Community-based research on the benign prostatic hyperplasia prevalence rate in Korean rural area

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Purpose: We investigated the prevalence rate of benign prostatic hyperplasia (BPH) among Korean males in a rural area through a cross-sectional, community-based epidemiologic survey and analyzed the correlation with epidemiologic factors.

Materials and Methods: A total of 779 males who lived in Yangpyeong County participated in a prostate examination campaign. Targeting these men, we collected the International Prostate Symptom Score (IPSS), medical history, demographic information, serum prostate-specific antigen, and prostate volume as measured by transrectal ultrasonography. The data for 599 participants were analyzed, excluding 180 men who had a possibility of prostate cancer. BPH was defined as an IPSS of 8 points or higher and a prostate volume of 25 mL or more.

Results: The prevalence rate of BPH was 20.0%. The prevalence rate increased with age. There were 2 subjects (4.4%) in the age group of 40–49 years, 18 subjects (10.9%) in the age group of 50–59 years, 44 subjects (22%) in the age group of 60–69 years, and 56 subjects (26.6%) in the age group of over 70 years; this increase with age was statistically significant (p<0.001). In the BPH group, the average IPSS was 14.67±5.95, the average prostate volume was 37.04±11.71 g, and the average prostate-specific antigen value was 1.56±0.88 ng/mL. In the analysis of correlations between the epidemiologic factors and the risk of BPH, smoking was the only statistically significant factor.

Conclusions: The total prevalence rate of BPH in this study was 20.0%, which was a little lower than the rate reported in other cities or rural areas.

Keywords: Prevalence; Prostatic hyperplasia

INTRODUCTION

Benign prostatic hyperplasia (BPH) is one of the most frequently occurring urologic diseases in men older than 50. BPH induces lower urinary tract symptoms (LUTS). The bladder outlet obstruction causes a variety of urinary symptoms including nocturia, incomplete voiding, urgency, and hesitancy and comes to the fore as a significant health problem interrupting the quality of life of men over middle age. The prevalence rate of BPH increases with age; BPH occurs in 40% to 70% of men aged 60 to 70 years [1,2]. The current Korean population is aging very

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rapidly compared with other countries; with this, interest in health after middle age is increasing throughout society. However, owing to a lack of recognition about BPH, the time until visiting the hospital is often delayed, and this tendency is truer in rural areas than in urban areas. In this situation, it is necessary to understand the prevalence rate of BPH, but few systematic epidemiologic investigations have been carried out about BPH in Korea. Also, there are limitations in the epidemiologic research conducted so far because the previous data were not collected by use of standardized diagnostic criteria or a specific clinical definition. Therefore, in this study, the prevalence rate of BPH was estimated among males living in the rural Korean area of Yangpyeong Country. Also, we investigated the correlation between epidemiologic factors and BPH.

MATERIALS AND METHODS

1. Research participants

This study was conducted to investigate the prevalence rate of BPH and its related factors on the basis of an epidemiologic investigation among males in one rural community in Korea. The Department of Preventive Medicine and the Department of Urology in Hanyang University Guri Hospital planned the cohort research by targeting Yangpyeong County. We recruited subjects through a prostate health screening campaign.

The participants of this study were males aged 40 and above in Yangpyeong County, Gyeonggi-do. The participants were recruited over August to September 2009, August 2010, and August 2011. Trained investigators collected the International Prostate Symptom Score (IPSS), individual medical history, and demographic information for each participant. We excluded those already diagnosed with BPH who were receiving treatment and taking health food supplements. Prostate disease was assessed by measuring serum prostate-specific antigen (PSA), a doctor's medical examination by interview, a digital rectal examination, and prostate volume by transrectal ultrasound (SA6000II, Medison Inc., Seoul, Korea). A total of 799 males responded to all of the survey questions and underwent examinations. Among them, 668 subjects remained for study after the exclusion of 1 person who did not consent to participate in the study, 1 person who had a prostate cancer history, and 109 subjects who were missing the digital rectal examination, transrectal ultrasonography, or other epidemiologic information. Among these subjects, data were analyzed from the 599 subjects finally participating in this study after the exclusion of subjects in whom a nodule was perceived or who had a serum PSA score of 4.0 or higher and thus who might have prostate cancer (Fig. 1) The severity of LUTS was evaluated by the IPSS and quality of life and the participants were divided into four groups by age (40–49, 50–59, 60–69, and 70 years and above). This study was approved by the Institutional Review Board (IRB) of Hanyang University College of Medicine. The IRB numbers were HYUH IRB 2010-R-38 and 2011-07-005.
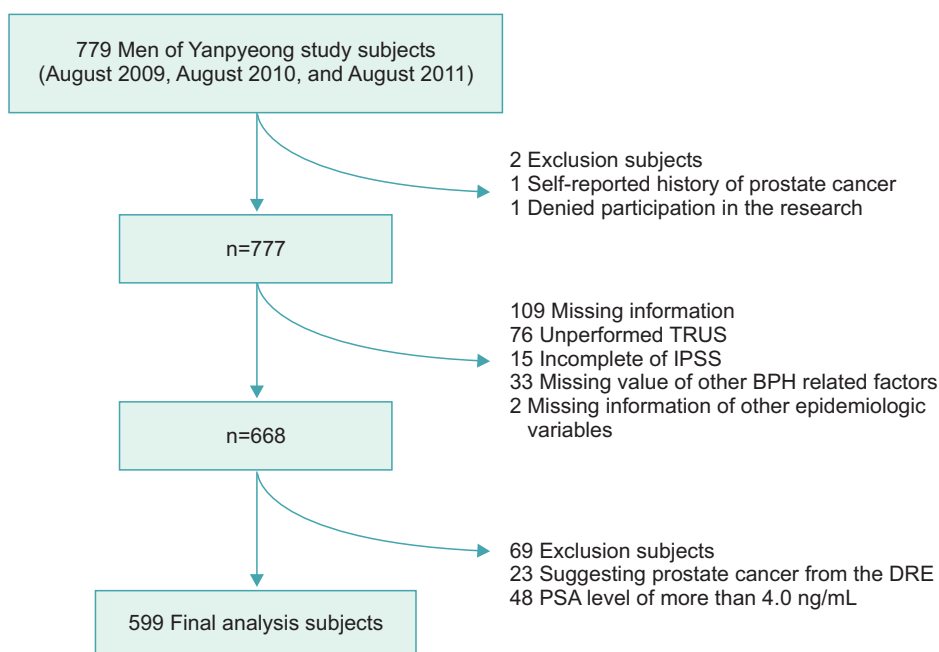

Fig. 1. Flow chart of the selection of subjects for the study. TRUS, transrectal ultrasonography; IPSS, International Prostate Symptom Score; PSA, prostate-specific antigen.

2. Criteria of epidemiologic investigation

In this study, BPH was defined as a score of 8 or higher on the IPSS and a prostate volume of 25 mL or above by transrectal ultrasonography, according to the criteria of the fourth edition of the textbook of urology published by the Korean Urological Association. The prevalence rate of BPH was compared by classifying the groups by age: 40–49, 50–59, 60–69, and 70 years and above. In addition, the prevalence rate of each LUTS was checked by classifying the total IPSS in each group into a mild symptom group (score of 1–7), a moderate symptom group (score of 8–19), and a severe symptom group (score of 20–35) [3]. Additionally, the analysis was conducted on the correlations between the epidemiologic factors (age, marital status, education level, smoking status, alcohol consumption status, regular exercise, body mass index [BMI]), comorbidities (hypertension, diabetes), and serum PSA and BPH.

3. Statistical analysis

SAS ver. 9.2 (SAS Institute Inc., Cary, NC, USA) was used for the statistical analysis; we also used the chi-square test, independent t-test, analysis of variance, and logistic regression analysis. The results of the statistical analysis were considered to be significant when the p-value was less than 0.05.

RESULTS

1. Prevalence rate of BPH

A total of 599 subjects participated in this study. The participants' average age was 63.72±9.40 years. There were 45 subjects (7.5%) in the aged 40–49 years group, 165 subjects (27.5%) in the aged 50–59 years group, 200 subjects (33.4%) in the aged 60–69 years group, and 189 subjects (31.5%) in the aged 70 years and above group. The prostate volume of the entire group of participants was 30.25±10.14 g, and the average PSA level was 1.20±0.79 ng/mL. The IPSS and the quality of life score were 5.96±6.72 and 2.70±1.04, respectively. In the age groups, the IPSS was 2.22±3.76 in men aged 40–49 years, 3.50±5.06 in those aged 50–59, 6.75±6.94 in those aged 60–69, and 8.16±7.28 in men aged 70 or more. These changes with age were statistically significant (p<0.001). Also, prostate volume was 25.36±5.22 g in men aged 40–49 years, 30.29±9.12 g in men aged 50–59 years, 30.54±9.7 g in men aged 60–69 years, and 31.07±11.91 g in men aged 70 years and above, and these age-related increases were statistically significant (p=0.008).

A total of 120 subjects (20.0%) in the entire group of participants met the standard of BPH as defined in this study. When we examined the prevalence rate according to age, we found that the prevalence rate increased with age. There were 2 subjects (4.4%) with BPH in the and aged 40–49 years group, 18 subjects (10.9%) in the aged 50–59 years group, 44 subjects (22%) in the aged 60–69 years group, and 56 subjects (26.6%) in the aged 70 years and above group, and this increase with age was statistically significant (p<0.001) (Table 1).

2. Distribution of factors associated With BPH

A total of 120 participants (20%) met the definition

Table 1. Basic characteristics of the study subjects

Characteristic	Age groups (y)					p-value
	Total (n=599)	40–49 (n=45)	50–59 (n=165)	60–69 (n=200)	≥70 (n=189)	
IPSS	5.96±6.72	2.22±3.76	3.50±5.06	6.75±6.94	8.16±7.28	<0.001
1–7	414 (69.1)	38 (84.5)	139 (84.2)	129 (64.5)	108 (57.1)	
8–19	152 (25.4)	7 (15.6)	24 (14.6)	56 (28.0)	65 (34.4)	
20–35	33 (5.5)	0 (0)	2 (1.2)	15 (7.5)	16 (8.5)	
Quality of life score	2.70±1.04	2.40±0.86	2.40±0.99	2.86±1.03	2.86±1.06	<0.001
Prostate volume (g)	30.25±10.14	25.36±5.22	30.29±9.12	30.54±9.70	31.07±11.91	0.008
<25	198 (33.1)	23 (51.1)	52 (31.5)	66 (33.0)	57 (30.2)	0.057
≥25	401 (66.9)	22 (48.9)	113 (68.5)	134 (67.0)	132 (69.8)	
PSA (ng/mL)	1.20±0.79	0.90±0.61	1.15±0.74	1.19±0.76	1.33±0.87	0.005
BPH prevalence						
Non-BPH	479 (80.0)	43 (95.6)	147 (89.1)	156 (78.0)	133 (70.4)	
BPH	120 (20.0)	2 (4.4)	18 (10.9)	44 (22.0)	56 (26.6)	<0.001

Values are presented as mean±standard deviation or number (%).
IPSS, International Prostate Symptom Score; PSA, prostate-specific antigen; BPH, benign prostatic hyperplasia.
The p-values were calculated using one-way analysis of variance for continuous variable and chi-square test for categorical variables. Significant at p<0.05.

of BPH in this study. The average age of the BPH group was 68.23±8.52 years, the average IPSS was 14.67±5.95, the average prostate volume was 37.04±11.71 g, and the average PSA level was 1.56±0.88 ng/mL (Table 2). In the subscores of the IPSS, the score for weak urinary stream was highest (3.37±2.08); the scores for incomplete emptying (2.43±2.18), hesitancy (2.19±2.15), and nocturia (2.05±1.31) were also high. In the survey questions about quality of life, the overall inconvenience of the patients due to their current urinary symptoms was used for the score; the scores were divided from 0 as very satisfied to 6 as very dissatisfied. The quality of life score was significantly higher in the BPH group (3.48±0.93) than in the non-BPH group (2.50±0.91).

3. Analysis of the factors influencing BPH

In this study, we conducted a correlation analysis to determine whether epidemiologic factors (marital status, education level, smoking status, alcohol consumption status, BMI, and regular exercise) and comorbidities (hypertension and diabetes) influenced the risk of BPH. A statistically significant factor was smoking status. The non-BPH group had a higher proportion of smokers than did the BPH group (Table 3). The reason the epidemiologic factors including lifestyle did not show a significant correlation may be that this study was based on a cross-sectional design that did not clearly show a sequential relationship by time. In the case of the BPH group, the patients' uncomfortable urinary status could have already influenced changes in health behavior.

DISCUSSION

BPH generally occurs in males in their 50s; 80% of males in their 70s suffer from the LUTS related to BPH [1]. Because in current Korean society the population is aging, the older population is rapidly increasing. Additionally, the incidence of metabolic syndrome, which is a risk factor for BPH, and the number of patients with obesity are also annually increasing owing to westernized eating habits. BPH and LUTS could lead to social problems caused by the increase in annual medical expenses related to serious complications such as falls, depression, and reduced quality of life, particularly in the elderly [4-6]. In this situation, it is necessary to conduct systematic epidemiologic investigations of the prevalence rate of BPH in Korea.

To investigate the prevalence rate of BPH, it is first necessary to clarify the diagnostic criteria of BPH. Although methods exists for the diagnosis of BPH, including taking the patient's medical history and recording urinary symptoms, prostate volume measurement by digital rectal examination and trans-rectal ultrasonography, peak urinary flow rate (Qmax), and residual urine measurement, accurate diagnostic

Table 2. Comparisons of factors between subjects with and without BPH

Variable	BPH (n=120)	Non-BPH (n=479)	p-value
Age (y)	68.23±8.52	62.59±9.27	<0.001
IPSS components			
Feeling of incomplete emptying	2.43±2.18	0.49±1.27	<0.001
Frequency	1.81±1.98	0.43±1.10	<0.001
Intermittency	1.69±2.05	0.25±0.87	<0.001
Urgency	1.13±1.99	0.21±0.89	<0.001
Weak stream	3.37±2.08	0.85±1.63	<0.001
Straining	2.19±2.15	0.50±1.31	<0.001
Nocturia	2.05±1.31	1.04±1.07	<0.001
Quality of life score	3.48±0.93	2.50±0.97	<0.001
IPSS	14.67±5.95	3.78±4.89	<0.001
0	0 (0)	108 (22.6)	<0.001
1–7	0 (0)	306 (63.9)	-
8–19	96 (80.0)	56 (11.7)	-
20–35	24 (20.0)	9 (1.88)	-
Prostate volume (g)	37.04±11.71	28.55±8.94	<0.001
PSA (ng/mL)	1.56±0.88	1.11±0.74	<0.001

Values are presented as mean±standard deviation or number (%).
BPH, benign prostatic hyperplasia; IPSS, International Prostate Symptom Score; PSA, prostate-specific antigen.
The p-values were calculated using independent t-test for continuous variable and chi-square test for categorical variables. Significant at p<0.05.

criteria have not been established. Currently, BPH is mainly defined clinically on the basis of the IPSS, prostate volume, and Qmax. Garraway et al. [2] defined BPH as urinary symptoms, prostate volume of 20 mL or more as measured by transrectal ultrasonography, and Qmax of 15 mL/s or less. In their study, they reported that the prevalence rate of BPH was 14% in males in their 40s and 40% in males in their 70s. Bosch et al. [7] defined BPH as a prostate volume of 30 mL or more and IPSS of 8 points or higher and reported a BPH prevalence rate of 19%. In a study targeting males aged 40 years and older in Spain. In studies defining BPH in Korea, Rhew et al. [8] defined BPH as an IPSS of 8 points or higher and a Qmax of 10 mL/s or less [8]. Chung et al. [9] defined it as an IPSS of 8 points or higher, prostate volume by digital rectal examination of 30 mL or more, and Qmax of 15 mL/

Table 3. Age-adjusted and multivariate OR (95% CI) of BPH risk according to selected factors

Variable	BPH (n=120), n (%)	Non-BPH (n=479), n (%)	Age adjusted model, OR (95% CI)	Multivariate model, OR (95% CI)
Age (y)				
40–49	2 (1.6)	43 (9.0)	1.00 (Referent)	1.00 (Referent)
50–59	18 (15.0)	147 (30.7)	2.63 (0.59–11.80)	2.51 (0.55–11.47)
60–69	44 (36.7)	156 (32.6)	6.06 (1.41–26.02)	5.40 (1.22–23.79)
≥70	56 (46.7)	133 (27.8)	9.05 (2.12–38.65)	6.74 (1.51–30.17)
Prostate specific antigen (ng/mL)				
<2.5	97 (80.8)	449 (93.7)	1.00 (Referent)	1.00 (Referent)
2.5–3.9	23 (19.2)	30 (6.3)	2.98 (1.63–5.43)	2.75 (1.48–5.12)
Marrital status				
Married	113 (94.2)	421 (94.2)	1.00 (Referent)	1.00 (Referent)
Single[a]	7 (5.8)	28 (5.8)	0.89 (0.37–2.13)	0.85 (0.34–2.12)
Educational status				
High school or higher	48 (40.0)	214 (44.7)	1.00 (Referent)	1.00 (Referent)
Middle school	21 (17.5)	104 (21.7)	0.86 (0.48–1.53)	0.91 (0.50–1.67)
Elementary or below	51 (42.5)	161 (33.6)	0.98 (0.61–1.57)	1.04 (0.63–1.71)
Smoking status				
Never	41 (34.2)	126 (26.3)	1.00 (Referent)	1.00 (Referent)
Ex-smoker	63 (52.5)	222 (46.4)	0.78 (0.49–1.23)	0.79 (0.49–1.28)
Current smoker	36 (13.3)	131 (27.4)	0.40 (0.21–0.75)	0.44 (0.22–0.85)
Drinking status				
Never	26 (21.7)	75 (15.7)	1.00 (Referent)	1.00 (Referent)
Ex-drinker	27 (22.5)	70 (14.6)	1.00 (0.53–1.91)	1.06 (0.54–2.08)
Current drinker	67 (55.8)	334 (69.7)	0.66 (0.38–1.12)	0.67 (0.38–1.17)
Body mass index (kg/m^2)				
<23.0	41 (42.5)	170 (35.5)	1.00 (Referent)	1.00 (Referent)
23.0–24.9	22 (18.3)	118 (24.6)	0.67 (0.38–1.18)	0.63 (0.35–1.14)
≥25	47 (39.2)	191 (39.9)	1.11 (0.69–1.78)	0.95 (0.57–1.58)
Regular exercise				
Yes	40 (33.3)	167 (34.9)	1.00 (Referent)	1.00 (Referent)
No	80 (66.7)	312 (65.1)	0.94 (0.61–1.46)	0.97 (0.61–1.55)
Chronic diseases				
Hypertension				
No	68 (56.7)	298 (62.2)	1.00 (Referent)	1.00 (Referent)
Yes	52 (43.3)	181 (37.8)	1.13 (0.75–1.72)	1.12 (0.72–1.75)
Diabetes				
No	95 (79.2)	391 (81.6)	1.00 (Referent)	1.00 (Referent)
Yes	25 (20.8)	88 (18.4)	1.18 (0.71–1.96)	1.13 (0.66–1.93)

OR, odds ratio; CI, confidence interval; BPH, benign prostatic hyperplasia.
[a]:Single including widowed, divorced or separated, and never married.

s or less. In studies investigating the prevalence rate in Seongnam City and Jeju Island, BPH was defined as an IPSS of 8 points or higher and prostate volume measured by transrectal ultrasonography of 30 mL or more [10,11]. In this study, BPH diagnosis was based on the symptom score and the prostate volume, and uroflowmetry examination was excluded. The reason the uroflowmetry examination was excluded was as follows. First, Blanker et al. [12] reported that the BPH prevalence rate defined by two variables including symptom score and prostate volume and the BPH prevalence rate defined by three variables including symptom score, prostate volume, and Qmax were 12% and 10%, respectively, and that there was no statistically significant difference between the two rates [10]. Second, it was thought that there could be many errors when determining BPH based on 10 mL/s or less or 15 mL/s or less in epidemiologic examinations because uroflowmetry can vary depending on the amount of urination [11]. Jakobsen et al. [13] measured prostate volume through transrectal ultrasonography by targeting 175 males whose ages were between 27 and 70 years; the average prostate volume of adenoma prostate was significantly higher than that of nonadenoma prostate: 28.0 mL (range, 14.5–62.1 mL) vs. 23.0 mL (range, 11.3–39.1 mL) [13]. Therefore, those authors proposed criteria for BPH as an IPSS of 8 points or higher and a prostate volume by transrectal ultrasonography of 25 mL or more.

The BPH prevalence rate was 20% (120/599 subjects) in the present study and lower than the rate in other reports in Korea. The reason for this could be that 210 of 599 males (35%) were in their 40s to 50s and were thus relatively younger than the groups in the other studies in Korea. BPH prevalence rates reported in Korea were 40% in the urban area of Seongnam and 25.5% in Busan [8,11]. In addition, the prevalence rates were 23.2% in the rural area of Yeoncheon, Gyeonggi-do, and 27.7% in the inland area of Chungcheongbuk-do [14,15]. The reasons for the differences in the prevalence rate are as follows. First, there were variables in the epidemiologic investigation, such as the selection of the target group and regional differences in the population. Second, the diagnostic criteria for BPH differed in each investigation. The prevalence rate in Seongnam was much higher than in other regions because the study was an epidemiologic investigation targeting the elderly population (65 years old and above). Although Lee et al. [14] conducted an epidemiologic investigation for the first time in Yeoncheon area in 1995, they only conducted a survey of the IPSS and then estimated the prevalence rate

of BPH. Chung et al. [9] reported that the BPH prevalence rate as assessed by LUTS, digital rectal examination, and uroflowmetry examination was 11%; here, the question about the accuracy of measuring prostate size could be raised because the prostate volume was measured by digital rectal examination. In this study, the survey and the epidemiologic investigation were performed by interviewers who were sufficiently trained; unlike other authors' measurement of the prostate volume by digital rectal examination, it could be thought that the reliability would be high because the prostate volume was accurately measured by transrectal ultrasonography.

Epidemiologic research on BPH has greatly evolved over the past several years, and many epidemiologic data have been accumulated. Even though age and genetics play an important role as causes of BPH, it is notable that lifestyle factors such as metabolic syndrome or cardiovascular disease, which can be corrected, have a considerable impact on the natural progression of BPH [16]. One cohort study showed that LUTS prevalence increased by 80% in the group diagnosed with at least three components of the metabolic syndrome compared with the group without diagnosed components of the metabolic syndrome. Additionally, other studies have shown that the risk of BPH and LUTS is significantly increased in people with heart disease [17-19].

In other previous studies, a correlation was observed in which the more the amount of fat increased, the more the prostate volume increased. In several research studies, weight, BMI, and waistline all showed a significant correlation with prostate volume [20-22]. In this study, there was no significant difference in BMI between the BPH group and the non-BPH group. The reason for this may be that the cross-sectional design of this study did not clearly show the sequential relationship of time. The study criteria were also vague because there are few studies related to BMI and prostate volume in Asia, including Korea. In the Longitudinal Study of Aging cohort in Baltimore, Maryland (USA), each 1-kg/m^2 increase in BMI corresponded to a 0.41-mL prostate volume increase. Compared with nonobese participants (BMI<25 kg/m^2), the obese participants (BMI≥35 kg/m^2) showed a 3.5-time higher BPH risk [20]. In addition, whereas some studies reported that there was a reverse protective effect of smoking on BPH and LUTS, other studies reported that the risk level increased or showed no change [21]. Therefore, it is necessary to conduct more studies on the correlation between smoking and BPH.

There were several limitations to the current study.

First, the subjects were not a random sample of the population because we recruited subjects through a prostate health screening campaign. Second, we did not consider the difference in the population distribution by age in Yangpyeong County and the study group. Third, although prevalence was the number of cases of the condition at a particular point in time, the participants of this study were recruited over 3 years (August–September 2009, August 2010, and August 2011) in an effort to collect more participants.

Consequently, the results of this epidemiologic research investigating the BPH prevalence rate in a rural Korean area showed a lower value than in other countries. One reason for this may be that the ratio of relatively younger males in their 40s to 50s was somewhat higher in this epidemiologic investigation than in other studies. Second, there may have been an influence of diet, with a focus on vegetables in the rural area compared with the westernized diet of high meat consumption in urban areas. Although our study did not survey the eating habits of the individuals, in a study performed to evaluate food intake of the elderly residing in different regions of Korea, the intake of meats was significantly higher in urban elderly than in rural elderly [23]. Third, the different diagnostic criteria of BPH applied in each study could be a cause of the differences in prevalence rates.

CONCLUSIONS

In this study, the prevalence rate of BPH was estimated by targeting males aged 40 years and older in a rural Korean area. The results showed that the prevalence rate of BPH in males aged 40 years and older in Yangpyeong County was 20.0%. When classifying the men according to age, the prevalence rate of BPH increased with age. The IPSS also increased with age. None of the epidemiologic factors studied including lifestyle showed a statistically significant correlation with BPH, except for smoking. This study showed a lower prevalence rate of BPH in a rural area than reported in other studies in Korea. Unlike other studies conducted in rural areas, however, the reliability of this study can be considered to be high because prostate volume was measured by use of a more objective method.

CONFLICTS OF INTEREST

The authors have nothing to disclose.

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