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ORIGINAL ARTICLE

Prevalence of benign prostatic hyperplasia in a population-based study in Iranian men 40 years old or older

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Abstract Epidemiology of benign prostatic hyperplasia (BPH) is incompletely understood. The following study was done to estimate the prevalence of BPH according to obstructive and irritative symptoms of prostate obstruction determined by uroflowmetry and prostate size. In a cross-sectional study a total of 8,466 men aged 40 or older were interviewed by 74 general practitioners and answered the International Prostate Symptom Score (I-PSS) questionnaire. The subjects were randomly identified from 30 counties of Iran. They were invited to have a digital rectal examination (DRE), serum total prostate-specific antigen (tPSA) assay, abdominal ultrasonography to measure prostate size and measurement of maximum urinary flow rate (Qmax). Data on medical history, toxic habits, and current use of medications were obtained. Of the men interviewed, the prevalence of BPH, defined as I-PSS greater than 7, maximum flow less than 15 ml/s and prostate size greater than 30 gm, was 23.8%. The prevalence increased with age, from 1.2% in men 40–49 to 36% in those >70 years (tested for trend, $P = 0.001$). A positive association was found between BPH and body mass index (BMI) ($P = 0.04$), height ($P = 0.03$), diabetes mellitus ($P = 0.04$), increased total energy intake ($P = 0.02$), age-adjusted levels of total PSA ($P = 0.02$), heart disease ($P = 0.03$), and marital status ($P = 0.01$). The prevalence of BPH is relatively high in Iran. The provided bothersome due to BPH did not correlate to symptom severity and should be considered independently in clinical decision-making.

Keywords Prevalence · Prostate · Prostatic hypertrophy · Epidemiology · Cross-sectional studies

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Introduction

Traditionally, epidemiology is the description of epidemics, which are occurrences of diseases that significantly affect various groups of people. Nearly all men will develop histological benign prostatic hyperplasia (BPH) by the age of 80. The disease is now known to adversely affect the quality of life of around one man in three over the age of 50. The prevalence of histologic BPH can be determined only from autopsy studies.

Berry et al. [1] summarized five autopsy studies addressing the prevalence of histologic BPH according to age. They reported that hyperplasia exists almost exclusively in glands greater than 20 g in weight and in men over 30 years of age. A review of the literature provides compelling evidence that the prevalence of histologic BPH is similar throughout the

world [2]. However, the prevalence of clinical BPH is largely different between countries. At the first international meeting on BPH, the World Health Organization (WHO) recommended performing epidemiological studies [3]. Several investigators in different countries have reported cross-sectional studies designed to determine the prevalence of clinical BPH [4–7]. The estimated prevalence of the disease from community-based studies is 40% for men in their 70s [7, 8]. Explanations for the large differences in the BPH data from different countries are that these were not population-based studies and did not use probabilistic samples representative of the general population. In some studies the International Prostate Symptom Score (I-PSS) questionnaire was not used. Prevalence depends on the age group examined, the definition of BPH, geographical areas involved, the composition of the population studied, the selection criteria and the method of the study used. In addition to racial differences in the prevalence of BPH, other environmental factors also influence this prevalence. An autopsy study in 1936 noted a low incidence of BPH in mainland China. However, men of Chinese descent in the United States have a similar incidence of BPH [9]. Reported risk factors for BPH include age, androgens, family history, cigarette smoking, and ethnicity [10]. Epidemiological data represents an invaluable tool for the development of strategies and the allocation of adequate resources necessary for providing assistance for populations. Asian men generally have smaller prostate glands than their Western counterparts [11]. Because Iranian men are ethnically and racially different from most of Asian men (e.g., Japanese, Chinese, and Arabic men) the biomedical parameters of BPH should be different. Thus, this population-based study was undertaken to describe the prevalence of BPH among Iranian men. To our knowledge, this is the first report of mass screening for BPH from Iran.

Materials and methods

A total of 8,466 men aged 40 years old or older from all over of Iran enrolled in the cross-sectional study for a 3-year period (March 2003 to November 2006). Sample sizes were determined for the 95% confidence interval with a design effect of 1.1. Using this assumption, a sample size of 7,196 would be required. With a projected subject dropout rate of 15%, the total number of subjects required for study was determined to be 8,466. A probabilistic two-stage cluster random sampling design was used, with stratification of the primary sampling units. It accounts for about 97% of the population in this age range, roughly 70 million Iranians. The primary sampling units were census sections, the secondary sampling units were dwellings, and the final sampling units were subjects. Subjects were chosen from polling-station lists of the electorate in order not to influence the representativeness of the selection. Seventy-four general practitioners from the national population in 30 counties supervised this selection and invited the selected subjects to a confidential interview. They were educated by the author in in-depth interviews, on the general information regarding BPH and on the items included in the survey. Every tenth man $\geq$40 years old was included in the selection until the desired sample size was obtained. The subjects were divided into four age groups: 40–49, 50–59, 60–69, and $\geq$70. After the study was explained to the participants, all subjects gave their informed consent before entering the study, which was conducted in accordance with the Declaration of Helsinki. The Human Ethics Committee approved the study protocol.

The following data were recorded: age at recruitment, geographical localization, body weight and height, occupational status (working, disabled, or retired), education level, personal and family history, eating habits, current health conditions, use of any medications, race, county of residence, causal renal disease, and presence of diabetes mellitus or other illnesses. Exclusion criteria were a history of previous operation of the lower urinary tract, a history of any bladder, urethral, or prostate disease, pelvic irradiation, known primary neurological condition which might affect lower urinary tract function, psychiatric disorders, or the use of drugs that affect urinary physiology.

After the interview, a physical examination was performed. Subjects then underwent a digital rectal examination (DRE), ultrasonographic measurement of post-void residual urine, and prostate volume. Also, maximum urinary flow rate (Qmax) was measured. Subjects who had either an abnormal DRE or who had a PSA greater than 2.5 ng/ml underwent transrectal ultrasound (TRUS) guided prostate biopsy. TRUS was

performed using General Electric Logic 500. Total PSA levels were determined with the total PSA kit (Hybritech Inc., San Diego, CA). TRUS-guided, systematic, sextant, six-core biopsies were done using a biopsy gun (Promag 1, MD Tech) with an 18-gauge biopsy needle (2.2 Biopsy Needle, MD Tech). Subjects with a negative biopsy were enrolled as potential participants for the study.

The urinary symptoms studied were frequency, nocturia, urgency, intermittency, weak stream, incomplete emptying and straining. Each subject was asked to grade the severity of urinary symptoms using the International Prostatic Symptom Score (I-PSS) for BPH [12]. A panel, consisting of urologists, professional translators, and epidemiologists prepared a Persian version of the I-PSS. The Persian version was validated in a cohort of normal men, men with BPH but no symptoms, and men with lower urinary tract symptoms (LUTS) secondary to BPH. A score of 1 or more defined a subject to have that particular symptom except for nocturia, which was scored as 2 or more. Based on correlations between the symptom index and other scores, three subclasses of men were created according to total score results: those with mild (I-PSS 0–7), moderate (I-PSS 8–19), and severe (I-PSS 20–35) symptoms. BPH was defined as I-PSS greater than 7, maximum flow less than 15 ml/s and prostate size greater than 30 g.

Visual analogue scale (VAS) was used to measure the variables of subject bother. The variables of participant bother or distress ranged from 0 (no distress) to 10 (a great level of distress). We categorized the subject bother into three groups: 1–3, mild bother; 4–7, moderate bother; and 8–10, great bother. The baseline category was 1–3. The cut-off value for great deal of subject concern or distress was >7. Participants were also asked about their willing to seek medical advice in relation to urinary symptoms.

Statistical analysis

Data were summarized according to the cross-sectional design. For assessing the prevalence of BPH across demographic characteristics, we performed multiple logistic regression analysis. This approach produced adjusted odds ratios (ORs). After the sample was weighted by the specified design, the percent or prevalence and population estimates of the degree of BPH in the population and the corresponding standard errors were obtained to construct the 95% confidence intervals (CI). Association between ordinal variables was measured using Spearman's rank correlation coefficient.

All background characteristics analyzed were coded as indicator variables and included in univariate and multivariate logistic regression models. Statistical analysis was performed using the computer statistical package SPSS/10.0 (SPSS, Chicago, IL) and SAS/6.4 (SAS Institute Cary, NC).

Results

Study population

Of the 8,466 men that were interviewed, 1,092 (12.9%) were excluded from analysis due to missing data (126), met some exclusion criteria (214), were uncooperative (512), and response not completed personally (240). The overall response rate was 87.1%. Baseline average age of the remainder 7,374 men in the analysis sample was 61.6 years (range 40–84). Of these, 1,917 (26%) were between 40 and 49, 1,844 (25%) were between 50 and 59, 1,991 (27%) were between 60 and 69, and 1,622 (22%) were ≥70 years of age. Those excluded from study did not significantly differ from the study group. The DRE was recorded as clinically suspicious of malignancy in 91 (1.2%) overall. Among the screened men, 842 (11.4%) had a serum PSA concentration >2.5 ng/ml and 257 prostate cancers were diagnosed (Positive Predictive Value 29.4%), corresponding to an overall detection rate of 3.48%. Additionally, 22 cancers were detected among 29 with PSA of <2.5 ng/ml who had a doubtful DRE finding.

Prevalence of BPH and impact of age

Of the 7,374 participants who provided information, 23.8% (1,755) (95% CI: 22.3–25.2), had BPH (Table 1). The prevalence of BPH increased with age (linear Chi-square 172.144, 1 degree of freedom, $P = 0.001$). The prevalence increased from 1.2% in adults aged 40–49 years to 36% in those >70 years (tested for trend $P = 0.001$). The oldest cohort of participants (age >70 years) is more than 8.2 times as

Table 1 Prevalence of BPH

Age groups (years)	Prevalence (%)	95% CI
40–49	1.2	1.0–1.4
50–59	18.4	17.5–19.4
60–69	26.8	25.6–28.1
≥70	36.0	35.1–37.2

BPH, benign prostatic hyperplasia; *CI*, confidence interval

likely to experience BPH (95% CI, 7.1–10.2) in comparison to adult aged 40–49 years.

Prevalence of symptoms

The most prevalent symptom was frequency (26.1% of subjects), followed by nocturia (20.4%), urgency (18.4%) and incomplete emptying (17.1%) (Table 2). The prevalence of bother for nocturia, frequency, urgency, and incomplete emptying was 16.2, 11.4, 8.1, and 6.7%, respectively.

For all three I-PSS categories the prevalence of urinary symptoms was 71.4% for mild (I-PSS 0–7) (95% CI: 67.73–75.33), 11.3% for moderate (I-PSS 8–19) (95% CI: 8.44–14.12), and 17.3% for severe (I-PSS ≥ 20) (95% CI: 14.68–19.46) prostatism (Table 3). In logistic regression analysis, the severity of symptoms increased with age. The severe prostatism increased from 2.2% in adults aged 40–49 years to 21.4% in those >70 years.

Prostate volume

On ultrasound mean prostate size (plus or minus standard error) was 39.47 ± 2.44 g. A strong correlation existed between total prostate size and age ($r = 24$; $P = 0.001$) (Table 4). Almost all men (98%) aged >60 years have a prostate volume of >30 g. Prostate size was between 20–30 g (95% CI: 17.8–33.41), 31–40 g (95% CI: 28.7–42.86), 41–50 g (95% CI: 38.4–47.61), 51–60 g (95% CI: 48.1–57.3) and >60 g (95% CI: 57.5–105.4), in 18.2, 27.8, 28.6, 17.4, and 8.0% of subjects, respectively. In 81.8% of the subjects (95% CI: 76.12–86.14), the prostate was greater than 30 g. The prostate gland volume also had positive association with BMI (OR: 1.87; 95% CI: 1.19–3.21; $P = 0.02$), and body weight (OR: 2.11; 95% CI: 1.45–3.04; $P = 0.02$).

Table 2 Percent prevalence of urinary symptoms (95% CI) by age groups (years)

Symptoms	Total population with BPH	40–49	50–59	60–69	≥70
Frequency	26.1 (24.2–28.4)	17.4 (16.1–18.6)	21.4 (20.1–23.1)	32.2 (31.4–33.6)	36.2 (35.3–37.6)
Nocturia	20.4 (19.2–21.6)	17.1 (16.0–18.3)	15.4 (14.4–16.6)	25.7 (24.3–26.8)	49.6 (45.2–51.7)
Urgency	18.4 (17.1–19.7)	15.2 (14.3–16.4)	13.2 (12.1–14.0)	20.6 (19.2–23.9)	29.4 (28.3–30.7)
Incomplete emptying	17.1 (16.9–18.2)	13.5 (12.2–14.6)	16.4 (15.2–17.6)	19.4 (18.3–20.6)	24.3 (23.2–25.5)
Weak stream	15.6 (14.4–16.2)	11.0 (9.9–12.0)	14.8 (13.9–15.9)	16.8 (15.7–17.0)	23.4 (22.2–24.30
Intermittency	11.3 (9.8–12.7)	6.7 (5.3–8.1)	11.4 (9.9–12.8)	12.7 (11.2–14.1)	15.8 (14.2–17.4)
Straining	5.8 (4.4–7.3)	1.8 (1.07–2.7)	4.4 (3.1–5.8)	6.9 (5.6–8.4)	9.7 (8.4–11.2)

BPH, benign prostatic hyperplasia; *CI*, confidence interval

Table 3 Percent frequency distribution of I-PSS (95% CI) by age groups (years)

I-PSS	Total population with BPH	40–49	50–59	60–69	≥70
Mild (0–7)	71.4 (67.7–75.3)	90.4 (86.8–93.7)	78.6 (75.3–81.2)	71.2 (68.2–74.1)	43.2 (40.4–46.1)
Moderate (8–19)	11.3 (8.4–14.1)	6.2 (4.7–9.1)	7.7 (5.1–10.2)	4.4 (2.1–6.9)	28.1 (25.3–30.8)
Severe (≥20)	17.3 (14.6–19.4)	3.4 (1.9–5.6)	13.7 (10.4–16.5)	24.4 (21.2–27.2)	28.8 (25.3–31.4)

BPH, benign prostatic hyperplasia; *CI*, confidence interval; *I-PSS*, international prostate symptom score

Table 4 Prostate volume by age groups (years)

Age groups (years)	Prostate size (Mean Gm. ± SE)	95% CI
40–49	24 ± 0.67	22.98–25.22
50–59	32.04 ± 0.64	30.58–33.24
60–69	42.18 ± 1.64	39.12–46.08
≥70	54.44 ± 4.86	47.48–61.64
Overall	39.47 ± 2.44	37.21–42.12

CI, confidence interval; *SE*, standard error

Maximum urinary flow rate

Qmax was less than 10 ml/s in 30.17% of the subjects (95% CI: 27.32–36.52), between 10 and 15 ml/s in 33.1% (95% CI: 26.12–37.26) and greater than 15 ml/s in 36.73% (95% CI: 32.44–41.32) (Table 5). The correlation between maximum flow rate and age was significant ($P = 0.03$). It was less than 10 ml/s in 8.98% of the 40–49-year-old group (95% CI: 6.11–10.68) but 55.16% (95% CI: 27.22–33.18) in the ≥70-year-old group.

Race or ethnicity

Due to different racial residents in a specific geographic area, a simultaneous ethnicity, geographical location, and BPH analysis was not possible. Therefore, two separate covariance analyses were performed. The first looked at race effects within one geographical location and the second analysis looked at geographical effects between all 30 counties. No effect of race was detected; neither the intercept (analysis of covariance $P = 0.36$) nor the slope of the age relationship was influenced by race (analysis of covariance $P = 0.41$). In the multivariate logistic regression models after adjustment for age, physical activity, cigarette smoking, and body mass index (BMI), this study failed to show any significant difference in the prevalence of BPH among different ethnic groups. However, black men may have a greater prevalence of moderate or severe (versus mild) I-PSS than do white men (OR: 1.73; 95% CI: 1.27–2.42; $P = 0.01$). Black men were shown to have a mean I-PSS that was 1.5 points greater than that for white men (OR: 2.01; 95% CI: 1.15–3.21; $P = 0.01$).

Help seeking

Our study showed that 61% of men with BPH sought help to solve the problem from their general practitioner or urologist and 18% consulted healthcare professionals. Of those who did not seek help for their problem, 83% stated they would like to. The reasons for help seeking were as follows: bothersome symptoms (77%), treatment to overcome the actual problems (69%), and distress about normality (65%).

Strategies for managing BPH

Watchful waiting was used in 14% of the subjects with BPH. Of the 1,510 subjects who received BPH treatment, 1,374 (91%) had medical therapy as initial treatment. Of these subjects, 560 (40.8%) were on α-blockers, 190 (13.8%) were on 5α-reductase inhibitor therapy, 555 (40.4%) were on combination therapy with the two types of medication, and 69 (5%) had received phytotherapy and/or "prostate preparations". Of the subjects, 136 had non-medical intervention as their initial treatments, including transurethral

Table 5 Maximum urinary flow rate by age groups (years)

Age groups (years)	>15 ml/s (%)	95% CI	10–15 ml/s (%)	95% CI	<10 ml/s (%)	95% CI
40–49	65.54	61.32–69.21	25.48	24.86–33.88	8.98	6.11–10.68
50–59	46.42	41.34–50.72	40.22	36.43–45.54	13.36	10.12–16.54
60–69	22.46	18.78–28.12	34.63	28.44–40.33	42.91	37.14–47.86
≥70	12.50	6.34–18.42	32.34	24.37–39.78	55.16	44.47–63.78
Overall	36.73	32.44–41.32	33.1	26.12–37.26	30.17	27.22–33.18

CI, confidence interval

prostatectomy in 117 (86%), open prostatectomy in 16 (11.8%) and other non-medical intervention in three (2.2%). Of men who were initially on medical therapy, 533 (38.8%) underwent a surgical procedure at a later date. Of these men, 234 (43.9%) initially used α-blocker monotherapy, 155 (29.1%) initially used 5α-reductase inhibitors and 144 (27%) initially used combination therapy. The mean time of medical therapy for subjects who started with medical therapy but subsequently underwent surgery was 3.2 years. Treatment was common in elderly men with nearly one in three was receiving treatment in the eighth decade of life.

Regional differences

The prevalence of BPH was different among different ethnicities, but not "*statistically*" significant ($P = 0.08$). For prevention from any bias and accuracy of results, statistical analysis was done after adjustment for race or ethnicity. After adjustment for age and ethnicity, the odds of ever having had BPH were lower among men who lived in south-central (Kerman and Hormozgan) and south-west (Fars, Boushehr, Khoozestan, Ilam and Chaharmahal va Bakhtiari) counties, with odds decreasing from west to east and from north to south. The odds of BPH among subjects who resided in north-west (Ardabil, East Azarbayjan and West Azarbayjan) and north-central (Gilan, Mazandaran, Golestan, Tehran, Semnan) counties, were nearly twice that of those living in the south-central (OR: 2.1; 95% CI: 1.17–3.26; $P = 0.01$) and south-west counties (OR: 2.3; 95% CI: 1.24–3.46; $P = 0.01$). After the simultaneous effects of all the studied risk factors that were considered, regional associations with BPH prevalence were mildly diminished (Table 6).

Family history

BPH was not significantly associated with a positive family history of BPH (OR: 1.17; 95% CI: 0.82–1.81; $P = 0.08$). The family history of BPH was found in 21.5% of first-degree relatives of participants with BPH, compared to 22.2% in the subjects without BPH ($P = 0.08$).

Table 6 Prevalence of BPH in Iranian counties

County	Prevalence (%)	95% CI
Ardabil	31.6	28.1–34.2
Azarbyjan East	30.8	27.4–32.5
Azarbyjan West	32.6	29.2–35.2
Booshehr	16.8	14.2–18.6
Chahar Mahal va Bakhtiari	23.6	21.8–25.1
Fars	16.2	14.6–17.8
Ghazvin	28.2	26.1–30.1
Ghom	26.7	25.2–27.6
Gilan	31.2	29.4–33.1
Golestan	30.4	28.6–32.1
Hamadan	24.3	22.4–26.5
Hormozgan	17.7	15.5–19.4
Ilam	23.4	21.6–25.2
Isfahan	22.8	20.9–24.7
Kerman	11.7	17.1–18.4
Kermanshah	24.1	22.4–25.8
Khoozestan	15.9	14.2–17.8
Khorasan North	20.2	18.4–22.1
Khorasan Razavi	20.7	18.9–22.4
Khorasan South	21.4	19.4–23.2
Kohgilooyeh va Boyer Ahmad	17.7	15.9–19.4
Kordestan	27.8	26.2–29.3
Lorestan	21.2	19.4–23.6
Markazi	22.7	23.2–26.1
Mazandaran	30.4	28.7–32.1
Semnan	31.1	29.4–32.8
Sistan va Baloochestan	15.2	13.6–16.8
Tehran	30.1	28.4–31.8
Yazd	17.6	15.8–19.3
Zanjan	23.4	21.8–25.1

BPH, benign prostatic hyperplasia; *CI*, confidence interval

Personal risk factors

In the multivariate logistic regression models after adjustment for age, a positive association was found between BPH and BMI (OR: 2.72; 95% CI: 1.72–3.27; $P = 0.02$), height (OR: 1.64; 95% CI: 1.28–2.42; $P = 0.03$), diabetes mellitus (OR: 1.82; 95% CI: 1.28–2.21; $P = 0.04$), increased total energy intake (OR: 2.16; 95% CI: 1.44–3.14; $P = 0.02$), increased energy adjusted total protein intake (OR: 2.14; 95% CI: 1.72–3.62; $P = 0.03$), increased consumption of milk and dairy products, (OR: 1.89;

95% CI: 1.21–2.79; $P = 0.02$), increased age-adjusted levels of total PSA (OR: 2.38; 95% CI: 1.79–3.21; $P = 0.02$), heart disease (OR: 2.19; 95% CI: 1.61–3.02; $P = 0.03$), and married status (OR: 1.76; 95% CI: 1.21–2.69; $P = 0.01$). However, a negative association was found between BPH and increased level of physical activity (OR: 0.4; 95% CI: 0.31–1.24; $P = 0.01$), consumption of pulse (green peas, beans, and lentils) (OR: 0.6; CI: 0.44–1.29; $P = 0.03$), higher fruit consumption (OR: 0.8; 95% CI: 0.62–1.69; $P = 0.02$), smoking (OR: 0.7; CI: 0.42–1.27; $P = 0.03$), and systolic blood pressure (OR: 0.8; 95% CI: 0.61–1.32; $P = 0.04$). No positive association was found with higher diastolic blood pressure (OR: 1.14; 95% CI: 0.82–1.76; $P = 0.081$), fat calorie intake (OR: 1.12; 95% CI: 0.75–1.72; $P = 0.071$), sexual activity level (OR: 1.28; 95% CI: 0.82–1.61; $P = 0.069$), or vasectomy (OR: 1.24; 95% CI: 0.81–1.66; $P = 0.082$) (Table 7).

Visual analog scale (VAS)

The mean VAS for subjects' concern about BPH was 4.2. When participants were asked to grade their concern about their disease and to specify how much distress it caused them, 44.6, 22.6, and 32.8% reported a mild, moderate and "great deal" of concern, respectively. There was a significant association between subjects' concern and the severity of symptoms (OR: 3.42; 95% CI: 2.22–4.28; $P = 0.01$). The mean VAS for bother for frequency, nocturia, urgency, and incomplete emptying was, 4.4, 4.8, 4.1, and 3.2, respectively.

Discussion

BPH is the most common disease affecting men of all ethnicities who are older than 40 years of age. Increasing evidence has shown that the prevalence and natural history of BPH may differ in ethnic groups. The large variation in existing prevalence depends on BPH definitions, assessments and geographic region. Prostatectomy is the most common form of major surgery in men >55 years of age in the United States [13, 14]. In the United States in 2000, BPH accounted for more than 4.4 million office visits, 117,000 emergency room visits, and 105,000 hospitalizations [15]. Regarding urinary symptoms in men older than 40 years, population-based studies have been conducted in the United States [4], Scotland [7], Japan [5], Singapore [16], and Spain [17]. However, to our knowledge, little population-based data are available regarding prevalence of BPH in men older than 40 years in this region.

Because there is not yet sufficient consensus on the definition of BPH, epidemiological studies attempting to define the prevalence of the disease must include data on symptoms, urinary flow, and prostate size of all study subjects. The evaluation of symptoms alone only establishes the prevalence of symptoms, which may or may not be related to BPH. In this study, we clearly distinguished men with lower urinary tract symptoms (LUTS) from those with BPH. Our prevalence rate falls within the large range of previously reported prevalence estimates. In a multinational study based on I-PSS questionnaire men between 40 and 79 years were randomly sampled. The study design was community-based. This study showed prevalences of 14, 18, 38, and 56% in France, Scotland, US and Japan, respectively [18]. Our prevalence rate of 23.8% is much lower than the prevalence of US and Japan. These differences may, in part, be due to differences in diet, environment, and prostate volume. An important consideration when interpreting the prevalence for BPH derived from clinical series is that not all cases of BPH are symptomatic and not every case of prostatism is BPH. The prevalence of BPH in the community may be considerably higher than that reported in clinical studies.

Garraway et al. [19] reported that of the 34% of the total population who had nocturia twice or more, 19% found the symptom to be bothersome, but only 9% consulted a physician. There is always the possibility of bias when comparing prevalences between countries and between time periods. Study design and sample size are the most important issues in any population based study. To our knowledge, our study is one of the largest populations to date in the literature.

In addition, the 28.6% prevalence of moderate and severe symptoms of prostatism according to I-PSS, is higher than most previous studies [4, 17], but lower than the 36.6% reported by Tsukamoto et al. [5] from Japan.

Possible reasons for the different prevalences for BPH include cultural factors, such as the acceptance or

Table 7 Relations between geographic region of residence, personal risk factors, and history of BPH among Iranian population

Risk factors	No.	Percent with BPH	Odds ratio*	95% CI
Region				
Northwest	2,483	34.4	2.1	1.17–3.26
North central	1,706	34.2	1.9	1.16–2.86
Northeast	193	22.7	1.4	1.2–2.3
Central counties	1,233	20.2	1.3	1.1–1.9
Southwest	1,162	20.4	1.4	1.2–2.1
South central	363	19.2	1.1	1.05–1.8
Southeast	234	17.6	1.0	–
BMI				
$\geq$35 kg/m^2	4,339	29.9	2.7	1.72–3.27
<25 kg/m^2	1,472	17.7	1.0	–
Height				
>170 cm	4,571	29.6	1.6	1.28–2.42
<165 cm	1,327	17.9	1.0	–
Diabetes mellitus				
Yes	1,032	31.4	1.8	1.28–2.21
No	6,342	16.1	1.0	–
Total calorie intake (kcal/day)				
>4,000	1,696	33.8	2.1	1.44–3.14
<2,000	1,327	14.6	1.0	–
Consumption of dairy products				
Any	5,015	31.3	1.8	1.21–2.79
None	2,359	16.4	1.0	–
Age adjusted level of total PSA				
Higher	593	32.6	2.3	1.79–3.21
Within normal limits	6,781	15.2	1.0	–
Marital status				
Married	6,784	28.2	1.7	1.21–2.69
Not married	590	19.6	1.0	–
Heart disease				
Yes	1,314	32.1	2.1	1.61–3.02
No	6,060	15.5	1.0	–
Physical activity (kcal/day)				
$\leq$500	4,719	32.3	1.0	–
$\geq$2,000	1,179	13.1	0.4	0.31–1.24
Consumption of pulse				
None	1,989	29.8	1.0	–
Any	5,385	17.7	0.6	0.44–1.29
Smoking				
Never	5,972	27.8	1.0	–
Yes	1,402	19.7	0.7	0.42–1.27
Systolic blood pressure				
$\leq$14 mmHg	5,825	26.7	1.0	–
>14 mmHg	1,549	20.9	0.8	0.61–1.32

Table 7 continued

Risk factors	No.	Percent with BPH	Odds ratio*	95% CI
Diastolic blood pressure				
≥9 mmHg	1,327	22.8	1.14	0.82–1.76
<9 mmHg	6,047	24.6	1.0	–
Total fat intake as percent of total calories				
<30% of total calories	2,654	24.1	1.0	–
≥30% of total calories	4,720	23.6	1.12	0.75–1.72
Sexual activity (per month)				
0–3	6,942	22.8	1.0	–
>3	432	24.7	1.28	0.82–1.61
Vasectomy				
Yes	832	22.9	1.24	0.81–1.66
No	6,542	24.3	1.0	–

* Odds ratios are adjusted for age and race

BPH, benign prostatic hyperplasia; *CI*, confidence interval; *BMI*, body mass index; *PSA*, prostatic specific antigen

non-acceptance of urinary symptoms as a natural part of aging and the active or inactive life-styles of the elderly men. But they may also result from the clinical definition used for BPH, type of trial performed (self-applicable questionnaire, mailed questionnaire, interview by phone, personal interview), the characteristic of samples (general population versus clinics) studied and study designs. There is strong evidence for the presence of racial variance in prostate size parameters. Asian men, despite having a smaller average prostate size, have a similar incidence of bladder outlet obstruction when compared to men in Western countries [11]. It is not known whether this is due to a higher prevalence of symptoms or to patient factors, such as higher degree of bother. Urgency was the most common bothersome symptom in the US study [4] but ranked third in Iran.

When comparing our results to those of others, several pertinent points should be noted. The sample used in this study was a representative sample of Iranian men ≥40 years old. Also in this study I-PSS questionnaire was verbally administered in a standardized manner. Finally, our response rate was 87.1%, which is much higher than most previous studies [4, 5, 7, 16].

Another strength of our study was that we had data on the subjects' demographics and medical history. BPH is generally not regarded to be a preventable disease but it is associated with modifiable risk factors. We well established the risk factors for BPH. We concluded that physical exercise and cigarette smoking appear to protect against development of clinical BPH. Our results are consistent with many studies reporting a protective association between cigarette smoking and development of BPH [20]. The mechanism underlying this association is unknown. A protective effect of exercise on development of BPH has also been reported in other studies [21]. We found elevated levels of total PSA to markedly increase risk for clinical BPH.

We observed a linear association with age. It is currently estimated that a 40-year-old man who lives to the age of 80 would have about one chance in three of having a prostatectomy for BPH if current surgery rates prevailed [13, 14].

Large cohort studies have consistently demonstrated that obese men are at increased risk for BPH.

There are prospective studies found that a greater BMI is associated with a decreased risk of BPH [22]. In contrast, some other studies reported a positive association between BPH and BMI and/or obesity [23]. We found that obese participants (BMI 35 kg/m^2 or greater) were at a 2.7-fold increased risk for BPH than non obese participants (BMI less than 25 kg/m^2). Men who were married and living with their wife had a 70% increased of subsequent clinical BPH. Overall, vasectomy, sexual activity, and fat calorie intake were not significantly related to subsequent clinical BPH. All of these effects remained after adjustment for age. Detailed discussing about associated risk factors with

BPH in this article is inappropriate and impossible. We will report them elsewhere.

Studies on the epidemiology of BPH often have a selection bias and sample sizes have frequently been too small to allow any definite conclusion. Our study is one of the first to report the prevalence of BPH in a population-based study. The present study used a random cluster sampling method with an adequate amount of sample sizes to estimate prevalence with acceptable accuracy.

Conclusions

Due to lack of consensus about definition for clinical BPH, the comparison of different studies is difficult. This study showed that BPH is prevalent in Iran. This is the first study to determine the level of BPH for all of Iran. Yet, further studies on the cause and geographical variations in the incidence and prevalence of BPH are needed. Epidemiological studies in the development of BPH would provide invaluable information about risk factors, eventually leading to effective prevention strategies and resources allocations. In addition, since BPH affects man's quality of life, and because of its consequences for the individual and for the general public health, BPH merits further study.

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