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

Journal:	BMJ Open
Manuscript ID	bmjopen-2024-097807
Article Type:	Original research
Date Submitted by the Author:	10-Dec-2024
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Keywords:	Prevalence, Risk Factors, Urinary incontinences < UROLOGY, Body Mass Index
	SCHOLARONE <sup>™</sup> Manuscripts

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### **BMJ** Open

The Prevalence of Urinary Incontinence among Nulliparous Chinese Females

The prevalence of urinary incontinence among nulliparous females and its association with

underweight body mass index: a secondary analysis of a nationwide cross-sectional study in China Haiyu Pang<sup>1,a</sup>, Tangdi Lin<sup>2,a</sup>, Qing Liu<sup>3</sup>, Luwen Wang<sup>4</sup>, Hangmei Jin<sup>5</sup>, Liyan Gong<sup>6</sup>, Jingyan Xie<sup>7</sup>, Ting Lai<sup>8</sup>, Aiyang Li<sup>9</sup>, Lubin Liu<sup>10</sup>, Lifei Zhou<sup>11</sup>, Yanqiu Luan<sup>12</sup>, Lin Wang<sup>13</sup>, Xiaoli Li<sup>14</sup>, Xiping Luo<sup>15</sup>, Yingjie Fu<sup>16</sup>, Jumin Niu<sup>17</sup>, Wen Zhao<sup>18</sup>, Qiming Liu<sup>19</sup>, Renfeng Zhao<sup>20</sup>, Abraham N Morse<sup>21</sup>, Jingyi Liu<sup>22</sup>, Xue Zhang<sup>2</sup>, Lan Zhu<sup>23\*</sup> Affiliations <sup>1</sup>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 100730, China. <sup>2</sup>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 100730, China. <sup>3</sup>Department of Gynecology, Gansu Provincial Maternity and Child-Care Hospital, Gansu Provincial Central Hospital, Lanzhou 730050, China. <sup>4</sup>Department of Gynecology, The Third Affiliated Hospital of Zhengzhou University, Zhengzhou 450052, China. <sup>5</sup>Department of Gynecology, Women's Hospital, School of Medicine, Zhejiang University, Hangzhou 310006, China. For peer review only - http://bmjopen.bmj.com/site/about/quidelines.xhtml

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The Prevalence of Urinary Incontinence among Nulliparous Chinese Females

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The Prevalence of Urinary Incontinence among Nulliparous Chinese Females

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2 3 4	62	Abstract
5 6 7	63	Objectives: To estimate the prevalence of urinary incontinence (UI) and its subtypes among
8 9	64	nulliparous Chinese females with associated risk factors. The prevalence of UI among those
10 11 12	65	living in urban or rural communities was also analyzed with potential risk factors.
13 14	66	Design: Nationwide cross-sectional study
16 17 18	67	Setting: Seven geographic regions of China
19 20	68	Participants: The original study was conducted between October 2019 and December 2021.
21 22 23	69	Data on demographic characteristics, health status, and medical history were collected.
24 25	70	Nulliparous women who aged $\geq 20$ years old and were permanent resident were included in this
26 27	71	secondary analysis. Participants who had severe mental or physical disorders or were pregnant
28 29 30	72	were excluded.
31 32 33	73	Primary and secondary outcome measures: The primary outcome was the prevalence of UI,
34 35	74	whereas secondary outcome measures were odds ratios (OR) for risk factor analysis.
36 37 38	75	Results: A total of 6,244 nulliparous females meeting inclusion criteria were selected from the
39 40	76	original study. The prevalence of UI was 1.9% for nulliparous Chinese females, with stress,
41 42 42	77	urgency, and mixed UI being prevalent at 0.9%, 0.3% and 0.7%, respectively. The prevalence of
43 44 45	78	UI was 2.1% and 1.6% for urban and rural subgroups. Abnormal body mass index was
46 47	79	significantly associated with UI in nulliparous group (underweight, OR:1.88, 95% CI: 1.03-3.45,
48 49	80	<i>p</i> =0.041; overweight, OR: 2.26, 95% CI: 1.37-3.73, <i>p</i> =0.001; and obesity, OR: 3.64, 95% CI:
50 51 52	81	1.86-7.15, <i>p</i> <0.001) and subgroup in urban areas (underweight, OR:2.43, 95% CI: 1.18-5.00, <i>p</i>
53 54	82	=0.016; overweight, OR: 3.31, 95% CI: 1.76-6.25, <i>p</i> <0.001; and obesity, OR: 4.53, 95% CI:
55 56 57 58	83	1.88-10.92, $p < 0.001$ ); however, no significant association was found for those in rural areas.

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1		The Prevalence of Urinary Incontinence among Nulliparous Chinese Females
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- 3 4	84	Conclusion: UI among nulliparous females deserves greater public attention. Abnormal body
5 6 7	85	mass index, including underweight status, was found to be risk factor for urinary incontinence
7 8 9	86	among Chinese nulliparous females. Further research requires to investigate the mechanism
10 11	87	underlying the association between underweight status and UI.
12 13 14 15	88	Strength and limitations of this study
16 17	89	• The original nationwide cross-sectional study has a robust study design. It utilized a six-
18 19	90	stage sampling strategy in seven regions of China with a total of 56,460 females to ensure
20 21 22	91	an accurate representation of the national population.
23 24	92	• This is the first study with the largest sample size that shows the prevalence of UI in
25 26 27	93	nulliparous females and identified underweight body mass index as a potential risk factor.
28 29	94	• Despite its cross-sectional design, this study provides a snapshot of UI prevalence in
30 31 22	95	nulliparous women and offers a solid basis for hypotheses that can be tested in further
32 33 34	96	longitudinal studies.
35 36	97	• All information was self-reported, which may have resulted in recall bias and information
37 38 39	98	bias. Nonetheless, a standardized reliable questionnaire was chosen for its feasibility in a
40 41	99	large-scale study.
42 43	100	
44 45 46	101	
40 47 48	102	
49 50 51	103	
52 53	104	Word count: abstract 301 words; main text 2686 words.
54 55 56 57	105	Keywords: nulliparity, female urinary incontinence, prevalence, risk factors, underweight
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### The Prevalence of Urinary Incontinence among Nulliparous Chinese Females

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Introduction

107	Urinary incontinence (UI) is defined as any complaint of involuntary leakage of urine according
108	to the International Continence Society <sup>1</sup> . UI demonstrates strongly negative impact on female
109	quality of life through not only mental dysfunction, such as embarrassment, depression, and low
110	self-esteem, but also deteriorated physical ability, resulting in decreased recreational activity
111	time and social isolation <sup>2,3</sup> . UI prevalence in China was estimated to be 30.9% in 2006 and
112	decreased to 16% in 2021 with significant efforts being made to implement pelvic floor
113	rehabilitation in the past fifteen years <sup>4</sup> . In spite of this, it is estimated that over 90 million
114	women in China are still suffering from UI <sup>5</sup> . There are several well-known risk factors for UI,
115	including childbirth, aging, obesity, and chronic medical conditions <sup>7</sup> . Considerable attention was
116	paid to how childbirth affects female UI symptoms; however, it cannot be neglected that
117	nulliparous females can also experience UI episodes. Minimal research has reported the
118	prevalence of UI among nulliparous females. A systematic review published in 2017 found that
119	UI prevalence varied between 1% and 42.2% in nulliparous females worldwide 8, which
120	suggested that UI among nulliparous group is with great uncertainty and highlighted the urgent
121	need for public attention and better preventative strategies for this underserved population.
122	Due to significant delays in childbirth and the transition of childbirth preference of Chinese
123	couples in the past two decades $10$ the number of nulliparous females with greater ages also
124	significantly increased in rural China. Previous research noted that women from rural areas may
125	suffer from more UI episodes due to lower educational level <sup>11</sup> with less personal health
126	awareness $1^2$ . To our knowledge, there was also very limited published study reporting the
127	nrevalence of III as well as risk factors in rural nullinarous nonulation. Therefore, the objective
128	of this study is to estimate the prevalence of LII and its subtypes among pulliparous Chinese
120	or this study is to estimate the prevalence of or and its subtypes among numparous enhibitse

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1		The Prevalence of Urinary Incontinence among Nulliparous Chinese Females
2 3 4	129	females with associated risk factors. UI prevalence among those living in urban or rural
- 5 6	130	communities was also analyzed with potential risk factors.
7 8 9	131	Methods
10 11 12	132	Study design and participations
13 14 15	133	This current study is a secondary data analysis of nulliparous subgroup from a national cross-
16 17	134	sectional research project which was conducted between October 2019 and December 2021
18 19 20	135	using a six-stage sampling strategy <sup>5</sup> . Detailed description of the concepts, study design,
21 22	136	methods, and data collection for the original study has been published <sup>5</sup> . Inclusion criteria were
23 24 25	137	females aged $\geq$ 20 years old and permanent resident defined as living in their current residence
23 26 27	138	for 1 year or longer. For this secondary analysis, we only include nulliparous females from the
28 29	139	original research. Participants who had severe mental or physical disorders or were pregnant
30 31 22	140	were excluded in the study. The original study has been approved by Peking Union Medical
32 33 34	141	College Ethics Committee (No. S-K970) and conducted according to the Declaration of Helsinki.
35 36	142	All participants signed consent forms before data collection.
37 38 39 40	143	Exposures and outcomes
40 41 42	144	This study included participants' basic information, such as demographic characteristics, medical
43 44	145	history, and health behaviors. Demographic characteristics included age, urbanization level,
45 46 47	146	ethnicity, education level, marital status, occupational status, monthly family income, and
47 48 49	147	menopause status. Body mass index (BMI) was categorized as underweight (BMI <18.5 kg/m <sup>2</sup> ),
50 51	148	normal (18.5 kg/m <sup>2</sup> $\leq$ BMI $\leq$ 24.9 kg/m <sup>2</sup> ), overweight (25 kg/m <sup>2</sup> $\leq$ BMI $\leq$ 29.9 kg/m <sup>2</sup> ), and obese
52 53	149	(BMI $\geq$ 30 kg/m <sup>2</sup> ). Medical history include chronic constipation, diabetes, high blood pressure,
54 55 56 57 58	150	and the history of other gynecological disease (i.e. pelvic inflammatory disease, pelvic pain,

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### The Prevalence of Urinary Incontinence among Nulliparous Chinese Females

151	endometriosis, fibroids, gynecological malignant tumors, and pelvic organ prolapse). By using
152	six-stage sampling strategy, participants were then divided into rural and urban subgroups based
153	on their residence during data collection. The primary outcome was UI, which was defined as the
154	complaint of any involuntary leakage of urine <sup>13</sup> , and UI was categorized into stress UI (SUI),
155	urgency UI (UUI), mixed UI (MUI) and other UI according to Chinese version of the
156	International Conference on Incontinence Questionnaire UI Short Form (ICIQ-UI SF) in the
157	original study <sup>14</sup> . No nulliparous participant recruited was categorized into other UI subgroup;
158	thus, only SUI, MUI, and MUI were analyzed in this current study.

### 159 Statistical analysis

Number and percentage were used to describe categorical variables. Participants' baseline characteristics were compared using Chi-square test or Fisher's exact test of independence for categorical variables. Cochran-Armitage trend test was used to demonstrate linear trends for ordinal categorical variables. We utilized binary logistic regression model to obtain odds ratio (OR) and 95% confidence interval (CI) to detect risk factors of UI for nulliparous population and subgroups living in urban or rural areas. In addition, multinominal logistic regression was applied to estimate risk factors of UI subtypes, including SUI, UUI, and MUI, among nulliparous population. The reference category was the group of participants without UI. Both logistic regression models were adjusted for age, urbanization level, ethnicity, education level, marital status, occupational status, monthly family income, menopause status, BMI, and medical history. Statistical significance was set at p < 0.05 (2-tailed). All analyses were performed using SPSS, version 24.0 (IBM).

### 172 Patient and public involvement

onal status, monthly family income, menopause status, BMI, and medical history. ficance was set at *p* <0.05 (2-tailed). All analyses were performed using SPSS, BM). **blic involvement** For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

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

**Results** 

### **Demographic characteristics**

A total of 6,244 nulliparous females were selected from the cohort of 54,346 participants in the original study (Figure 1). Overall, 2,718 (43.5%) participants were from rural areas whereas 3,526 (56.5%) were from urban areas (Table 1). No significant differences were noted in consideration of BMI, menopausal status, and the medical history of coughing, diabetes and high blood pressure (p > 0.05) between 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 gynecological disease (*p*<0.001) (*Table 2*).

### The prevalence of urinary incontinence among nulliparous Chinese females and subgroups

The prevalence of UI was 1.9% among Chinese nulliparous females while that of SUI, UUI and MUI were 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 analyzed among BMI, age groups and menopause status. Nulliparous population and urban subgroup showed that normal BMI group had the lowest UI prevalence compared to underweight, overweight and obese subgroups, whereas a positive trend of UI prevalence was noted among BMI groups for rural subgroup (Figure 2). As nulliparous females became aging and postmenopausal, higher UI prevalence was shown (Figure S1). Urban subgroup demonstrated higher UI prevalence during

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The Prevalence of Urinary Incontinence among Nulliparous Chinese Females

195 premenopausal period but lower prevalence during postmenopausal period than rural subgroup196 (*Figure S2*).

### 197 The risk factors of urinary incontinence among nulliparous Chinese females

*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 (OR: 0.31, 95% CI: 0.18-0.54) and employed status (mentally employed, OR: 0.53, 95% CI: 0.29-0.98; physically employed, OR: 0.55, 95% CI: 0.31-0.96) were both protective factors for nulliparous females. Nulliparous women with chronic constipation had the strongest association with UI occurrence (OR: 5.75, 95% CI:2.59-12.74), followed by aging 30-39 years (OR: 4.16, 95% CI: 2.05-8.45), having postmenopausal status (OR: 2.22, 95% CI: 1.22-4.05), and belonging to an ethical minority (OR: 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 in regardless of under-or overweight status (underweight, OR:1.88, 95% CI: 1.03-3.45; overweight, OR: 2.26, 95% CI: 1.37-3.73; and obesity, OR: 3.64, 95% CI: 1.86-7.15). In multinominal logistic regression, nulliparous females who have chronic coughing (OR: 7.11, 95% CI: 2.80-18.01), older age (≥ 40 years, OR: 5.31, 95% CI: 2.22-12.70), urban residence (OR: 2.27, 95% CI: 1.16-4.46), and belonging to an ethical minority (OR: 3.05, 95% CI: 1.52-6.15) are more likely to report SUI. Nulliparous females who are overweight (OR: 2.54, 95% CI: 1.29-4.98) or obese (OR: 2.97, 95% CI:1.12-7.89) demonstrated significant odds of developing SUI while obesity is a statistically significant risk factor for UUI (OR: 4.42, 95% CI: 1.01-19.37) and MUI (OR: 4.19, 95% CI: 1.49-11.78). Nulliparous females with a medical history of other gynecological disease found to have increased risk of developing UUI (OR: 6.23, 95% CI: 1.86-

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### The risk factors of urinary incontinence among nulliparous Chinese females 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 females residing in urban areas (underweight, OR:2.43, 95% CI: 1.18-5.00; overweight, OR: 3.31, 95% CI: 1.76-6.25; and obesity, OR: 4.53, 95% CI: 1.88-10.92); 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 females (rural, OR:0.34, 95% CI:0.11-1.00; urban, OR:0.32, 95% CI: 0.17-0.61) while chronic constipation demonstrates strongest association with UI occurrence (rural, OR:5.66, 95% CI:1.14-28.15; urban, OR:6.29, 95% CI: 2.51-15.80). In rural subgroup, participants aged over 30 years showed increased odds of developing UI (age 30-39 years, OR:4.29, 95% CI: 1.17-15.79; age  $\geq$  40 years, OR: 7.28, 95% CI: 1.87-28.24); however, only age greater than 40 years old (age  $\geq$  40 years, OR: 2.94, 95% CI: 1.25-6.92) is 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 of nulliparous female with the largest sample size through a nationwide study. This current study revealed that the prevalence of UI among nulliparous Chinese females was 1.9%, which is slightly higher compared to a previous study (1%) conducted in 2003 within a smaller

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### The Prevalence of Urinary Incontinence among Nulliparous Chinese Females

2		
2 3 4	239	Chinese nulliparous population <sup>15</sup> . The prevalence of UI found in this current study among
5 6	240	nulliparous females living in urban areas (2.1%) was reported to be higher than that in rural areas
/ 8 9	241	(1.6%). It is agreeable in this current study that chronic constipation and overweight status were
) 10 11	242	risk factors for UI development; however, underweight status was for the first time also
12 13	243	identified as an influencing factor for UI development among nulliparous population.
14 15 16	244	A systematic review including multiple cohort or cross-sectional studies investigated UI
17 18 10	245	prevalence among nulliparous females in different countries, such as the 10.8% in Australia <sup>16</sup> ,
19 20 21	246	14% in Denmark <sup>17</sup> , 19.9% in Portugal <sup>18</sup> , and 38.6% in Sweden <sup>19</sup> , which were all higher than
22 23	247	results in this current study. One possible explanation for the ratio differences could lie in
24 25	248	different study designs, including data collection method and use of UI definition. The study
26 27 28	249	design included a six-stage sampling strategy to accurately represent the national population.
29 30	250	Additionally, we used an internationally accepted definition of UI, as well as a reliable
31 32	251	international standardized questionnaire to measure outcomes. The results showed that SUI is the
33 34 35	252	most prevalent subtype among Chinese nulliparous females, which was consistent with several
36 37	253	previous high-quality research conducted in other countries <sup>17</sup> . Despite low prevalence compared
38 39	254	to parous females, UI among nulliparous women remains an important health issue requiring
40 41 42	255	increased public attention. A shift in the marriage conception and fertility preference from
42 43 44	256	Chinese females has been noted with the national postponement of parenthood, such as late
45 46	257	marriage, long marriage and conception interval, and advanced pregnancy <sup>20</sup> . Nulliparous
47 48 40	258	females with advanced age may present with UI symptoms before pregnancy, which can result in
-+9 50 51	259	more severe adverse outcomes and postpartum pelvic floor dysfunction <sup>21–24</sup> . Thus, advocating
52 53	260	for pelvic floor checks before pregnancy for nulliparous population could assist in preventing the
54 55 56	261	detrimental effects of UI after childbirth with increased age.

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Our study is also the first one to report UI prevalence of nulliparous Chinese females living in urban and rural areas with a rate of 2.1% and 1.6%, respectively. A recent study provided supporting evidence that urban females who demonstrated better knowledge towards UI and its negative life impact, were more likely to seek medical care <sup>5</sup>. In contrast, rural females with comparable lower education level are ignorant with less awareness of UI as a treatable medical condition. This speculation could be further supported by this current study as 83.7% of UI females from rural areas had only senior school or below educational background. Rural females also would be more likely to perceive themselves with decent well-being despite occasional "urine drops" as a natural process of aging. In this current study, nearly 70% of UI females in rural areas aged equal to or greater than 40 years and 55.8% of them were currently in postmenopausal status. Social life with less boundaries plays a more important role during rural daily life, for instance, in-person socialization with neighbors, friends and relatives, which are less valued within urban population <sup>3,25</sup>. Higher limitations in role, social and physical aspects of daily living due to incontinence for rural population may result in a loss of personal identity with more severe deterioration in their mental health. In 2020, the rate of childlessness of females aged 49 and above has reached 5.16% in China  $^{26}$ . 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 "bearing down" toilet
strategy, may contribute to increased abdominal pressure and chronically weak pelvic floor
muscles <sup>6,27</sup>. 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

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### The Prevalence of Urinary Incontinence among Nulliparous Chinese Females

2		
3 4	285	strategy to improve UI symptoms <sup>28,29</sup> . Our study agreed that overweight or obese BMI are risk
5 6	286	factors; however, the results surprisingly showed that underweight BMI also increased the
7 8 0	287	possibility of UI occurrence for Chinese nulliparous females. We speculated that underweight
9 10 11	288	BMI is associated with loss or weakening of whole-body muscle mass and strength, which
12 13	289	includes that of pelvic floor muscles. One previous research showed that underweight BMI was
14 15	290	significantly associated with an increased likelihood of sarcopenia, which is often diagnosed
16 17 10	291	with lower hand grip strength to overall represent whole-body muscle mass and strength <sup>30</sup> .
18 19 20	292	Zhang et al. discovered that lower level of hand grip strength is significantly associated with an
21 22	293	increased prevalence and severity of SUI, suggesting that decreased muscle mass may correlate
23 24	294	with UI development <sup>31</sup> . No significant association among rural population can be possibly
25 26 27	295	explained due to the smaller sample size in rural subgroup.
28 29 30	296	The robust study design of the original nationwide cross-sectional study was the key strength of
31 32	297	this research. It utilized a six-stage sampling strategy in six regions of China with a total of
33 34	298	56,460 females for a more accurate nationally representative population <sup>5</sup> , allowing this
35 36 27	299	secondary analysis to be the first one showing UI prevalence in nulliparous females with the
37 38 39	300	largest sample size. However, this study also has several limitations. First, it is a cross-sectional
40 41	301	design, which cannot infer causality. Despite this, this study design is effective for providing a
42 43	302	snapshot of UI prevalence in this population and offering a solid base for generating hypotheses
44 45 46	303	that could be tested in future longitudinal studies. Second, females with severe mental
40 47 48	304	dysfunction who could not complete the survey were not included in this study, which might lead
49 50	305	to an underestimation of UI prevalence of this population. However, the exclusion was necessary
51 52	306	to ensure the accuracy of responses as the excluded population may have difficulty providing
53 54 55 56	307	reliable information during the survey. Third, all information was derived self-reported, which

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1		The Prevalence of Urinary Incontinence among Nulliparous Chinese Females
2 3 4	308	may lead to recall and information bias. Even though we did not use an objective test to collect
5 6	309	results, a standardized reliable questionnaire was chosen for its feasibility in a large-scale study.
7 8 9 10	310	Conclusion
10 11 12	311	In conclusion, even though low UI prevalence was reported for nulliparous Chinese females,
12 13 14	312	action should be made for this underserved population to enhance their awareness of UI
15 16	313	symptoms and its negative life impact. Abnormal BMI, especially underweight status, was also
17 18	314	found as a risk factor for UI in nulliparous females. Further research could focus on investigating
19 20 21	315	the mechanism underlying the association between underweight BMI and UI development.
22 23 24	316	Funding statement
25 26	317	This work was supported by the National Key R&D Program of China (Grant Numbers:
27 28 29	318	2021YFC2701300, 2021YFC2701302, 2018YFC2002201, the National Natural Science
30 31 32 33	319	Foundation of China (Grant Number: 72104247), the National High Level Hospital Clinical
	320	Research Funding (Grant Number: 2022-PUMCH-A-023).
35 36 27	321	Competing interest statement
37 38 39	322	The authors declare that they have no known competing financial interests or personal
40 41 42	323	relationships that could have appeared to influence the work reported in this paper.
43 44 45	324	Authorship contribution statement
46 47 48	325	LZ and HP contributed to the conception and design of the study. QL, LW, HJ, LG, JX, TL, AL,
49 50	326	LL, LZ, YW, LW XL, XL, YF, JN, WZ, QL, and RZ were responsible for the acquisition of
51 52	327	data. HP, TL, JL, and XZ performed the statistical analysis. HP and TL interpreted data and
53 54 55	328	drafted the manuscript. LZ and AM critically revised the manuscript for important intellectual
56 57 58		
59 60		For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

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content. LZ and HP obtained funding, provided supervision and administrative, technical, or material support for this work. All authors revised the manuscript and approved the final version before submission. Acknowledgement We thank all participants in this study. **Details of Ethics Approval** The study protocol was approved by the institutional review board of Peking Union Medical College Hospital (Number: S-K970). The study protocol was approved and written informed consent was obtained from each participant before data collection. Data availability statement Data are available upon reasonable request. The data from the present research that were used and analyzed are accessible from the corresponding author upon reasonable request. Reference 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(2):167-178. doi:10.1002/nau.10052 Gallego-Gómez C, Rodríguez-Gutiérrez E, Torres-Costoso A, et al. Urinary incontinence 2. increases risk of postpartum depression: systematic review and meta-analysis. Am J Obstet Gynecol. 2024;231(3):296-307.e11. doi:10.1016/j.ajog.2024.02.307 

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### The Prevalence of Urinary Incontinence among Nulliparous Chinese Females

Table 1: Demographic	characteristics o	of the s	sample	population
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Variables	Total	Rural (%)	Urban (%)	<i>P</i> Value
Total Number	6244	2718 (43.5)	3526 (56 5)	1 Vulue
Age group vrs	0211	2/10(15.5)	5520 (50.5)	<0.001
20_29	4731(75.8)	22/1(82.5)	2490(70.6)	-0-001
20-29	4731(73.8) 820(13.3)	2241(02.5) 240(8.8)	2490(70.0) 589(16 7)	
>-40	629(13.3)	240(0.0) 227(9.7)	339(10.7)	
Z=40	004(11.0)	237(0.7)	447(12.7)	<0.001
Linnety	5501(00.1)	2242(82.5)	2250(02.4)	~0.001
Minority	742(11.0)	2242(02.3)	2239(92.4) 267(7.6)	
Education	/43(11.9)	4/0(17.3)	207(7.0)	<0.001
Education Service askesslage balance	1001(21.0)	115( (42.5)	925 (22.7)	~0.001
Senior school or below	1991(31.9)	1150 (42.5)	833 (23.7)	
College	1/82(28.5)	/48 (27.5)	1034 (29.3)	
Undergrad or above	24/1(39.6)	814 (29.9)	1657 (47.0)	-0.001
Marital Status	1011(00.5)	=00 (0 ( 0)	(100(00 1)	<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				<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	0102()0.0)	2000(00.1)	0111(0011)	0.573
Yes	36(0,6)	14(0.6)	22(0.5)	0.070
No	6208(99.4)	2704(99.5)	3504(99.4)	
Other Gynecological Disease	0200()).1)	2701(77.5)	5501(55.1)	<0.001
Vec	205(3.3)	51(1.9)	154(4.4)	.0.001
No	6039(96 7)	2667(98.1)	3372(95.6)	
High Blood Pressure	0037(70.7)	2007(90.1)	5512(95.0)	0.125
Voc	05(1.5)	24(1,2)	61(17)	0.125
r es	93(1.3) 6140(08 5)	34(1.3)	01(1.7) 2465(08.2)	
INO	0149(98.5)	2684(98.7)	<u> </u>	

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

### The Prevalence of Urinary Incontinence among Nulliparous Chinese Females

Variables	Urban	n (%)	Rural n (%)		
	UI 74(2.1)	P value	UI 43(1.6)	P value	
Age group		<0.001ª		<0.001ª	
20-29	20(27.0)		8(18.6)		
30-39	9(12.2)		5(11.6)		
<u>≥40</u>	45(60.8)		30(69.8)		
Ethnicity		$0.025^{b}$		$0.847^{b}$	
Han	63(85.1)		36(83.7)		
Minority	11(14.9)		7(16.3)		
Education Level		<0.001 a		<0.001ª	
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 <sup>b</sup>		<0.001 <sup>b</sup>	
Married	55(74.3)		35(81.4)		
Unmarried	19(25.7)		8(18.6)		
Body Mass Index		<0.001 ª		<0.001ª	
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		<0.001 <sup>b</sup>		0.002 <sup>b</sup>	
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		$0.323^{b}$		$0.440^{b}$	
≤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 <sup>c</sup>	
Yes	9(12.2)		3(7.0)		
No	65(87.8)		40(93.0)		
Diabetes		<0.001°		0.020 <sup>c</sup>	
Yes	8(10.8)		2(4.7)		
No	66(89.2)		41(95.3)		
Other Gynecological Disease		0.001c		0.008c	
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)		

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

### The Prevalence of Urinary Incontinence among Nulliparous Chinese Females

Variable	UI (%)	SUI (%)	UUI (%)	MUI (%)
Total	117(1.9)	58(0.9)	18(0.3)	41(0.7)
Age group, yrs			. ,	· · ·
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	<0.001ª	<0.001ª	<0.001 á	<0.001 á
Urbanization 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 <sup>b</sup> (	0.001 <sup>b</sup> ´	0.938 <i>6</i>	0.1895
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 <sup>b</sup>	0.038 <sup>b</sup>	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)
<i>P</i> for trend	<0.001 *	0.004 ª	<0.001 ª	<0.001 ª
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 <sup>b</sup>	<0.001 b
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)
<i>P</i> for trend	<0.001*	<0.001ª	<0.001 ª	<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 <sup>b</sup>
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	36(30.8) 0.515 <sup>b</sup>	23(39.7) <b>0.049</b> <sup>b</sup>	6(33.3) 0.620 <sup>b</sup>	7(17.1) <i>0.115⁵</i>
P for difference Menopausal Status	36(30.8) 0.515 <sup>b</sup>	23(39.7) 0.049 <sup>b</sup>	6(33.3) 0.620 <sup>b</sup>	7(17.1) 0.115 <sup>b</sup>
P for difference Menopausal Status Premenopausal	36(30.8) 0.515 <sup>b</sup>	23(39.7) 0.049 <sup>b</sup> 39(67.2)	6(33.3) 0.620 <sup>b</sup> 9(50.0)	7(17.1) 0.115 <sup>b</sup> 13(31.7)
P for difference Menopausal Status Premenopausal Postmenopausal	61(52.1) 56(47.9)	23(39.7) 0.049 <sup>b</sup> 39(67.2) 19(32.8)	6(33.3) 0.620 <sup>b</sup> 9(50.0) 9(50.0)	7(17.1) 0.115 <sup>b</sup> 13(31.7) 28(68.3)
P for difference Menopausal Status Premenopausal Postmenopausal P for difference	61(00.2) 36(30.8) 0.515 <sup>b</sup> 61(52.1) 56(47.9) < <b>0.001</b> <sup>b</sup>	23(39.7) 0.049 <sup>b</sup> 39(67.2) 19(32.8) <0.001 <sup>c</sup>	6(33.3) 0.620 <sup>b</sup> 9(50.0) 9(50.0) < <b>0.001</b> <sup>c</sup>	7(17.1) 0.115 <sup>b</sup> 13(31.7) 28(68.3) < <b>0.001</b> <sup>c</sup>
P for difference Menopausal Status Premenopausal Postmenopausal P for difference Chronic Constipation	61(00.2) 36(30.8) 0.515 <sup>b</sup> 61(52.1) 56(47.9) <0.001 <sup>b</sup>	23(39.7) 0.049 <sup>b</sup> 39(67.2) 19(32.8) <0.001°	6(33.3) 0.620 <sup>b</sup> 9(50.0) 9(50.0) < <b>0.001</b> <sup>c</sup>	7(17.1) 0.115 <sup>b</sup> 13(31.7) 28(68.3) < <b>0.001</b> <sup>c</sup>
P for difference Menopausal Status Premenopausal Postmenopausal P for difference Chronic Constipation Yes	61(00.2) 36(30.8) 0.515 <sup>b</sup> 61(52.1) 56(47.9) <0.001 <sup>b</sup> 12(10.3)	23(39.7) 0.049 <sup>b</sup> 39(67.2) 19(32.8) <0.001 <sup>c</sup> 7(12.1)	6(33.3) 0.620 <sup>b</sup> 9(50.0) 9(50.0) <0.001 <sup>c</sup>	7(17.1) 0.115 <sup>b</sup> 13(31.7) 28(68.3) < <b>0.001</b> <sup>c</sup> 4(9.8)
P for difference Menopausal Status Premenopausal Postmenopausal P for difference Chronic Constipation Yes No	61(00.2) 36(30.8) 0.515 <sup>b</sup> 61(52.1) 56(47.9) <0.001 <sup>b</sup> 12(10.3) 105(89.7)	23(39.7) 0.049 <sup>b</sup> 39(67.2) 19(32.8) <0.001 <sup>c</sup> 7(12.1) 51(87.9)	6(33.3) 0.620 <sup>b</sup> 9(50.0) 9(50.0) <0.001 <sup>c</sup> 1(5.6) 17(94.4)	7(17.1) 0.115 <sup>b</sup> 13(31.7) 28(68.3) < <b>0.001</b> <sup>c</sup> 4(9.8) 37(90.2)
P for difference Menopausal Status Premenopausal Postmenopausal P for difference Chronic Constipation Yes No P for difference	36(30.8) 0.515 <sup>b</sup> 61(52.1) 56(47.9) <0.001 <sup>b</sup> 12(10.3) 105(89.7) <0.001 <sup>c</sup>	23(39.7) 0.049 <sup>b</sup> 39(67.2) 19(32.8) <0.001° 7(12.1) 51(87.9) <0.001°	6(33.3) 0.620 <sup>b</sup> 9(50.0) 9(50.0) <0.001 <sup>c</sup> 1(5.6) 17(94.4) 0.235 <sup>c</sup>	7(17.1) 0.115 <sup>b</sup> 13(31.7) 28(68.3) <0.001 <sup>c</sup> 4(9.8) 37(90.2) 0.003 <sup>c</sup>
P for difference         Menopausal Status         Premenopausal         Postmenopausal         P for difference         Chronic Constipation         Yes         No         P for difference         Diabetes	36(30.8) 0.515 <sup>b</sup> 61(52.1) 56(47.9) <0.001 <sup>b</sup> 12(10.3) 105(89.7) <0.001 <sup>c</sup>	23(39.7) 0.049 <sup>b</sup> 39(67.2) 19(32.8) <0.001 <sup>c</sup> 7(12.1) 51(87.9) <0.001 <sup>c</sup>	6(33.3) 0.620 <sup>b</sup> 9(50.0) 9(50.0) <b>&lt;0.001</b> <sup>c</sup> 1(5.6) 17(94.4) 0.235 <sup>c</sup>	7(17.1) 0.115 <sup>b</sup> 13(31.7) 28(68.3) <0.001 <sup>c</sup> 4(9.8) 37(90.2) 0.003 <sup>c</sup>
P for difference         Menopausal Status         Premenopausal         Postmenopausal         P for difference         Chronic Constipation         Yes         No         P for difference         Diabetes         Yes	36(30.8) 0.515 <sup>b</sup> 61(52.1) 56(47.9) <0.001 <sup>b</sup> 12(10.3) 105(89.7) <0.001 <sup>c</sup> 10(8.5)	23(39.7) 0.049 <sup>b</sup> 39(67.2) 19(32.8) <0.001 <sup>c</sup> 7(12.1) 51(87.9) <0.001 <sup>c</sup> 5(8.6)	6(33.3) 0.620 <sup>b</sup> 9(50.0) 9(50.0) <b>&lt;0.001</b> <sup>c</sup> 1(5.6) 17(94.4) 0.235 <sup>c</sup> 2(11.1)	7(17.1) 0.115 <sup>b</sup> 13(31.7) 28(68.3) <0.001 <sup>c</sup> 4(9.8) 37(90.2) 0.003 <sup>c</sup> 3(7.3)
P for difference         Menopausal Status         Premenopausal         Postmenopausal         P for difference         Chronic Constipation         Yes         No         P for difference         Diabetes         Yes         No	36(30.8) 36(30.8) 0.515 <sup>b</sup> 61(52.1) 56(47.9) <0.001 <sup>b</sup> 12(10.3) 105(89.7) <0.001 <sup>c</sup> 10(8.5) 107(91.5)	23(39.7) 0.049 <sup>b</sup> 39(67.2) 19(32.8) <0.001 <sup>c</sup> 7(12.1) 51(87.9) <0.001 <sup>c</sup> 5(8.6) 53(91.4)	6(33.3) 0.620 <sup>b</sup> 9(50.0) 9(50.0) <b>&lt;0.001</b> <sup>c</sup> 1(5.6) 17(94.4) 0.235 <sup>c</sup> 2(11.1) 16(88.9)	7(17.1) 0.115 <sup>b</sup> 13(31.7) 28(68.3) <0.001 <sup>c</sup> 4(9.8) 37(90.2) 0.003 <sup>c</sup> 3(7.3) 38(92.7)
P for difference         Menopausal Status         Premenopausal         Postmenopausal         P for difference         Chronic Constipation         Yes         No         P for difference         Diabetes         Yes         No         P for difference         Diabetes         Yes         No         P for difference	36(30.8) 0.515 <sup>b</sup> 61(52.1) 56(47.9) <0.001 <sup>b</sup> 12(10.3) 105(89.7) <0.001 <sup>c</sup> 10(8.5) 107(91.5) <0.001 <sup>c</sup> 	23(39.7) 0.049 <sup>b</sup> 39(67.2) 19(32.8) <0.001 <sup>c</sup> 7(12.1) 51(87.9) <0.001 <sup>c</sup> 5(8.6) 53(91.4) <0.001 <sup>c</sup>	6(33.3) 0.620 <sup>b</sup> 9(50.0) 9(50.0) 9(50.0) <b>0.001</b> <sup>c</sup> 1(5.6) 17(94.4) 0.235 <sup>c</sup> 2(11.1) 16(88.9) <b>0.005</b> <sup>c</sup>	7(17.1) 0.115 <sup>b</sup> 13(31.7) 28(68.3) <0.001 <sup>c</sup> 4(9.8) 37(90.2) 0.003 <sup>c</sup> 3(7.3) 38(92.7) 0.002 <sup>c</sup>
P for difference         Menopausal Status         Premenopausal         Postmenopausal         P for difference         Chronic Constipation         Yes         No         P for difference         Diabetes         Yes         No         P for difference         Diabetes         Yes         No         P for difference         Other Gynecological Disease	36(30.8)         36(30.8)         0.515 <sup>b</sup> 61(52.1)         56(47.9)         <0.001 <sup>b</sup> 12(10.3)         105(89.7)         <0.001 <sup>c</sup> 10(8.5)         107(91.5)         <0.001 <sup>c</sup>	23(39.7) 0.049 <sup>b</sup> 39(67.2) 19(32.8) <0.001 <sup>c</sup> 7(12.1) 51(87.9) <0.001 <sup>c</sup> 5(8.6) 53(91.4) <0.001 <sup>c</sup>	6(33.3) 0.620 <sup>b</sup> 9(50.0) 9(50.0) <b>0.001</b> <sup>c</sup> 1(5.6) 17(94.4) 0.235 <sup>c</sup> 2(11.1) 16(88.9) 0.005 <sup>c</sup>	7(17.1) 0.115 <sup>b</sup> 13(31.7) 28(68.3) <0.001 <sup>c</sup> 4(9.8) 37(90.2) 0.003 <sup>c</sup> 3(7.3) 38(92.7) 0.002 <sup>c</sup>
P for difference         Menopausal Status         Premenopausal         Postmenopausal         P for difference         Chronic Constipation         Yes         No         P for difference         Diabetes         Yes         No         P for difference         Other Gynecological Disease         Yes	36(30.8)         0.515 <sup>b</sup> 61(52.1)         56(47.9)         <0.001 <sup>b</sup> 12(10.3)         105(89.7)         <0.001 <sup>c</sup> 10(8.5)         107(91.5)         <0.001 <sup>c</sup> 14(12.0)	23(39.7) 0.049 <sup>b</sup> 39(67.2) 19(32.8) <0.001 <sup>c</sup> 7(12.1) 51(87.9) <0.001 <sup>c</sup> 5(8.6) 53(91.4) <0.001 <sup>c</sup> 6(10.3)	6(33.3) 0.620 <sup>b</sup> 9(50.0) 9(50.0) 9(50.0) <b>0.001</b> <sup>c</sup> 1(5.6) 17(94.4) 0.235 <sup>c</sup> 2(11.1) 16(88.9) 0.005 <sup>c</sup> 5(27.8)	7(17.1) 0.115 <sup>b</sup> 13(31.7) 28(68.3) <0.001 <sup>c</sup> 4(9.8) 37(90.2) 0.003 <sup>c</sup> 3(7.3) 38(92.7) 0.002 <sup>c</sup> 3(7.3)
P for difference         Menopausal Status         Premenopausal         Postmenopausal         P for difference         Chronic Constipation         Yes         No         P for difference         Diabetes         Yes         No         P for difference         Other Gynecological Disease         Yes         No         No         P for difference	36(30.8)         36(30.8)         0.515 <sup>b</sup> 61(52.1)         56(47.9)         <0.001 <sup>b</sup> 12(10.3)         105(89.7)         <0.001 <sup>c</sup> 10(8.5)         107(91.5)         <0.001 <sup>c</sup> 14(12.0)         103(88.0)	23(39.7) 0.049 <sup>b</sup> 39(67.2) 19(32.8) <0.001 <sup>c</sup> 7(12.1) 51(87.9) <0.001 <sup>c</sup> 5(8.6) 53(91.4) <0.001 <sup>c</sup> 6(10.3) 52(89.7)	6(33.3) 0.620 <sup>b</sup> 9(50.0) 9(50.0) <0.001 <sup>c</sup> 1(5.6) 17(94.4) 0.235 <sup>c</sup> 2(11.1) 16(88.9) 0.005 <sup>c</sup> 5(27.8) 13(72.2)	7(17.1) 0.115 <sup>b</sup> 13(31.7) 28(68.3) <0.001 <sup>c</sup> 4(9.8) 37(90.2) 0.003 <sup>c</sup> 3(7.3) 38(92.7) 0.002 <sup>c</sup> 3(7.3) 38(92.7)
P for difference         Menopausal Status         Premenopausal         Postmenopausal         P for difference         Chronic Constipation         Yes         No         P for difference         Diabetes         Yes         No         P for difference         Other Gynecological Disease         No         P for difference	36(30.8) 0.515 <sup>b</sup> 61(52.1) 56(47.9) <0.001 <sup>b</sup> 12(10.3) 105(89.7) <0.001 <sup>c</sup> 10(8.5) 107(91.5) <0.001 <sup>c</sup> 14(12.0) 103(88.0) <0.001 <sup>c</sup>	23(39.7) 0.049 <sup>b</sup> 39(67.2) 19(32.8) <0.001 <sup>c</sup> 7(12.1) 51(87.9) <0.001 <sup>c</sup> 5(8.6) 53(91.4) <0.001 <sup>c</sup> 6(10.3) 52(89.7) 0.011 <sup>c</sup>	6(33.3) 0.620 <sup>b</sup> 9(50.0) 9(50.0) <0.001 <sup>c</sup> 1(5.6) 17(94.4) 0.235 <sup>c</sup> 2(11.1) 16(88.9) 0.005 <sup>c</sup> 5(27.8) 13(72.2) <0.001 <sup>c</sup>	7(17.1) 0.115 <sup>b</sup> 13(31.7) 28(68.3) <0.001 <sup>c</sup> 4(9.8) 37(90.2) 0.003 <sup>c</sup> 3(7.3) 38(92.7) 0.002 <sup>c</sup> 3(7.3) 38(92.7) 0.150 <sup>c</sup>
P for difference         Menopausal Status         Premenopausal         Postmenopausal         P for difference         Chronic Constipation         Yes         No         P for difference         Diabetes         Yes         No         P for difference         Other Gynecological Disease         Yes         No         P for difference	36(30.8) 36(30.8) 0.515 <sup>b</sup> 61(52.1) 56(47.9) <0.001 <sup>b</sup> 12(10.3) 105(89.7) <0.001 <sup>c</sup> 10(8.5) 107(91.5) <0.001 <sup>c</sup> 14(12.0) 103(88.0) <0.001 <sup>c</sup>	23(39.7) 0.049 <sup>b</sup> 39(67.2) 19(32.8) <0.001 <sup>c</sup> 7(12.1) 51(87.9) <0.001 <sup>c</sup> 5(8.6) 53(91.4) <0.001 <sup>c</sup> 6(10.3) 52(89.7) 0.011 <sup>c</sup>	6(33.3) 0.620 <sup>b</sup> 9(50.0) 9(50.0) <0.001 <sup>c</sup> 1(5.6) 17(94.4) 0.235 <sup>c</sup> 2(11.1) 16(88.9) 0.005 <sup>c</sup> 5(27.8) 13(72.2) <0.001 <sup>c</sup>	7(17.1) 0.115 <sup>b</sup> 13(31.7) 28(68.3) <0.001 <sup>c</sup> 4(9.8) 37(90.2) 0.003 <sup>c</sup> 3(7.3) 38(92.7) 0.002 <sup>c</sup> 3(7.3) 38(92.7) 0.150 <sup>c</sup>
P for difference         Menopausal Status         Premenopausal         Postmenopausal         P for difference         Chronic Constipation         Yes         No         P for difference         Diabetes         Yes         No         P for difference         Other Gynecological Disease         Yes         No         P for difference         High Blood Pressure         Yes	36(30.8) 36(30.8) 0.515 <sup>b</sup> 61(52.1) 56(47.9) <0.001 <sup>b</sup> 12(10.3) 105(89.7) <0.001 <sup>c</sup> 10(8.5) 107(91.5) <0.001 <sup>c</sup> 14(12.0) 103(88.0) <0.001 <sup>c</sup> 20(17.1)	23(39.7) 0.049 <sup>b</sup> 39(67.2) 19(32.8) <0.001 <sup>c</sup> 7(12.1) 51(87.9) <0.001 <sup>c</sup> 5(8.6) 53(91.4) <0.001 <sup>c</sup> 6(10.3) 52(89.7) 0.011 <sup>c</sup> 6(10.3)	6(33.3) 0.620 <sup>b</sup> 9(50.0) 9(50.0) <0.001 <sup>c</sup> 1(5.6) 17(94.4) 0.235 <sup>c</sup> 2(11.1) 16(88.9) 0.005 <sup>c</sup> 5(27.8) 13(72.2) <0.001 <sup>c</sup> 3(16.7)	7(17.1) 0.115 <sup>b</sup> 13(31.7) 28(68.3) $<0.001^{c}$ 4(9.8) 37(90.2) 0.003 <sup>c</sup> 3(7.3) 38(92.7) 0.002 <sup>c</sup> 3(7.3) 38(92.7) 0.150 <sup>c</sup> 11(26.8)
P for difference         Menopausal Status         Premenopausal         Postmenopausal         P for difference         Chronic Constipation         Yes         No         P for difference         Diabetes         Yes         No         P for difference         Other Gynecological Disease         Yes         No         P for difference         Other Gynecological Disease         Yes         No         P for difference         High Blood Pressure         No         Yes         No	36(30.8)         36(30.8)         0.515 <sup>b</sup> 61(52.1)         56(47.9)         <0.001 <sup>b</sup> 12(10.3)         105(89.7)         <0.001 <sup>c</sup> 10(8.5)         107(91.5)         <0.001 <sup>c</sup> 14(12.0)         103(88.0)         <0.001 <sup>c</sup> 20(17.1)         97(82.9)	23(39.7) 0.049 <sup>b</sup> 39(67.2) 19(32.8) <0.001 <sup>c</sup> 7(12.1) 51(87.9) <0.001 <sup>c</sup> 5(8.6) 53(91.4) <0.001 <sup>c</sup> 6(10.3) 52(89.7) 0.011 <sup>c</sup> 6(10.3) 52(89.7)	6(33.3) 0.620 <sup>b</sup> 9(50.0) 9(50.0) <0.001 <sup>c</sup> 1(5.6) 17(94.4) 0.235 <sup>c</sup> 2(11.1) 16(88.9) 0.005 <sup>c</sup> 5(27.8) 13(72.2) <0.001 <sup>c</sup> 3(16.7) 15(83.3)	7(17.1) 0.115 <sup>b</sup> 13(31.7) 28(68.3) $<0.001^{c}$ 4(9.8) 37(90.2) 0.003 <sup>c</sup> 3(7.3) 38(92.7) 0.002 <sup>c</sup> 3(7.3) 38(92.7) 0.150 <sup>c</sup> 11(26.8) 30(73.2)
P for difference         Menopausal Status         Premenopausal         Postmenopausal         P for difference         Chronic Constipation         Yes         No         P for difference         Diabetes         Yes         No         P for difference         Other Gynecological Disease         Yes         No         P for difference         High Blood Pressure         High Blood Pressure         No         P for difference	36(30.8)         36(30.8)         0.515 <sup>b</sup> 61(52.1)         56(47.9)         <0.001 <sup>b</sup> 12(10.3)         105(89.7)         <0.001 <sup>c</sup> 10(8.5)         107(91.5)         <0.001 <sup>c</sup> 14(12.0)         103(88.0)         <0.001 <sup>c</sup> 20(17.1)         97(82.9)         <0.001 <sup>c</sup>	23(39.7) 0.049 <sup>b</sup> 39(67.2) 19(32.8) <0.001 <sup>c</sup> 7(12.1) 51(87.9) <0.001 <sup>c</sup> 5(8.6) 53(91.4) <0.001 <sup>c</sup> 6(10.3) 52(89.7) 0.011 <sup>c</sup> 6(10.3) 52(89.7) <0.001 <sup>c</sup>	6(33.3) 0.620 <sup>b</sup> 9(50.0) 9(50.0) <0.001 <sup>c</sup> 1(5.6) 17(94.4) 0.235 <sup>c</sup> 2(11.1) 16(88.9) 0.005 <sup>c</sup> 5(27.8) 13(72.2) <0.001 <sup>c</sup> 3(16.7) 15(83.3) 0.002 <sup>c</sup>	7(17.1) 0.115 <sup>b</sup> 13(31.7) 28(68.3) <0.001 <sup>c</sup> 4(9.8) 37(90.2) 0.003 <sup>c</sup> 3(7.3) 38(92.7) 0.002 <sup>c</sup> 3(7.3) 38(92.7) 0.150 <sup>c</sup> 11(26.8) 30(73.2) <0.001 <sup>c</sup>

a. Cochran-Armitage Trend Test. b. Chi-square test. c. Fisher's exact test

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able 4: Fotential fisk factors (	of of and its subtypes	among nur	nparous Chinese	women		
		UI		SUI	UUI	
	OR (95% CI)	beta	p-value	OR (95% CI)	OR (95% CI)	0 • • • • • • • • • • • • • • • • • • •
Age group, yrs	D.C.	DC	D.C.		D.C.	
20-29	Kei 4 16(2 05 8 45)	Ker 1 43		Kei 1 47(0 58 3 73)	Rei $0.57(0.06.5.46)$	3 <b>9</b> 7(0 <b>st</b> ) 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)	25340 $24$ 12 06)
Urbanization Level	1.70(0.05,5.47)	0.55	0.144	5.51(2.22,12.70)	2.17(0.52,15.04)	0 n a
Rural	Ref	Ref	Ref	Ref	Ref	Ref <b>Q</b> . N
Urban	1.19(0.76,1.85)	0.17	0.449	2.27(1.16,4.46)	1.11(0.39,3.17)	0 a 4 (1.09)
Ethnicity						5.
Han	Ref	Ref	Ref	Ref	Ref	REFEC
Minority	2.03(1.14,3.64)	0.71	0.017	3.05(1.52,6.15)	0.47(0.06,3.81)	1.99(2). (6,5.42)
Marital	D-f	D-f	Def	Def	Def	
Married		Ker		$\begin{array}{c} \text{Rei} \\ 0.32(0.16.0.64) \end{array}$	Kei 0.72(0.10.2.67)	
Education	0.51(0.10,0.54)	-1.10	<0.001	0.52(0.10,0.04)	0.72(0.19,2.07)	<u> </u>
Senior school or below	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 2 1 20. 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 <b>3</b> 7 <b>4</b> ,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)	228(0.84,6.76)
Normal	Ref	Ref	Ref	Ref 2 54(1 20 4 00)	Ref	Ref <b>H</b>
Overweight	2.20(1.37, 3.73) 3.64(1.86.7.15)	0.82	0.001	2.54(1.29,4.98) 2.07(1.12,7.80)	5.14(0.96,10.31) 4.42(1.01.10.37)	1.75(0.73,4.10)
Occupation	3.04(1.00,7.13)	1.29	<0.001	2.97(1.12,7.89)	4.42(1.01,17.57)	4 4 5 (1. <b>a</b> ), 11. 78)
Mainly mental	0.53(0.29.0.98)	-0.64	0.042	0.62(0.29.1.33)	0.17(0.02.1.58)	072(0.01.1.54)
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(0.70, 0.77)
Unemployed	Ref	Ref	Ref	Ref	Ref	R <del>o</del> f <u>c</u>
Family Income						d
≤5000	Ref	Ref	Ref	Ref	Ref	Rif O
>5000	1.48(0.92,2.38)	0.39	0.106	1.69(0.91,3.13)	2.72(0.93,7.97)	0 <u>30</u> (0.31,2.05)
Menopausal Status	Pof	Pof	Pof	Pof	Pof	
Postmenopausal	2 22(1 22 4 05)	0.80	0 009	1.26(0.56.2.81)	1 82(0 44 7 50)	
Chronic Constipation	1122(1122,1100)	0.00	0.009	1.20(0.30,2.01)	1.02(0.11,7.50)	5
No	Ref	Ref	Ref	Ref	Ref	Rat D
Yes	5.75(2.59,12.74)	1.75	<0.001	7.11(2.80,18.01)	3.32(0.37,30.13)	4 <u>9</u> 0(1.91,16.83)
Diabetes						at es.
No	Ref	Ref	Ref	Ref	Ref	Ref D
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 Gynecological Disease	Dof	Dof	Dof	Dof	Daf	Dof 0
NO Ves	1 39(0 71 2 73)	0.33	0.335	1 30(0 52 3 28)	6 23(1 86 20 88)	$0.45(0  {\bf B}  1.77)$
High Blood Pressure	1.57(0.71,2.75)	0.55	0.555	1.50(0.52,5.20)	0.20(1.00,20.00)	0.13(0. <b>5</b> ,1.//)
No	Ref	Ref	Ref	Ref	Ref	Ref <b>G</b>
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
				25		shique de

### The Prevalence of Urinary Incontinence among Nulliparous Chinese Females

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

		Rural			Urban	
	beta	OR (95% CI)	p-value	beta	OR (95% CI)	p-value
Age group, yrs						
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
$\geq$ 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						
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						
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						
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
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 Gynecological 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



## BMJ Open: first published as 10.1136/bmjopen-2024-097807 on 14 May 2025. Downloaded from http://bmjopen.bmj.com/ on June 6, 2025 at Agence Bibliographique de l Enseignement Superieur (ABES) Protected by copyright, including for uses related to text and data mining, Al training, and similar technologies

### Figure 2. The prevalence of UI among different BMI groups

Bars indicate the prevalence of UI among BMI subgroups in nulliparous population and urban and rural subgroups, respectively. The graph demonstrates the trends of UI prevalence in each population group as BMI becomes greater.





### Figure S1. The prevalence of UI among different age groups

Bars indicate the prevalence of UI among age groups in nulliparous population and urban and rural subgroups, respectively. The graph demonstrates the trends of UI prevalence in each population group as females get older.





### Figure S2. The prevalence of UI between different menopausal status

Bars indicate the prevalence of UI between different menopausal status in nulliparous population and urban and rural subgroups, respectively.



	Item No	Recommendation	Pa N
Title and abstract	1	( <i>a</i> ) Indicate the study's design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of	4
		(b) From the dost det an informative and outlineed summary of what was done and what was found	
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation	6
		being reported	
Objectives	3	State specific objectives, including any prespecified hypotheses	6-7
Methods			
Study design	4	Present key elements of study design early in the paper	7
Setting	5	Describe the setting, locations, and relevant dates, including periods	7
		of recruitment, exposure, follow-up, and data collection	
Participants	6	(a) Give the eligibility criteria, and the sources and methods of	7
-		selection of participants	
Variables	7	Clearly define all outcomes, exposures, predictors, potential	7-8
		confounders, and effect modifiers. Give diagnostic criteria, if	
		applicable	
Data sources/	8*	For each variable of interest, give sources of data and details of	7-8
measurement		methods of assessment (measurement). Describe comparability of	
		assessment methods if there is more than one group	
Bias	9	Describe any efforts to address potential sources of bias	7
Study size	10	Explain how the study size was arrived at	7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If	7-8
		applicable, describe which groupings were chosen and why	
Statistical methods	12	(a) Describe all statistical methods, including those used to control	8
		for confounding	
		( <i>b</i> ) Describe any methods used to examine subgroups and interactions	8
		(c) Explain how missing data were addressed	No
			appli
		( <i>d</i> ) If applicable, describe analytical methods taking account of	No
		sampling strategy	appli
		( <u>e</u> ) Describe any sensitivity analyses	No
			appli
Results	101		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg	Figur
Participants			
Participants		numbers potentially eligible, examined for eligibility, confirmed	
Participants		eligible, included in the study, completing follow-up, and analysed	E
Participants		<ul> <li>numbers potentially eligible, examined for eligibility, confirmed</li> <li>eligible, included in the study, completing follow-up, and analysed</li> <li>(b) Give reasons for non-participation at each stage</li> <li>(c) Consider use of a flow discussion</li> </ul>	Figur
	1 4 4	numbers potentially eligible, examined for eligibility, confirmed       eligible, included in the study, completing follow-up, and analysed         (b) Give reasons for non-participation at each stage       (c) Consider use of a flow diagram	Figur Figur
Participants Descriptive data	14*	numbers potentially eligible, examined for eligibility, confirmed       eligible, included in the study, completing follow-up, and analysed         (b) Give reasons for non-participation at each stage       (c) Consider use of a flow diagram         (a) Give characteristics of study participants (eg demographic,         disingle participants (eg demographic,	Figur Figur 9

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		(b) Indicate number of participants with missing data for each	No
		variable of interest	applicable
Outcome data	15*	Report numbers of outcome events or summary measures	Table1
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-	9-11
		adjusted estimates and their precision (eg, 95% confidence interval).	
		Make clear which confounders were adjusted for and why they were	
		included	
		(b) Report category boundaries when continuous variables were	No
		categorized	applicable
		(c) If relevant, consider translating estimates of relative risk into	No
		absolute risk for a meaningful time period	applicable
Other analyses	17	Report other analyses done-eg analyses of subgroups and	9-11
		interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	11-12
Limitations	19	Discuss limitations of the study, taking into account sources of	14-15
		potential bias or imprecision. Discuss both direction and magnitude	
		of any potential bias	
Interpretation	20	Give a cautious overall interpretation of results considering	12-14
		objectives, limitations, multiplicity of analyses, results from similar	
		objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	
Generalisability	21	objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence Discuss the generalisability (external validity) of the study results	14-15
Generalisability Other information	21	objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence Discuss the generalisability (external validity) of the study results	14-15
Generalisability Other information Funding	21	objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence Discuss the generalisability (external validity) of the study results Give the source of funding and the role of the funders for the present	14-15
Generalisability Other information Funding	21	objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence Discuss the generalisability (external validity) of the study results Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present	14-15
Generalisability Other information Funding	21	objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence Discuss the generalisability (external validity) of the study results Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	14-15

\*Give information separately for exposed and unexposed groups.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.
#### The prevalence of urinary incontinence among nulliparous females and its association with underweight body mass index: a secondary analysis of a nationwide cross-sectional study in China

Journal:	BMJ Open
Manuscript ID	bmjopen-2024-097807.R1
Article Type:	Original research
Date Submitted by the Author:	31-Mar-2025
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	Liu, Jingyi; Peking Union Medical College, Department of Public Health Zhang, Xue; Peking Union Medical College, Department of Obstetrics and Gynecology Zhu, Lan; Peking Union Medical College Hospital Department of Obstetrics and Gynecology, Department of Obstetrics and Gynecology
<b>Primary Subject Heading</b> :	Obstetrics and gynaecology
Secondary Subject Heading:	Epidemiology, Urology
Keywords:	Prevalence, Risk Factors, Urinary incontinences < UROLOGY, Body Mass Index

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#### **BMJ** Open

The prevalence of urinary incontinence among nulliparous females and its association with

underweight body mass index: a secondary analysis of a nationwide cross-sectional study in

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The Prevalence of Urinary Incontinence among Nulliparous Chinese Females

2 3 4	62	Abstract
6 7	63	Objectives: To estimate the prevalence of urinary incontinence (UI) and its subtypes among
8 9	64	nulliparous Chinese females with associated risk factors. The prevalence of UI among those
10 11 12	65	living in urban or rural communities was also analyzed with potential risk factors.
13 14 15	66	<b>Design:</b> This is a secondary analysis of epidemiological survey data on UI in Chinese women.
16 17	67	The original study was design as a nationwide cross-sectional study involving 56460 adult
18 19	68	women conducted from October 2019 to December 2021.
20 21 22 23	69	Setting: Seven geographic regions of China
24 25	70	<b>Participants:</b> Nulliparous women who aged $\geq 20$ years old and were permanent resident were
26 27	71	included in this secondary analysis. Participants who had severe mental or physical disorders or
28 29 30	72	were pregnant were excluded. Data on demographic characteristics, health status, and medical
31 32 33	73	history were collected.
34 35	74	Primary and secondary outcome measures: The primary outcome was the prevalence of UI,
36 37 38	75	whereas secondary outcome measures were adjusted odds ratios (aOR) for risk factor analysis.
39 40	76	Results: A total of 6244 nulliparous women were included in analysis. The prevalence of UI was
41 42	77	1.9% for nulliparous Chinese females, with stress, urgency, and mixed UI being prevalent at
43 44 45	78	0.9%, 0.3% and 0.7%, respectively. The prevalence of UI was 2.1% and 1.6% for urban and rural
46 47	79	subgroups. Abnormal body mass index was significantly associated with UI in nulliparous group
48 49	80	(underweight, aOR:1.88, 95% CI: 1.03-3.45, <i>p</i> =0.041; overweight, aOR: 2.26, 95% CI: 1.37-
50 51 52	81	3.73, <i>p</i> =0.001; and obesity, aOR: 3.64, 95% CI: 1.86-7.15, <i>p</i> <0.001) and subgroup in urban
53 54 55 56	82	areas (underweight, aOR:2.43, 95% CI: 1.18-5.00, <i>p</i> =0.016; overweight, aOR: 3.31, 95% CI:

1

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1		The Prevalence of Urinary Incontinence among Nulliparous Chinese Females
2 3 4	83	1.76-6.25, <i>p</i> <0.001; and obesity, aOR: 4.53, 95% CI: 1.88-10.92, <i>p</i> <0.001); however, no
5 6 7	84	significant association was found for those in rural areas.
, 8 9	85	Conclusion: UI among nulliparous females deserves greater public attention. Abnormal body
10 11 12	86	mass index, including underweight status, was found to be risk factor for urinary incontinence
13 14	87	among Chinese nulliparous females. Further research requires to investigate the mechanism
15 16 17	88	underlying the association between underweight status and UI.
17 18 19	89	Strength and limitations of this study
20 21 22	90	• The original study, which served as the basis for this secondary analysis, employed a
23 24 25	91	methodologically robust six-stage sampling strategy and included representative of
25 26 27	92	adult women in China.
28 29	93	• This study represents the largest epidemiological sample to date estimating urinary
30 31 32	94	incontinence (UI) prevalence among Chinese nulliparous females.
33 34	95	• Data collection utilized a standardized, validated questionnaire to mitigate recall and
35 36	96	information bias inherent in self-reported methodologies.
37 38 39	97	• Owing to the cross-sectional design of the original study, causal inference cannot be
40 41	98	established.
42 43	99	
44 45 46 47	100	
48 49	101	Word count: abstract 318 words; main text 2979 words.
50 51 52	102	Keywords: nulliparity, female urinary incontinence, prevalence, risk factors, body mass index,
53 54 55 56 57	103	underweight
58 59 60		For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

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#### The Prevalence of Urinary Incontinence among Nulliparous Chinese Females

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Introduction

105	Urinary incontinence (UI) is defined as any complaint of involuntary leakage of urine according
106	to the International Continence Society <sup>1</sup> . UI demonstrates strongly negative impact on female
107	quality of life through not only mental dysfunction, such as embarrassment, depression, and low
108	self-esteem, but also deteriorated physical ability, resulting in decreased recreational activity
109	time and social isolation <sup>2,3</sup> . UI prevalence in China was estimated to be 30.9% in 2006 and
110	decreased to 16% in 2021 with significant efforts being made to implement pelvic floor
111	rehabilitation in the past fifteen years <sup>4</sup> . In spite of this, it is estimated that over 90 million
112	women in China are still suffering from UI <sup>5</sup> . There are several well-known risk factors for UI,
113	including childbirth, aging, obesity, and chronic medical conditions <sup>7</sup> . Considerable attention was
114	paid to how childbirth affects female UI symptoms; however, it cannot be neglected that
115	nulliparous females can also experience UI episodes. Minimal research has reported the
116	prevalence of UI among nulliparous females. A systematic review published in 2017 found that
117	UI prevalence varied between 1% and 42.2% in nulliparous females worldwide <sup>6</sup> , which
118	suggested that UI among nulliparous group is with great uncertainty and highlighted the urgent
119	need for public attention and better preventative strategies for this underserved population.
120	Due to significant delays in childbirth and the transition of childbirth preference of Chinese
121	couples in the past two decades <sup>10</sup> , the number of nulliparous females with greater ages also
122	significantly increased in rural China. Previous research noted that women from rural areas may
123	suffer from more UI episodes due to lower educational level <sup>7</sup> with less personal health
124	awareness <sup>8</sup> . To our knowledge, there was also very limited published study reporting the
125	prevalence of UI as well as risk factors in rural nulliparous population. Therefore, the objective
126	of this study is to estimate the prevalence of UI and its subtypes among nulliparous Chinese

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	The Prevalence of Urinary Incontinence among Nulliparous Chinese Females
127	females with associated risk factors. UI prevalence among those living in urban or rural
128	communities was also analyzed with potential risk factors.
129	Methods
130	Study design and participations
131	This current study is a secondary data analysis of nulliparous subgroup from a national cross-
132	sectional research project which was conducted between October 2019 and December 2021
133	using a six-stage sampling strategy <sup>5</sup> . Detailed description of study design, sample size
134	calculation, and participant recruitment for the original study has been published <sup>5</sup> . Inclusion
135	criteria were females aged $\geq 20$ years old and permanent resident defined as living in their
136	current residence for 1 year or longer. For this secondary analysis, we only include nulliparous
137	females from the original research. Participants who had severe mental or physical disorders or
138	were pregnant were excluded in the study. The original study has been approved by Peking
139	Union Medical College Ethics Committee (No. S-K970) and conducted according to the
140	Declaration of Helsinki. All participants signed consent forms before data collection. A
141	completed STROBE checklist detailing compliance with all 22 items is provided in
142	Supplementary Table S1.
143	Exposures and outcomes
144	This study included participants' basic information, such as demographic characteristics, medical

history, and health behaviors. Demographic characteristics included age, urbanization level,
ethnicity, education level, marital status, occupational status, monthly family income, and

147 menopause status. Body mass index (BMI) was categorized as underweight (BMI <18.5 kg/m<sup>2</sup>),

148 normal (18.5 kg/m<sup>2</sup>  $\leq$  BMI  $\leq$  24.9 kg/m<sup>2</sup>), overweight (25 kg/m<sup>2</sup>  $\leq$  BMI  $\leq$  29.9 kg/m<sup>2</sup>), and obese

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#### The Prevalence of Urinary Incontinence among Nulliparous Chinese Females

	149	(BMI $\geq$ 30 kg/m <sup>2</sup> ). Medical history include chronic constipation, diabetes, high blood pressure,
	150	and the history of other gynecological disease (i.e. pelvic inflammatory disease, pelvic pain,
	151	endometriosis, fibroids, gynecological malignant tumors, and pelvic organ prolapse). By using
0 1	152	six-stage sampling strategy, participants were then divided into rural and urban subgroups based
2 3	153	on their residence during data collection. The primary outcome was UI, which was defined as the
4 5	154	complaint of any involuntary leakage of urine 9, and UI was categorized into stress UI (SUI),
o 7 8	155	urgency UI (UUI), mixed UI (MUI) and other UI according to Chinese version of the
9 0	156	International Conference on Incontinence Questionnaire UI Short Form (ICIQ-UI SF) in the
1 2	157	original study <sup>10</sup> . The type of UI was determined by the following two questions: (1) 'During the
3 4 5	158	past 4 weeks, did you leak urine when you were performing some physical activity, such as
6 7	159	coughing, sneezing, lifting, or exercise?' (yes or no); and (2) 'During the past 4 weeks, did you
8 9	160	leak urine when you had the urge or the feeling that you needed to empty your bladder, but you
0 1 2	161	could not get to the toilet fast enough?' (yes or no). Women who answered yes for question (1)
2 3 4	162	were categorized as having SUI. Women who answered yes for question (2) were categorized as
5 6	163	having UUI. Women who answered yes for both questions were categorized as having MUI.
7 8	164	Other types of UI were defined as those with a negative response to the two preceding questions
9 0 1 2 3	165	about leakage (SUI or UUI) among those who reported having UI during the past 4 weeks. No
	166	nulliparous participant recruited was categorized into other UI subgroup; thus, only SUI, MUI,
4 5	167	and MUI were analyzed in this current study.

#### 168 Statistical analysis

169 Number and percentage were used to describe categorical variables. Participants' baseline
170 characteristics were compared using Chi-square test or Fisher's exact test of independence for
171 categorical variables. Cochran-Armitage trend test was used to demonstrate linear trends for

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1 2		The Prevalence of Urinary Incontinence among Nulliparous Chinese Females
2 3 4	172	ordinal categorical variables. We utilized binary logistic regression model to obtain odds ratio
5 6	173	(OR) and 95% confidence interval (CI) to detect risk factors of UI for nulliparous population and
/ 8 9	174	subgroups living in urban or rural areas. In addition, multinominal logistic regression was
10 11	175	applied to estimate risk factors of UI subtypes, including SUI, UUI, and MUI, among nulliparous
12 13	176	population. The reference category was the group of participants without UI. Statistical
14 15 16	177	significance was set at $p < 0.05$ (2-tailed). All analyses were performed using SPSS, version 24.0
17 18	178	(IBM).
19 20 21	179	Patient and public involvement
22 23 24	180	Patients or the public were not involved in the design, conduct, reporting, or dissemination plans
25 26	181	of this study.
27 28 29	182	Results
30 31 32	183	Demographic characteristics
33 34 35	184	A total of 6,244 nulliparous females were selected from the cohort of 54,346 participants in the
36 37	185	original study (Figure 1). Overall, 2,718 (43.5%) participants were from rural areas whereas
38 39 40	186	3,526 (56.5%) were from urban areas (Table 1). No significant differences were noted in
41 42	187	consideration of BMI, menopausal status, and the medical history of coughing, diabetes and high
43 44	188	blood pressure ( $p$ >0.05) between two groups. Rural population tends to be younger ( $p$ <0.001),
45 46 47	189	unmarried ( $p < 0.001$ ), unemployed ( $p < 0.001$ ), belongs to an ethnic minority group ( $p < 0.001$ ),
48 49	190	has lower education background ( $p < 0.001$ ), lower monthly family income ( $p < 0.001$ ), and less
50 51 52	191	probability to have medical history of chronic constipation ( $p=0.001$ ) and other gynecological
52 53 54	192	disease ( <i>p</i> <0.001) ( <i>Table 2</i> ).
55 56 57	193	The prevalence of urinary incontinence among nulliparous Chinese females and subgroups

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#### The Prevalence of Urinary Incontinence among Nulliparous Chinese Females

The prevalence of UI was 1.9% among Chinese nulliparous females while that of SUI, UUI and MUI were 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 analyzed among BMI. age groups and menopause status. Nulliparous population and urban subgroup showed that normal BMI group had the lowest UI prevalence compared to underweight, overweight and obese subgroups, whereas a positive trend of UI prevalence was noted among BMI groups for rural subgroup (Figure 2). As nulliparous females became aging and postmenopausal, higher UI prevalence was shown (Figure S1). Urban subgroup demonstrated higher UI prevalence during premenopausal period but lower prevalence during postmenopausal period than rural subgroup (Figure S2).

#### 204 The risk factors of urinary incontinence among nulliparous Chinese females

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: 0.18-0.54) and employed status (mentally employed, aOR: 0.53, 95% CI: 0.29-0.98; physically employed, aOR: 0.55, 95% CI: 0.31-0.96) were both protective factors for nulliparous females. Nulliparous women with chronic constipation had the strongest association with UI occurrence (aOR: 5.75, 95% CI:2.59-12.74), followed by aging 30-39 years (aOR: 4.16, 95% CI: 2.05-8.45), having postmenopausal status (aOR: 2.22, 95% CI: 1.22-4.05), and belonging to an ethical 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 in regardless of under-or overweight status (underweight, aOR:1.88, 95% CI: 1.03-3.45; overweight, aOR: 2.26, 95% CI: 1.37-3.73; and obesity, aOR: 3.64, 95% CI: 1.86-7.15).

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1		The Prevalence of Urinary Incontinence among Nulliparous Chinese Females
2 3 4	216	In multinominal logistic regression, nulliparous females who have chronic coughing (aOR: 7.11,
5 6	217	95% CI: 2.80-18.01), older age (≥ 40 years, aOR: 5.31, 95% CI: 2.22-12.70), urban residence
7 8 0	218	(aOR: 2.27, 95% CI: 1.16-4.46), and belonging to an ethical minority (aOR: 3.05, 95% CI: 1.52-
9 10 11	219	6.15) are more likely to report SUI. Nulliparous females who are overweight (aOR: 2.54, 95%
12 13	220	CI: 1.29-4.98) or obese (aOR: 2.97, 95% CI:1.12-7.89) demonstrated significant odds of
14 15	221	developing SUI while obesity is a statistically significant risk factor for UUI (aOR: 4.42, 95%
16 17 18	222	CI: 1.01-19.37) and MUI (aOR: 4.19, 95% CI: 1.49-11.78). Nulliparous females with a medical
19 20	223	history of other gynecological disease found to have increased risk of developing UUI (aOR:
21 22	224	6.23, 95% CI: 1.86-20.88). Postmenopausal nulliparous females have the strongest association
23 24 25	225	with MUI occurrence (aOR: 8.79, 95% CI: 1.98-39.01).
26 27 28	226	The risk factors of urinary incontinence among nulliparous Chinese females in either urban
29 30 31	227	or rural areas
32 33	228	Table 5 shows the analysis of risk factors of UI among urban and rural nulliparous Chinese
34 35	229	women. Subgroup analyses revealed that abnormal BMI is significantly associated with UI
36 37 28	230	occurrence for nulliparous females residing in urban areas (underweight, aOR:2.43, 95% CI:
38 39 40	231	1.18-5.00; overweight, aOR: 3.31, 95% CI: 1.76-6.25; and obesity, aOR: 4.53, 95% CI: 1.88-
41 42	232	10.92); however, BMI is not a significant risk factor for those living in rural areas. For
43 44	233	participants in both residential areas, unmarried status continues to be a protective factor for
45 46 47	234	nulliparous females (rural, aOR:0.34, 95% CI:0.11-1.00; urban, aOR:0.32, 95% CI: 0.17-0.61)
48 49	235	while chronic constipation demonstrates strongest association with UI occurrence (rural,
50 51	236	aOR:5.66, 95% CI:1.14-28.15; urban, aOR:6.29, 95% CI: 2.51-15.80). In rural subgroup,
52 53 54	237	participants aged over 30 years showed increased odds of developing UI (age 30-39 years,
55 56 57	238	aOR:4.29, 95% CI: 1.17-15.79; age ≥ 40 years, aOR: 7.28, 95% CI: 1.87-28.24); however, only
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The Prevalence of Urinary Incontinence among Nulliparous Chinese Females

age greater than 40 years old (age ≥ 40 years, aOR: 2.94, 95% CI: 1.25-6.92) is risk factor for
those residing in urban communities.

241 Discussion

To the best of our knowledge, this research is the first to report the prevalence of UI and its subtypes of nulliparous female with the largest sample size through a nationwide study. This current study revealed that the prevalence of UI among nulliparous Chinese females was 1.9%, which is slightly higher compared to a previous study (1%) conducted in 2003 within a smaller Chinese nulliparous population<sup>11</sup>. The prevalence of UI found in this current study among nulliparous females 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 nulliparous population. A systematic review including multiple cohort or cross-sectional studies investigated UI prevalence among nulliparous females in different countries, such as the 10.8% in Australia<sup>12</sup>, 14% in Denmark <sup>13</sup>, 19.9% in Portugal <sup>14</sup>, and 38.6% in Sweden <sup>15</sup>, 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 standardized questionnaire to measure outcomes. The results showed that SUI is the most prevalent subtype among Chinese nulliparous females, which was consistent with several previous high-quality research conducted in other countries <sup>17</sup>. Despite low prevalence compared to parous females. UI among nulliparous women remains an important health issue requiring 

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3 4	262	increased public attention. A shift in the marriage conception and fertility preference from
5 6	263	Chinese females has been noted with the national postponement of parenthood, such as late
7 8 9	264	marriage, long marriage and conception interval, and advanced pregnancy <sup>16</sup> . Nulliparous
10 11	265	females with advanced age may present with UI symptoms before pregnancy, which can result in
12 13	266	more severe adverse outcomes and postpartum pelvic floor dysfunction <sup>17–20</sup> . Thus, advocating
14 15 16	267	for pelvic floor checks before pregnancy for nulliparous population could assist in preventing the
17 18 19	268	detrimental effects of UI after childbirth with increased age.

Our study is also the first one to report UI prevalence of nulliparous Chinese females 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<sup>5</sup>. This is further supported by the finding that 83.7% of UI females from rural areas had only senior school or below educational background. Occupation demands also explain the UI prevalence difference between urban and rural communities. Rural females were more likely to do labor work and retire late, whith 28.7% rural females in this current study performing mainly physical work compared to only 14.9% of urban females<sup>21</sup>. The rural National Retire Pension program, phased in since 2009, provided less coverage than urban areas but did not require quitting agricultural activities, exposing rural females to activities inducing long-lasting increased abdominal pressure longer. Due to unequal distribution of medical resources, UI prevalence has potential to be underreported in rural areas. As inadequate access to healthcare and limited access to information exist, only a small proportion of Chinese rural citizens had consulted a health care provider for UI symptoms<sup>22,23</sup>. A lack of health literacy not only affects patients and 

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	285	their care providers, but also rural health providers who had insufficient knowledge of the impact
	286	of UI; therefore, inappropriate prevention and management strategies were undertaken <sup>24</sup> . Rural
	287	females may perceive occasional "urine drops" as a natural process of aging and prioritized other
0	288	life-threatening conditions, such as cardiac vascular disease, which accounts for 46.74%
2 3	289	mortality in rural areas <sup>25</sup> . UI, affecting quality of life but not life threatening, received less
4 5	290	priority in rural communities. However, higher limitations in social and physical aspects due to
6 7	291	incontinence in rural population can lead to a loss of personal identity and more severe mental
8 9 0	292	health deterioration as social life with fewer boundaries is more important in rural daily life than
1 2	293	in urban areas <sup>3,26</sup> .
3 4		
5	294	In 2020, the rate of childlessness of females aged 49 and above has reached 5.16% in China <sup>27</sup> .
6 7 8	295	Considering those who chose to be lifelong nulliparous, this study revealed that multiple risk
9 0	296	factors contribute to UI occurrence even if no pregnancy or childbirth happened. Our result is
1 2	297	consistent with previous research showing that chronic constipation is detrimental to the
3 4	298	development of UI. Poor living habits, such as the widespread use of "bearing down" toilet
5 6 7	299	strategy, may contribute to increased abdominal pressure and chronically weak pelvic floor
, 8 9	300	muscles <sup>28,29</sup> . It is globally agreeable that obesity with long-lasting increased abdominal pressure
0 1	301	is a significant risk factor to UI as multiple studies proved that weight loss is an effective
2 3 4	302	strategy to improve UI symptoms <sup>30,31</sup> . Our study agreed that overweight or obese BMI are risk
4 5 6	303	factors; however, the results surprisingly showed that underweight BMI also increased the
7 8	304	possibility of UI occurrence for Chinese nulliparous females. We speculated that underweight
9 0	305	BMI is associated with loss or weakening of whole-body muscle mass and strength, which
ו 2 3	306	includes that of pelvic floor muscles. One previous research showed that underweight BMI was
4 5 6	307	significantly associated with an increased likelihood of sarcopenia, which is often diagnosed
7		

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54 55

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1		The Prevalence of Urinary Incontinence among Nulliparous Chinese Females
2 3	308	with lower hand grip strength to overall represent whole-body muscle mass and strength <sup>32</sup> .
4 5 6	309	Zhang et al. discovered that lower level of hand grip strength is significantly associated with an
7 8	310	increased prevalence and severity of SUI, suggesting that decreased muscle mass may correlate
9 10 11	311	with UI development <sup>33</sup> . No significant association among rural population can be possibly
12 13	312	explained due to the smaller sample size in rural subgroup.
14 15 16	313	The robust study design of the original nationwide cross-sectional study was the key strength of
17 18	314	this research. It utilized a six-stage sampling strategy in six regions of China with a total of
19 20 21	315	56,460 females for a more accurate nationally representative population <sup>5</sup> , allowing this
22 23	316	secondary analysis to be the first one showing UI prevalence in nulliparous females with the
24 25 26	317	largest sample size. However, this study also has several limitations. First, it is a cross-sectional
20 27 28	318	design, which cannot infer causality. Despite this, this study design is effective for providing a
29 30	319	snapshot of UI prevalence in this population and offering a solid base for generating hypotheses
31 32 33	320	that could be tested in future longitudinal studies. Second, females with severe mental
34 35	321	dysfunction who could not complete the survey were not included in this study, which might lead
36 37	322	to an underestimation of UI prevalence of this population. However, the exclusion was necessary
38 39 40	323	to ensure the accuracy of responses as the excluded population may have difficulty providing
41 42	324	reliable information during the survey. Third, all information was derived self-reported, which
43 44 45	325	may lead to recall and information bias. Even though we did not use an objective test to collect
46 47	326	results, a standardized reliable questionnaire was chosen for its feasibility in a large-scale study.
48 49 50	327	Conclusion
50 51 52	328	In conclusion, even though low UI prevalence was reported for nulliparous Chinese females,
53	329	action should be made for this underserved population to enhance their awareness of UI

330 symptoms and its negative life impact. Abnormal BMI, especially underweight status, was also

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found as a risk factor for UI in nulliparous females. 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.

#### Funding statement

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

#### 341 Competing interest statement

The authors declare that they have no known competing financial interests or personalrelationships that could have appeared to influence the work reported in this paper.

344 Authorship contribution statement

Lan Zhu and Haiyu Pang contributed to the conception and design of the study. Qing Liu, Luwen Wang, Hangmei Jin, Liyan Gong, Jingyan Xie, Ting Lai, Aiyang Li, Lubin Liu, Lifei Zhou, Yanqiu Luan, Lin Wang, Xiaoli Li, Xiping Luo, Yingjie Fu, Jumin Niu, Wen Zhao, Qiming Liu, and Renfeng Zhao were responsible for the acquisition of data. Haiyu Pang, Tangdi Lin, Jingyi Liu, and Xue Zhang performed the statistical analysis. Haiyu Pang and Tangdi Lin interpreted data and drafted the manuscript. Lan Zhu and Abraham N. Morse critically revised the manuscript for important intellectual content. Lan Zhu and Haiyu Pang obtained funding, provided supervision and administrative, technical, or material support for this work. All authors

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2 3 4	353	revised the manuscript and approved the final version before submission. Lan Zhu is the
5 6	354	guarantor of this manuscript and affirms that this manuscript is an honest, accurate, and
7 8 9	355	transparent report of the study.
10 11 12	356	Acknowledgement
13 14 15	357	We thank all participants in this study.
16 17 18	358	Details of Ethics Approval
19 20	359	The study protocol was approved by the institutional review board of Peking Union Medical
21 22 23	360	College Hospital (Number: S-K970). The study protocol was approved and written informed
24 25	361	consent was obtained from each participant before data collection.
26 27 28	362	Data availability statement
29 30 31	363	Data are available upon reasonable request. The data from the present research that were used
32 33	364	and analyzed are accessible from the corresponding author upon reasonable request.
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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, yrs				<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				<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				<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 Gynecological 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)	

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

#### The Prevalence of Urinary Incontinence among Nulliparous Chinese Females

Variables	Urban	n (%)	Rural	n (%)
	UI 74(2.1)	P value	UI 43(1.6)	P value
ge group		<0.001ª		<0.001ª
20-29	20(27.0)		8(18.6)	
30-39	9(12.2)		5(11.6)	
≥40	45(60.8)	0.025	30(69.8)	0.047h
Ilen	(2(95.1)	0.025	26(02.7)	0.8478
nan Minority	11(14.9)		7(16.3)	
ucation Level	11(14.7)	<0 001 ª	/(10.5)	<0 001ª
Senior school or below	43(58.1)	••••••	36(83.7)	-0.001
College	9(12.2)		3(7.0)	
Undergrad or above	22(29.7)		4(9.3)	
arital Status		<0.001 <sup>b</sup>		<0.001 <sup>b</sup>
Married	55(74.3)		35(81.4)	
Unmarried	19(25.7)		8(18.6)	
dy Mass Index	10/17 ()	<0.001 ª	2/7.0	<0.001ª
Underweight	13(17.6)		3(7.9)	
Normal			22(31.2) 12(27.0)	
Obese	21(20.4) 10(13.5)		12(27.9) 6(14.0)	
cupation	10(13.3)	<0.001 <sup>b</sup>	0(17.0)	0.002 <sup>b</sup>
Mainly mental	18(24.3)	-0.001	3(7.0)	J+00=
Mainly physical	9(12.2)		10(23.3)	
Unemployed	47(63.5)		30(69.8)	
onthly Family Income		$0.323^{b}$		$0.440^{b}$
≤5000	44(59.5)		37(86.0)	
>5000	30(40.5)		6(14.0)	.0.001
enopausal Status	10(5( 0)	<0.001 <sup>c</sup>	10(44.2)	<0.001°
Premenopausal	42(56.8) 32(42.2)		19(44.2)	
ronic Constination	52(45.2)	<0.001c	24(33.8)	0 007c
Yes	9(12.2)	-0.001	3(7.0)	0.007
No	65(87.8)		40(93.0)	
abetes		<0.001°		0.020 <sup>c</sup>
Yes	8(10.8)		2(4.7)	
No	66(89.2)		41(95.3)	
her Gynecological Disease		0.001 <sup>c</sup>		0.008 <sup>c</sup>
Yes	10(13.5)		4(9.3)	
no ah Blood Pressure	64(80.5)	<0.001c	39(90.7)	<0.001c
Ves	12(16.2)	~0.001	8(18.6)	~0.001
No	62(83.8)		35(81.4)	
	(((((((((((((((((((((((((((((((((((((((			
Table 3: Association between var	iables and UI and its s	ubtypes among nulli	parous Chinese wom	en

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#### The Prevalence of Urinary Incontinence among Nulliparous Chinese Females

Variable	UI (%)	SUI (%)	UUI (%)	MUI (%)
Total	117(1.9)	58(0.9)	18(0.3)	41(0.7)
Age group, yrs	· ·	· · ·		· ·
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	<0.001ª	<0.001ª	<0.001 <sup>á</sup>	<0.001 <sup>a</sup>
Urbanization 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)
<i>P</i> for difference	0 136	0.001 b	0.938	0 189 5
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)
<i>P</i> for difference	0 240	0 038	0 7140	1 0000
Education	0.240	0.030	0.714	1.000
Sonier school er below	70(67.5)	31(53.4)	15/83 3)	33(80.5)
	12(10.2)	10(17 2)	1(5.5)	1(2 4)
	12(10.3)	10(17.2) 17(20.2)	1(0.0)	1(2.4) 7(17.1)
Dirucigiad of above	ZO(ZZ.Z)	11(29.3)	2(11.1) <0.001a	/( /. )
r Ior trend	SU.UU1 *	0.004 °	<0.001 *	<b>NU.UU1</b> *
Mantal Status	00(70.0)	40(70.4)	40(70.0)	05/05 4
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)
<i>P</i> for difference	<0.001 b	<0.001 <sup>b</sup>	<0.001 <sup>b</sup>	<0.001 <sup>b</sup>
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 ª	<0.001 ª	<0.001 ª	<0.001 ª
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 b	0.017 <sup>b</sup>	0.009 <sup>b</sup>	<0.001 <sup>b</sup>
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 <sup>b</sup>	0.049 b	0.620 5	0.115 <sup>6</sup>
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)
<i>P</i> for difference	<0.001	<0.001	<0.001	<0.001
Chronic Constination				
Vae	12(10 3)	7(12.1)	1(5.6)	4(9.8)
No	105(80 7)	51(87.0)	17(94 4)	37(00.2)
P for difforence			0 2250	0 00.2)
Diabataa	<0.001	<b>NO.001</b>	0.233	0.003
Vaa	10/9 E)	E(9.6)	2(11.1)	2(7.2)
Yes	10(8.5)	0(0.0)	2(11,1)	3(1.3) 29(02 7)
	107(91.5)	53(91.4)	10(88.9)	38(92.7)
	<0.001°	<0.001 °	0.005	0.002
Other Gynecological Disease	11/10 0	0(40.0)	E(07.0)	0(7.0)
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 tor 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)
Yes No	20(17.1) 97(82.9)	6(10.3) 52(89.7)	3(16.7) 15(83.3)	11(26.8) 30(73.2)
Yes No <i>P</i> for difference	20(17.1) 97(82.9) <b>&lt;0.001</b> °	6(10.3) 52(89.7) <b>&lt;0.001</b> °	3(16.7) 15(83.3) <b>0.002</b> °	11(26.8) 30(73.2) <b>&lt;0.001</b> °

a. Cochran-Armitage Trend Test. b. Chi-square test. c. Fisher's exact test

# BMJ Open The Prevalence of Urinary Incontinence among Nulliparous Chinese Femaleso its subtypes among nulliparous Chinese women

		I II		CUII	THH	<u> </u>
	-OB (050/ CD	UI		SUI	UUI	
	aOK (95% CI)	beta	p-value	aOK (95% CI)	aOK (95% CI)	
Age group, yrs	D-f	D - C	Def	Def	D-f	<u> </u>
20-29	Kei A 1((2 05 0 45)	Ker	Kei <0.001	Kei 1 47(0 58 2 72)	Rei 0.57(0.0(.5.4()	
50-39	4.16(2.05,8.45)	1.43	<0.001	1.4/(0.58,5.75)	0.57(0.06,5.46)	3.4/(0.52,13 <u>0</u> 3
$\geq 40$	1./0(0.83,3.4/)	0.53	0.144	5.31(2.22,12.70)	2.79(0.52,15.04)	2.03(0. <b>3</b> 4 <b>4</b> / <del>2</del> 0
Jrbanization Level			<b>D</b> 0			
Rural	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(0.2032.02)
thnicity						
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(0.06,442)
Aarıtal						
Married	Ref	Ref	Ref	Ref	Ref	Ref To a
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(0.57,56,66)
Iducation						
Senior school or below	Ref	Ref	Ref	Ref	Ref	Ref at To
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. <b>9</b> 3
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(0.31,459)
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)	<u>6. کې</u> 2.48(0
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(0.75,4.4)
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(1.39,1138
Decupation						<u> </u>
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(0,71,1.53)
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(0.10,0.7)
Unemployed	Ref	Ref	Ref	Ref	Ref	Ref 🖁 👷
amily Income						d i
≤5000	Ref	Ref	Ref	Ref	Ref	Ref Si C
>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. <u></u> ,2. <b>)</b>
Aenopausal Status						Jر ar
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 1
Chronic Constipation				· · · ·	· · · ·	
No	Ref	Ref	Ref	Ref	Ref	Ref C
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(1991,1693
Diabetes						es
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(0.20.3.48)
Other Gynecological Disease						<u> </u>
No	Ref	Ref	Ref	Ref	Ref	Ref
Vec	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 🕿)
	1.07(0.11,2.10)	0.00	0.000			<u> </u>
Ligh Blood Pressure			Pof	Ref	Ref	Ref Ö
High Blood Pressure	Ref	Ref	N E I		INC.	1101 (0)
High Blood Pressure No Ves	Ref 1 34(0 68 2 64)	Ref 0.29	0 397	0 79(0 27 2 36)	0.71(0.15.3.49)	2 65(1 08 6 53)

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#### BMJ Open

#### The Prevalence of Urinary Incontinence among Nulliparous Chinese Females

#### 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, yrs						
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
$\geq$ 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	_					
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						
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						
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
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 Gynecological 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

#### The Prevalence of Urinary Incontinence among Nulliparous Chinese Females

#### 

#### **Figure legends**

Figure 1 Study flowchart

#### Figure 2 The prevalence of UI among different BMI groups

Bars indicate the prevalence of UI among BMI subgroups in nulliparous population and urban and rural subgroups, respectively. The graph demonstrates the trends of UI prevalence in each population group as BMI becomes greater.

#### Figure S1. The prevalence of UI among different age groups

Bars indicate the prevalence of UI among age groups in nulliparous population and urban and rural subgroups, respectively. The graph demonstrates the trends of UI prevalence in each population group as females get older.

#### Figure S2. The prevalence of UI between different menopausal status

Bars indicate the prevalence of UI between different menopausal status in nulliparous population and urban and rural subgroups, respectively.



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	Item No	Recommendation	Pa N
Title and abstract	1	( <i>a</i> ) Indicate the study's design with a commonly used term in the title or the abstract	1,4
		(b) Provide in the abstract an informative and balanced summary of	4-5
		what was done and what was found	
Introduction			1
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	6
Objectives	3	State specific objectives, including any prespecified hypotheses	6-7
Methods			
Study design	4	Present key elements of study design early in the paper	7
Setting	5	Describe the setting, locations, and relevant dates, including periods	7
C		of recruitment, exposure, follow-up, and data collection	
Participants	6	(a) Give the eligibility criteria, and the sources and methods of	7
1		selection of participants	
Variables	7	Clearly define all outcomes, exposures, predictors, potential	7-8
		confounders, and effect modifiers. Give diagnostic criteria, if	
		applicable	
Data sources/	8*	For each variable of interest, give sources of data and details of	7-8
measurement		methods of assessment (measurement). Describe comparability of	
		assessment methods if there is more than one group	
Bias	9	Describe any efforts to address potential sources of bias	7
Study size	10	Explain how the study size was arrived at	7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If	7-8
		applicable, describe which groupings were chosen and why	
Statistical methods	12	( <i>a</i> ) Describe all statistical methods, including those used to control for confounding	8
		(b) Describe any methods used to examine subgroups and interactions	8
		(c) Explain how missing data were addressed	No appli
		(d) If applicable, describe analytical methods taking account of	No
		sampling strategy	appli
		( <u>e</u> ) Describe any sensitivity analyses	No
			applic
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg	Figur
-		numbers potentially eligible, examined for eligibility, confirmed	
		eligible, included in the study, completing follow-up, and analysed	
		(b) Give reasons for non-participation at each stage	Figur
		(c) Consider use of a flow diagram	Figur
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic,	9-10
		clinical, social) and information on exposures and potential	
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		(b) Indicate number of participants with missing data for each	No
		variable of interest	applicable
Outcome data	15*	Report numbers of outcome events or summary measures	Table1
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-	10-12
		adjusted estimates and their precision (eg, 95% confidence interval).	
		Make clear which confounders were adjusted for and why they were	
		included	
		(b) Report category boundaries when continuous variables were	No
		categorized	applicable
		(c) If relevant, consider translating estimates of relative risk into	No
		absolute risk for a meaningful time period	applicable
Other analyses	17	Report other analyses done-eg analyses of subgroups and	10-12
		interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	12
	10		12
Limitations	19	Discuss limitations of the study, taking into account sources of	15
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude	15
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	15
Limitations	19 19 20	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias Give a cautious overall interpretation of results considering	15
Limitations Interpretation	19 19 20	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar	15
Limitations	19 19 20	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	15
Limitations Interpretation Generalisability	10 19 20 21	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence Discuss the generalisability (external validity) of the study results	12-16 12-16 14-16
Limitations Interpretation Generalisability Other information	10       19       20       21	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence Discuss the generalisability (external validity) of the study results	12 15 12-16 14-16
Limitations Interpretation Generalisability Other information Funding	10 19 20 21 22	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence Discuss the generalisability (external validity) of the study results Give the source of funding and the role of the funders for the present	12 15 12-16 14-16 16
Limitations Interpretation Generalisability Other information Funding	10       19       20       21       22	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence Discuss the generalisability (external validity) of the study results Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present	12 15 12-16 14-16 16

\*Give information separately for exposed and unexposed groups.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.