BMJ Open

Prevalence of urinary incontinence among nulliparous women and its association with underweight body mass index: a secondary analysis of a nationwide cross-sectional study in China

Haiyu Pang,[1] Tangdi Lin,[2] Qing Liu,[3] Luwen Wang,[4] Hangmei Jin,[5] Liyan Gong,[6] Jingyan Xie,[7] Ting Lai,[8] Aiyang Li,[9] Lubin Liu ,[10] Lifei Zhou,[11] Yanqiu Luan,[12] Lin Wang,[13] Xiaoli Li,[14] Xiping Luo,[15] Yingjie Fu,[16] Jumin Niu,[17] Wen Zhao,[18] Qiming Liu,[19] Renfeng Zhao,[20] Abraham N Morse,[21] Jingyi Liu,[22] Xue Zhang,[2] Lan Zhu [23]

To cite: Pang H, Lin T, Liu Q, *et al* . Prevalence of urinary incontinence among nulliparous women and its association with underweight body mass index: a secondary analysis of a nationwide cross-sectional study in China. *BMJ Open* 2025;**15**:e097807. doi:10.1136/bmjopen-2024-097807

► Prepublication history and additional supplemental material for this paper are available online. To view these files, please visit the journal online (https://doi.org/10.1136/bmjopen-2024-097807).

HP and TL contributed equally.

Received 10 December 2024
Accepted 15 April 2025

For numbered affiliations see end of article.

Correspondence to
Lan Zhu;
zhu_julie@vip.sina.com

ABSTRACT

Objectives To estimate the prevalence of urinary incontinence (UI) and its subtypes among nulliparous Chinese women with associated risk factors. The prevalence of UI among those living in urban or rural communities was also analysed with potential risk factors.

Design This is a secondary analysis of epidemiological survey data on UI in Chinese women. The original study was designed as a nationwide cross-sectional study involving 56 460 adult women conducted from October 2019 to December 2021.

Setting Seven geographic regions of China.

Participants Nulliparous women who were aged ≥20 years old and were permanent residents were included in this secondary analysis. Participants who had severe mental or physical disorders or were pregnant were excluded. Data on demographic characteristics, health status and medical history were collected.

Primary and secondary outcome measures The primary outcome was the prevalence of UI, whereas secondary outcome measures were adjusted odds ratios (aOR) for risk factor analysis.

Results A total of 6244 nulliparous women were included in the analysis. The prevalence of UI was 1.9% for nulliparous Chinese women, with stress, urgency and mixed UI being prevalent at 0.9%, 0.3% and 0.7%, respectively. The prevalence of UI was 2.1% and 1.6% for urban and rural subgroups. Abnormal body mass index was significantly associated with UI in the nulliparous group (underweight, aOR: 1.88, 95% CI: 1.03 to 3.45, p=0.041; overweight, aOR: 2.26, 95% CI: 1.37 to 3.73, p=0.001; and obesity, aOR: 3.64, 95% CI: 1.86 to 7.15, p<0.001) and the subgroup in urban areas (underweight, aOR: 2.43, 95% CI: 1.18 to 5.00, p=0.016; overweight, aOR: 3.31, 95% CI: 1.76 to 6.25, p<0.001; and obesity, aOR: 4.53, 95% CI: 1.88 to 10.92, p<0.001); however, no significant association was found for those in rural areas.

Conclusion UI among nulliparous women deserves greater public attention. Abnormal body mass index, including underweight status, was found to be a risk factor for UI among Chinese nulliparous women. Further research is required to investigate the mechanism underlying the association between underweight status and UI.

Ethics and dissemination The study was approved by Peking Union Medical College Ethics Committee (No. S-K970) and conducted according to the Declaration of Helsinki. All participants signed consent forms before data collection. A completed STROBE checklist detailing compliance with all 22 items is provided.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ The original study, which served as the basis for this secondary analysis, employed a methodologically robust six-stage sampling strategy and included representatives of adult women in China.
⇒ This study represents the largest epidemiological sample to date estimating urinary incontinence prevalence among Chinese nulliparous women.
⇒ Data collection used a standardised, validated questionnaire to mitigate recall and information bias inherent in self-reported methodologies.
⇒ Owing to the cross-sectional design of the original study, causal inference cannot be established.

INTRODUCTION

Urinary incontinence (UI) is defined as any complaint of involuntary leakage of urine according to the International Continence Society.[1] UI demonstrates a strongly negative impact on female quality of life through not only mental dysfunction, such as embarrassment, depression, and low self-esteem, but also deteriorated physical ability, resulting in decreased recreational activity time and social isolation.[2 3] UI prevalence in China was estimated to be 30.9% in 2006 and decreased to 16% in 2021 with significant efforts being

made to implement pelvic floor rehabilitation in the past fifteen years.[4] In spite of this, it is estimated that over 90 million women in China are still suffering from UI.[5] There are several well-known risk factors for UI, including childbirth, ageing, obesity and chronic medical conditions.[6] Considerable attention was paid to how childbirth affects female UI symptoms; however, it cannot be neglected that nulliparous women can also experience UI episodes. Minimal research has reported the prevalence of UI among nulliparous women. A systematic review published in 2017 found that UI prevalence varied between 1% and 42.2% in nulliparous women worldwide,[7] which suggested that UI among the nulliparous group is with great uncertainty and highlighted the urgent need for public attention and better preventative strategies for this underserved population.

Due to significant delays in childbirth and the transition of childbirth preference of Chinese couples in the past two decades[10], the number of nulliparous women with greater ages also significantly increased in rural China. Previous research noted that women from rural areas may suffer from more UI episodes due to lower educational level [7] with less personal health awareness.[8] To our knowledge, there was also very limited published study reporting the prevalence of UI as well as risk factors in the rural nulliparous population. Therefore, the objective of this study is to estimate the prevalence of UI and its subtypes among nulliparous Chinese women with associated risk factors. UI prevalence among those living in urban or rural communities was also analysed with potential risk factors.

METHODS

Study design and participation

This current study is a secondary data analysis of the nulliparous subgroup from a national cross-sectional research project which was conducted between October 2019 and December 2021 using a six-stage sampling strategy.[5] Detailed description of the study design, sample size calculation and participant recruitment for the original study has been published.[5] Inclusion criteria were women aged ≥20 years old and permanent residents defined as living in their current residence for 1 year or longer. For this secondary analysis, we only include nulliparous women from the original research. Participants who had severe mental or physical disorders or were pregnant were excluded from the study. The original study has been approved by Peking Union Medical College Ethics Committee (No. S-K970) and conducted according to the *Declaration of Helsinki*. All participants signed consent forms before data collection. A completed STROBE checklist detailing compliance with all 22 items is provided in online supplemental table 1.

Exposures and outcomes

This study included participants' basic information, such as demographic characteristics, medical history and health behaviours. Demographic characteristics included age, urbanisation level, ethnicity, education level, marital status, occupational status, monthly family income and menopause status. Body mass index (BMI) was categorised as underweight (BMI<18.5 kg/m^2), normal (18.5 kg/m^2≤BMI≤24.9 kg/m^2), overweight (25 kg/m^2 ≤BMI≤29.9 kg/m^2) and obese (BMI≥30 kg/m^2). Medical history includes chronic constipation, diabetes, high blood pressure and the history of other gynaecological diseases (ie, pelvic inflammatory disease, pelvic pain, endometriosis, fibroids, gynaecological malignant tumours and pelvic organ prolapse). By using a six-stage sampling strategy, participants were then divided into rural and urban subgroups based on their residence during data collection. The primary outcome was UI, which was defined as the complaint of any involuntary leakage of urine,[9] and UI was categorised into stress UI (SUI), urgency UI (UUI), mixed UI (MUI) and other UI according to the Chinese version of the International Conference on Incontinence Questionnaire UI Short Form in the original study.[10] The type of UI was determined by the following two questions: (1) 'During the past 4 weeks, did you leak urine when you were performing some physical activity, such as coughing, sneezing, lifting or exercise?' (yes or no); and (2) 'During the past 4 weeks, did you leak urine when you had the urge or the feeling that you needed to empty your bladder, but you could not get to the toilet fast enough?' (yes or no). Women who answered yes for question (1) were categorised as having SUI. Women who answered yes for question (2) were categorised as having UUI. Women who answered yes to both questions were categorised as having MUI. Other types of UI were defined as those with a negative response to the two preceding questions about leakage (SUI or UUI) among those who reported having UI during the past 4 weeks. No nulliparous participant recruited was categorised into the other UI subgroup; thus, only SUI, MUI and MUI were analysed in this current study.

Statistical analysis

Number and percentage were used to describe categorical variables. Participants' baseline characteristics were compared using χ^2 test or Fisher's exact test of independence for categorical variables. The Cochran-Armitage trend test was used to demonstrate linear trends for ordinal categorical variables. We used a binary logistic regression model to obtain OR and 95% CI to detect risk factors of UI for the nulliparous population and subgroups living in urban or rural areas. In addition, multinomial logistic regression was applied to estimate risk factors of UI subtypes, including SUI, UUI and MUI, among the nulliparous population. The reference category was the group of participants without UI. Statistical significance was set at p<0.05 (two-tailed). All analyses were performed using SPSS, V. 24.0 (IBM).

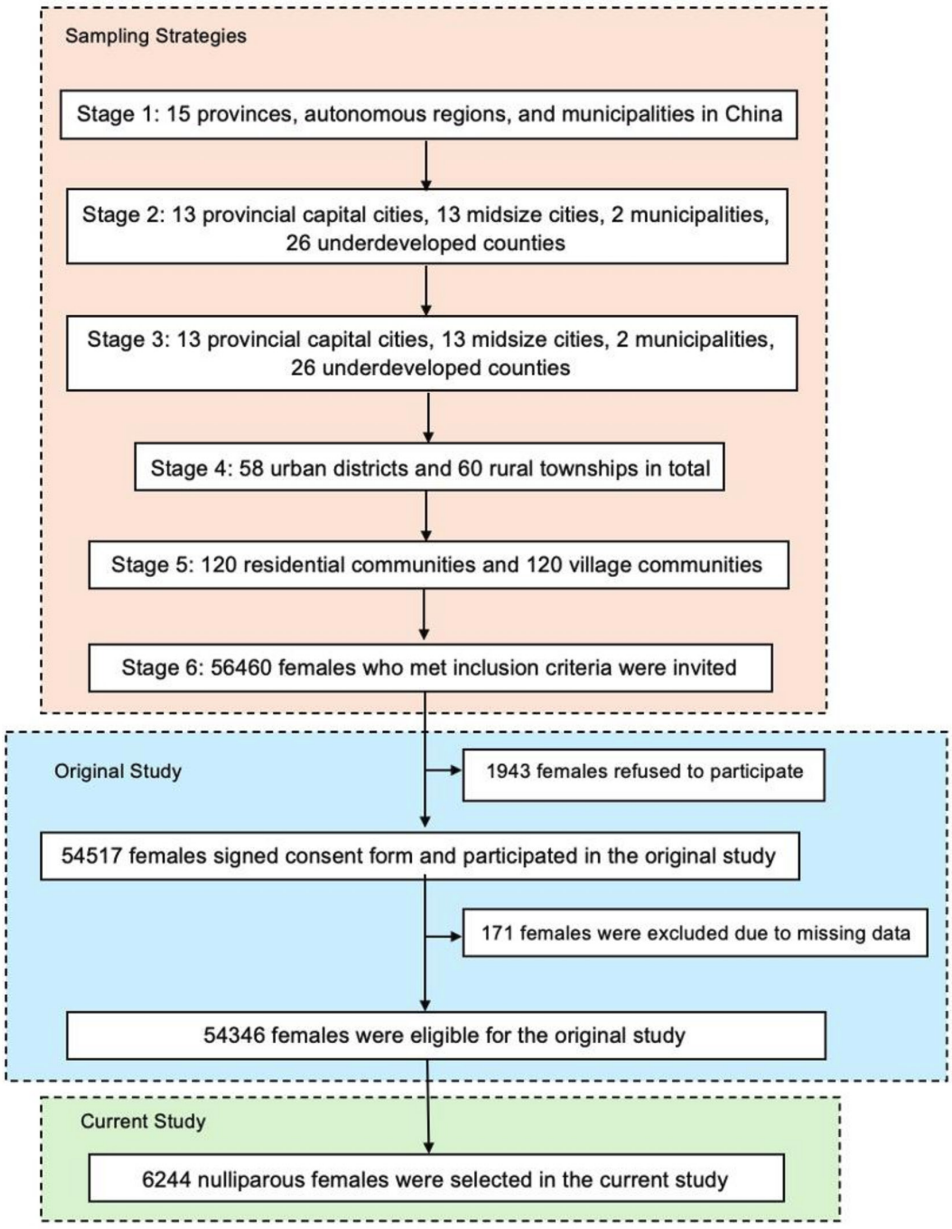

Figure 1 Study flowchart.

Patient and public involvement

Patients or the public were not involved in the design, conduct, reporting or dissemination plans of this study.

RESULTS

Demographic characteristics

A total of 6244 nulliparous women were selected from the cohort of 54346 participants in the original study (figure 1). Overall, 2718 (43.5%) participants were from rural areas, whereas 3526 (56.5%) were from urban areas (table 1). No significant differences were noted in BMI, menopausal status and the medical history of coughing, diabetes and high blood pressure (p>0.05) between the two groups. Rural population tends to be younger (p<0.001), unmarried (p<0.001), unemployed (p<0.001), belongs to an ethnic minority group (p<0.001), has lower education background (p<0.001), lower monthly family income (p<0.001) and less probability to have medical history of chronic constipation (p=0.001) and other gynaecological disease (p<0.001) (table 2).

The prevalence of UI among nulliparous Chinese women and subgroups

The prevalence of UI was 1.9% among Chinese nulliparous women, while that of SUI, UUI and MUI was 0.9%, 0.3% and 0.7%, respectively (table 3). For urban and rural subgroups, the prevalence of UI was 2.1% and 1.6%. The trend of prevalence was also analysed among BMI, age groups and menopause status. The nulliparous population and urban subgroup showed that the normal BMI group had the lowest UI prevalence compared with

Table 1 Demographic characteristics of the sample population

Variables	Total	Rural (%)	Urban (%)	P value
Total number	6244	2718 (43.5)	3526 (56.5)	
Age group, years				**<0.001***
20–29	4731 (75.8)	2241 (82.5)	2490 (70.6)	
30–39	829 (13.3)	240 (8.8)	589 (16.7)	
≥40	684 (11.0)	237 (8.7)	447 (12.7)	
Ethnicity				**<0.001***
Han	5501 (88.1)	2242 (82.5)	3259 (92.4)	
Minority	743 (11.9)	476 (17.5)	267 (7.6)	
Education level				**<0.001***
Senior school or below	1991 (31.9)	1156 (42.5)	835 (23.7)	
College	1782 (28.5)	748 (27.5)	1034 (29.3)	
Undergrad or above	2471 (39.6)	814 (29.9)	1657 (47.0)	
Marital status				**<0.001***
Married	1841 (29.5)	708 (26.0)	1133 (32.1)	
Not married	4403 (70.5)	1916 (74.0)	2393 (67.9)	
Body mass index				0.671*
Underweight (<18.5)	1019 (16.3)	434 (16.0)	585 (16.6)	
Normal (18.5–24.9)	4493 (72.0)	1965 (72.3)	2528 (71.7)	
Overweight (25–29.9)	527 (8.4)	236 (8.7)	291 (8.3)	
Obese (≥30)	205 (3.3)	83 (3.1)	122 (3.5)	
Occupation status				**<0.001***
Mainly mental	2517 (40.3)	723 (26.6)	1794 (50.9)	
Mainly physical	1307 (20.9)	781 (28.7)	526 (14.9)	
Unemployed	2420 (38.8)	1214 (44.7)	1206 (34.2)	
Monthly family income				**<0.001***
≤5000	4490 (71.9)	2181 (80.2)	2309 (65.5)	
>5000	1754 (28.1)	537 (19.8)	1217 (34.6)	
Menopausal status				0.069*
Premenopausal	5906 (94.6)	2587 (95.2)	3319 (94.1)	
Postmenopausal	338 (5.4)	131 (4.8)	207 (5.9)	
Chronic constipation				**0.001***
Yes	92 (1.5)	25 (0.9)	67 (1.9)	
No	6152 (98.5)	2693 (99.1)	3474 (98.1)	
Diabetes				0.573*
Yes	36 (0.6)	14 (0.6)	22 (0.5)	
No	6208 (99.4)	2704 (99.5)	3504 (99.4)	
Other gynaecological disease				**<0.001***
Yes	205 (3.3)	51 (1.9)	154 (4.4)	
No	6039 (96.7)	2667 (98.1)	3372 (95.6)	
High blood pressure				0.125*
Yes	95 (1.5)	34 (1.3)	61 (1.7)	
No	6149 (98.5)	2684 (98.7)	3465 (98.3)	

Bold P values denote statistical significance ($p < 0.05$).
*χ^2 test.

Table 2 Variables and UI occurrence among urban/rural nulliparous Chinese women

	Urban n (%)		Rural n (%)	
Variables	**UI 74 (2.1)**	**P value**	**UI 43 (1.6)**	**P value**
Age group		**<0.001***		**<0.001***
20–29	20 (27.0)		8 (18.6)	
30–39	9 (12.2)		5 (11.6)	
≥40	45 (60.8)		30 (69.8)	
Ethnicity		**0.025†**		0.847†
Han	63 (85.1)		36 (83.7)	
Minority	11 (14.9)		7 (16.3)	
Education level		**<0.001***		**<0.001***
Senior school or below	43 (58.1)		36 (83.7)	
College	9 (12.2)		3 (7.0)	
Undergrad or above	22 (29.7)		4 (9.3)	
Marital status		**<0.001†**		**<0.001†**
Married	55 (74.3)		35 (81.4)	
Unmarried	19 (25.7)		8 (18.6)	
Body mass index		**<0.001***		**<0.001***
Underweight	13 (17.6)		3 (7.9)	
Normal	30 (40.5)		22 (51.2)	
Overweight	21 (28.4)		12 (27.9)	
Obese	10 (13.5)		6 (14.0)	
Occupation level		**<0.001†**		**0.002†**
Mainly mental	18 (24.3)		3 (7.0)	
Mainly physical	9 (12.2)		10 (23.3)	
Unemployed	47 (63.5)		30 (69.8)	
Monthly family income		0.323†		0.440†
≤5000	44 (59.5)		37 (86.0)	
>5000	30 (40.5)		6 (14.0)	
Menopausal status		**<0.001‡**		**<0.001‡**
Premenopausal	42 (56.8)		19 (44.2)	
Postmenopausal	32 (43.2)		24 (55.8)	
Chronic constipation		**<0.001‡**		**0.007‡**
Yes	9 (12.2)		3 (7.0)	
No	65 (87.8)		40 (93.0)	
Diabetes		**<0.001‡**		**0.020‡**
Yes	8 (10.8)		2 (4.7)	
No	66 (89.2)		41 (95.3)	
Other gynaecological disease		**0.001‡**		**0.008‡**
Yes	10 (13.5)		4 (9.3)	
No	64 (86.5)		39 (90.7)	
High blood pressure		**<0.001‡**		**<0.001‡**
Yes	12 (16.2)		8 (18.6)	
No	62 (83.8)		35 (81.4)	

Bold P values denote statistical significance ($p < 0.05$).
*Cochran-Armitage trend test.
†χ^2 test.
‡Fisher's exect test.
UI, urinary incontinence.

Table 3 Association between variables and UI and its subtypes among nulliparous Chinese women

Variable	UI (%)	SUI (%)	UUI (%)	MUI (%)
Total	117 (1.9)	58 (0.9)	18 (0.3)	41 (0.7)
Age group, years				
20–29	28 (23.9)	17 (29.3)	5 (27.8)	6 (14.6)
30–39	14 (12.0)	8 (13.8)	1 (5.6)	5 (12.2)
≥40	75 (64.1)	33 (56.9)	12 (66.7)	30 (73.2)
P for trend	**<0.001***	**<0.001***	**<0.001***	**<0.001***
Urbanisation level				
Urban	74 (63.2)	45 (77.6)	10 (55.6)	19 (46.3)
Rural	43 (36.8)	13 (22.4)	8 (44.4)	22 (53.7)
P for difference	0.136†	**0.001**†	0.938†	0.189†
Ethnicity				
Han	99 (84.6)	46 (79.3)	17 (94.4)	36 (87.8)
Minority	18 (15.4)	12 (20.7)	1 (5.6)	5 (12.2)
P for difference	0.240†	**0.038**†	0.714‡	1.000‡
Education				
Senior school or below	79 (67.5)	31 (53.4)	15 (83.3)	33 (80.5)
College	12 (10.3)	10 (17.2)	1 (5.6)	1 (2.4)
Undergrad or above	26 (22.2)	17 (29.3)	2 (11.1)	7 (17.1)
P for trend	**<0.001***	**0.004***	**<0.001***	**<0.001***
Marital status				
Married	90 (76.9)	42 (72.4)	13 (72.2)	35 (85.4)
Not married	27 (23.1)	16 (27.6)	5 (27.8)	6 (14.6)
P for difference	**<0.001**†	**<0.001**†	**<0.001**†	**<0.001**†
Body mass index				
Underweight (<18.5)	16 (13.7)	8 (13.8)	2 (11.1)	6 (14.6)
Normal (18.5–24.9)	52 (44.4)	28 (48.3)	7 (38.9)	17 (41.5)
Overweight (25–29.9)	33 (28.2)	16 (27.6)	6 (33.3)	11 (26.8)
Obese (≥30)	16 (13.7)	6 (10.3)	3 (16.7)	7 (17.1)
P for trend	**<0.001***	**<0.001***	**<0.001***	**<0.001***
Occupation				
Mainly mental	21 (17.9)	16 (27.6)	1 (5.6)	4 (9.8)
Mainly physical	19 (16.2)	9 (15.5)	5 (27.8)	5 (12.2)
Non-worker	77 (65.8)	33 (56.9)	12 (66.7)	32 (78.0)
P for difference	**<0.001**†	**0.017**†	**0.009**†	**<0.001**†
Monthly family income				
≤5000	81 (69.2)	35 (60.3)	12 (66.7)	34 (82.9)
>5000	36 (30.8)	23 (39.7)	6 (33.3)	7 (17.1)
P for difference	0.515†	**0.049**†	0.620†	0.115†
Menopausal status				
Premenopausal	61 (52.1)	39 (67.2)	9 (50.0)	13 (31.7)
Postmenopausal	56 (47.9)	19 (32.8)	9 (50.0)	28 (68.3)
P for difference	**<0.001**†	**<0.001**‡	**<0.001**‡	**<0.001**‡
Chronic constipation				
Yes	12 (10.3)	7 (12.1)	1 (5.6)	4 (9.8)
No	105 (89.7)	51 (87.9)	17 (94.4)	37 (90.2)
P for difference	**<0.001**‡	**<0.001**‡	0.235‡	**0.003**‡

Continued

Table 3 Continued

Variable	UI (%)	SUI (%)	UUI (%)	MUI (%)
Diabetes				
Yes	10 (8.5)	5 (8.6)	2 (11.1)	3 (7.3)
No	107 (91.5)	53 (91.4)	16 (88.9)	38 (92.7)
P for difference	**<0.001‡**	**<0.001‡**	**0.005‡**	**0.002‡**
Other gynaecological disease				
Yes	14 (12.0)	6 (10.3)	5 (27.8)	3 (7.3)
No	103 (88.0)	52 (89.7)	13 (72.2)	38 (92.7)
P for difference	**<0.001‡**	**0.011‡**	**<0.001‡**	0.150‡
High blood pressure				
Yes	20 (17.1)	6 (10.3)	3 (16.7)	11 (26.8)
No	97 (82.9)	52 (89.7)	15 (83.3)	30 (73.2)
P for difference	**<0.001‡**	**<0.001‡**	**0.002‡**	**<0.001‡**

Bold P values denote statistical significance (p < 0.05).
*Cochran-Armitage trend test.
†χ^2 test.
‡Fisher's exact test.
MUI, mixed urinary incontinence; SUI, stress urinary incontinence; UI, urinary incontinence; UUI, urgency urinary incontinence.

underweight, overweight and obese subgroups, whereas a positive trend of UI prevalence was noted among BMI groups for the rural subgroup (figure 2). As nulliparous women became ageing and postmenopausal, higher UI prevalence was shown (online supplemental figure S1). The urban subgroup demonstrated higher UI prevalence during the premenopausal period but lower prevalence during the postmenopausal period than the rural subgroup (online supplemental figure S2).

The risk factors of UI among nulliparous Chinese women

Table 4 shows the analysis of risk factors of UI and its subtypes among nulliparous Chinese women. In binary logistic regression, the results showed that unmarried (aOR: 0.31, 95% CI: 0.18 to 0.54) and employed status (mentally employed, aOR: 0.53, 95% CI: 0.29 to 0.98; physically employed, aOR: 0.55, 95% CI: 0.31 to 0.96) were both protective factors for nulliparous women. Nulliparous women with chronic constipation had the strongest association with UI occurrence (aOR: 5.75, 95% CI: 2.59 to 12.74), followed by ageing 30–39 years (aOR: 4.16, 95% CI: 2.05 to 8.45), having postmenopausal status (aOR: 2.22, 95% CI: 1.22 to 4.05) and belonging to an ethnic minority (aOR: 2.03, 95% CI: 1.14, 3.64). This current study also noted that abnormal BMI is significantly associated with UI occurrence in nulliparous female groups, regardless of under- or overweight status (underweight, aOR: 1.88, 95% CI: 1.03 to 3.45; overweight, aOR: 2.26, 95% CI: 1.37 to 3.73; and obesity, aOR: 3.64, 95% CI: 1.86 to 7.15).

In multinomial logistic regression, nulliparous women who have chronic coughing (aOR: 7.11, 95% CI: 2.80 to 18.01), are of older age (≥40 years, aOR: 5.31, 95% CI: 2.22 to 12.70), are urban residents (aOR: 2.27, 95% CI: 1.16 to 4.46) and belong to an ethnic minority (aOR: 3.05, 95% CI: 1.52 to 6.15) are more likely to report SUI. Nulliparous women who are overweight (aOR: 2.54, 95% CI: 1.29 to 4.98) or obese (aOR: 2.97, 95% CI: 1.12 to 7.89) demonstrated significant odds of developing SUI, while obesity is a statistically significant risk factor for UUI (aOR: 4.42, 95% CI: 1.01 to 19.37) and MUI (aOR: 4.19, 95% CI: 1.49 to 11.78). Nulliparous women with a medical history of other gynaecological diseases were found to have an increased risk of developing UUI (aOR: 6.23, 95% CI: 1.86 to 20.88). Postmenopausal nulliparous women have the strongest association with MUI occurrence (aOR: 8.79, 95% CI: 1.98 to 39.01).

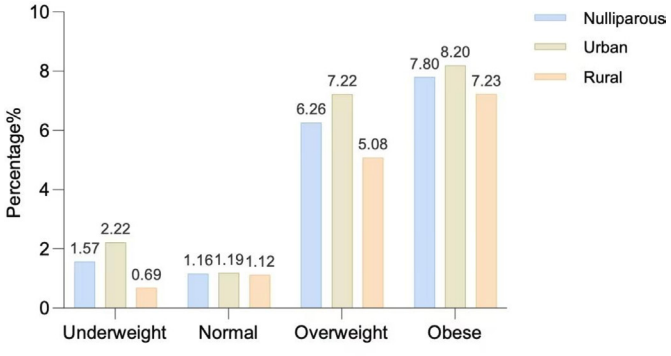

Figure 2 The prevalence of urinary incontinence (UI) among different body mass index (BMI) groups. Bars indicate the prevalence of UI among BMI subgroups in the nulliparous population and urban and rural subgroups, respectively. The graph demonstrates the trends of UI prevalence in each population group as BMI becomes greater.

Table 4 Potential risk factors of UI and its subtypes among nulliparous Chinese women

	UI			SUI	UUI	MUI
	aOR* (95% CI)	Beta	P value	aOR† (95% CI)	aOR† (95% CI)	aOR† (95% CI)
Age group, years						
20–29	Ref	Ref	Ref	Ref	Ref	
30–39	**4.16 (2.05, 8.45)**	**1.43**	**<0.001**	1.47 (0.58, 3.73)	0.57 (0.06, 5.46)	3.47 (0.92, 13.03)
≥40	1.70 (0.83, 3.47)	0.53	0.144	**5.31 (2.22, 12.70)**	2.79 (0.52, 15.04)	2.03 (0.34, 12.06)
Urbanisation level						
Rural	Ref	Ref	Ref	Ref	Ref	Ref
Urban	1.19 (0.76, 1.85)	0.17	0.449	**2.27 (1.16, 4.46)**	1.11 (0.39, 3.17)	0.54 (0.26, 1.09)
Ethnicity						
Han	Ref	Ref	Ref	Ref	Ref	Ref
Minority	**2.03 (1.14, 3.64)**	**0.71**	**0.017**	**3.05 (1.52, 6.15)**	0.47 (0.06, 3.81)	1.89 (0.66, 5.42)
Marital status						
Married	Ref	Ref	Ref	Ref	Ref	Ref
Unmarried	**0.31 (0.18, 0.54)**	**−1.16**	**<0.001**	**0.32 (0.16, 0.64)**	0.72 (0.19, 2.67)	**0.20 (0.07, 0.60)**
Education level						
Senior school or below	Ref	Ref	Ref	Ref	Ref	Ref
College	0.55 (0.27, 1.13)	−0.61	0.102	0.83 (0.35, 1.97)	0.21 (0.03, 1.84)	0.21 (0.03, 1.75)
Undergrad or above	1.01 (0.53, 1.94)	0.01	0.980	1.17 (0.50, 2.74)	0.36 (0.06, 2.13)	1.37 (0.41, 4.59)
Body mass index						
Underweight	**1.88 (1.03, 3.45)**	**0.63**	**0.041**	1.55 (0.68, 3.54)	1.80 (0.35, 9.16)	2.48 (0.91, 6.76)
Normal	Ref	Ref	Ref	Ref	Ref	Ref
Overweight	**2.26 (1.37, 3.73)**	**0.82**	**0.001**	**2.54 (1.29, 4.98)**	3.14 (0.96, 10.31)	1.75 (0.75, 4.10)
Obese	**3.64 (1.86, 7.15)**	**1.29**	**<0.001**	**2.97 (1.12, 7.89)**	**4.42 (1.01, 19.37)**	**4.19 (1.49, 11.78)**
Occupation level						
Mainly mental	**0.53 (0.29, 0.98)**	**−0.64**	**0.042**	0.62 (0.29, 1.33)	0.17 (0.02, 1.58)	0.42 (0.11, 1.54)
Mainly physical	**0.55 (0.31, 0.96)**	**−0.60**	**0.034**	0.63 (0.28, 1.40)	0.83 (0.26, 2.64)	**0.28 (0.10, 0.77)**
Unemployed	Ref	Ref	Ref	Ref	Ref	Ref
Monthly family income						
≤5000	Ref	Ref	Ref	Ref	Ref	Ref
>5000	1.48 (0.92, 2.38)	0.39	0.106	1.69 (0.91, 3.13)	2.72 (0.93, 7.97)	0.80 (0.31, 2.05)
Menopausal status						
Premenopausal	Ref	Ref	Ref	Ref	Ref	Ref
Postmenopausal	**2.22 (1.22, 4.05)**	**0.80**	**0.009**	1.26 (0.56, 2.81)	1.82 (0.44, 7.50)	**8.79 (1.98, 39.01)**
Chronic constipation						
No	Ref	Ref	Ref	Ref	Ref	Ref
Yes	**5.75 (2.59, 12.74)**	**1.75**	**<0.001**	**7.11 (2.80, 18.01)**	3.32 (0.37, 30.13)	**4.70 (1.31, 16.83)**
Diabetes						
No	Ref	Ref	Ref	Ref	Ref	Ref
Yes	1.74 (0.70, 4.34)	0.56	0.232	2.78 (0.83, 9.28)	2.42 (0.41, 14.45)	0.83 (0.20, 3.43)
Other gynaecological disease						
No	Ref	Ref	Ref	Ref	Ref	Ref
Yes	1.39 (0.71, 2.73)	0.33	0.335	1.30 (0.52, 3.28)	**6.23 (1.86, 20.88)**	0.45 (0.12, 1.77)
High blood pressure						
No	Ref	Ref	Ref	Ref	Ref	Ref
Yes	1.34 (0.68, 2.64)	0.29	0.397	0.79 (0.27, 2.36)	0.71 (0.15, 3.49)	**2.65 (1.08, 6.52)**

Continued

Table 4 Continued

	UI			SUI	UUI	MUI
	aOR* (95% CI)	Beta	P value	aOR† (95% CI)	aOR† (95% CI)	aOR† (95% CI)

Bold values denote statistical significance (p < 0.05).
*Binary logistic regression model
†Multinominal logistic regression model
aOR, adjusted odds ratio; MUI, mixed urinary incontinence; SUI, stress urinary incontinence; UI, urinary incontinence; UUI, urgency urinary incontinence.

The risk factors of UI among nulliparous Chinese women in either urban or rural areas

Table 5 shows the analysis of risk factors of UI among urban and rural nulliparous Chinese women. Subgroup analyses revealed that abnormal BMI is significantly associated with UI occurrence for nulliparous women residing in urban areas (underweight, aOR: 2.43, 95% CI: 1.18 to 5.00; overweight, aOR: 3.31, 95% CI: 1.76 to 6.25; and obesity, aOR: 4.53, 95% CI: 1.88 to 10.92); however, BMI is not a significant risk factor for those living in rural areas. For participants in both residential areas, unmarried status continues to be a protective factor for nulliparous women (rural, aOR: 0.34, 95% CI: 0.11 to 1.00; urban, aOR: 0.32, 95% CI: 0.17 to 0.61) while chronic constipation demonstrates the strongest association with UI occurrence (rural, aOR: 5.66, 95% CI: 1.14 to 28.15; urban, aOR: 6.29, 95% CI: 2.51 to 15.80). In the rural subgroup, participants aged over 30 years showed increased odds of developing UI (age 30–39 years, aOR: 4.29, 95% CI: 1.17 to 15.79; age ≥40 years, aOR: 7.28, 95% CI: 1.87 to 28.24); however, only age greater than 40 years old (age ≥40 years, aOR: 2.94, 95% CI: 1.25 to 6.92) is a risk factor for those residing in urban communities.

DISCUSSION

To the best of our knowledge, this research is the first to report the prevalence of UI and its subtypes in nulliparous women with the largest sample size through a nationwide study. This current study revealed that the prevalence of UI among nulliparous Chinese women was 1.9%, which is slightly higher compared with a previous study (1%) conducted in 2003 within a smaller Chinese nulliparous population.[11] The prevalence of UI found in this current study among nulliparous women living in urban areas (2.1%) was reported to be higher than that in rural areas (1.6%). It is agreeable in this current study that chronic constipation and overweight status were risk factors for UI development; however, underweight status was for the first time also identified as an influencing factor for UI development among the nulliparous population.

A systematic review including multiple cohort or cross-sectional studies investigated UI prevalence among nulliparous women in different countries, such as 10.8% in Australia,[12] 14% in Denmark,[13] 19.9% in Portugal[14] and 38.6% in Sweden,[15] which were all higher than results in this current study. One possible explanation for the ratio differences could lie in different study designs, including data collection method and use of UI definition. The study design included a six-stage sampling strategy to accurately represent the national population. Additionally, we used an internationally accepted definition of UI, as well as a reliable international standardised questionnaire to measure outcomes. The results showed that SUI is the most prevalent subtype among Chinese nulliparous women, which was consistent with several previous high-quality research studies conducted in other countries.[16] Despite low prevalence compared with parous women, UI among nulliparous women remains an important health issue requiring increased public attention. A shift in the marriage conception and fertility preference from Chinese women has been noted with the national postponement of parenthood, such as late marriage, long marriage and conception interval and advanced pregnancy.[17] Nulliparous women with advanced age may present with UI symptoms before pregnancy, which can result in more severe adverse outcomes and postpartum pelvic floor dysfunction.[16 18–20] Thus, advocating for pelvic floor checks before pregnancy for the nulliparous population could assist in preventing the detrimental effects of UI after childbirth with increased age.

Our study is also the first one to report UI prevalence of nulliparous Chinese women living in urban and rural areas with a rate of 2.1% and 1.6%, respectively. Several risk factors contribute to UI development in underdeveloped areas. A recent study found that urban women with better knowledge of UI and its negative impact were more likely to seek medical care, while rural women with similar lower education levels were less aware of UI as a treatable condition.[5] This is further supported by the finding that 83.7% of UI women from rural areas had only senior school or below educational backgrounds. Occupation demands also explain the UI prevalence difference between urban and rural communities. Rural women were more likely to do labour work and retire late, with 28.7% rural women in this current study performing mainly physical work compared with only 14.9% of urban women.[21] The rural National Retirement Pension programme, phased in since 2009, provided less coverage than urban areas but did not require quitting agricultural activities, exposing rural women to activities inducing long-lasting increased abdominal pressure longer. Due to the unequal distribution of medical resources, UI prevalence has the potential to be underreported in rural areas. As inadequate access to healthcare and limited access to information exist,

Table 5 Potential risk factors of UI among rural and urban nulliparous Chinese women

	Rural			Urban		
	Beta	**aOR* (95% CI)**	**P value**	**Beta**	**aOR* (95% CI)**	**P value**
Age group, years						
20–29	Ref	Ref	Ref	Ref	Ref	Ref
30–39	**1.46**	**4.29 (1.17, 15.79)**	**0.028**	0.13	1.14 (0.48, 2.72)	0.770
≥40	**1.98**	**7.28 (1.87, 28.24)**	**0.004**	**1.08**	**2.94 (1.25, 6.92)**	**0.014**
Ethnicity						
Han	Ref	Ref	Ref	Ref	Ref	Ref
Minority	0.70	2.01 (0.74, 5.44)	0.169	**0.77**	**2.16 (1.03, 4.56)**	**0.043**
Marital status						
Married	Ref	Ref	Ref	Ref	Ref	Ref
Unmarried	**−1.09**	**0.34 (0.11, 1.00)**	**0.049**	**−1.14**	**0.32 (0.17, 0.61)**	**<0.001**
Education level						
Senior school or below	Ref	Ref	Ref	Ref	Ref	Ref
College	−0.36	0.70 (0.15, 3.19)	0.642	−0.69	0.50 (0.21, 1.19)	0.117
Undergrad or above	−0.02	0.98 (0.24, 4.01)	0.974	−0.03	0.98 (0.45, 2.09)	0.947
Body mass index						
Underweight	−0.18	0.83 (0.23, 3.03)	0.783	**0.89**	**2.43 (1.18, 5.00)**	**0.016**
Normal	Ref	Ref	Ref	Ref	Ref	Ref
Overweight	0.28	1.32 (0.58, 3.03)	0.510	**1.20**	**3.31 (1.76, 6.25)**	**<0.001**
Obese	0.88	2.41 (0.79, 7.38)	0.123	**1.51**	**4.53 (1.88, 10.92)**	**<0.001**
Occupation level						
Mainly mental	−0.79	0.46 (0.11, 1.90)	0.280	−0.67	0.51 (0.25, 1.03)	0.062
Mainly physical	**−1.00**	**0.37 (0.17, 0.82)**	**0.015**	−0.48	0.62 (0.28, 1.40)	0.248
Unemployed	Ref	Ref	Ref	Ref	Ref	Ref
Monthly family income						
≤5000	Ref	Ref	Ref	Ref	Ref	Ref
>5000	0.35	1.41 (0.53, 3.79)	0.495	0.49	1.63 (0.93, 2.86)	0.087
Menopausal status						
Premenopausal	Ref	Ref	Ref	Ref	Ref	Ref
Postmenopausal	**1.14**	**3.14 (1.14, 8.61)**	**0.026**	0.74	2.09 (0.96, 4.57)	0.065
Chronic constipation						
No	Ref	Ref	Ref	Ref	Ref	Ref
Yes	**1.73**	**5.66 (1.14, 28.15)**	**0.034**	**1.84**	**6.29 (2.51, 15.80)**	**<0.001**
Diabetes						
No	Ref	Ref	Ref	Ref	Ref	Ref
Yes	−1.12	0.33 (0.05, 2.03)	0.230	**1.35**	**3.87 (1.24, 12.07)**	**0.020**
Other gynaecological disease						
No	Ref	Ref	Ref	Ref	Ref	Ref
Yes	−0.62	0.54 (0.13, 2.20)	0.391	0.76	2.15 (0.98, 4.69)	0.056
High blood pressure						
No	Ref	Ref	Ref	Ref	Ref	Ref
Yes	0.89	2.43 (0.85, 7.00)	0.099	0.01	1.01 (0.40, 2.55)	0.978

Bold values denote statistical significance ($p < 0.05$).
*Binary logistic regression model
aOR, adjusted odds ratio; UI, urinary incontinence.

only a small proportion of Chinese rural citizens had consulted a healthcare provider for UI symptoms.[22 23] A lack of health literacy not only affects patients and their care providers, but also rural health providers who had insufficient knowledge of the impact of UI; therefore, inappropriate prevention and management strategies were undertaken.[24] Rural women may perceive occasional 'urine drops' as a natural process of ageing and prioritised other life-threatening conditions, such as cardiac vascular disease, which accounts for 46.74% mortality in rural areas.[25] UI, affecting quality of life but not life threatening, received less priority in rural communities. However, higher limitations in social and physical aspects due to incontinence in the rural population can lead to a loss of personal identity and more severe mental health deterioration, as social life with fewer boundaries is more important in rural daily life than in urban areas.[3 26]

In 2020, the rate of childlessness of women aged 49 and above reached 5.16% in China.[27] Considering those who chose to be lifelong nulliparous, this study revealed that multiple risk factors contribute to UI occurrence even if no pregnancy or childbirth happened. Our result is consistent with previous research showing that chronic constipation is detrimental to the development of UI. Poor living habits, such as the widespread use of the 'bearing down' toilet strategy, may contribute to increased abdominal pressure and chronically weak pelvic floor muscles.[28 29] It is globally agreeable that obesity with long-lasting increased abdominal pressure is a significant risk factor to UI, as multiple studies proved that weight loss is an effective strategy to improve UI symptoms.[30 31] Our study agreed that overweight or obese BMI is a risk factor; however, the results surprisingly showed that underweight BMI also increased the possibility of UI occurrence for Chinese nulliparous women. We speculated that underweight BMI is associated with loss or weakening of whole-body muscle mass and strength, which includes that of pelvic floor muscles. One previous research study showed that underweight BMI was significantly associated with an increased likelihood of sarcopenia, which is often diagnosed with lower hand grip strength to overall represent whole-body muscle mass and strength.[32] Zhang *et al* discovered that lower levels of hand grip strength are significantly associated with an increased prevalence and severity of SUI, suggesting that decreased muscle mass may correlate with UI development.[33] No significant association among the rural population can possibly be explained due to the smaller sample size in the rural subgroup.

The robust study design of the original nationwide cross-sectional study was the key strength of this research. It used a six-stage sampling strategy in six regions of China with a total of 56 460 women for a more accurate nationally representative population,[5] allowing this secondary analysis to be the first one showing UI prevalence in nulliparous women with the largest sample size. However, this study also has several limitations. First, it is a cross-sectional design, which cannot infer causality. Despite this, this study design is effective for providing a snapshot of UI prevalence in this population and offering a solid base for generating hypotheses that could be tested in future longitudinal studies. Second, women with severe mental dysfunction who could not complete the survey were not included in this study, which might lead to an underestimation of UI prevalence in this population. However, the exclusion was necessary to ensure the accuracy of responses, as the excluded population may have difficulty providing reliable information during the survey. Third, all information was derived from self-reported data, which may lead to recall and information bias. Even though we did not use an objective test to collect results, a standardised reliable questionnaire was chosen for its feasibility in a large-scale study.

CONCLUSION

In conclusion, even though low UI prevalence was reported for nulliparous Chinese women, action should be taken for this underserved population to enhance their awareness of UI symptoms and its negative life impact. Abnormal BMI, especially underweight status, was also found to be a risk factor for UI in nulliparous women. Although obesity-related UI has dominated clinical practice, the association between low BMI and UI deserves urgent clinical attention with progress in both clinical assessment and targeted intervention strategies. Further research could focus on investigating the mechanism underlying the association between underweight BMI and UI development.

Author affiliations
[1]Institute of Clinical Medicine, National Infrastructures for Translational Medicine, State Key Laboratory of Common Mechanism Research for Major Diseases, Peking Union Medical College Hospital, Chinese Academy of Medical Sciences and Peking Union Medical College, Beijing, China
[2]Department of Obstetrics and Gynecology, National Clinical Research Center for Obstetric & Gynecologic Diseases, Peking Union Medical College Hospital, Chinese Academy of Medical Sciences and Peking Union Medical College, Beijing, China
[3]Department of Gynecology, Gansu Provincial Maternity and Child-Care Hospital, Gansu Provincial Central Hospital, Lanzhou, Gansu, China
[4]Department of Gynecology, The Third Affiliated Hospital of Zhengzhou University, Zhengzhou, Henan, China
[5]Department of Gynecology, Women's Hospital, School of Medicine, Zhejiang University, Hangzhou, Zhejiang, China
[6]Department of Pelvic Floor Rehabilitation, Hubei Maternity and Childcare Hospital, Hubei Province Women and Children Hospital, Wuhan, Hubei, China
[7]Department of Gynecology, Nanjing First Hospital, Nanjing Medical University, Nanjing, Jiangsu, China
[8]Department of Gynecology, Guiyang Maternal and Child Health Care Hospital, Guiyang, Guizhou, China
[9]Beijing Miyun District Hospital, Beijing, China
[10]Department of Obstetrics and Gynecology, Women and Children's Hospital of Chongqing Medical University, Chongqing, China
[11]Department of Gynecology, Shijiazhuang Maternal and Child Health Hospital, Shijiazhuang, Hebei, China
[12]Maternal and Child Health Hospital of Beijing Dongcheng District, Beijing, China
[13]Department of Gynecology, People's Hospital of Xinjiang Uygur Autonomous Region, Urumqi, Xinjiang Uygur Autonomous Region, China
[14]Department of Gynecology, Shanxi Maternal and Child Health Hospital, Taiyuan, Shanxi, China
[15]Department of Gynecology, Guangdong Province Women and Children Hospital, Guangzhou, Guangdong, China

[16]Ministry of Women's Health, Harbin Maternal and Child Health Care and Family Planning Service Center, Harbin, Heilongjiang, China
[17]Department of Gynecology, Shenyang Women's and Children's Hospital, Shenyang, Liaoning, China
[18]Haidian District Maternal and Child Health Care Hospital, Beijing, China
[19]Department of Gynecology and Obstetrics, Maternal and Child Health Hospital of Yanqing District, Beijing, China
[20]Department of Gynecology and Obstetrics, Guangxi Academy of Medical Sciences, The People's Hospital of Guangxi Zhuang Autonomous Region, Nanning, Guangxi Zhuang Autonomous Region, China
[21]Department of OBGYN, Tufts University School of Medicine, Boston, Massachusetts, USA
[22]Department of Public Health, School of Population Medicine and Public Health, Chinese Academy of Medical Sciences & Peking Union Medical College, Beijing, China
[23]Department of Obstetrics and Gynecology, National Clinical Research Center for Obstetric & Gynecologic Diseases, State Key Laboratory of Common Mechanism Research for Major Diseases, Peking Union Medical College Hospital, Chinese Academy of Medical Sciences and Peking Union Medical College, Beijing, China

Acknowledgements We thank all participants in this study.

Contributors LZ and HP contributed to the conception and design of the study. QL, LW, HJ, LG, JX, TL, AL, LL, LZ, YL, LW, XL, XL, YF, JN, WZ, QL and RZ were responsible for the acquisition of data. HP, TL, JL and XZ performed the statistical analysis. HP and TL interpreted data and drafted the manuscript. LZ and AM critically revised the manuscript for important intellectual content. LZ and HP obtained funding and provided supervision and administrative, technical or material support for this work. All authors revised the manuscript and approved the final version before submission. LZ is the guarantor of this manuscript and affirms that this manuscript is an honest, accurate and transparent report of the study.

Funding This work was supported by the National Natural Science Foundation of China (Grant Number: 72104247), the National Key R&D Program of China (Grant Numbers: 2021YFC2701300, 2021YFC2701302, 2018YFC2002201, the National High Level Hospital Clinical Research Funding (Grant Number: 2022-PUMCH-A-023).

Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval This study involves human participants and was approved by the institutional review board of Peking Union Medical College Hospital (Number: S-K970). Participants gave informed consent to participate in the study before taking part.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request. The data from the present research that were used and analysed are accessible from the corresponding author upon reasonable request.

ORCID iDs
Lubin Liu http://orcid.org/0000-0002-1138-552X
Lan Zhu http://orcid.org/0000-0001-5753-5426

REFERENCES

1 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.
2 Gallego-Gómez C, Rodríguez-Gutiérrez E, Torres-Costoso A, *et al*. Urinary incontinence increases risk of postpartum depression: systematic review and meta-analysis. *Am J Obstet Gynecol* 2024;231:296–307.
3 Murukesu RR, Singh DKA, Shahar S. Urinary incontinence among urban and rural community dwelling older women: prevalence, risk factors and quality of life. *BMC Public Health* 2019;19:529.
4 Zhu L, Lang J, Liu C, *et al*. The epidemiological study of women with urinary incontinence and risk factors for stress urinary incontinence in China. *Menopause* 2009;16:831–6.
5 Zhu J, Pang H, Wang P, *et al*. Female urinary incontinence in China after 15 years' efforts: Results from large-scale nationwide surveys. *Sci Bull Sci Found Philipp* 2024;69:3272–82.
6 Ding QJ, Hesketh T. Family size, fertility preferences, and sex ratio in China in the era of the one child family policy: results from national family planning and reproductive health survey. *BMJ* 2006;333:371–3.
7 Almousa S, Bandin van Loon A. The prevalence of urinary incontinence in nulliparous adolescent and middle-aged women and the associated risk factors: A systematic review. *Maturitas* 2018;107:78–83.
8 Zhang L, De Brauw A, Rozelle S. China's rural labor market development and its gender implications. *China Economic Review* 2004;15:230–47.
9 Landefeld CS, Bowers BJ, Feld AD, *et al*. National Institutes of Health state-of-the-science conference statement: prevention of fecal and urinary incontinence in adults. *Ann Intern Med* 2008;148:449–58.
10 Huang L, Zhang S, Wu S, *et al*. The Chinese version of ICIQ: a useful tool in clinical practice and research on urinary incontinence. *Neurourol Urodyn* 2008;27:522–4.
11 Stones RW, Padmadas SS, Guo S, *et al*. Dyspareunia, urinary sensory symptoms, and incontinence among young Chinese women. *Arch Sex Behav* 2006;35:561–7.
12 Brown SJ, Donath S, MacArthur C, *et al*. Urinary incontinence in nulliparous women before and during pregnancy: prevalence, incidence, and associated risk factors. *Int Urogynecol J* 2010;21:193–202.
13 Hansen BB, Svare J, Viktrup L, *et al*. Urinary incontinence during pregnancy and 1 year after delivery in primiparous women compared with a control group of nulliparous women. *Neurourol Urodyn* 2012;31:475–80.
14 Da Roza T, Brandão S, Mascarenhas T, *et al*. Urinary Incontinence and Levels of Regular Physical Exercise in Young Women. *Int J Sports Med* 2015;36:776–80.
15 Eliasson K, Nordlander I, Mattsson E, *et al*. Prevalence of urinary leakage in nulliparous women with respect to physical activity and micturition habits. *Int Urogynecol J Pelvic Floor Dysfunct* 2004;15:149–53.
16 Zhang Y, Ding W, Dai X, *et al*. Burden of multiple high-risk factors in pregnancy before and after the universal two-child policy in Chinese women: An observational study. *J Glob Health* 2024;14:04134.
17 Wang L, Han C, Lv X, *et al*. Structural transition of parenthood among Chinese nulliparous couples with planned pregnancies, 2013-2019. *BMC Public Health* 2023;23:2412.
18 Kahveci B, Melekoglu R, Evruke IC, *et al*. The effect of advanced maternal age on perinatal outcomes in nulliparous singleton pregnancies. *BMC Pregnancy Childbirth* 2018;18:343.
19 Cattani L, Van Schoubroeck D, De Bruyn C, *et al*. Body image and pelvic floor dysfunction in pregnancy and postpartum: A prospective one-year follow-up cohort study. *BJOG* 2024;131:1420–9.
20 Swenson CW, Hendrickson WK, Allshouse AA, *et al*. Older maternal age at first vaginal delivery is associated with increased genital hiatus size at 1 year postpartum. *Am J Obstet Gynecol* 2024;230:e110–2.
21 Giles J, Lei X, Wang G, *et al*. One country, two systems: evidence on retirement patterns in China. *J Pension Econ Financ* 2023;22:188–210.
22 Zhang X, Dupre ME, Qiu L, *et al*. Urban-rural differences in the association between access to healthcare and health outcomes among older adults in China. *BMC Geriatr* 2017;17:151.
23 Luo Y, Zou P, Wang K, *et al*. Prevalence and Risk Factors of Urinary Incontinence Among Elderly Adults in Rural China: A Cross-Sectional Survey. *J Wound Ostomy Continence Nurs* 2022;49:78–86.
24 Yuan H, Williams BA. Knowledge of urinary incontinence among Chinese community nurses and community-dwelling older people. *Health Soc Care Community* 2010;18:82–90.

25 Hu S-S, The Writing Committee Of The Report On Cardiovascular Health And Diseases In China. Report on cardiovascular health and diseases in China 2021: an updated summary. *J Geriatr Cardiol* 2023;20:399–430.
26 Klein AJ, Eisenhauer C, Mollard E, *et al*. "The constant worry": Urinary incontinence self-management in rural women: A qualitative study. *Res Nurs Health* 2023;46:603–15.
27 Jiang Q, Zhang C, Zhuang Y, *et al*. Rising trend of childlessness in China: analysis of social and regional disparities with 2010 and 2020 census data. *BMJ Open* 2023;13:e070553.
28 Xue K, Palmer MH, Zhou F. Prevalence and associated factors of urinary incontinence in women living in China: a literature review. *BMC Urol* 2020;20:159.
29 Bardino M, Di Martino M, Ricci E, *et al*. Frequency and Determinants of Urinary Incontinence in Adolescent and Young Nulliparous Women. *J Pediatr Adolesc Gynecol* 2015;28:462–70.
30 Alsannan B, Alharmi J, Alrahal F, *et al*. Prevalence and Quality of Life among Overweight and Obese Women with Different Severity and Types of Urinary Incontinence. *Med Princ Pract* 2024;33:47–55.
31 Taastrøm K, Kjeldsen AC, Hjorth S, *et al*. Urinary Incontinence in Midlife According to Weight Changes Across and After Childbearing Years. *Int Urogynecol J* 2024;35:579–88.
32 Curtis M, Swan L, Fox R, *et al*. Associations between Body Mass Index and Probable Sarcopenia in Community-Dwelling Older Adults. *Nutrients* 2023;15:1505.
33 Zhang N, Mao W, Sun S, *et al*. Association between grip strength and stress urinary incontinence of NHANES 2011-2014. *BMC Womens Health* 2023;23:521.