Published in final edited form as:

Clin Gastroenterol Hepatol. 2020 January ; 18(1): 107–114.e1. doi:10.1016/j.cgh.2019.04.058.

Association of Obesity With Colonic Diverticulosis in Women

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Abstract

Background & Aims—Obesity has been associated with an increased risk of colonic diverticulosis. Evidence for this association is limited. We assessed whether anthropometric measures of obesity were associated with colonic diverticulosis.

Methods—We analyzed data from a prospective study of 623 patients undergoing screening colonoscopies from 2013 through 2015; colonoscopies included examinations for diverticulosis. Body measurements were made the day of the procedure. Multivariate analyses were performed using modified Poisson regression to estimate prevalence ratios (PRs) and 95% CIs while adjusting for confounding variables. All analyses were stratified by sex.

Results—Among men, there was no association between any measure of obesity and diverticulosis. After adjustment, women with an obese body mass index (BMI ≥ 30) had an increased risk of any diverticulosis (PR, 1.48; 95% CI, 1.08–2.04) compared to women with a normal body mass index (BMI 18.5–24.9). The strength of this association was greater for more than 5 diverticula (PR, 2.05; 95% CI, 1.23–3.40). There was no significant association between measures of central obesity and diverticulosis in women. Stratified by sex, colonic diverticulosis was significantly less prevalent in women compared to men before the age of 51 years (29% vs 45%, $P=.06$). The prevalence of diverticulosis did not differ by sex in older age groups.

Conclusions—In an analysis of data from 623 patients undergoing screening colonoscopies, we found that obesity (BMI ≥ 30) significantly increased the risk of colonic diverticulosis in women but not men. Colonic diverticulosis was less prevalent in premenopausal-age women compared with similar-age men. These findings suggest that sex hormones may influence the development of diverticulosis.

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Author Contributions: AFP, KJ, RSS study concept and design, analysis and interpretation of data, drafting of manuscript, critical revision of manuscript for content; AK and JAG analysis and interpretation of data, drafting of manuscript, critical revision of manuscript for content

Conflicts of Interest/Disclosures: None

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Keywords

diverticular disease; adiposity; male; female

Introduction

Colonic diverticula are commonly acquired defects in the colon wall.¹ Diverticula can hemorrhage, become inflamed or infected, or rupture. These morbid complications are termed diverticular disease.² Diverticular disease accounts for 1,920,970 ambulatory visits, 208,015 hospital admissions and 4,602 deaths every year in the United States.³ Health care expenditures attributable to colonic diverticulosis and diverticular disease total \$5.5 billion dollars annually.³

Obesity has been associated with an increased risk of colonic diverticulosis,^{4–10} but evidence for this association is limited. Prior studies used body mass index but did not include measures of abdominal obesity, which is assessed by waist circumference, waist to hip ratio and waist to height ratio. Furthermore, prior studies did not assess for heterogeneity of these associations by sex, even though obesity in men and women differs significantly.

Understanding modifiable risk factors for colonic diverticulosis has the potential to improve prevention efforts for diverticular disease and improve our understanding of diverticulosis biology. In the present study, we assessed the association between anthropometric measures and the risk of colonic diverticulosis using data from a prospective study of patients undergoing screening colonoscopy and detailed examination for diverticulosis.

Methods

Using data from a colonoscopy-based study of colonic diverticulosis (NIH R01DK094738), we assessed whether anthropometric measures were associated with diverticulosis. The study recruited outpatients 30 years of age and older presenting for a screening colonoscopy at the University of North Carolina Hospital in Chapel Hill, North Carolina between 2013–2015. The study included patients with a complete examination to the cecum and at least a satisfactory preparation for a screening colonoscopy. The study excluded any patient with: 1) prior colonoscopy, 2) indication other than screening, 3) familial polyposis syndrome defined as greater than 100 polyps or FAP gene test positive, 4) evidence of colitis, either ulcerative, Crohn's, radiation or infectious colitis, 5) previous colonic resection based on history and colonoscopy, or 6) previous colon cancer or adenomas. For this analysis, we excluded those with a history of diverticulitis (n=1). Informed consent was obtained from all participants. The University of North Carolina School of Medicine Institutional Review Board approved this study.

Anthropometric measures and covariates

Interviews were conducted over the telephone prior to the colonoscopy using a computer assisted telephone interview. The telephone interview used a structured questionnaire designed to obtain information about dietary and lifestyle exposures including smoking and alcohol use. Age and sex were extracted from the medical record. Race was self-reported.

Diet was measured using a food frequency questionnaire developed by the National Cancer Institute.¹¹ The instrument has been shown to reasonably estimate absolute intakes when validated against 24-hour recalls. Participants were asked to estimate consumption of dietary items during the year prior to colonoscopy. Physical activity was measured using the International Physical Activity Questionnaire.¹² A research assistant followed a standard protocol to measure height, weight, hip and waist the day of the colonoscopy. The waist and hip were measured with a tape measure in centimeters. The waist measurement was taken at the midpoint between the lowest rib and the iliac crest. The participant was asked to breathe out gently at the time of the measurement for a more accurate reading. The hip measurement was taken at the fullest part of the hips over the buttocks. Two measurements were taken. If they differed by more than 1 cm, a third measurement was taken.

Colonoscopy and assessment of diverticulosis

All colonoscopies were performed by experienced board-certified attending gastroenterologists. The colonoscopy was complete to the cecum and the preparation judged to be at least adequate (excellent, good or fair) for a screening exam. Endoscopists were instructed to carefully examine the colon for diverticula and a research assistant was present during the entire procedure to enumerate the diverticula on a standard data collection form. The form included information on the exact number and location of diverticula.

Statistical analysis

Means and standard deviations were calculated for continuous variables and proportions for categorical data. We included four measures of obesity: body mass index, waist circumference, waist to height ratio and waist to hip ratio. Body mass index is a measure of general adiposity. The remaining three are measures of central obesity. For analysis in the models, waist circumference, waist to hip ratio and waist to height ratio were converted into categories (quartiles). The 10% change-in estimate approach was used to identify confounding variables. Several potential confounding variables were considered including age, race, education, NSAID and aspirin use, dietary fiber, red meat and fat intake, alcohol use, physical activity and total energy intake. In the final models, central measures of obesity were adjusted for the confounding variables identified using 10% approach. Because all measures of central obesity are co-linear with body mass index, we performed modified Poisson regression (Poisson regression with a robust variance estimator)¹³ and also Bayesian log-binominal models with moderately informative null-priors. The models produced similar results, so we only report results from modified Poisson analyses. Using likelihood ratio tests, there was significant heterogeneity of the association with exposures by sex. Therefore, all analyses were stratified by sex. Multivariate analyses were performed using modified Poisson regression to estimate prevalence ratios and 95% confidence intervals while adjusting for confounding variables. We performed analyses with all diverticulosis cases and cases stratified by number of diverticula (1–5, and >5). The analysis was performed using SAS 9.4 (SAS, Cary, North Carolina).

Results

Our analysis included 623 participants; 56% were women. The prevalence of diverticulosis increased with age (Figure 1). Before the age of 51, colonic diverticulosis was less prevalent in women (29%) compared to men (45%) ($p=0.06$; Figure 1). In the group 51–60 years old, the prevalence of colonic diverticulosis in women was 37% and in men 43% ($p=0.31$). After the age of 60, colonic diverticulosis was equally prevalent in women (55%) and men (57%) ($p=0.90$). Women with diverticulosis were older and more likely to have an obese body mass index compared to women without diverticulosis (Table 1). Among women with diverticulosis, 7% had proximal diverticulosis, 61% distal, and 31% both proximal and distal. The average number of diverticula was 14 (standard deviation 19). Men with diverticulosis were not more likely to be obese. Among men with diverticulosis, 8% had proximal diverticulosis, 61% distal, and 30% both proximal and distal. The average number of diverticula was 15 (standard deviation 21).

Body mass index

After adjusting for confounding variables, women with an obese body mass index (BMI ≥ 30) had an increased risk of any diverticulosis (PR 1.48; 95% CI 1.08–2.04) compared to women with a normal body mass index (BMI 18.5–24.9) (Table 2). When we categorize obesity by severity, the strength of the association was greatest (PR 1.92; 95% CI 1.29–2.84) for women with the most severe class of obesity (Class III [BMI >40]). The strength of the association with an obese body mass index (BMI ≥ 30) was greater (PR 2.05; 95% CI 1.23–3.40) when considering women with >5 diverticula (versus 1–5 diverticula) (Table 4). Stratified by age category, women ≤ 50 (PR 1.99; 95% CI 0.79–5.05) and 51–60 years old (PR 1.63; 95% CI 1.07–2.47) with an obese body mass index (≥ 30) had an increased risk of diverticulosis compared to women with a normal body mass index (18.5–24.9) (Supplemental table). There was no association between body mass index and risk of diverticulosis among women >60 years old (PR 1.00; 95% CI 0.57–1.74).

Among men, there was no association between body mass index and risk of any diverticulosis. After adjusting for confounding variables, the risk for diverticulosis was similar for men with an obese body mass index (≥ 30) compared to men with a normal body mass index (18.5–24.9), (PR 1.07; 95% CI 0.75–1.51) (Table 3). There was also no association (PR 1.35; 95% CI 0.82–2.21) with risk of >5 diverticula (Table 4).

Waist circumference

After adjusting for confounding variables, there was no significant association between women in the highest quartile of waist circumference, compared with women in the lowest quartile (PR 1.56; 95% CI, 0.74–3.27) (Table 2). There was no association between men in the highest quartile of waist circumference, compared with men in the lowest quartile (PR 1.20; 95% CI, 0.65–2.21) for any diverticulosis (Table 3). There was no association when limited to women or men with >5 diverticula (Table 4).

Waist-to-hip

There was no significant association between waist to hip ratio and any diverticulosis when comparing the highest quartile of this ratio with the lowest among women (PR 1.13; 95% CI 0.74–1.71) or men (PR 1.01; 95% CI 0.60–1.68) (Tables 2 and 3). There was no association when limited to >5 diverticula (Table 4).

Waist-to-height

After adjusting for confounding variables, there was no significant association between women in the highest quartile of waist-to-height ratio, compared with women in the lowest quartile (PR 1.27; 95% CI, 0.61–2.65). Among men, waist-to-height ratio was not associated with the risk of any diverticulosis when the highest and lowest quartiles were compared (PR 0.89; 95% CI, 0.47–1.71). There was no association when limited to women or men with >5 diverticula (Table 4).

Discussion

In this prospective colonoscopy-based study, general obesity was significantly associated with the risk of colonic diverticulosis among women, but not among men. These associations were dose-dependent and stronger when considering >5 diverticula. We also found that premenopausal age women appear to be protected from diverticulosis compared with age-comparable men. There was no difference in the prevalence of diverticulosis by sex after the age of 50.

Previous studies in Western populations have found that obesity, measured by body mass index only, is a risk factor for diverticulosis.^{4–10} In contrast with prior work, the present study determined whether participants had colonic diverticulosis in a standard manner by colonoscopy, examined the association between multiple measures of obesity and diverticulosis, and accounted for effect measure modification between measures of obesity and sex. Similar to our work, a genetic study of colonic diverticulosis in Germany and Lithuania also found that obesity was associated with an increased risk of diverticulosis in women but not men.¹⁴

General obesity, not central obesity, significantly increased the risk of colonic diverticulosis among women but not men. This elevated risk was limited to women before the age of 60. Obesity in premenopausal women is associated with higher concentrations of free testosterone and lower concentrations of sex hormone-binding globulin, and total estrogen.¹⁵ We hypothesize that premenopausal ovarian steroid hormones may protect women from developing diverticulosis. Premenopausal obesity could increase the risk by decreasing circulating estrogen and increasing free testosterone. Obesity is associated with alterations in the gut microbiome, however in a prior study we found little association between the mucosal adherent microbial community composition and colonic diverticulosis.¹⁶

The lower prevalence of diverticulosis among women compared with men before the age of 51 is a novel finding and suggests that ovarian steroid hormones in premenopausal women may reduce the risk of diverticulosis. The lower prevalence of diverticulosis in women is congruent with a population-based study that found that *diverticulitis* was more common in

men compared with women before the age of 49. After the age of 60, *diverticulitis* was more common in women.¹⁷ Genome-wide association analyses suggest that some of the risk of developing diverticulosis is attributable to impaired intestinal neuromuscular function, mesenteric vascular smooth muscle and connective tissue.^{14, 18, 19} Sex hormones alter elastin and collagen synthesis,^{20, 21} and endogenous ovarian steroid hormones may therefore reduce the risk of diverticulosis in premenopausal women because of beneficial effects of steroid hormones on collagen and/or elastin.

The lower prevalence of diverticulosis among women compared with men before the age of 51 is another argument against the hypothesis that constipation is the root cause of diverticulosis. Compared to women, men more commonly report looser and more frequent bowel movements.²² If the hypothesis that colonic diverticulosis results from constipation and higher intraluminal pressures were true, then we would expect a higher prevalence of diverticulosis in women compared with men.^{6, 23} Instead, we found the opposite.

Central obesity, defined by waist circumference and waist to hip ratio, is a risk factor for diverticulitis and diverticular hemorrhage.^{24–26} Menopausal hormone therapy may also be associated with an increased risk of diverticulitis.²⁷ Because diverticulitis and diverticular hemorrhage are distinct pathologies, risk factors for developing colonic diverticulosis must be considered separately from risk factors for diverticular diseases.

This work has limitations. A research assistant measured height, weight, hip and waist the day of the colonoscopy. Measurements were taken after the patients took the preparation for colonoscopy. Because every participant was prepped for the procedure, we would expect uniform changes in waist measurements. This would be a non-differential measurement bias towards the null. We have no data on anthropometric measurements prior to the colonoscopy and could not assess whether early life obesity or weight gain over time is associated with diverticulosis. Furthermore, this is a cross-sectional study that assessed associations and cannot be used to determine causality. Despite a detailed colonoscopy performed by an experienced gastroenterologist with a trained research assistant present to record data, colonic diverticula may have been missed. If diverticula were missed, this non-differential misclassification would bias our results towards the null. Because diverticulosis limited to the proximal colon was rare, we could not assess whether there was a differential association between distal and proximal diverticulosis. Finally, although the sex/age stratified results in the supplemental table are intriguing, we stress that these stratified results are based on small numbers and should be interpreted cautiously.

In conclusion, general obesity significantly increased the risk of colonic diverticulosis among women. There was no association between any measure of obesity and diverticulosis among men. Diverticulosis is less prevalent in premenopausal age women compared with age-comparable men. These sex differences may have implications that lead to a better understanding of diverticulosis pathogenesis.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

Grant Support: This research was supported in part by grants from the National Institutes of Health K23DK113225, R01DK09473, and P30 DK034987

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Need to Know

Background

We assessed whether anthropometric measures of obesity were associated with colonic diverticulosis.

Findings

In an analysis of data from 623 patients undergoing screening colonoscopies, we found that obesity significantly increased the risk of colonic diverticulosis in women but not men. Colonic diverticulosis was less prevalent in premenopausal-age women compared with similar-age men.

Implications for Patient Care

In women, obesity might contribute to development of diverticulosis.

Figure 1.
Colonic diverticulosis on colonoscopy in screening only persons by age and sex

Table 1.

Study characteristics

	Women			Men		
	Diverticulosis n = 135	No diverticulosis n = 214	p-value	Diverticulosis n = 124	No diverticulosis n = 150	p-value
% or mean $\pm$ standard deviation						
Age	56.3 $\pm$ 6.8	53.2 $\pm$ 6.5	<0.001	54.7 $\pm$ 7.4	53.5 $\pm$ 6.5	0.16
Race			0.11			0.44
White	77.5%	76.1%		81.0%	75.9%	
Black	22.5%	20.7%		18.2%	21.4%	
Other	0.0%	3.3%		0.8%	2.8%	
Education			0.17			.46
Less than high school	1.0%	2.5%		3.2%	3.9%	
High school	15.8%	7.5%		14.7%	7.8%	
Some college	23.8%	26.1%		20.0%	18.6%	
College graduate	59.4%	64.0%		62.1%	69.6%	
Smoking status			0.49			.05
Never	63.0%	59.0%		43.2%	60.8%	
Former	24.0%	30.0%		39.0%	26.5%	
Current	13.0%	10.6%		17.9%	12.8%	
Body mass index, kg/m ²			0.04			0.36
Underweight (<18.5)	2.2%	3.3%		2.4%	0.0%	
Normal (18.5–25)	26.7%	40.1%		25.0%	26.4%	
Overweight (25–30)	24.4%	22.6%		41.1%	42.6%	
Obese (>30)	46.7%	34.0%		31.5%	31.1%	
Waist circumference, centimeters	94.9 $\pm$ 18.4	88.1 $\pm$ 16.2	0.001	100.4 $\pm$ 15.0	99.6 $\pm$ 12.7	0.65
Waist to hip ratio	0.9 $\pm$ 0.1	0.9 $\pm$ 0.1	0.02	1.0 $\pm$ 0.1	1.0 $\pm$ 0.1	0.58
Waist to height ratio	0.6 $\pm$ 0.1	0.5 $\pm$ 0.1	0.002	0.6 $\pm$ 0.1	0.6 $\pm$ 0.1	0.92
Physical activity per week, metabolic equivalent task	2,814.2 $\pm$ 3,264.2	3,375.8 $\pm$ 4,248.8	0.23	4,306.8 $\pm$ 5800	3,256.5 $\pm$ 3970	0.14
Daily dietary intake						

	Women			Men		
	Diverticulosis n = 135	No diverticulosis n = 214	p-value	Diverticulosis n = 124	No diverticulosis n = 150	p-value
Total energy intake, kilocalories	1890.9 ± 712.6	1953.6 ± 646.9	0.47	2,324.0 ± 828	2,183.0 ± 923	0.27
Total fiber, grams	19.8 ± 9.3	19.8 ± 8.7	0.99	20.7 ± 8.1	21.8 ± 12.0	0.45
Red meat, ounces	1.2 ± 0.8	1.3 ± 1.0	0.42	2.0 ± 1.5	1.6 ± 1.2	0.06
Fat, grams	78.6 ± 31.7	85.1 ± 35.3	0.13	97.6 ± 40.4	93.3 ± 43.3	0.48
Nonsteroidal antiinflammatory drug use per month			0.09			0.43
Never	48.0%	56.3%		55.9%	64.4%	
1–4 times	30.0%	18.1%		24.7%	17.8%	
>4 times	22.0%	25.6%		19.4%	17.8%	
Aspirin use per month			0.40			0.39
Never	56.4%	64.6%		51.6%	57.8%	
1–4 times	32.7%	27.3%		45.2%	36.3%	
>4 times	10.9%	8.1%		3.2%	5.9%	
Daily alcohol use, drinks	0.8 ± 1.6	0.6 ± 1.2	0.49	0.9 ± 1.4	0.9 ± 2.0	0.88

Table 2.

Anthropometric measures and risk of colonic diverticulosis in women

	Body mass index, kg/m ²				P for trend
	18–25	25–30	>30		
Cases (n)	36	33	63		
Crude prevalence ratios (95% CI)	1.0 (reference)	1.37 (0.94, 2.00)	1.57 (1.13, 2.18)		0.006
Adjusted prevalence ratios (95% CI) ^a	1.0 (reference)	1.27 (0.88, 1.85)	1.48 (1.08, 2.04)		0.01
	Waist circumference, quartiles				P for trend
	1	2	3	4	
Cases (n)	21	18	26	48	
Range (cm)	40, 76	77, 84	85, 98	99, 140	
Crude prevalence ratios (95% CI)	1.0 (reference)	0.98 (0.58, 1.64)	1.17 (0.73, 1.86)	1.71 (1.15, 2.56)	0.003
Adjusted prevalence ratios (95% CI) ^a	1.0 (reference)	1.05 (0.63, 1.77)	1.18 (0.75, 1.87)	1.67 (1.12, 2.48)	0.007
Adjusted prevalence ratios (95% CI) ^b	1.0 (reference)	0.99 (0.57, 1.74)	1.09 (0.57, 2.09)	1.56 (0.74, 3.27)	0.21
	Waist to hip ratio, quartiles				P for trend
	1	2	3	4	
Cases (n)	25	21	25	42	
Range	0.70, 0.81	0.81, 0.86	0.86, 0.90	0.91, 1.14	
Crude prevalence ratios (95% CI)	1.0 (reference)	0.91 (0.57, 1.45)	0.99 (0.63, 1.53)	1.39 (0.96, 2.03)	0.06
Adjusted prevalence ratios (95% CI) ^a	1.0 (reference)	0.95 (0.60, 1.50)	1.00 (0.65, 1.54)	1.35 (0.92, 1.99)	0.10
Adjusted prevalence ratios (95% CI) ^b	1.0 (reference)	0.87 (0.55, 1.39)	0.88 (0.57, 1.38)	1.13 (0.74, 1.71)	0.49
	Waist to height ratio, quartiles				P for trend
	1	2	3	4	
Cases (n)	19	19	30	45	
Range	0.22, 0.46	0.46, 0.52	0.52, 0.60	0.61, 0.85	
Crude prevalence ratios (95% CI)	1.0 (reference)	1.00 (0.59, 1.69)	1.34 (0.84, 2.12)	1.66 (1.09, 2.54)	0.005
Adjusted prevalence ratios (95% CI) ^a	1.0 (reference)	1.05 (0.62, 1.77)	1.32 (0.84, 2.07)	1.60 (1.05, 2.43)	0.01

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Adjusted prevalence ratios (95% CI) ^a	1.0 (reference)	0.99 (0.57, 1.71)	1.14 (0.60, 2.18)	1.27 (0.61, 2.65)	0.50
BMI, body mass index; CI confidence intervals					
^a adjusted for age					
^b adjusted for age and body mass index					

Table 3.

Anthropometric measures and risk of colonic diverticulosis in men

	Body mass index, kg/m ²				P for trend
	18–25	25–30	>30		
Cases (n)	31	51	39		
Crude prevalence ratios (95% CI)	1.0 (reference)	1.01 (0.72, 1.41)	1.04 (0.73, 1.47)		0.84
Adjusted prevalence ratios (95% CI) ^a	1.0 (reference)	1.02 (0.73, 1.42)	1.07 (0.75, 1.51)		0.72
	Waist circumference, quartiles				P for trend
	1	2	3	4	
Cases (n)	31	15	29	30	
Range (cm)	65, 91	92, 97	98, 107	108, 147	
Crude prevalence ratios (95% CI)	1.0 (reference)	0.78 (0.48, 1.27)	1.04 (0.72, 1.51)	1.06 (0.74, 1.53)	0.55
Adjusted prevalence ratios (95% CI) ^a	1.0 (reference)	0.78 (0.48, 1.26)	1.03 (0.71, 1.49)	1.06 (0.74, 1.53)	0.57
Adjusted prevalence ratios (95% CI) ^b	1.0 (reference)	0.84 (0.50, 1.41)	1.16 (0.72, 1.89)	1.20 (0.65, 2.21)	0.50
	Waist to hip ratio, quartiles				P for trend
	1	2	3	4	
Cases (n)	25	22	38	20	
Range	0.73, 0.92	0.92, 0.96	0.96, 1.00	1.01, 1.10	
Crude prevalence ratios (95% CI)	1.0 (reference)	0.93 (0.60, 1.44)	1.14 (0.79, 1.65)	0.99 (0.64, 1.54)	0.71
Adjusted prevalence ratios (95% CI) ^a	1.0 (reference)	0.92 (0.60, 1.43)	1.12 (0.78, 1.63)	0.97 (0.63, 1.51)	0.79
Adjusted prevalence ratios (95% CI) ^b	1.0 (reference)	0.98 (0.61, 1.58)	1.20 (0.80, 1.81)	1.01 (0.60, 1.68)	0.62
	Waist to height ratio, quartiles				P for trend
	1	2	3	4	
Cases (n)	30	15	34	26	
Range	0.36, 0.51	0.51, 0.55	0.55, 0.60	0.60, 0.85	
Crude prevalence ratios (95% CI)	1.0 (reference)	0.66 (0.40, 1.08)	1.05 (0.74, 1.49)	0.94 (0.64, 1.38)	0.78
Adjusted prevalence ratios (95% CI) ^a	1.0 (reference)	0.62 (0.38, 1.01)	1.03 (0.72, 1.46)	0.91 (0.62, 1.34)	0.83

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Adjusted prevalence ratios (95% CI) ^a	1.0 (reference)	0.65 (0.37, 1.14)	1.06 (0.63, 1.78)	0.89 (0.47, 1.71)	0.92
BMI, body mass index; CI confidence intervals					
^a adjusted for age					
^b adjusted for age and body mass index					

Table 4.

Anthropometric measures and risk by number of diverticula

	Body mass index, kg/m ²			
	Women		Men	
Adjusted prevalence ratios (95% CI) ^a	18–25	>30	18–25	>30
Number of diverticula				
1–5	1.0 (reference)	1.15 (0.67, 1.97)	1.0 (reference)	0.73 (0.36, 1.46)
>5	1.0 (reference)	2.05 (1.23, 3.40)	1.0 (reference)	1.35 (0.82, 2.21)
	Waist circumference, quartiles			
	Women		Men	
Adjusted prevalence ratios (95% CI) ^b	1	4	1	4
Number of diverticula				
1–5	1.0 (reference)	2.42 (0.65, 9.03)	1.0 (reference)	0.93 (0.24, 3.49)
>5	1.0 (reference)	1.90 (0.63, 5.79)	1.0 (reference)	1.51 (0.62, 3.65)
	Waist to hip ratio, quartiles			
	Women		Men	
Adjusted prevalence ratios (95% CI) ^b	1	4	1	4
Number of diverticula				
1–5	1.0 (reference)	1.40 (0.68, 2.89)	1.0 (reference)	0.80 (0.24, 2.65)
>5	1.0 (reference)	1.09 (0.61, 1.94)	1.0 (reference)	1.00 (0.52, 1.94)
	Waist to height ratio, quartiles			
	Women		Men	
Adjusted prevalence ratios (95% CI) ^b	1	4	1	4
Number of diverticula				
1–5	1.0 (reference)	1.44 (0.39, 5.36)	1.0 (reference)	0.59 (0.17, 2.09)
>5	1.0 (reference)	1.74 (0.58, 5.22)	1.0 (reference)	1.08 (0.41, 2.85)

CI confidence intervals

^a adjusted for age

adjusted for age and body mass index^q

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