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# Predictors of self-reported benign prostatic hyperplasia in European men: analysis of the European National Health and Wellness Survey

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**Abstract**

*Purpose* This study aimed to identify predictors of European men who self-reported being diagnosed with benign prostatic hyperplasia (DxBPH) compared to men with moderate-to-severe lower urinary tract symptoms [American Urological Association Symptom Index (AUA-SI) score $\geq 8$] who did not self-report a BPH diagnosis (non-DxBPH).

*Methods* Data were taken from the 2010 European National Health and Wellness Survey; a cross-sectional, self-administered, Internet-based questionnaire. This analysis included males $\geq 40$ years with DxBPH or without DxBPH, but with AUA-SI $\geq 8$. Chi-square tests were used for categorical variables and independent samples *t* tests were used for continuous variables. Logistic regressions were conducted among all men $\geq 40$ years to predict being DxBPH.

*Results* About 1,638 DxBPH and 3,676 non-DxBPH men were included. The estimated prevalence of DxBPH and non-DxBPH was 8.53 and 19.13 %. Men with DxBPH were older than non-DxBPH males (mean age 66.1 and 58.3, $P < 0.001$). The mean AUA-SI score was 11.3 for DxBPH and 13.2 for non-DxBPH. Being older (OR = 1.077), having a university education (OR = 1.252), having private health insurance (OR = 1.186), and specific health behaviors/attitudes [regular exercise (OR = 1.191), visiting a doctor within the previous 6 months (OR = 2.398), consulting with a medical professional when not feeling well (OR = 1.097), reporting having an attentive doctor (OR = 1.112)], and higher voiding symptoms (OR = 1.032) were significant predictors of DxBPH.

*Conclusions* Older men with higher education and access to care and more engagement in their healthcare were more likely to self-report being diagnosed.

**Keywords** Benign prostatic hyperplasia · Predictors · Lower urinary tract symptoms

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## Introduction

Benign prostatic hyperplasia (BPH) is a histological diagnosis of nonmalignant prostate enlargement, which may or may not involve a verified bladder outlet obstruction and/or lower urinary tract symptoms (LUTS) [1, 2]. Prevalence estimates of men reporting moderate-to-severe LUTS can vary by population and age. Although men may experience urinary symptoms, they may not seek medical care or receive treatment for their symptoms. For example, in a survey of men >50-year old in the United Kingdom (UK)—designed to assess the prevalence of LUTS, self-reported BPH, and health-seeking behavior—41 % of the men reported moderate-to-severe LUTS; however, only 18 % reported that they had been diagnosed with BPH [3].

Erectile dysfunction can be associated with LUTS and BPH [4–10]; however, variability exists in the current published prevalence data of coexisting erectile dysfunction (ED) and LUTS/BPH [5, 11–14]. Rosen et al. [5] conducted a study in the USA and six European countries to investigate the relationship between LUTS and sexual dysfunction in older men. Results were consistent from one country to another. Although 90 % of the men had LUTS, only 19 % had sought medical help for urinary problems

and only 11 % had been medically treated [5]. Sexual disorders and their bothersomeness were strongly related to both age and severity of LUTS.

While a BPH diagnosis may not be needed before initiating LUTS treatment [1, 2], a BPH diagnosis represents a treatment-seeking outcome. This study aimed to identify predictors of reporting being diagnosed with BPH (DxBPH), as opposed to having moderate or severe LUTS (AUA-SI score ≥8) and no diagnosis (non-DxBPH) in a European population. Further, the analysis was repeated for men with ED to identify whether different predictors were associated with a diagnosis of BPH, since most men seeking treatment for either LUTS or ED have both conditions [11]. Understanding these predictors may provide additional information to clinicians as they are evaluating men who may be at risk for BPH or who may benefit from educational efforts to recognize the symptoms and treatment options for managing BPH.

## Methods

### Study design

Data were taken from the 2010 European (EU) National Health and Wellness Survey (NHWS), a cross-sectional, self-administered, Internet-based questionnaire fielded in five countries, including France, Germany, Italy, Spain, and the UK. The NHWS is weighted by age and gender to reflect the demographic composition of each country's total adult population. Weights are based on the International Database of the US Census Bureau and Organization for Economic Cooperation and Development. The survey collects data such as demographics, general health, and multiple disease and treatment characteristics, resource utilization, healthcare access, symptoms, treatment adherence, satisfaction, work productivity and activity impairment, and health-related quality of life. All participants provided informed consent, and the study protocol was approved by the Essex Institutional Review Board (Lebanon, New Jersey, USA) (Approval number KH-NHWS-EU2011-3753).

Data were collected during three quarters in the 2010 EU NHWS. A total of 219,935 invitations were sent to potential panel participants. Overall, 57,804 adults met survey inclusion criteria, provided written (electronic) informed consent, and completed the interview; 42,260 adults responded, met inclusion criteria, and provided informed consent, but terminated their participation; and 100,038 either did not respond or terminated participation prior to their eligibility being determined (28.89 % response rate).

All men ≥40 in the NHWS sample were asked to complete the American Urological Association Symptom Index (AUA-SI). The severity of LUTS and treatment success

are typically assessed using the AUA-SI, which has been psychometrically validated in the target populations. The AUA-SI measures the following three domains: voiding (obstructive) symptoms; storage (irritative) symptoms; and postmicturition symptoms [15]. The AUA-SI has a five-item response set that ranges from "not at all" to "almost always" for the individual items. Individual questions on the AUA-SI, as well as the overall AUA-SI score, were evaluated. Respondents with an AUA-SI score ≥8 were considered to have moderate-to-severe LUTS [16]. Respondents were also questioned about their experiences seeking professional help for the relief of their urinary symptoms. Men's health information was collected in the NHWS survey, including self-reported ED and self-reported diagnosed BPH.

All males ≥40 years were included in the analysis, if they met one of the following requirements:

- reported DxBPH by responding yes to both of the following NHWS questions: (1) Do you have an enlarged prostate (BPH)? and (2) If yes, was your BPH diagnosed?
- had no BPH diagnosis, though scored ≥8 on the AUA-SI [16, 17] items; hereafter, referred to as non-DxBPH.

Respondents were categorized as self-reporting ED by responding to the following:

- Which of the following have you experienced within the last 12 months (premature ejaculation, difficulty achieving/maintaining an erection, none of the above, or decline to answer)?
  - If they respond "yes" to "difficulty achieving/maintaining an erection," then they respond to the following:
- In the past 6 months, have you had difficulty achieving/maintaining an erection?

### Covariates

Covariates for this analysis included demographic characteristics such as age, marital status, education level, household income, health insurance, and employment status. Also evaluated were health risk behaviors, such as body mass index (underweight, normal weight, overweight, or obese); alcohol consumption (consume alcohol vs. abstain from alcohol); tobacco smoking (current smoker, former smoker, or nonsmoker); and exercise (exercised vigorously at least 1 day of the past 30 days). Comorbidities evaluated in this analysis included atherosclerosis, congestive heart failure, diabetes (type 1 and type 2), hypertension, mini-stroke/transient ischemia attack, stroke, multiple sclerosis, muscular dystrophy, Parkinson's disease, stress urinary

incontinence, and insomnia/sleep difficulties. The adjusted Charlson comorbidity index (CCI) was used as a measure of comorbidity burden [18]; the higher the CCI score, the more severe the burden of comorbidity. Patient attitudes/behaviors were also examined through their responses on a Likert-type response scale (strongly disagree to strongly agree).

## Statistical analysis

Differences in sociodemographics, health risk behaviors, comorbidity status and symptoms, and patient attitudes and behaviors were examined using chi-square tests for categorical variables and independent samples $t$ tests for continuous variables. Two sets of bivariate analyses were conducted in males ≥40-year old: DxBPH versus non-DxBPH; and based on the same cohort, men with ED were categorized into men with DxBPH and non-DxBPH. Logistic regression models were used to predict factors that may be associated with a diagnosis of BPH. Significant variables were collectively examined for potential multicollinearity by examining tolerance and variance inflation factor assessments. No evidence for multicollinearity was identified; thus, a single step regression approach (i.e., entering all predictors simultaneously) was used in the analysis.

## Results

### Prevalence

In the general population of European men ≥40 years of age, the estimated prevalence of DxBPH was 8.53 %, non-DxBPH (but AUA-SI ≥8) was 19.13 %, coexistent ED/DxBPH was 5.27 %, and coexistent ED/non-DxBPH (but AUA-SI ≥8) was 11.79 %.

### Sociodemographic characteristics

Sociodemographic characteristics are summarized in Table 1. Men who reported DxBPH were older than men who had non-DxBPH (mean age 66.1 and 58.3, respectively, $P < 0.001$; ED/DxBPH mean age 66.4, ED/non-BPH mean age 59.1, $P < 0.001$). Differences in marital status, having a university education, and annual household income were found between men who reported DxBPH and men who reported non-DxBPH.

### Clinical characteristics

Clinical characteristics are summarized in Table 2. Statistically significant differences were found between men with DxBPH compared to non-DxBPH men when evaluating weight, smoking history, and exercise (Table 2).

Hypertension, sleep difficulties, and type 2 diabetes were the most reported comorbidities in both DxBPH and non-DxBPH males. Men with DxBPH were more likely to report hypertension (43.7 vs. 38.2 %, $P < 0.001$) compared to non-DxBPH men. Also, men with DxBPH were less likely to report sleep difficulties (17.0 vs. 24.0 %. $P < 0.001$) compared to non-DxBPH men. There were no differences in overall CCI. Regarding urinary symptoms, the mean AUA-SI score was 11.3 for DxBPH males and 13.2 for non-DxBPH males; both the storage and voiding symptom composite scores were lower among diagnosed men compared to undiagnosed men (Table 2).

A majority of men in both groups reported visiting a doctor within the previous 6 months. Men with DxBPH were more likely to report consulting a medical professional when not feeling well, and feeling that their doctor was more attentive compared to non-DxBPH men. In addition, men with DxBPH were less likely to indicate preferring over-the-counter (OTC) medications to prescriptions. Health attitudes were similar between the groups in the men's willingness to make lifestyle changes to avoid taking a prescription.

Overall, the men with ED had similar findings to the overall population of men that were evaluated in this study. Regarding urinary symptoms, only the summed storage symptoms were significantly different because men with ED/DxBPH reported fewer storage symptoms compared to ED/non-DxBPH males. The average AUA-SI score was 12.2 for ED/DxBPH males and 13.7 for ED/non-DxBPH males.

### Predictors of a BPH diagnosis

Upon entering all variables into a single logistic regression model (Table 3), being from France (OR = 1.422), Germany (OR = 1.803), Italy (OR = 2.250), or Spain (OR = 1.351) versus the UK (reference group) was associated with being diagnosed with BPH. Other factors that were significantly associated with DxBPH were being older (OR = 1.077), having a university education (OR = 1.252), and having private health insurance (OR = 1.186). Health behaviors and attitudes, such as regular exercise (OR = 1.191), visiting a doctor within the previous 6 months (OR = 2.398), consulting with a medical professional when not feeling well (OR = 1.097), reporting having an attentive doctor (OR = 1.112), and higher voiding symptoms (OR = 1.032) were all significantly associated with a BPH diagnosis. Conversely, factors associated with a decreased likelihood of being diagnosed with BPH included being single (OR = 0.613), being divorced (OR = 0.699), being widowed (OR = 0.648), living with a partner (OR = 0.678), unsure of insurance (OR = 0.465), being obese (OR = 0.752),

**Table 1** Sociodemographic differences between men diagnosed and undiagnosed with BPH and in men with ED who are diagnosed or undiagnosed with BPH

|  | Diagnosed BPH (DxBPH) (N = 1,638) | Undiagnosed BPH (non-DxBPH) (N = 3,676) | P value | ED with diagnosed BPH (ED/DxBPH) (N = 1,012) | ED without diagnosed BPH (ED/non-DxBPH) (N = 2,265) | P value |
|---|---|---|---|---|---|---|
| Age (years), mean ± SD | 66.1 ± 7.52 | 58.3 ± 10.61 | <0.001 | 66.4 ± 7.41 | 59.1 ± 10.17 | <0.001 |
| Marital status |  |  | <0.001 |  |  | <0.001 |
| Married (%) | 79.8 | 63.2 |  | 79.6 | 65.9 |  |
| Single, never married (%) | 3.9 | 11.5 |  | 3.4 | 9.6 |  |
| Divorced (%) | 5.8 | 10.1 |  | 5.2 | 10.3 |  |
| Separated (%) | 2.3 | 2.9 |  | 2.8 | 2.9 |  |
| Widowed (%) | 3.7 | 3.1 |  | 4.2 | 2.4 |  |
| Living with partner (%) | 4.5 | 9.2 |  | 4.7 | 8.9 |  |
| Education level |  |  | <0.001 |  |  | <0.001 |
| Less than University education (%) | 51.6 | 63.2 |  | 50.4 | 62.4 |  |
| University education or higher (%) | 48.4 | 36.8 |  | 49.6 | 37.6 |  |
| Annual household income |  |  | <0.001 |  |  | 0.009 |
| Below country median (%) | 38.4 | 45.3 |  | 39.0 | 44.8 |  |
| Above country median (%) | 52.3 | 46.1 |  | 53.3 | 48.5 |  |
| Decline to answer (%) | 9.3 | 8.6 |  | 7.7 | 6.8 |  |
| Type of health insurance |  |  | <0.001 |  |  | <0.001 |
| Public only (%) | 74.1 | 77.3 |  | 74.1 | 77.8 |  |
| Private (%) | 24.6 | 17.7 |  | 24.4 | 17.2 |  |
| Not sure (%) | 1.3 | 5.0 |  | 1.5 | 5.0 |  |
| Employment status |  |  | <0.001 |  |  | <0.001 |
| Not currently employed (%) | 75.5 | 55.8 |  | 76.0 | 58.4 |  |
| Employed (%) | 24.5 | 44.2 |  | 24.0 | 41.6 |  |

*BPH* Benign prostatic hyperplasia, *ED* erectile dysfunction, *SD* standard deviation

being a current smoker (OR = 0.799), and having higher storage symptom scores (OR = 0.850). Overall logistic regression findings in the ED population (data not shown) were similar, with the exception that having private health insurance, consulting with a medical professional when not feeling well, and being widowed were not predictors of a BPH diagnosis.

## Discussion

In this population-based analysis of European men ≥40-year old, findings indicate that a large proportion of men with moderate-to-severe LUTS have not been diagnosed with BPH. Older men with higher education and access to care were more likely to have been diagnosed. Having better engagement in their healthcare and a better relationship

with their doctor were factors also associated with a diagnosis. This study examined predictors of a diagnosis for BPH in a general population; further, we analyzed a subset of men who reported having ED to identify whether there were different predictors of having their LUTS diagnosed. Although less than one-third of middle-aged and older men in the general population have coexisting LUTS and ED, most men seeking treatment for either LUTS or ED have both conditions. Symptom severity and impact on quality of life in each condition increase when LUTS and ED coexist [11].

There is extensive literature showing that rates of urinary symptoms [3, 5, 11, 12, 19, 20] and rates of ED [4, 11, 12] rise with age. Many men do not seek care for these conditions [11, 21, 22]. In our study, older men with greater education and higher income were more likely to have been diagnosed with BPH. This may be because

**Table 2** Health characteristic differences between men diagnosed and undiagnosed with BPH and in men with ED who are diagnosed or undiagnosed with BPH

| | Diagnosed BPH (DxBPH) (N = 1,638) | Undiagnosed BPH (non-DxBPH) (N = 3,676) | P value | ED with Diagnosed BPH (ED/DxBPH) (N = 1,012) | ED without Diagnosed BPH (ED/non-DxBPH) (N = 2,265) | P value |
|---|---|---|---|---|---|---|
| Body mass index category | | | <0.001 | | | <0.001 |
| Underweight (%) | 0.2 | 0.6 | | 0.2 | 0.6 | |
| Normal weight (%) | 26.3 | 24.7 | | 25.8 | 22.3 | |
| Overweight (%) | 51.2 | 43.3 | | 50.1 | 44.2 | |
| Obese (%) | 22.1 | 30.3 | | 23.8 | 32.1 | |
| Decline to provide weight (%) | 0.2 | 1.0 | | 0.1 | 0.8 | |
| Drink alcohol (%) | 82.7 | 81.9 | 0.489 | 83.8 | 83.8 | 0.976 |
| Smoking behavior | | | <0.001 | | | <0.001 |
| Never smoked (%) | 27.5 | 25.7 | | 27.9 | 22.5 | |
| Former smoker (%) | 57.4 | 48.2 | | 56.4 | 50.6 | |
| Current smoker (%) | 15.1 | 26.1 | | 15.7 | 27.0 | |
| Regularly exercise (%) | 55.4 | 49.9 | <0.001 | 55.3 | 50.0 | 0.005 |
| Comorbidities | | | | | | |
| CCI, mean ± SD | 0.62 ± 1.03 | 0.65 ± 1.11 | 0.416 | 0.68 ± 1.07 | 0.73 ± 1.18 | 0.314 |
| Type 2 diabetes (%) | 13.9 | 15.1 | 0.229 | 16.5 | 17.7 | 0.384 |
| Type 1 diabetes (%) | 0.5 | 0.7 | 0.355 | 0.5 | 0.8 | 0.285 |
| Hypertension (%) | 43.7 | 38.2 | <.001 | 45.5 | 42.3 | 0.087 |
| Mini-stroke/TIA (%) | 3.1 | 2.3 | 0.100 | 3.2 | 2.7 | 0.455 |
| Stroke (%) | 1.9 | 2.7 | 0.091 | 1.8 | 3.0 | 0.037 |
| Stress urinary incontinence (%) | 2.1 | 1.8 | 0.533 | 2.3 | 2.1 | 0.780 |
| Multiple sclerosis (%) | 0.3 | 0.8 | 0.050 | 0.3 | 0.9 | 0.050 |
| Parkinson's disease (%) | 0.5 | 0.4 | 0.680 | 0.6 | 0.4 | 0.566 |
| Erectile dysfunction (%) | 61.8 | 61.6 | 0.908 | | | |
| Sleep difficulties (%) | 17.0 | 24.0 | <0.001 | 19.3 | 26.4 | <0.001 |
| Visited a doctor in the past 6 months (%) | 97.4 | 91.3 | <0.001 | 98.1 | 92.9 | <0.001 |
| Consult a medically trained professional when not feeling well (mean ± SD) | 3.50 ± 1.07 | 3.24 ± 1.09 | <0.001 | 3.54 ± 1.06 | 3.29 ± 1.07 | <0.001 |
| Willing to make lifestyle changes to avoid taking an Rx | | | | | | |
| (mean ± SD) | 3.43 ± 1.00 | 3.40 ± 0.97 | 0.322 | 3.42 ± 0.98 | 3.38 ± 0.97 | 0.262 |
| My doctor is attentive (mean ± SD) | 3.92 ± 0.89 | 3.69 ± 1.00 | <0.001 | 3.92 ± 0.89 | 3.69 ± 1.01 | <0.001 |
| Prefer OTC medication to Rx (mean ± SD) | 2.11 ± 1.03 | 2.37 ± 1.09 | <0.001 | 2.09 ± 1.03 | 2.32 ± 1.07 | <0.001 |

**Table 2** continued

| | Diagnosed BPH (DxBPH) (N = 1,638) | Undiagnosed BPH (non-DxBPH) (N = 3,676) | P value | ED with Diagnosed BPH (ED/DxBPH) (N = 1,012) | ED without Diagnosed BPH (ED/non-DxBPH) (N = 2,265) | P value |
|---|---|---|---|---|---|---|
| Summed storage symptoms (mean ± SD) | 5.45 ± 3.36 | 6.90 ± 2.63 | <0.001 | 5.76 ± 3.42 | 5.98 ± 2.63 | <0.001 |
| Summed voiding symptoms (mean ± SD) | 5.88 ± 4.86 | 6.27 ± 4.07 | 0.003 | 6.45 ± 4.96 | 6.74 ± 4.15 | 0.085 |
| AUA-SI score (mean ± SD) | 11.3 ± 7.4 | 13.2 ± 5.2 | <0.001 | 12.2 ± 7.5 | 13.7 ± 5.4 | <0.001 |

*BPH* Benign prostatic hyperplasia, *CCI* Charlson comorbidity index, *ED* erectile dysfunction, *OTC* over-the-counter, *Rx* prescription, *SD* standard deviation, *TIA* transient ischemic attack

physicians are more likely to solicit symptoms of LUTS in older men compared to younger men, or younger men may be less likely to discuss their symptoms. Our finding about age is consistent with the literature, as symptom rate and severity have been reported to increase with age, and severity has been shown to be a determinant in the decision to consult a physician [3]. Men who were not employed were also more likely to have a diagnosis, which, in conjunction with their older age, may suggest that retired men are more likely to be diagnosed. Patients who reported better engagement in their healthcare and a better relationship with their doctor were more likely to be diagnosed. This result may indicate a greater willingness to discuss symptoms or to have their physician potentially initiate a discussion of urinary symptoms compared to those reporting symptoms, but not diagnosed. Diagnosed men were less likely to prefer OTC medications to prescription medications, which may indicate that they are more likely to discuss symptoms with their physician and actively seek care.

Interestingly, there was an association between marital status and BPH diagnosis. Urinary symptoms (e.g., getting up at night) may be more bothersome for married men and their spouses, which may lead them to be more active in seeking care. Differences in voiding and storage symptoms suggest that the presence of symptoms generally is associated with a lower likelihood of diagnosis; however, this should be interpreted cautiously, given the context of the inclusion/exclusion criteria. By definition, those in the undiagnosed group must have had a significant symptom score. Those in the diagnosed group were not required to have a high symptom score, as long as they were diagnosed (e.g., their scores could have decreased through treatment). As a result, the direction of the symptom findings is somewhat an artifact of the definitions of the groups.

There were also some substantial country differences: Men in the UK were the least likely to be diagnosed relative to men in the other European countries. For the other countries, men in Italy had the greatest likelihood of reporting being diagnosed, followed by men in Germany, France, and Spain, respectively. Each of these countries has different healthcare systems which may affect access to healthcare, including access to specialists. There may also be cultural differences in how symptoms are viewed by men in each of these countries and their willingness to seek care.

Information on treatment was not available, so even though some patients were not diagnosed, they may have been receiving treatment for urinary symptoms. This information was not available from this survey.

ED is a common comorbidity in the cohort of men diagnosed with BPH and in the cohort reporting moderate or

**Table 3** Logistic regression results of predictors of a BPH diagnosis

| Variable | BPH diagnosis | | | BPH diagnosis among those with ED | | |
|---|---|---|---|---|---|---|
| | OR | 95 % CI | *P* value | OR | 95 % CI | *P* value |
| France | 1.422 | 1.146, 1.765 | 0.0014 | 1.667 | 1.269, 2.190 | 0.0002 |
| Germany | 1.803 | 1.485, 2.190 | <0.0001 | 1.908 | 1.488, 2.447 | <0.0001 |
| Italy | 2.250 | 1.823, 2.776 | <0.0001 | 2.477 | 1.901, 3.227 | <0.0001 |
| Spain | 1.351 | 1.033, 1.766 | 0.0279 | 1.874 | 1.332, 2.635 | 0.0003 |
| Age (years) | 1.077 | 1.067, 1.087 | <0.0001 | 1.080 | 1.067, 1.093 | <0.0001 |
| Marital status: single | 0.613 | 0.453, 0.829 | 0.0015 | 0.624 | 0.414, 0.939 | 0.0237 |
| Marital status: divorced | 0.699 | 0.538, 0.909 | 0.0076 | 0.673 | 0.478, 0.949 | 0.0238 |
| Marital status: separated | 0.869 | 0.565, 1.336 | 0.5217 | 0.897 | 0.534, 1.506 | 0.6799 |
| Marital status: widowed | 0.648 | 0.450, 0.934 | 0.0199 | 1.212 | 0.749, 1.961 | 0.433 |
| Marital status: living with partner | 0.678 | 0.508, 0.905 | 0.0085 | 0.711 | 0.496, 1.020 | 0.0637 |
| University educated | 1.252 | 1.083, 1.446 | 0.0023 | 1.248 | 1.040, 1.498 | 0.0173 |
| Income: above country median | 1.064 | 0.914, 1.237 | 0.4243 | 0.965 | 0.799, 1.166 | 0.7145 |
| Income: decline to answer | 1.004 | 0.786, 1.282 | 0.9736 | 1.047 | 0.747, 1.466 | 0.7907 |
| Private insurance | 1.186 | 1.002, 1.404 | 0.047 | 1.174 | 0.947, 1.457 | 0.1441 |
| Not sure of insurance | 0.465 | 0.286, 0.756 | 0.002 | 0.470 | 0.259, 0.852 | 0.0129 |
| Employment status | 0.980 | 0.821, 1.171 | 0.8267 | 1.014 | 0.812, 1.267 | 0.9006 |
| BMI: underweight | 0.407 | 0.109, 1.521 | 0.1812 | 0.357 | 0.072, 1.764 | 0.2065 |
| BMI: overweight | 0.996 | 0.846, 1.172 | 0.9608 | 0.944 | 0.767, 1.162 | 0.5867 |
| BMI: obese | 0.752 | 0.620, 0.913 | 0.004 | 0.755 | 0.595, 0.959 | 0.021 |
| BMI: missing weight | 0.370 | 0.107, 1.280 | 0.1164 | 0.285 | 0.036, 2.234 | 0.232 |
| Former smoker | 0.890 | 0.760, 1.043 | 0.1514 | 0.745 | 0.608, 0.913 | 0.0046 |
| Current smoker | 0.799 | 0.649, 0.983 | 0.0343 | 0.683 | 0.525, 0.888 | 0.0045 |
| Exercise behavior | 1.191 | 1.040, 1.363 | 0.0115 | 1.214 | 1.024, 1.440 | 0.0256 |
| Stroke | 1.081 | 0.939, 1.245 | 0.279 | 0.439 | 0.246, 0.786 | 0.0055 |
| Sleep difficulties | 0.941 | 0.791, 1.119 | 0.4903 | 1.000 | 0.810, 1.234 | 0.9984 |
| Summed storage symptoms | 0.850 | 0.829, 0.871 | <0.0001 | 0.876 | 0.848, 0.904 | <0.0001 |
| Summed voiding symptoms | 1.032 | 1.015, 1.049 | 0.0002 | 1.044 | 1.022, 1.066 | <0.0001 |
| Visited the doctor in the past 6 months | 2.398 | 1.674, 3.437 | <0.0001 | 3.128 | 1.840, 5.317 | <0.0001 |
| Consult a medically trained professional when not feeling well | 1.097 | 1.023, 1.175 | 0.0089 | 1.073 | 0.983, 1.172 | 0.1151 |
| My doctor is attentive | 1.112 | 1.031, 1.200 | 0.0058 | 1.149 | 1.044, 1.264 | 0.0044 |
| Prefer OTC medication over prescription | 0.975 | 0.909, 1.046 | 0.4781 | 0.983 | 0.900, 1.074 | 0.6998 |

*BPH* Benign prostatic hyperplasia, *BMI* body mass index, *CI* confidence interval, *ED* erectile dysfunction, *OR* odds ratio, *OTC* over-the-counter

severe LUTS, with over 60 % of men in each group reporting ED; however, men with ED were not different than men without ED in their responses to key predictors.

The NHWS relies upon respondents reporting that they have been diagnosed with one or more specific disease states. Given the nature of the survey, these diagnoses are not clinically verified. The large sample size and population-level analyses, based on weighted data to reflect the demographic composition of the European population, enhance the generalizability of this study; however, selection bias cannot be completely eliminated. The NHWS survey is a self-administered, web-based survey, and there may be subsets of the population that may be less likely to participate, such as those who are not comfortable using the Internet or who have limited access to the Internet. Also, the questions used for assessing BPH and ED are a limitation. The questions in the NHWS may not reflect how conditions are diagnosed in a healthcare setting. The item used to identify self-reported ED does not have the breadth of information and symptoms or the psychometric validity of a comprehensive validated instrument, like the International Index of Erectile Function (IIEF). Although participants did provide responses for the AUA-SI, neither it nor the IIEF questionnaire was used to screen and/or define conditions in this study. Similarly, self-reported diagnosed BPH may or may not represent a true histologic

diagnosis of BPH. The survey does not provide information on how the physician made the diagnosis nor how enlarged prostate was defined. Also, response bias may be a factor in that men may not accurately report their symptoms. The NHWS is a general survey that addresses multiple disease states and is not specifically designed to address aging male conditions. Men who choose to take the survey may not be aware that questions about erections or urinary symptoms will be asked and may not feel comfortable addressing those questions. Finally, recall bias may be a factor because the NHWS survey only reflects the participants' recollection of their symptoms and diagnoses and is not verified using chart reviews or clinician diagnoses. Despite these potential limitations, this study provides patients' unique, self-reported perspective on the burden associated with these conditions.

In conclusion, older men with higher education and access to healthcare insurance were more likely to self-report being diagnosed with BPH. In addition, men who were more involved in their healthcare as demonstrated by healthcare behaviors and attitudes were also more likely to be diagnosed. Understanding the characteristics of men who may be more or less likely to be diagnosed with BPH may provide valuable insights to physicians as they evaluate men that may be at risk for BPH and or who may benefit from education aimed at understanding symptoms and/or the management of BPH.

## References

1. American Urological Association, Inc (2010) Management of benign prostatic hyperplasia (BPH). http://www.auanet.org/content/guidelines-and-quality-care/clinical-guidelines.cfm?sub=bph. Accessed 03 Oct 2013
2. European Association of Urology (2013) Guidelines on the treatment of non-neurogenic male LUTS, including benign prostatic obstruction. http://www.uroweb.org/?id=217&tyid=2. Accessed 03 Oct 2013
3. Trueman P, Hood SC, Nayak US, Mrazek MF (1999) Prevalence of lower urinary tract symptoms and self-reported diagnosed 'benign prostatic hyperplasia', and their effect on quality of life in a community-based survey of men in the UK. BJU Int 83:410–415
4. Hoesl CE, Woll EM, Burkart M, Altwein JE (2005) Erectile dysfunction (ED) is prevalent, bothersome and underdiagnosed in patients consulting urologists for benign prostatic syndrome (BPS). Eur Urol 47:511–517
5. Rosen R, Altwein J, Boyle P, Kirby RS, Lukacs B, Meuleman E, O'Leary MP, Puppo P, Robertson C, Giuliano F (2003) Lower urinary tract symptoms and male sexual dysfunction: the multinational survey of the aging male (MSAM-7). Eur Urol 44:637–649
6. Rosen RC, Wei JT, Althof SE, Seftel AD, Miner M, Perelman MA, BPH Registry and Patient Survey Steering Committee (2009) Association of sexual dysfunction with lower urinary tract symptoms of BPH and BPH medical therapies: results from the BPH Registry. Urology 73:562–566
7. Rhoden EL, Riedner CE, Fornari A, Fuchs SC, Ribeiro EP (2008) Evaluation of the association between lower urinary tract symptoms and erectile dysfunction, considering its multiple risk factors. J Sex Med 5:2662–2668
8. Morant S, Bloomfield G, Vats V, Chapple C (2009) Increased sexual dysfunction in men with storage and voiding lower urinary tract symptoms. J Sex Med 6:1103–1110
9. Gacci M, Eardley I, Giuliano F, Hatzichristou D, Kaplan SA, Maggi M, McVary KT, Mirone V, Porst H, Roehrborn CG (2011) Critical analysis of the relationship between sexual dysfunctions and lower urinary tract symptoms due to benign prostatic hyperplasia. Eur Urol 60:809–825
10. McVary K, Foley KA, Long SR, Sander S, Curtice TG, Shah H (2008) Identifying patients with benign prostatic hyperplasia through a diagnosis of, or treatment for, erectile dysfunction. Curr Med Res Opin 24:775–784
11. Seftel AD, de la Rosette J, Birt J, Porter V, Zarotsky V, Viktrup L (2013) Coexisting lower urinary tract symptoms and erectile dysfunction: a systematic review of epidemiological data. Int J Clin Pract 67:32–45
12. Braun MH, Sommer F, Haupt G, Mathers MJ, Reifenrath B, Engelmann UH (2003) Lower urinary tract symptoms and erectile dysfunction: co-morbidity or typical "Aging Male" symptoms? Results of the "Cologne Male Survey". Eur Urol 44:588–594
13. Khoo EM, Tan HM, Low WY (2008) Erectile dysfunction and comorbidities in aging men: an urban cross-sectional study in Malaysia. J Sex Med 5:2925–2934
14. Li MK, Garcia L, Patron N, Moh LC, Sundram M, Leungwattanakij S, Pripatnanont C, Cheng C, Chi-Wai M, Loi-Cheong N (2008) An Asian multinational prospective observational registry of patients with benign prostatic hyperplasia, with a focus on comorbidities, lower urinary tract symptoms and sexual function. BJU Int 101:197–202
15. Abrams P, Cardozo L, Fall M, Griffiths D, Rosier P, Ulmsten U, Van Kerrebroeck P, Victor A, Wein A, Standardisation Sub-Committee of the International Continence Society (2003) The standardisation of terminology in lower urinary tract function: report from the standardisation sub-committee of the International Continence Society. Urology 61:37–49
16. American Urological Association, Inc (2003) Benign prostatic hyperplasia (BPH): a patient's guide. Benign prostatic hyperplasia guideline update panel of the AUA. http://www.auanet.org/content/clinical-practice-guidelines/clinical-guidelines/archived-guidelines/chapt_1_appendix.pdf. Accessed 22 May 2012
17. Barry MJ, Fowler FJ Jr, O'Leary MP, Bruskewitz RC, Holtgrewe HL, Mebust WK, Cockett AT (1992) The American Urological Association symptom index for benign prostatic hyperplasia. The Measurement Committee of the American Urological Association. J Urol 148:1549–1557
18. Charlson ME, Pompei P, Ales KL, MacKenzie CR (1987) A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. J Chronic Dis 40:373–383
19. Irwin DE, Milsom I, Kopp Z, Abrams P, Artibani W, Herschorn S (2009) Prevalence, severity, and symptom bother of lower urinary

tract symptoms among men in the EPIC study: impact of overactive bladder. Eur Urol 56:14–20

20. Boyle P, Robertson C, Mazzetta C, Keech M, Hobbs FD, Fourcade R, Kiemeney L, Lee C, UrEpik Study Group (2003) The prevalence of lower urinary tract symptoms in men and women in four centres. the UrEpik study. BJU Int 92:409–414

21. Jacobsen SJ, Jacobson DJ, Girman CJ, Roberts RO, Rhodes T, Guess HA, Lieber MM (1999) Treatment for benign prostatic hyperplasia among community dwelling men: the Olmsted County study of urinary symptoms and health status. J Urol 162:1301–1306

22. de Boer BJ, Bots ML, Nijeholt AA, Moors JP, Verheij TJ (2005) The prevalence of bother, acceptance, and need for help in men with erectile dysfunction. J Sex Med 2:445–450