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Body mass index, recreational physical activity and female urinary incontinence in Gansu, China

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Abstract

Objective—To elucidate the influence of recreational physical activity, body mass index (BMI), and waist circumference on the risk of specific types of urinary incontinence.

Study design—We conducted a population-based cross-sectional survey in Gansu, China among 2603 women aged 20 years or older.

Results—The study found that BMI was positively associated with urinary incontinence (P for trend = 0.008) and the association was mainly observed for stress urinary incontinence (OR = 1.4, 95% CI: 1.1, 1.9 for BMI = 24.0–27.9 kg/m²; OR = 2.3, 95% CI: 1.5, 3.6 for BMI ≥ 28.0 kg/m²; P for trend = 0.0005). A positive association between stress incontinence (OR = 1.7, 95% CI: 1.2, 2.5) and waist circumference was observed for women who had waist circumference between 70 cm and 75 cm compared to waist circumference less than 70 cm. Recreational physical activity was inversely associated with overall and mixed urinary incontinence (P for trend <0.0001 for both). A significant interaction between physical activity and waist circumference was found for overall (P = 0.0007) and stress incontinence (P = 0.001).

Conclusions—The findings that physical activity inversely associated with urinary incontinence and its interaction with waist circumference warrant further investigation, particularly in prospective studies.

Keywords

Recreational physical activity; Body mass index; Waist circumference; Female urinary incontinence

1. Introduction

Female urinary incontinence is a complaint of involuntary urinary leakage [1]. Although urinary incontinence is not a fatal disease, it seriously influences an individual's physical, psychological, and social life [2,3]. The prevalence of female urinary incontinence varies from 4.8% to 58.4% depending on different population [4]. There are three major clinical types of urinary incontinence: stress urinary incontinence, overactive bladder syndrome, and mixed urinary incontinence, which have been suggested as having different

pathophysiologies, degrees of severity, and risk factors [5]. Epidemiological studies have suggested a number of risk factors associated with female urinary incontinence including age, parity, mode of delivery, birth weight, gestational age, menopause, and obesity [4]. However, very few studies have investigated these risk factors by the clinical types.

Being overweight and obese is an increasing health concern worldwide and has been suggested as a risk factor for female urinary incontinence [4]. While the mechanisms underlying the link between urinary incontinence and overweight/obesity are unclear, it is possible that overweight and obesity add additional weight on pelvic tissues resulting in chronic strain, stretching and weakening of the muscles, nerves, and other structures of the pelvic floor. In addition, physical activity has the potential to strengthen the pelvic muscles and contribute to loss of weight. We speculate that the associations among BMI, waist circumference, and urinary incontinence could be modified by recreational physical activity. Few studies, however, have been conducted to investigate the interaction between physical activity and overweight/obesity in relation to urinary incontinence. To fill this gap, we conducted a population-based cross-sectional survey in Gansu, China.

2. Materials and methods

2.1. Study population

A population-based cross-sectional study was conducted in four communities located in the east (Mengba community, Qingyang city), central (Hongxing and Tumendun communities, Lanzhou city) and west areas (Gaoba community, Wuwei city) of Gansu province from March to July in 2006. Eligible women were aged 20 years or older and had been living in the study areas for more than 10 years based on 2006 census list from community registry offices. A total of 2700 eligible women were approached by study personnel and 2603 (96.4%) women participated in the study. The study was approved by the Gansu Provincial Maternity and Child Care Hospital.

2.2. Data collection

After obtaining a signed consent form, a standardized structured questionnaire was administered to each study subject by a trained interviewer at the community hospitals to collect information on demographic factors, active and passive smoking, drinking, reproductive history, medical conditions and medication use, leisure time physical activity, and dietary habits. Information on urinary incontinence was collected using the authorized Bristol Female Lower Urinary Tract Symptoms questionnaire. A physical examination was conducted for each subject after an in-person interview to measure height, weight, waist circumference, and blood pressure.

Body mass index (BMI) was calculated as weight (kg) divided by the square of height (m^2), using the measured height and weight at interview. We defined individuals as normal weight if $BMI < 24.0 \text{ kg/m}^2$, overweight if BMI equal to or larger than 24.0 kg/m^2 and less than 28.0 kg/m^2 , and obese if $BMI \geq 28.0 \text{ kg/m}^2$ according to the suggested cutoffs in Asian population [6]. Physical activity was categorized into three categories: often, sometimes, and no. If participants reported at least 30 min recreational activities per day during the past year, they were classified as “often”; if less than 30 min per day, but more than 30 min per week, they were classified as “sometimes”; all others were classified as “no”. Recreational activities included walking or hiking, running, swimming, dancing, tennis, badminton, ping pong, bicycling, and other aerobic recreations (e.g., yoga).

Disease definitions in the study were based on recommendations from the International Continence Society [7]. Urinary incontinence was defined as the complaint of any involuntary leakage of urine. Urinary incontinence was further classified into three subtypes:

stress urinary incontinence, overactive bladder syndrome, and mixed urinary incontinence. Stress urinary incontinence was defined as the complaint of involuntary leakage on effort or exertion, or due to sneezing or coughing. Overactive bladder syndrome was defined as the complaint of involuntary leakage accompanied by or immediately preceded by urgency. Mixed urinary incontinence was defined as the complaint of involuntary leakage associated with urgency and also with exertion, effort, sneezing or coughing. We also classified the urinary incontinence into mild and moderate/severe types. Mild incontinence was defined as an incontinence occurring less than four times per month. Moderate incontinence was defined as an incontinence occurring at least once per week but not daily. Severe incontinence was defined as an incontinence occurring at least once a day.

2.3. Statistical analysis

Unconditional logistic regression models were used to estimate odds ratios (ORs) and 95% confidence intervals (CIs) for associations among BMI, physical activity and prevalence of urinary incontinence and its subtypes. Potential confounding variables included in the final models were age (<32, 32–38, 39–49, ≥50 years) and parity (0, 1, 2, 3+). Adjustment for other variables, such as smoking (no, yes), alcohol drinking (no, yes), and menopause (yes, no), did not result in a material change of the observed associations and were not included in the final models.

Significance of interactions was assessed by adding an interaction term in the logistic models. The interaction term was a product of physical activity and BMI or waist circumference. Numbers 1, 2, and 3 were assigned to physical activity to represent “often”, “sometimes” and “no” respectively. Normal weight, overweight, and obese were presented by 1, 2 and 3 respectively. Waist circumference categories were created by dividing into quartiles based on the distribution in the control population and each quartile represented as 1, 2, 3, and 4. All *P* values presented are 2-sided and all statistical analyses were performed using SAS version 9.2 (SAS Institute, Inc., Cary, NC).

3. Results

The prevalence rate of urinary incontinence in the study population was 41.3% ($n = 1074$). Broken down into each subtype, 19.9% ($n = 517$) was stress, 2.7% ($n = 69$) was overactive bladder syndrome, and 18.6% ($n = 485$) was mixed urinary incontinence. As shown in Table 1, urinary incontinence cases were older than controls. The proportion of women who were postmenopausal, had one or more live births, and were married or separated/widowed were greater in cases than those in controls. The distributions of cigarette smoking and alcohol drinking were similar between cases and controls. Studies have suggested urinary incontinence associated with smoking [8] or alcohol consumption [9].

BMI was associated with urinary incontinence with or without adjustment of waist circumference and physical activity (Table 2). Compared to BMI less than 24.0 kg/m², BMI equal to or larger than 28.0 kg/m² was positively associated with urinary incontinence (OR = 1.7, 95% CI: 1.2, 2.5) with a significant trend ($P = 0.008$). The observed associations were strengthened for stress incontinence (OR = 1.4, 95% CI: 1.1, 1.9 for BMI = 24.0–27.9 kg/m²; OR = 2.3, 95% CI: 1.5, 3.6 for BMI ≥ 28.0 kg/m²; P for trend = 0.0005), but weakened for overactive bladder syndrome and mixed incontinence. After adjustment of BMI and recreational physical activity, no statistically significant association was observed between waist circumference and all urinary incontinence, overactive bladder syndrome or mixed incontinence. A positive association with stress incontinence (OR = 1.7, 95% CI: 1.2, 2.5) was found for women with waist circumference between 70 cm and 75 cm compared to women who had waist circumference less than 70 cm, but not for women with waist circumference larger than 81 cm. Recreational physical activity was inversely associated

with overall urinary incontinence (OR = 0.6, 95% CI: 0.5, 0.8) with significant trend ($P < 0.0001$), stress incontinence (OR = 0.7, 95% CI: 0.5, 0.9 for sometimes; OR = 0.7, 95% CI: 0.5, 1.0 for often; P for trend = 0.01), and mixed incontinence (OR = 0.5, 95% CI: 0.4, 0.8 for sometimes and often; P for trend < 0.0001), but not with overactive bladder syndrome. The associations remained the same with or without adjustment of BMI and waist circumference.

We conducted stratified analyses of the associations among BMI, waist circumference, and urinary incontinence by recreational physical activity (Table 3). Recreational physical activity did not modify the association between BMI and urinary incontinence, although an interaction was suggested for both overall and stress urinary incontinences ($P_{\text{interaction}} = 0.02$). A significantly positive association between large waist circumference and urinary incontinence was only observed among women who had recreational physical activity, but not among women without recreational physical activity with P for interaction of 0.0007 for urinary incontinence overall and 0.001 for stress urinary incontinence. No significant findings were observed for overactive bladder syndrome and mixed urinary incontinence (data not shown).

We further stratified the analyses by severity of urinary incontinence (Table 4). Similar associations among BMI, recreational physical activity, and urinary incontinence were observed for mild or moderate/severe incontinence. A striking difference between mild and moderate/severe incontinence was observed for the stress urinary incontinence and waist circumference, although the sample size was small for moderate/severe incontinence.

4. Comments

The current study suggests an inverse association between recreational physical activity and the prevalence of urinary incontinence, particularly for stress and mixed incontinence. This association persisted with or without adjustment for BMI and waist circumference. In addition, a significant interaction between recreational physical activity and waist circumference was observed for stress urinary incontinence.

To date, few studies have investigated the association among recreational physical activity, BMI, and waist circumference simultaneously with urinary incontinence. While earlier studies in female elite athletes suggested an increased risk of stress urinary incontinence associated with sports activity [10], both prospective and cross-sectional studies in the general population have suggested an inverse association between recreational physical activity and urinary incontinence after adjustment for BMI [11,12], which was consistent with the findings in the current study. Rigorous physical activity, which can increase intra-abdominal pressure and pelvic floor muscle fatigue, can result in stress urinary incontinence [10]. Moderate physical activity (i.e., recreational physical activities) helps to maintain body weight by reducing intra-abdominal pressure. The independent association with urinary incontinence observed in our study and others may indicate that recreational physical activity reduces the risk of incontinence not only through reduction of body weight, but also via other potential mechanisms such as strengthening of the pelvic floor muscles and other systemic mechanisms [12].

In our study, the strongest link between recreational physical activity and urinary incontinence was observed for mixed urinary incontinence. The not statistically significant inverse association between recreational activity and overactive bladder syndrome could be due to the small sample size. The inverse association between recreational physical activity and all clinical types of urinary incontinence may suggest that systemic physiological changes resulting from recreational physical activity may play a critical role in urinary

incontinence. Recreational physical activity has been demonstrated to increase antioxidant enzyme activity levels [13], which can alleviate oxidative stress systemically. Increased oxidative stress has been linked to impaired bladder function [14] and damaged skeletal muscle homeostasis [15]. Reducing of oxidative stress might improve pelvic floor muscles and bladder function.

Very few studies have investigated the roles of BMI and waist circumference in relation to urinary incontinence simultaneously. The Nurse Health Study by Townsend et al. [16] including 35,754 women aged 54–79 years reported significant trends of increasing risk of urinary incontinence with increasing BMI and waist circumference (P for trend <0.001 for both). When BMI and waist circumference were included in models simultaneously, the associations were attenuated. BMI was associated with overactive bladder syndrome and mixed urinary incontinence (P for trend 0.003 and 0.03, respectively), but not stress incontinence (P for trend 0.77). Waist circumference was only associated with stress urinary incontinence (P for trend <0.001) [16]. Waetjen et al. [17] conducted a cross-sectional study in the U.S. including 2702 women aged 42–52 years. The study found an increased risk of prevalent stress urinary incontinence with each centimeter increase in waist circumference, but not with each unit increase in BMI when adjusted for each other. Another U.S. cross-sectional study by Brown et al. [18] reported an increased risk of stress incontinence, but not overactive bladder syndrome or mixed urinary incontinence, with per 0.1 unit increase in waist-to-hip ratio, after adjusting for BMI in postmenopausal women with coronary heart disease. A cross-sectional study of 769 Korean women aged ≥ 30 years found both high BMI and high waist circumferences associated with stress urinary incontinence, however, the significant association was pronounced only for waist circumference after simultaneous adjustment for BMI and waist circumference [19].

A few published studies have suggested that large waist circumference was associated with an increased risk of stress urinary incontinence after adjustment for BMI. Our study observed similar results but only among physically active women. In addition, our study suggested a greater positive association between waist circumferences and moderate/severe stress urinary incontinence, which warrants further investigation. The relationship between BMI and specific types of incontinence has been inconsistent. Differences in age ethnic groups in different study populations may have contributed to the inconsistent results. In addition, the mean and range of BMI and waist circumferences varied significantly among different studies.

In the current study, we found a significant interaction between recreational physical activity and waist circumference in stress urinary incontinence. The interaction suggested that women with large waist circumferences had a greater positive association with stress urinary incontinence if they had recreational physical activity. Rigorous physical activity not moderate/mild physical activity has been suggested to increase intra-abdominal pressure and pelvic floor muscle fatigue [10]. Recreational physical activity could add additional intra-abdominal pressure to women who already have pressure and fatigue pelvic floor muscles resulting from large waist circumferences. On the other hand, excessive adiposity resulting from greater waist circumference can increase oxidative stress [20] which has been suggested to play a critical role in muscle homeostasis and pathophysiology of skeletal muscle [15]. As such, the increased oxidative stress resulting from elevated waist circumference may damage the pelvic floor muscles. Although recreational physical activity has been demonstrated to increase endogenous antioxidative enzyme activity [13] and eliminate excessive reactive oxygen species resulting from elevated waist circumferences, this study suggested that damage of pelvic floor muscles due to intra-abdominal pressure resulting from large waist circumferences and recreational physical activity could play a

major role in stress urinary incontinence. This intriguing finding deserves further investigation.

The current study is a cross-sectional study with prevalent urinary incontinence cases, which limited the ability to address the temporal relationship among recreational physical activity, BMI, waist circumference and urinary incontinence. Urinary incontinence diagnosis was self-reported, so misclassification was possible. However, studies have suggested that the reliability and validity of self-reported urinary incontinence is generally high [21,22]. The self-reported urinary incontinence types have been found to be highly accurate compared to clinical diagnosis [23]. Although the study has a relatively large sample, the numbers in subtype analyses, particularly for overactive bladder syndrome and moderate/severe urinary incontinence, were small and limited our statistical power. Finally, compared to other study populations, particularly the western populations, our study population has relatively lower BMI and smaller waist circumference, which limited our ability to examine associations with larger body sizes.

In summary, urinary incontinence is a major public health concern in women's health due to the severity of which it interferes with an individual's quality of life. The inverse association between recreational physical activity and various urinary incontinences and its interactions with waist circumference warrants further investigation.

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References

1. Menezes M, Pereira M, Hextall A. Predictors of female urinary incontinence at midlife and beyond. *Maturitas*. 2010; 65:167–71. [PubMed: 20005056]
2. Wyman JF, Harkins SW, Choi SC, et al. Psychosocial impact of urinary incontinence in women. *Obstet Gynecol*. 1987; 70:378–81. [PubMed: 3627585]
3. Wyman JF, Harkins SW, Fantl JA. Psychosocial impact of urinary incontinence in the community-dwelling population. *J Am Geriatr Soc*. 1990; 38:282–8. [PubMed: 2179369]
4. Minassian VA, Drutz HP, Al-Badr A. Urinary incontinence as a worldwide problem. *Int J Gynaecol Obstet*. 2003; 82:327–38. [PubMed: 14499979]
5. Minassian VA, Stewart WF, Wood GC. Urinary incontinence in women: variation in prevalence estimates and risk factors. *Obstet Gynecol*. 2008; 111:324–31. [PubMed: 18238969]
6. Zhou BF. Effect of body mass index on all-cause mortality and incidence of cardiovascular diseases – report for meta-analysis of prospective studies open optimal cut-off points of body mass index in Chinese adults. *Biomed Environ Sci*. 2002; 15:245–52. [PubMed: 12500665]
7. Abrams P, Cardozo L, Fall M, et al. The standardisation of terminology of lower urinary tract function: report from the Standardisation Sub-committee of the International Continence Society. *Neurourol Urodyn*. 2002; 21:167–78. [PubMed: 11857671]
8. Hsieh CH, Chang WC, Hsu MI, et al. Risk factors of urinary frequency among women aged 60 and older in Taiwan. *Taiwan J Obstet Gynecol*. 2010; 49:260–5. [PubMed: 21056308]
9. Zhu L, Lang J, Liu C, et al. Epidemiological study of urge urinary incontinence and risk factors in China. *Int Urogynecol J Pelvic Floor Dysfunct*. 2010; 21:589–93.
10. Bo K. Urinary incontinence, pelvic floor dysfunction, exercise and sport. *Sports Med*. 2004; 34:451–64. [PubMed: 15233598]
11. Hannestad YS, Rortveit G, Daltveit AK, et al. Are smoking and other lifestyle factors associated with female urinary incontinence? The Norwegian EPIN-CONT Study *BJOG*. 2003; 110:247–54.

12. Townsend MK, Danforth KN, Rosner B, et al. Physical activity and incident urinary incontinence in middle-aged women. *J Urol.* 2008; 179:1012–6. discussion 6–7. [PubMed: 18206951]
13. Covas MI, Elosua R, Fito M, et al. Relationship between physical activity and oxidative stress biomarkers in women. *Med Sci Sports Exerc.* 2002; 34:814–9. [PubMed: 11984300]
14. Oka M, Fukui T, Ueda M, et al. Suppression of bladder oxidative stress and inflammation by a phytotherapeutic agent in a rat model of partial bladder outlet obstruction. *J Urol.* 2009; 182:382–90. [PubMed: 19447421]
15. Musaro A, Fulle S, Fano G. Oxidative stress and muscle homeostasis. *Curr Opin Clin Nutr Metab Care.* 2010; 13:236–42. [PubMed: 20098320]
16. Townsend MK, Curhan GC, Resnick NM, et al. BMI, waist circumference, and incident urinary incontinence in older women. *Obesity (Silver Spring).* 2008; 16:881–6. [PubMed: 18379564]
17. Waetjen LE, Liao S, Johnson WO, et al. Factors associated with prevalent and incident urinary incontinence in a cohort of midlife women: a longitudinal analysis of data: study of women's health across the nation. *Am J Epidemiol.* 2007; 165:309–18. [PubMed: 17132698]
18. Brown JS, Grady D, Ouslander JG, et al. Prevalence of urinary incontinence and associated risk factors in postmenopausal women. Heart & Estrogen/Progestin Replacement Study (HERS) Research Group. *Obstet Gynecol.* 1999; 94:66–70. [PubMed: 10389720]
19. Han MO, Lee NY, Park HS. Abdominal obesity is associated with stress urinary incontinence in Korean women. *Int Urogynecol J Pelvic Floor Dysfunct.* 2006; 17:35–9. [PubMed: 16021328]
20. Urakawa H, Katsuki A, Sumida Y, et al. Oxidative stress is associated with adiposity and insulin resistance in men. *J Clin Endocrinol Metab.* 2003; 88:4673–6. [PubMed: 14557439]
21. Grodstein F, Fretts R, Lifford K, et al. Association of age, race, and obstetric history with urinary symptoms among women in the Nurses' Health Study. *Am J Obstet Gynecol.* 2003; 189:428–34. [PubMed: 14520212]
22. Diokno AC, Brown MB, Brock BM, et al. Clinical and cystometric characteristics of continent and incontinent noninstitutionalized elderly. *J Urol.* 1988; 140:567–71. [PubMed: 3411676]
23. Sandvik H, Hunskaar S, Vanvik A, et al. Diagnostic classification of female urinary incontinence: an epidemiological survey corrected for validity. *J Clin Epidemiol.* 1995; 48:339–43. [PubMed: 7897455]

Table 1Selected characteristics of the study population ($n=2603$) in Gansu, China.

Characteristic	Cases (<i>n</i> =1074)		Controls (<i>n</i> =1529)	
	<i>n</i>	%	<i>n</i>	%
Age (year)				
<30	65	6.1	445	29.1
30–39	319	29.7	521	34.1
40–49	320	29.8	253	16.5
50–59	201	18.7	154	10.1
60–69	131	12.2	124	8.1
70+	38	3.5	32	2.1
Mean (SD)	45.5 (12.2)		38.2 (13.4)	
Menopause				
Pre-menopause	738	68.9	1238	81.1
Post-menopause	333	31.1	289	18.9
Parity				
0	25	2.3	289	18.9
1	295	27.5	580	38
2	438	40.8	410	26.8
3+	315	29.4	249	16.3
Smoking				
No	1047	97.5	1505	98.4
Yes	27	2.5	24	1.6
Drinking				
No	844	78.6	1207	78.9
Yes	230	21.4	322	21.1

Table 2

Associations among body mass index, waist circumference, physical activity, and female urinary incontinence among women in Gansu, China.

Controls	Urinary incontinence			Stress urinary incontinence			Mixed urinary incontinence			Overactive bladder syndrome		
	Cases	OR ^a (95% CI)	OR ^b (95% CI)	Cases	OR ^a (95% CI)	OR ^b (95% CI)	Cases	OR ^a (95% CI)	OR ^b (95% CI)	Cases	OR ^a (95% CI)	OR ^b (95% CI)
Body mass index (kg/m ²)												
<24.0	1134	1.0	1.0	317	1.0	1.0	295	1.0	1.0	45	1.0	1.0
24.0–27.9	325	1.2 (1.0–1.4)	1.2 (1.0–1.4)	150	1.4 (1.1–1.7)	1.4 (1.1–1.9)	143	1.1 (0.8–1.4)	1.0 (0.8–1.4)	16	0.9 (0.5–1.7)	0.8 (0.4–1.5)
≥28.0	69	1.6 (1.1–2.2)	1.7 (1.2–2.5)	50	1.9 (1.3–2.9)	2.3 (1.5–3.6)	47	1.3 (0.9–2.0)	1.4 (0.9–2.2)	8	2.1 (0.9–4.7)	1.6 (0.7–4.1)
<i>P</i> for trend		0.004	0.008		0.0003	0.0005		0.23	0.31		0.25	0.50
Waist circumference (cm)												
<70	328	1.0	1.0	48	1.0	1.0	35	1.0	1.0	9	1.0	1.0
70–75	391	1.4 (1.0–1.8)	1.3 (0.9–1.7)	147	1.8 (1.2–2.6)	1.7 (1.2–2.5)	77	0.9 (0.6–1.4)	0.8 (0.5–1.4)	14	1.0 (0.4–2.4)	1.0 (0.4–2.4)
76–81	406	1.5 (1.1–2.1)	1.3 (1.0–1.8)	169	1.8 (1.2–2.6)	1.5 (1.0–2.2)	177	1.4 (0.9–2.1)	1.2 (0.8–1.9)	14	0.8 (0.3–2.0)	0.8 (0.3–2.2)
>81	398	1.4 (1.1–2.0)	1.1 (0.8–1.6)	153	1.6 (1.1–2.4)	1.1 (0.7–1.7)	196	1.2 (0.8–1.9)	1.0 (0.6–1.7)	32	1.6 (0.7–3.7)	1.5 (0.6–4.0)
<i>P</i> for trend		0.05	0.74		0.14	0.63		0.13	0.49		0.19	0.45
Physical activity												
No	877	1.0	1.0	360	1.0	1.0	390	1.0	1.0	50	1.0	1.0
Sometimes	424	0.6 (0.5–0.8)	0.6 (0.5–0.8)	93	0.7 (0.5–0.9)	0.7 (0.5–0.9)	44	0.5 (0.4–0.7)	0.5 (0.4–0.8)	15	0.9 (0.5–1.8)	0.9 (0.5–1.8)
Often	217	0.6 (0.5–0.8)	0.6 (0.5–0.8)	61	0.7 (0.5–1.0)	0.7 (0.5–1.0)	45	0.5 (0.4–0.8)	0.5 (0.4–0.8)	4	0.4 (0.1–1.0)	0.3 (0.1–1.0)
<i>P</i> for trend		<0.0001	<0.0001		0.01	0.01		<0.0001	<0.0001		0.08	0.09

^aAdjusted for age and parity.

^bAdjusted for age, parity, and variables listed above.

Table 3

Associations among body mass index, waist circumference, and female urinary incontinence by physical activity among women in Gansu, China.

	Urinary incontinence				Stress urinary incontinence			
	Recreational physical activity				Recreational physical activity			
	Yes	No	Yes	No	Yes	No	Yes	No
	Controls	Cases	OR ^a (95% CI)	Controls	Cases	OR ^a (95% CI)	Controls	Cases
Body mass index (kg/m ²)								
<24.0	499	138	1.0	626	513	1.0	499	82
24.0–27.9	115	91	1.4 (0.9–2.1)	208	218	1.1 (0.9–1.4)	115	52
≥28.0	27	36	1.8 (1.0–3.5)	42	69	1.7 (1.1–2.6)	27	20
<i>P</i> for interaction					0.02			0.02
Waist circumference (cm)								
<70	234	30	1.0	94	62	1.0	234	19
70–75	180	70	1.9 (1.2–3.2)	209	169	0.9 (0.6–1.4)	180	46
76–81	121	66	2.0 (1.2–3.6)	279	292	1.0 (0.6–1.4)	121	40
>81	104	99	2.5 (1.3–4.6)	291	277	0.7 (0.5–1.1)	104	49
<i>P</i> for interaction					0.0007			0.001

^a Adjusted for age, parity, and variables listed above.

Table 4

Associations among body mass index, physical activity, and urinary incontinence by severity among women in Gansu, China.

	Urinary incontinence				Stress urinary incontinence				Mixed urinary incontinence			
	Mild		Moderate/severe		Mild		Moderate/severe		Mild		Moderate/severe	
	Cases	OR ^a (95% CI)	Cases	OR ^a (95% CI)	Cases	OR ^a (95% CI)	Cases	OR ^a (95% CI)	Cases	OR ^a (95% CI)	Cases	OR ^a (95% CI)
Body mass index (kg/m ²)												
<24	519	1.0	140	1	293	1	24	1	192	1	103	1
24–28	218	1.1 (0.9–1.4)	92	1.3 (0.9–1.7)	134	1.4 (1.1–1.9)	16	1.4 (0.7–3.1)	73	0.8 (0.6–1.2)	70	1.3 (0.9–2.0)
≥28	74	1.6 (1.1–2.3)	31	1.6 (1.0–2.6)	43	2.3 (1.5–3.6)	7	2.5 (0.9–7.1)	27	1.4 (0.8–2.4)	20	1.4 (0.8–2.7)
<i>P</i> for trend		0.01		0.04		0.0008		0.17		0.88		0.09
Waist circumference (cm)												
<70	72	1.0	21	1	46	1	2	1	18	1	17	1
70–75	180	1.4 (1.0–1.9)	59	1.2 (0.7–2.1)	134	1.6 (1.1–2.4)	13	3.6 (0.8–16.6)	39	0.8 (0.4–1.5)	38	0.8 (0.4–1.6)
76–81	297	1.7 (1.3–2.4)	63	1.0 (0.5–1.7)	156	1.5 (1.0–2.2)	13	2.9 (0.6–14.1)	131	1.8 (1.0–3.2)	46	0.6 (0.3–1.2)
>81	262	1.5 (1.1–2.1)	120	1.2 (0.7–2.1)	134	1.0 (0.7–1.6)	19	2.8 (0.6–14.3)	104	1.2 (0.7–2.3)	92	0.7 (0.4–1.4)
<i>P</i> for trend		0.04		0.60		0.50		0.50		0.21		0.44
Physical activity												
No	613	1.0	187	1	334	1	26	1	244	1	146	1
Sometimes	424	0.6 (0.5–0.8)	34	0.7 (0.5–1.1)	84	0.7 (0.5–0.9)	9	1.0 (0.4–2.2)	24	0.5 (0.3–0.8)	20	0.6 (0.4–1.1)
Often	73	0.5 (0.4–0.7)	38	0.9 (0.6–1.3)	49	0.6 (0.5–0.9)	12	1.7 (0.8–3.5)	22	0.4 (0.3–0.7)	23	0.7 (0.4–1.1)
<i>P</i> for trend		<0.0001		0.30		0.002		0.22		<0.0001		0.06

^a Adjusted for age, parity and variables listed above.