked	2,432 (48.1)	2,875 (49.3)	2,843 (50.4)	
Past smoker	1,857 (36.7)	2,298 (39.4)	2,334 (41.4)	
Current smoker	709 (14.0)	607 (10.4)	392 (6.9)	
Total hormone usage				<.001
Missing	3 (0.1)	2 (0.0)	2 (0.0)	
Never used	3,582 (70.8)	4,260 (73.0)	4,393 (77.8)	
Past user	1,061 (21.0)	1,216 (20.9)	975 (17.3)	
Current user	415 (8.2)	354 (6.1)	273 (4.8)	
Constipation				.021
Missing	33 (0.7)	51 (0.9)	41 (0.7)	
No	4,685 (92.6)	5,354 (91.8)	5,132 (90.9)	
Yes	343 (6.8)	427 (7.3)	470 (8.3)	
Any incontinence				<.001

Characteristic, Baseline	BMI Category (kg/m^2)			*P*
	Less Than 25	25 to Less Than 30	30 or Higher	
Missing	25 (0.5)	45 (0.8)	34 (0.6)	
No	1,807 (35.7)	1,724 (29.6)	1,356 (24.0)	
Yes	3,229 (63.8)	4,063 (69.7)	4,253 (75.4)	

BMI, body mass index.

Data are n (%) unless otherwise specified.

Baseline data by BMI are limited to those participants with known BMI data at baseline (n=16,536).

Table 4

Results of Logistic Regression Models for Cystocele, Rectocele, and Uterine Prolapse in Women's Health Initiative Estrogen Plus Progestin Participants

Characteristic, Baseline	Cystocele	Rectocele	Uterine Prolapse
Age	1.02 (1.01-1.02), ***P***<.001	1.02 (1.01-1.02), ***P***<.001	1.02 (1.01-1.02), ***P***<.001
Ethnicity (vs white)	***P***<.001	***P***<.001	***P***<.001
African American	0.69 (0.62-0.78)	0.52 (0.44-0.60)	0.77 (0.66-0.91)
Hispanic	1.21 (1.08-1.35)	0.98 (0.85-1.12)	0.91 (0.78-1.07)
Native American	1.09 (0.73-1.63)	0.66 (0.38-1.17)	0.50 (0.25-1.00)
Asian/Pacific Islander	2.55 (2.13-3.05)	2.36 (1.98-2.81)	0.67 (0.53-0.83)
Unknown	1.46 (1.17-1.82)	1.47 (1.15-1.88)	0.99 (0.75-1.30)
Parity (vs never pregnant)	***P***<.001	***P***<.001	***P***<.001
Never had term pregnancy	1.27 (1.01-1.60)	1.26 (0.90-1.77)	1.23 (0.87-1.74)
1	2.19 (1.90-2.53)	2.59 (2.14-3.14)	1.98 (1.58-2.47)
2	2.83 (2.51-3.20)	3.54 (3.01-4.15)	2.29 (1.88-2.78)
3	3.15 (2.79-3.55)	3.70 (3.15-4.33)	2.45 (2.02-2.97)
4	3.53 (3.12-3.99)	4.30 (3.65-5.06)	2.56 (2.10-3.12)
5 or more	4.26 (3.77-4.81)	5.29 (4.51-6.21)	3.18 (2.62-3.87)
Smoking (vs never smoked)	***P***<.001	***P***<.001	***P***<.001
Past smoker	0.85 (0.81-0.90)	0.85 (0.80-0.91)	0.83 (0.77-0.90)
Current smoker	0.74 (0.67-0.81)	0.66 (0.59-0.75)	0.75 (0.66-0.86)
Moderate/severe constipation	1.02 (0.92-1.13), ***P***=.73	1.00 (0.89-1.12), ***P***=.98	0.96 (0.84-1.10), ***P***=.59
Asthma	1.02 (0.91-1.13), ***P***=.78	0.98 (0.86-1.11), ***P***=.73	0.91 (0.78-1.06), ***P***=.23
Emphysema	0.95 (0.82-1.11), ***P***=.53	1.02 (0.85-1.22), ***P***=.85	0.85 (0.69-1.04), ***P***=.10
Total hormone usage (vs never used)	***P***=.53	***P***=.01	***P***=.05
Past user	1.00 (0.94-1.07)	1.03 (0.95-1.11)	0.89 (0.81-0.98)
Current user	0.94 (0.84-1.05)	1.17 (1.04-1.33)	0.94 (0.81-1.09)
E+P treatment	1.08 (1.03-1.14), ***P***=.003	1.15 (1.09-1.23), ***P***<.001	1.10 (1.03-1.19), ***P***=.008
Waist circumference more than 88 cm	1.20 (1.11-1.29), ***P***<.001	1.31 (1.20-1.43), ***P***<.001	0.93 (0.83-1.03), ***P***=.17
Physical activity	0.98 (0.96-1.00), .02	0.99 (0.96-1.01), .34	0.99 (0.96-1.02), .39
BMI (kg/m^2, vs less than 25)	***P***<.001	***P***<.001	***P***<.001
25 to less than 30	1.32 (1.23-1.42)	1.37 (1.26-1.49)	1.43 (1.29-1.57)
30 or higher	1.48 (1.34-1.63)	1.58 (1.41-1.76)	1.69 (1.47-1.93)

E+P, Estrogen plus Progestin; BMI, body mass index.

Data are odds ratio (95% confidence interval) unless otherwise specified.

Table 5

Results of Logistic Regression Modeling of the Effect of 10% Weight Loss in Association With No Pelvic Organ Prolapse in Women's Health Initiative Estrogen Plus Progestin Participants

Characteristic	Cystocele	Rectocele	Uterine Prolapse
Baseline prolapse	0.24 (0.23-0.26), ***P***<.001	0.18 (0.17-0.20), ***P***<.001	0.15 (0.14-0.17), ***P***<.001
Age	0.99 (0.98-0.99), ***P***<.001	0.98 (0.98-0.99), ***P***<.001	0.99 (0.99-1.00), ***P***=.04
Ethnicity (vs white)	***P***<.001	***P***<.001	***P***<.001
African American	1.27 (1.12-1.44)	1.66 (1.41-1.96)	1.17 (0.97-1.42)
Hispanic	0.95 (0.84-1.08)	1.12 (0.96-1.31)	1.42 (1.18-1.72)
Other/unknown	0.58 (0.50-0.67)	0.56 (0.48-0.65)	1.62 (1.27-2.06)
Parity (vs never term pregnancy)	***P***<.001	***P***<.001	***P***<.001
1-2	0.52 (0.47-0.59)	0.40 (0.34-0.46)	0.58 (0.48-0.70)
3-4	0.42 (0.38-0.48)	0.33 (0.29-0.39)	0.50 (0.41-0.60)
5 or more	0.37 (0.33-0.42)	0.28 (0.24-0.33)	0.40 (0.33-0.49)
Smoking (vs never smoked)	***P***<.001	***P***<.001	***P***<.001
Past smoker	1.15 (1.08-1.22)	1.21 (1.13-1.30)	1.25 (1.14-1.36)
Current smoker	1.36 (1.23-1.51)	1.57 (1.39-1.77)	1.36 (1.16-1.60)
Moderate/severe constipation	1.00 (0.90-1.12), ***P***=.99	1.06 (0.93-1.21), ***P***=.35	1.11 (0.94-1.31), ***P***=.22
Asthma	1.04 (0.92-1.17), ***P***=.51	1.01 (0.88-1.15), ***P***=.91	1.23 (1.03-1.47), ***P***=.01
Total hormone usage (vs never used)	***P***=.45	***P***=.14	***P***=.62
Past user	0.96 (0.90-1.04)	1.00 (0.92-1.08)	1.03 (0.92-1.14)
Current user	1.04 (0.92-1.17)	0.87 (0.76-1.00)	1.09 (0.90-1.30)
E+P treatment	0.92 (0.87-0.97), ***P***=.003	0.81 (0.76-0.87), ***P***<.001	0.87 (0.80-0.95), ***P***=.001
Physical activity (increase of 5 MET/wk)	1.03 (1.00-1.05), ***P***=.02	1.01 (0.98-1.04), ***P***=.43	1.00 (0.97-1.03), ***P***=.86
Waist-to-hip ratio (0.1 decrease)	1.07 (1.03-1.12), ***P***=.001	1.14 (1.08-1.20), ***P***<.001	0.98 (0.92-1.05), ***P***=.63
Baseline BMI (kg/m^2)	***P***<.001	***P***<.001	***P***<.001
25 to less than 30	0.83 (0.77-0.89)	0.77 (0.70-0.84)	0.78 (0.70-0.86)
30 or higher	0.72 (0.67-0.78)	0.67 (0.61-0.74)	0.77 (0.68-0.87)
Change in weight from baseline (loss of 10%)	1.03 (1.00-1.05), ***P***=.04	1.04 (1.01-1.07), ***P***=.02	0.93 (0.88-0.97), ***P***<.001

E+P, Estrogen plus Progestin; MET, metabolic units above resting; BMI, body mass index.

Data are odds ratio (95% confidence interval) unless otherwise specified.