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## Sociodemographic factors that affect the real treatment rate among patients diagnosed with benign prostatic hyperplasia

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### ABSTRACT

**Background:** Real treatment rate among patients diagnosed with benign prostatic hyperplasia (BPH/LUTS) and also its association with sociodemographic factor (SDF) have not been extensively investigated.

**Methods:** Data were obtained from the 2006, 2008, 2010, 2012, 2014, and 2016 waves of the Korean Longitudinal Study of Aging (KLoSA). Among 10,254 individuals at the first baseline survey in 2006, a total of 4383 participants were ultimately included for final analysis. For statistical analysis, chi-square tests and generalized estimating equation regression models were conducted.

**Results:** The prevalence rate of BPH/LUTS was 6.1% (266/4383) and real treatment rate was 58.3 percent (155/266). After adjusting for all confounders, odds ratio (OR) for the treatment of prostate disease in patients ages 55–64 and 65 years or more was 1.884 times higher (95% CI 1.096–3.237;  $p = .022$ ) and 2.989 times higher (95% CI 1.755–5.091;  $p < .0001$ ) than patients ages under 55, respectively. The OR for treatment of prostate disease in those residing in urban areas was 0.756 times lower (95% CI 0.573–0.998;  $p = .048$ ) than those residing in metropolitan areas. The OR for treatment of prostate disease in those with bad self-rated health was 1.886 times higher (95% CI 1.461–2.436;  $p < .0001$ ), compared to those with good self-rated health.

**Conclusion:** The real treatment rate among patients diagnosed with BPH/LUTS was 58.3%, a larger treatment rate than earlier reports. However, there are still a large proportion of patients who do not seek treatment; and age, residential area, and self-rated health were all found to be associated with real treatment rate.

### ARTICLE HISTORY

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### KEYWORDS

Benign prostatic hyperplasia; elderly; lower urinary tract symptoms

### Introduction

Benign prostatic hyperplasia/lower urinary tract symptoms (BPH/LUTS) is a non-communicable disease prevalent among men worldwide and is directly related to aging. With the shift to an aging society, BPH/LUTS the incidence and prevalence of symptomatic BPH/LUTS has rapidly increased [1]. Moreover, earlier detection and treatment of BPH/LUTS is directly related to individual quality of life and is also related to future risk of urologic complications, including acute urinary retention (AUR), urinary tract infection (UTI), or neurogenic bladder [2].

To date, there have been several studies investigating the influence of sociodemographic factors (SDF), such as age, education status, economic

status, comorbidities, residential area, etc., on the severity of BPH/LUTS [3,4]. However, only a few studies have investigated the role of SDF on real treatment rates among diagnosed BPH/LUTS patient. This could be a crucial issue since untreated BPH/LUTS may result in severe complications, including UTI, gross hematuria, urolithiasis, hydronephrosis, and renal failure [2].

BPH/LUTS treatment has evolved to encompass comfort measures [5], pharmacological treatment [6,7], and efforts to educate BPH/LUTS patient on overcoming their SDF issues. [8]. Moreover, pharmacological treatments undertaken earlier in the course of the disease can decrease AUR episodes and future need for urologic surgery for BPH/LUTS [9].

In aged men, BPH/LUTS could be affected by various metabolic status including androgen, vitamins,

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obesity, and other non-communicable comorbidities [10,11]. The fact that there are no standardized clinical definitions of BPH/LUTS makes investigating its real treatment rate difficult or effective self-assessment tool for elderly [5]. Even the real prevalence of untreated symptomatic BPH has received little investigation [1]. In one large population study, the real treatment rate was found to be only 11% among BPH/LUTS patients [12].

As mentioned above, although there have been quite a few studies investigating the role of SDF in relation to severity of BPH/LUTS [3,4,13–15], there have been very few on SDF as a mitigating factor, which can directly affect treatment access or treatment seeking [15]. A Boston Area Community Health (BACH) study reported on the effect of SDF, including education and income, to affect the severity of BPH/LUTS clinical outcomes in different male ethnicities [15]. It is clear that SDF can directly affect one's motivation to seek or maintain treatment for BPH/LUTS, thereby affecting the access [3,4,13–15]. Among people with increased access to advanced medical care, including those in urban areas, those with a high income, and a higher education status were more likely to report symptoms or seek treatment for BPH/LUTS [3,4,13–15].

The aim of our study was to investigate the prevalence of BPH/LUTS and real treatment rate for BPH/LUTS. Moreover, this study also focused on the role of SDF on treatment rate among patients with diagnosed BPH/LUTS.

## Methods

### *Study sample and design*

We obtained 2006–2016 data from the Korean Longitudinal Study of Aging (KLoSA) conducted by the Korea Employment Institute Information Service. The KLoSA is a survey of nationally representative Koreans aged 45 years or older, excluding institutionalized people and residents of Che-Ju Island, used to create a database for use in devising effective social and economic policies to address the aging population. Sampling was conducted by sorting the population surveyed in a given area and 15 residential types according to the order of the administrative codes, and then extracting the assigned number by applying a systematic extraction method (the multistage and stratified sampling method). As per the KLoSA study protocol, trained surveyors collected informed consents from participants and conducted face-to-face interviews using a computer-assisted personal

interviewing program. The study was approved by the Soonchunhyang University Hospital (No. 2018-07-022)

In the first baseline survey in 2006, 10,254 individuals in 6171 households (1.7 per household) were interviewed. There were 292 individuals with cancer. The second survey, in 2008, followed up with 8675 subjects, who represented 86.6% of the original panel. The third survey, conducted in 2010, followed up with 8229 subjects, who represented 81.7% of the original panel. The fourth survey, in 2012, followed up with 7813 subjects, who represented 80.1% of the original panel and the fifth survey, in 2014, followed up with 8387 subjects (including 920 who newly participated in the sample), who represented 80.4% of the original panel. The sixth survey, in 2016, followed up with 9913 subjects (including 878 new participants), who represented 79.6% of the original panel (Figure 1).

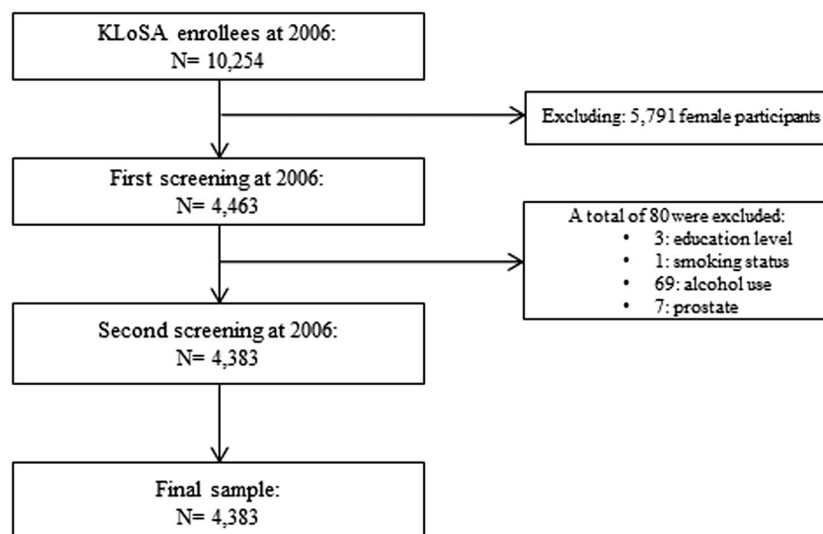
## *Variables and measurement*

### *Sociodemographic factors and health-related risk factors*

Age, education level, marital status, residential region, current economic activity and type of health insurance were considered as sociodemographic factors. Levels of education were categorized as “less than elementary school”, “middle school graduate”, “high school graduate”, or “college graduate or beyond”. Education level was categorized into two groups: low (elementary school and lower, middle school) or high (high school and college or higher).

Marital status was categorized as “married” or “unmarried”, which included “separated”, “divorced”, “widowed or disappeared”, or “never married”. The residency regions were categorized into metropolitan (Seoul), urban (administrative divisions of a city: Daejeon, Daegu, Busan, Incheon, Kwangju, or Ulsan) or rural (not classified as administrative of a city). Current economic activity was categorized as “employed” or “unemployed”. The type of health insurance was categorized into National Health Insurance (NHI) (either employee-insured or self-insured) or Medical Aid.

Participants were asked to rate their health status on a five-point Likert scale (1 corresponding to “very good” and 5 to “very bad”). Self-rated health was categorized into three groups: Good (sufficient or very sufficient), Normal (moderate), or Bad (insufficient or very insufficient). Self-reported data regarding comorbidities of hypertension, diabetes, cancer, chronic obstructive pulmonary disease, liver disease, cardiovascular disease, cerebrovascular disease, mental illness, arthritis was included and



**Figure 1.** Flow chart of study participants.

categorized into two groups:  $\leq 1$ , and  $\geq 2$ . Smoking status was categorized into nonsmoker who never smoked, former smoker, or smoker, and alcohol use was categorized into drinker or former drinker.

### Dependent variables

Prostate disease during the time interval from year 2006 to year 2016 was the main outcome of the study. Prostate disease referred to data self-reported when responding to the question, "Have you been diagnosed by a doctor with a prostate disease since the last basic survey?" First response variable were categorized as either "yes" or "no". Additionally, treatment of prostate disease was extracted from first response variable to the question, "Are you currently taking (medication for?) or being treating for prostate disease?" Second response variable were categorized as either "yes" or "no".

### Analytical approach and statistics

In this study, we employed a chi-square test and a generalized estimating equation (GEE) regression model. In GEE, proc genmod was used, with link logit, distribution normal. GEE was controlled for the characteristics of individuals that change over time, such as confounding variables. SAS statistical software package, version 9.4 (SAS Institute, Inc., Cary, NC, USA) was used in all analysis. All statistical tests were two-tailed, with the null hypothesis of no difference being rejected if  $p < .05$ .

## Results

### Sample characteristics

Table 1 shows the general characteristics of the participants. Of the 4383 participants included in our study at baseline, there were 2118 (48.3%) educated through middle school or below and 2265 (51.7%) attended high school or above. Of the middle school or below participants, 141 (6.7%) reported BPH/LUTS. Of the high school or above participants, 125 (5.5%) reported BPH/LUTS. There were 1440 (32.9%) participants aged  $\leq 54$  years, 1259 (28.7%) aged 55–64 years, and 1684 (38.4%) aged 65 years or more. In the  $\leq 54$  years group, 22 (1.5%) reported BPH/LUTS. In the 55–64 years group and 65 years or more group, 75 (6.0%) and 169 (10.0%) reported BPH/LUTS, respectively. There were 4029 (91.9%) married participants and of them, 244 (6.1%) reported BPH/LUTS. In terms of residential region, there were 736 (16.8%) metropolitan, 1246 (28.4%) urban, and 2401 (54.8%) rural participants. Of the 736 metropolitan participants, 47 (6.4%) reported BPH/LUTS.

Table 2 shows the general characteristics of the participants with BPH/LUTS. Of the 266 participants with BPH/LUTS included in our study at baseline, there were 141 (53.0%) educated through middle school or below and 125 (47.0%) at high school or above. Of the middle school or below participants, 78 (55.3%) reported treatment of BPH/LUTS. Of the high school or above participants, 77 (61.6%) reported treatment of BPH/LUTS. There were 22 (8.3%) participants aged  $\leq 54$  years, 75 (28.2%) aged 55–64 years, and 1,69 (63.5%) aged 65 years or more. In the  $\leq 54$  years

**Table 1.** General characteristics of subjects included for analysis ( $n = 4383$ ).

	Total		Benign prostatic hyperplasia				<i>p</i> -Value
	<i>N</i>	%	Yes	%	No	%	
Age							<.0001
≤54	1,440	32.9	22	1.5	1418	98.5	
55–64	1,259	28.7	75	6.0	1184	94.0	
≥65	1,684	38.4	169	10.0	1515	90.0	
Marital status							.905
Married	4,029	91.9	244	6.1	3785	93.9	
Single, separated, divorced	354	8.1	22	6.2	332	93.8	
Residential region							.911
Metropolitan	736	16.8	47	6.4	689	93.6	
Urban	1,246	28.4	76	6.1	1170	93.9	
Rural	2,401	54.8	143	6.0	2258	94.0	
Education level							.115
≤Elementary/middle school	2,118	48.3	141	6.7	1977	93.3	
High school/≥college	2,265	51.7	125	5.5	2140	94.5	
Current economic activity							<.0001
Employed	2,524	57.6	92	3.7	2432	96.4	
Unemployed	1,859	42.4	174	9.4	1685	90.6	
Health insurance							.050
National Health Insurance	4,138	94.4	244	5.9	3894	94.1	
Medical Aid	245	5.6	22	9.0	223	91.0	
Self-rated Health							<.0001
Good	2,036	46.5	53	2.6	1983	97.4	
Normal	1,340	30.6	95	7.1	1245	92.9	
Bad	1,007	23.0	118	11.7	889	88.3	
Number of chronic disease*							<.0001
≤1	3,654	83.4	90	2.5	3564	97.5	
≥2	729	16.6	176	24.1	553	75.9	
Smoking status							<.0001
Never	1,710	39.0	108	6.3	1602	93.7	
Former smoker	922	21.0	93	10.1	829	89.9	
Smoker	1,751	40.0	65	3.7	1686	96.3	
Alcohol use							<.0001
Drinker	3,848	87.8	213	5.5	3635	94.5	
Former drinker	535	12.2	53	9.9	482	90.1	
Total	4,383	100.0	266	6.1	4117	93.9	

\*Hypertension, diabetes, cancer, chronic obstructive pulmonary disease, liver disease, cardiovascular disease, cerebrovascular disease, mental illness, arthritis.

group, 6 (27.3%) reported treatment for BPH/LUTS. In the 55–64 years group and 65 years or more group, 42 (56.0%) and 107 (63.3%) reported treatment for BPH/LUTS, respectively. There were 244 (91.7%) married participants and of them, 142 (58.2%) reported treatment for BPH/LUTS. In terms of residential region, there were 47 (17.7%) metropolitan, 76 (28.6%) urban and 143 (53.8%) rural. Of the 47 metropolitans, 33 (70.2%) reported treatment of BPH/LUTS and of the 76 urbans, 45 (59.2%) reported treatment for BPH/LUTS.

### **Relationship between sociodemographic factors and BPH/LUTS and its treatment rate**

Table 3 represents effects of SFD on BPH/LUTS after fully adjusting for age, marital status, residential region, education level, current economic activity, national health insurance, self-rated health, number of chronic diseases, smoking status, use, and year. After adjusting for all of these confounders, the odds of BPH/LUTS in older participants of 65 years or more were 4.121 times higher (95% CI 3.193–5.316;  $p <$

.0001) than those of people aged 54 years or below. The odds ratio of BPH/LUTS in married participants was 1.211 times higher (95% CI 1.022–1.435;  $p = .027$ ) than that in unmarried participants, a categorization which included never married, separated, and divorced. The odds ratio of BPH/LUTS in people who attended high school or above was 1.222 times higher (95% CI 1.105–1.352;  $p < .0001$ ) than those with middle school education or below. The odds ratio of BPH/LUTS in unemployed people was 1.185 times higher (95% CI 1.059–1.327;  $p = .003$ ) than that in employed people.

Table 4 shows a subgroup analysis of the relationship between sociodemographic factors and real treatment rate among BPH/LUTS patients. After adjusting for all confounders, the OR for real treatment rate in people aged 55–64 and 65 years or more was 1.884 times higher (95% CI 1.096–3.237;  $p = .022$ ) and 2.989 times higher (95% CI 1.755–5.091;  $p < .0001$ ), respectively than patients under 55 years.

The OR for real treatment in those residing in urban areas was 0.756 times lower (95% CI 0.573–0.998;  $p =$



**Table 2.** General characteristics for real treatment rate among benign prostatic hyperplasia ( $n = 266$ ).

	Total		Treatment of benign prostatic hyperplasia				<i>p</i> -Value
	<i>N</i>	%	Yes	%	No	%	
Age							.005
≤54	22	8.3	6	27.3	16	72.7	
55–64	75	28.2	42	56.0	33	44.0	
≥65	169	63.5	107	63.3	62	36.7	
Marital status							.935
Married	244	91.7	142	58.2	102	41.8	
Single, separated, divorced	22	8.3	13	59.1	9	40.9	
Residential region							.140
Metropolitan	47	17.7	33	70.2	14	29.8	
Urban	76	28.6	45	59.2	31	40.8	
Rural	143	53.8	77	53.9	66	46.2	
Education level							.300
≤Elementary/middle school	141	53.0	78	55.3	63	44.7	
High school/≥college	125	47.0	77	61.6	48	38.4	
Current economic activity							.012
Employed	92	34.6	44	47.8	48	52.2	
Unemployed	174	65.4	111	63.8	63	36.2	
Health insurance							.325
National Health Insurance	244	91.7	140	57.4	104	42.6	
Medical Aid	22	8.3	15	68.2	7	31.8	
Self-rated Health							.187
Good	53	19.9	25	47.2	28	52.8	
Normal	95	35.7	58	61.1	37	39.0	
Bad	118	44.4	72	61.0	46	39.0	
Number of chronic disease*							.090
≤1	90	33.8	46	51.1	44	48.9	
≥2	176	66.2	109	61.9	67	38.1	
Smoking status							.605
Never	108	40.6	61	56.5	47	43.5	
Former smoker	93	35.0	58	62.4	35	37.6	
Smoker	65	24.4	36	55.4	29	44.6	
Alcohol use							.111
Drinker	213	80.1	119	55.9	94	44.1	
Former drinker	53	19.9	36	67.9	17	32.1	
Total	266	100.0	155	58.3	111	41.7	

\*Hypertension, diabetes, cancer, chronic obstructive pulmonary disease, liver disease, cardiovascular disease, cerebrovascular disease, mental illness, arthritis.

.048) than in those residing in metropolitan areas. The OR for real treatment in unemployed people was 1.451 times higher (95% CI 1.191–1.776;  $p = .000$ ) than in employed people, and OR for real treatment in those with bad self-rated health was 1.886 times higher (95% CI 1.461–2.436;  $p < .0001$ ) than in those with good self-rated health.

## Discussion

Our study represents the prevalence rate of BPH/LUTS among a nationally representative population sample and also represents the treatment rate among those patients diagnosed with BPH/LUTS. Considering the chronic nature of the disease, BPH/LUTS requires constant monitoring and continuous treatment, so knowing the real treatment rate is crucial because it might affect both individuals with the disease and the economic burden to the healthcare system [9,16]. Moreover, evidence that BPH/LUTS is a progressive disease is growing. Our study showed that the prevalence

rate of BPH/LUTS was 6.1% and the real treatment rate among diagnosed BPH/LUTS was 58.3%.

Several other studies have reported the overall prevalence rates for BPH/LUTS as being 14 ~ 40% [13,17] and 9 ~ 20% among those over 50 years old [18]. The prevalence rate of BPH/LUTS found in our study is a little smaller than other studies, which could be attributed to the definition of disease by self-questionnaire and not by objective symptom severity or biologic tests. In a cross-sectional study in the United Kingdom, the real intention to treat rate was only reported as 41% among those patients with moderate to severe LUTS [19]. In our study, the treatment rate was 58.3%, which was quite a bit higher than other reports. A longitudinal study investigating the long-term treatment compliance rate of BPH/LUTS found 27.1% among those patients had started medication more than 9 months ago and 17.6% among those patients had been taking medication for more than a year [20].

Our previous studies have shown that the self-perception period for LUTS, which is defined as the

**Table 3.** Adjusted effect between Sociodemographic factors and benign prostatic hyperplasia.

	Benign prostatic hyperplasia			p-Value
	OR	95% CI		
Age				
≤54	1.000			
55–64	2.166	1.675	2.799	<.0001
≥65	4.121	3.193	5.316	<.0001
Marital status				
Married	1.211	1.022	1.435	.027
Single, separated, divorced	1.000			
Residential region				
Metropolitan	1.000			
Urban	1.045	0.899	1.216	.564
Rural	1.040	0.907	1.192	.579
Education level				
≤Elementary/middle school	1.000			
High school/≥college	1.222	1.105	1.352	<.0001
Current economic activity				
Employed	1.000			
Unemployed	1.185	1.059	1.327	.003
Health insurance				
National Health Insurance	1.000			
Medical Aid	1.048	0.867	1.266	.629
Self-rated Health				
Good	1.000			
Normal	1.141	1.001	1.300	.049
Bad	1.038	0.897	1.201	.618
Number of chronic disease*				
≤1	1.000			
≥2	7.861	7.039	8.778	<.0001
Smoking status				
Never	1.000			
Former smoker	1.190	1.066	1.329	.002
Smoker	0.795	0.697	0.907	.001
Alcohol use				
Drinker	1.019	0.912	1.139	.736
Former drinker	1.000			
Year				
2006	1.000			
2008	1.122	0.934	1.348	.219
2010	1.365	1.142	1.632	.001
2012	1.470	1.232	1.754	<.0001
2014	1.422	1.194	1.695	<.0001
2016	1.390	1.166	1.657	.000

CI: confidence interval; OR: odds ratio.

\*Hypertension, diabetes, cancer, chronic obstructive pulmonary disease, liver disease, cardiovascular disease, cerebrovascular disease, mental illness, arthritis.

duration from feeling the first discomfort of LUTS until a real time to visit to the hospital to seek proper treatment, could be regarded as the untreated period [3,4]. This self-perception period for LUTS was affected by various SDF factors and life-style factors [3,4]. Moreover, several studies have shown fundamental differences regarding perceptions of BPH/LUTS, including treatment and monitoring between patients and doctors [21–23].

The treatment rate for BPH/LUTS could be affected by two factors: (1) compliance rate among those patients who started any treatment for BPH/LUTS and (2) self-perception of BPH/LUTS which resulted in seeking treatment after or prior to diagnosis of BPH/LUTS. Numerous studies have dealt with compliance issues

**Table 4.** Adjusted effect between Sociodemographic factors and treatment of benign prostatic hyperplasia.

	Treatment of benign prostatic hyperplasia			p-Value
	OR	95% CI		
Age				
≤54	1.000			
55–64	1.884	1.096	3.237	.022
≥65	2.989	1.755	5.091	<.0001
Marital status				
Married	0.895	0.650	1.231	.494
Single, separated, divorced	1.000			
Residential region				
Metropolitan	1.000			
Urban	0.756	0.573	0.998	.048
Rural	0.834	0.646	1.076	.162
Education level				
≤Elementary/middle school	1.000			
High school/≥college	1.047	0.874	1.254	.617
Current economic activity				
Employed	1.000			
Unemployed	1.451	1.191	1.766	.000
Health insurance				
National Health Insurance	1.000			
Medical Aid	0.964	0.686	1.354	.831
Self-rated Health				
Good	1.000			
Normal	1.520	1.201	1.925	.001
Bad	1.886	1.461	2.436	<.0001
Number of chronic disease*				
≤1	1.000			
≥2	0.899	0.727	1.111	.325
Smoking status				
Never	1.000			
Former smoker	1.070	0.879	1.303	.498
Smoker	1.220	0.953	1.561	.114
Alcohol use				
Drinker	0.839	0.688	1.023	.084
Former drinker	1.000			
Year				
2006	1.000			
2008	0.815	0.579	1.148	.243
2010	0.950	0.683	1.322	.761
2012	0.973	0.702	1.347	.867
2014	1.045	0.755	1.447	.790
2016	1.131	0.817	1.566	.459

CI: confidence interval; OR: odds ratio.

\*Hypertension, diabetes, cancer, chronic obstructive pulmonary disease, liver disease, cardiovascular disease, cerebrovascular disease, mental illness, arthritis.

after initiation of treatment for BPH/LUTS; however, few studies focused on the issue of self-perception of BPH/LUTS. Interestingly, these self-perceptions could be affected by various SDF factors and could explain the potential role of SDF as mitigating factors to aggravate the severity of BPH/LUTS. Our study directly focused on this issue and showed that age, residential area, employment state and self-rated health were significant SDF factors that predicted the treatment rate among patients diagnosed with BPH/LUTS.

Other studies have shown that age, income status, and racial differences were associated with BPH/LUTS not recognized as a condition needing treatment, which is related to the self-perception period or non-treatment rate among BPH/LUTS patients [13]. Age



could be regarded as both a biologic and SDF factor, but recently the mean age of unrecognized or unrecognized BPH/LUTS were found to be similar [24], which means that the role of age as an SDF factor is not as powerful as the role of age as a biologic factor. Our study showed that the treatment rate was significantly affected by age; however, this could have been due to the general trend of LUTS severity according to age. In other reports, younger aged patients with high education status and high income status have higher rates of treatment access, which resulted in a higher diagnosis rate of LUTS [25].

Other SDF factors of ethnicity, education status, economic status, and residential area were found to be associated with the prevalence of BPH/LUTS [14,15,26]. A BACH study showed a marked difference according to ethnicity regarding prevalence rate of BPH/LUTS [15]. It is plausible that those patients with low income and low education status could not fully understand or accept the definition of LUTS by questionnaire, nature of disease, and method to access to the urologic care [14,26].

In our study, among the SDF or life style factors, education level, age, marital status, number of chronic diseases, employment state, smoking status, and year were significantly associated with the diagnosis of BPH/LUTS. However, as mentioned above, only age, residential area, employment state and self-rated health were related to real treatment rate among those patients with BPH/LUTS. Interestingly, non-employed people had significantly higher real treatment rates than employed people. The higher treatment rate seen in nonemployed people could be due to more time available for hospital visits.

In real practice, self-perception of BPH/LUTS, which is related to treatment rate, could persist for a relatively long time. A possible reason for this phenomenon is that patients could perceive severity of LUTS as just an aging phenomenon, together with other natural physiologic changes [16,27,28]. This perception may also lead to decreased access to medical care, which could allow symptoms to progress. Moreover, although BPH/LUTS is a progressive disease, LUTS itself acts as a dynamic status, which can result in spontaneous improvement or aggravation [29–31]. Diverse health care system may influence patients' access to hospitals for treatment of LUTS [32]. Advancing age, itself, has a negative impact on real BPH/LUTS treatment; hence, individual approach to educate the symptom and to treatment and outcome are needed [33].

Our study has potential strengths. First, we have focused on the real treatment rate which is much more important than prevalence rate of BPH/LUTS in terms of prevention of disease progression. Second, this study is a large and nationally representative study in an aged cohort. Lastly, vigorous methodology with diverse variables were considered in order to properly estimate the effect of SDF on real treatment rates. However, there are several limitations, too. First, self-reported BPH/LUTS without a validated questionnaire or objective diagnostic tool including uroflowmetry or urodynamic studies may lead to misclassification or underestimation of the prevalence of BPH/LUTS because the self-reporting tool could be affected by various factors. Second, this study does not include information about severity of LUTS, hence, we could not consider LUTS severity as confounding factors or covariates. Third, considering that this study is including old population cohort, specific factors including individual status of management by caregivers or comorbidities. Older patients with caregivers or comorbidities have better compliance to treatment than those with self-managed patient [34]. Lastly, the study design is a cross-sectional one, hence, a direct causal relationship could not be established.

## Conclusion

The real treatment rate among patients diagnosed with BPH/LUTS was 58.3%, a larger prevalence rate than earlier reports. However, there remains a large portion of patients who do not seek treatment; and age, residential area, and self-rated health were associated with real treatment rate. Considering the progressive nature of BPH/LUTS and the increasing incidence and prevalence of BPH/LUTS in an aged society, more studies are needed to investigate possible risk factors and also to design a prospective trial to determine whether education could increase the real treatment rate for BPH/LUTS.

## Ethical approval

The present study protocol was reviewed and approved by the institutional review board of Soonchunhyang University Seoul Hospital (Reg. No. 2018–07–022).

## Disclosure statement

No potential conflict of interest was reported by the authors.

## Author contribution

Conceptualization: Jin-Won Noh, Jae-Hyun Kim, Young Dae Kwon and Jae Heon Kim; Data curation: Jin-Won Noh and Jae-Hyun Kim; Formal analysis: Jin-Won Noh and Jae-Hyun Kim; Funding acquisition: Jae Heon Kim, Methodology: Jin-Won Noh, Jae-Hyun Kim and Young Dae Kwon; Project administration: Jin-Won Noh, Jae-Hyun Kim, Young Dae Kwon and Jae Heon Kim; Supervision: Young Dae Kwon; Writing – original draft: Jin-Won Noh, Jae-Hyun Kim, Young Dae Kwon and Jae Heon Kim; Writing – review & editing: Jin-Won Noh, Jae-Hyun Kim, Young Dae Kwon and Jae Heon Kim.

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