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ORIGINAL ARTICLE

Prostate Disease

Healthcare utilization and costs in patients with benign prostatic hyperplasia: a population-based study

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This study aimed to investigate differences in healthcare service utilization between patients with and those without benign prostatic hyperplasia (BPH) using Taiwan's National Health Insurance population-based database. A total of 7413 patients with BPH and 7413 age-matched patients without BPH were included. The outcome variable was 1-year utilization of healthcare services including the number of outpatient visits, inpatient days, and the costs of outpatient and inpatient treatments. In addition, we separated healthcare services into urology services and nonurology services for analysis. We found that as to the utilization of outpatient urological services, patients with BPH had more outpatient services (7.84 vs 0.52, $P < 0.001$), higher outpatient costs (US\$372 vs US\$34, $P < 0.001$), a longer length of inpatient stay (0.55 vs 0.11, $P < 0.001$), higher in-patients costs (US\$149 vs US\$32, $P < 0.001$), and higher total costs (US\$521 vs US\$67, $P < 0.001$) than the comparison group. As for nonurological services, patients with BPH also had more outpatient services (49.11 vs 24.79, $P < 0.001$), higher outpatient costs (US\$1794 vs US\$1014, $P < 0.001$), a longer length of in-patient stay (3.72 vs 2.04, $P < 0.001$), higher inpatient costs (US\$874 vs US\$486, $P < 0.001$), and higher total costs (US\$2668 vs US\$1500, $P < 0.001$) compared to comparison patients. We also found that the average total cost was about 2-fold greater for patients with BPH than comparison patients. We concluded that patients with BPH had higher healthcare utilization than comparison patients without BPH.

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INTRODUCTION

Benign prostatic hyperplasia (BPH) is one of the most common chronic diseases of men worldwide.¹ The high prevalence of BPH is also associated with high medical expenditures. One study reported that total medical expenditures with BPH were US\$776 million in the United States in the year of 2000.² Another study reported that the annual cost of treating BPH in New Zealand was about US\$8.73 million.³ In addition, Saigal and Joyce⁴ indicated that the annual spending for BPH was US\$5729 per person-year for patients aged 45–64 years. Medical expenditures for treating BPH represent tremendous financial burdens to healthcare delivery systems in Western societies.

However, although plenty of studies have reported medical expenditures for patients with BPH, few studies attempted to compare differences in healthcare utilization or costs between patients with and those without BPH. This may prevent clinicians and policy makers from developing effective strategies for treatment alternatives and cost containment for patients with BPH. In addition, all such studies were conducted in Western societies, and no study has reported the economic burden on healthcare systems attributable to treating BPH in Asian countries.

Therefore, this study aimed to investigate differences in healthcare service utilization and costs between patients with and those without BPH using a population-based dataset in Taiwan, China. Data from Taiwan present an excellent opportunity to explore the association of healthcare service utilization with BPH. Taiwan initiated the National Health Insurance (NHI) program in 1995 to provide affordable health care for all residents of Taiwan. Taiwan's NHI has a unique combination of characteristics including universal coverage, a single-payer payment system, comprehensive benefits, low out-of-pocket payment, and free access to any medical institution of the patient's choice.

MATERIALS AND METHODS

Database

This study used data retrieved from the Longitudinal Health Insurance Database (LHID2000). The LHID2000 includes medical claims and registration files for 1 000 000 enrollees, who were randomly selected from all enrollees listed in the 2000 Registry of Beneficiaries ($n = 23.72$ million) under the NHI program. The Taiwan National Health Research Institute and other researchers have demonstrated the high validity of the administrative data sourced from the NHI program.⁵

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Hundreds of studies have also been published using data from the NHI program.

This study was exempt from full review by the Institutional Review Board of the National Defense Medical Center because the LHID2000 consists of de-identified secondary data released to the public for research purposes.

Study sample

This cross-sectional study features a study group and comparison group. For the study group, we first identified 9550 patients with a diagnosis of BPH (ICD-9-CM code 600.0) in their ambulatory care visits from January 1, 2011 to December 31, 2011. In order to increase the validity of the BPH diagnoses, we only included patients who had ≥ 2 diagnoses of BPH in 2011, with at least one diagnosis having been made by a certified urologist ($n = 7643$). We then excluded patients aged < 40 years ($n = 26$) because of the very low prevalence in this age group. We also excluded those who died in 2011 ($n = 204$) in order to assure a 1-year follow-up period (1 year) for all selected patients. Ultimately, 7413 patients with BPH were included in the study group.

For the comparison group, we first excluded all patients who had ever received a diagnosis of BPH since initiation of the NHI program in 1995. We then randomly selected 7413 comparison patients matched to the study patients by age group (40–49, 50–59, 60–69, 70–79, and 980 years) through the SAS PROC SURVEYSELECT Program (SAS, Cary, North Carolina, USA). We likewise assured that none of the selected comparison patients had died in 2011.

Variables of interest

Utilization of healthcare services was evaluated in the year 2011 and was defined as the mean \pm s.e. per group of the following: the number of outpatient visits, the number of inpatient days, and the mean costs of outpatient and inpatient treatments. The costs were defined as the copayment and aggregate monetary value of itemized costs of all services and disposables provided by medical providers. Utilization of healthcare services was also separated into urological and nonurological services. We defined urological services as services provided by a certified urologist.

Statistical analysis

We used an SAS statistical package (SAS System for Windows, version 8.2, Cary, North Carolina, USA) to perform all statistical analyses in this study. Descriptive statistical analyses, including the frequency, percentage, mean, and standard deviation, were carried out on all of the outcome variables. Chi-squared tests were used to explore statistical differences in patients' monthly income, geographic location, and urbanization level between patients with and those without BPH. We also used Wilcoxon–Mann–Whitney tests to explore differences in outcome variables for patients with and those without BPH. Furthermore, we performed a multivariate regression analysis to model the logarithm of mean costs as a linear function of a set of independent variables. The difference was considered significant if the two-sided $P \leq 0.05$.

RESULTS

Of the 14 826 sampled patients, the mean age was 69.4 ± 11.4 years, and only 20% were younger than 60 years. After matching for age group and the year of the index date, **Table 1** shows that BPH patients were more likely to live in the most urbanized communities ($P < 0.001$), have a monthly income of \leq US\$546 ($P < 0.001$), and reside in the northern region ($P < 0.001$) than patients without BPH.

Table 2 presents the use and costs of healthcare services in the year 2011 for patients with and those without BPH. As to utilization of

Table 1: Demographic characteristics of patients with benign prostatic enlargement (BPH) and comparison patients ($n=14\ 826$)

Variable	Patients with BPH ($n=7413$)		Comparison patients ($n=7413$)		P
	Total n	Percentage	Total n	Percentage	
Age (years)					
40–49	285	3.8	285	3.8	>0.999
50–59	1231	16.6	1231	16.6	
60–69	2025	27.3	2025	27.3	
70–79	2206	29.8	2206	29.8	
≥ 80	1666	22.5	1666	22.5	
Urbanization level					
1 (most urbanized)	2368	31.9	2071	27.9	<0.001
2	2079	28.1	1921	25.9	
3	1005	13.6	1195	16.1	
4	1081	14.6	1195	16.1	
5 (least urbanized)	880	11.9	1031	13.9	
Monthly income (US\$)					
\$1–546	3535	47.7	3103	41.9	<0.001
\$546–862	2182	29.4	2706	36.5	
\geq \$862	1696	22.9	1604	21.6	
Geographic region					
Northern	3613	48.7	3289	44.4	<0.001
Central	1743	23.5	1865	25.2	
Southern	1902	25.7	2076	28.0	
Eastern	155	2.1	183	2.5	

The average exchange rate in 2011 was US\$1.00 \approx NT\$ 29. BPH: benign prostatic hyperplasia; NT\$: New Taiwan Dollar

Table 2: Use and costs of healthcare services within 1 year for patients with benign prostatic enlargement (BPH) and comparison patients

Variable	Patients with BPH ($n=7413$)		Comparison patients ($n=7413$)		P
	Mean	s.d.	Mean	s.d.	
Urological services					
Outpatients services (n)	7.84	11.24	0.52	3.58	<0.001
Outpatient costs (US\$)	372	870	34	288	<0.001
Inpatient days	0.55	3.54	0.11	4.57	<0.001
Inpatient costs (US\$)	149	857	32	1302	<0.001
Total costs (US\$)	521	1512	67	1367	<0.001
Nonurological services					
Outpatients services (n)	49.11	66.0	24.79	41.1	<0.001
Outpatient costs (US\$)	1794	3517	1014	3545	<0.001
Inpatient days	3.72	21.12	2.04	13.52	<0.001
Inpatient costs (US\$)	874	4967	486	2,796	<0.001
Total costs (US\$)	2668	6985	1500	4954	<0.001
All healthcare services					
Outpatients services (n)	56.96	71.45	25.31	42.2	<0.001
Outpatient costs (US\$)	2167	3770	1048	3569	<0.001
Inpatient days	4.28	21.54	2.15	15.03	<0.001
Inpatient costs (US\$)	1023	5058	519	3292	<0.001
Total costs (US\$)	3189	7284	1567	3189	<0.001

The average exchange rate in 2011 was US\$1.00 \approx NT\$ 29. s.d.: standard deviation; BPH: benign prostatic hyperplasia; NT\$: New Taiwan Dollar

outpatients urological services, patients with BPH had more outpatient services (7.84 vs 0.52, $P < 0.001$) and higher outpatients costs (US\$372 vs US\$34, $P < 0.001$) than comparison patients (the average exchange rate in 2011 was US\$1.00 \approx New Taiwan Dollar [NT\$] 29). Similarly, patients with BPH also had a longer length of inpatient stay (0.55 vs 0.11,

$P < 0.001$), higher inpatients costs (US\$149 vs US\$32, $P < 0.001$), and higher total costs (US\$521 vs US\$67, $P < 0.001$) than the comparison group for utilization of urological services.

As for nonurological services, patients with BPH had more outpatient services (49.11 vs 24.79, $P < 0.001$), higher outpatient costs (US\$1794 vs US\$1014, $P < 0.001$), a longer length of inpatient stay (3.72 vs 2.04, $P < 0.001$), higher inpatient costs (US\$874 vs US\$486, $P < 0.001$), and higher total costs (US\$2668 vs US\$1500, $P < 0.001$) compared to comparison patients.

In addition, **Table 2** also shows the use and costs of all healthcare services. Patients with BPH had more outpatient services (56.96 vs 25.31, $P < 0.001$), higher outpatient costs (US\$2167 vs US\$1048, $P < 0.001$), more inpatient days (4.28 vs 2.15, $P < 0.001$), higher in-patients costs (US\$1023 vs US\$519, $P < 0.001$), and total costs (US\$3189 vs US\$1567, $P < 0.001$) than comparison patients. On the other hand, the mean number of yearly outpatient services, outpatient costs, inpatients days, and inpatients costs for all health services within the follow-up period were 2.25-, 2.07-, 1.99-, 1.97-, and 2.04-fold greater, respectively, for patients with BPH than comparison patients.

Table 3 shows the multiple regression analyses for adjusted relationships between log costs of all health services and BPH. After adjusting for the urbanization level, monthly income, and geographic region, patients with BPH had higher total costs for all healthcare services than comparison patients.

DISCUSSION

Our population-based study found that patients with BPH had a higher number of times utilizing health services than did patients without BPH. Patients with BPH had about 2-fold higher outpatient services and inpatient days for all healthcare services compared to patients without BPH. Our findings are consistent with results of a study by Wu *et al.* which reported that patients with BPH/lower urinary tract symptoms (LUTSs) had higher rates of outpatient visits and hospitalization than a comparison group.⁶ In addition, another

similar study reported that patients with LUTSs were associated with increased resource use in terms of emergency room visits, medical provider visits, and hospitalizations than were those without LUTSs.⁷

The mechanisms contributing to the association between BPH and high healthcare utilization remain unclear. However, we propose three possible explanations for this association. First, BPH may be linked to the development of medical and surgical conditions. In particular, some studies pointed out that patients with BPH had a higher incidence of metabolic syndrome.^{8,9} One study revealed that diabetes and elevated fasting plasma glucose were associated with BPH.¹⁰ In addition, BPH may be an underlying risk factor for cardiovascular disease (CVD).^{11,12} One matched cohort study by Shah *et al.* found that 39% of men with BPH had been diagnosed with CVD at the time of receiving a BPH diagnosis.¹³ They also reported that men with simultaneous BPH and CVD were more likely to have additional comorbidities such as hyperlipidemia, diabetes, erectile dysfunction, premature ejaculation, hypotension, and chronic renal disease than men with CVD alone.

Second, some studies showed that BPH is associated with overactive bladder (OAB) syndrome. Hu and Wagner¹⁴ indicated that OAB/LUTSs were associated with increased health risks such as urinary tract infections, falls, and fall-related injuries. Coyne *et al.* reported that men with bothersome OAB were more likely to have healthcare-seeking behaviors to treat their urinary symptoms.¹⁵ These observations are in light of our findings that in terms of utilization of urological services, patients with BPH had more outpatient visits and higher outpatient costs than did the controls.

Third, previous studies reported that patients with BPH had a higher prevalence of mental disorders (anxiety, depression, and anxiety and depression combined) compared to the controls.^{10,16} (Lung-Cheng Huang *et al.*) They also indicated that BPH/LUTSs may interfere with the daily life functioning and sleep quality resulting in a low quality of life. Wu *et al.* reported that a poor quality of life among people with BPH/LUTSs can lower the threshold of outpatient visits and hospitalization requests.⁶ Those potential medical conditions may increase the opportunity to use urological and nonurological health services among patients with BPH.

A strength of our study is that it is based on a large population-based dataset, and it covers wide health benefits and a single-payer system in Taiwan. These unique characteristics can increase the statistical power, provide a sufficient sample size, and diminish selection bias allowing us to distinguish differences in healthcare service utilization between subjects with BPH and comparison patients. Nevertheless, there are several limitations to this study. First, the dataset used in this study contains no information on health behaviors such as diet, nicotine and alcohol consumption, and the level of education. Second, the LHID2000 contains no laboratory data and thus, we were unable to explore the severity of BPH in the association between utilization of healthcare services and BPH. Third, the insurance system in Taiwan is specific in that the LHID2000 predominantly includes an ethnic Chinese population, so the ability to generalize the results to other countries cannot be inferred.

CONCLUSION

We found higher healthcare utilization by patients with BPH than comparison patients. Further studies are encouraged to explore factors contributing to the increased healthcare utilization by patients with BPH. In addition, future studies are suggested to investigate how BPH can be treated with outpatient modalities, which are less expensive, or to treat patients with the shortest hospitalization possible.

Table 3: Multiple regression analysis for adjusted relationships between log costs of all health services and benign prostatic enlargement (BPH)

Variable	Log (all health services costs)		
	B	95% CI	P
Group			
Patients with BPH	0.890	0.845–0.934	<0.001
Controls			
Urbanization level			
1 (most urbanized)			
2	0.025	–0.035–0.085	0.413
3	–0.032	–0.105–0.041	0.395
4	0.065	–0.011–0.141	0.096
5 (least urbanized)	0.001	–0.081–0.084	0.974
Monthly income (US\$)			
\$1–546			
\$546–862	–0.305	–0.359–0.250	<0.001
≥\$862	–0.506	–0.563–0.449	<0.001
Geographic region			
Northern			
Central	0.034	–0.027–0.095	0.275
Southern	0.036	–0.021–0.092	0.217
Eastern	0.138	–0.015–0.290	0.077

The average exchange rate in 2011 was US\$1.00=NT\$ 29. BPH: benign prostatic hyperplasia; CI: confidence interval; NT\$: New Taiwan Dollar

AUTHOR CONTRIBUTIONS

YMT conceived of the study, participated in its design and drafted the manuscript. SDC participated in its design and drafted the manuscript. HCL performed the statistical analysis and drafted the manuscript. MJT drafted the manuscript. CYH conceived of the study, participated in its design, coordination and helped to draft the manuscript. All authors read and approved the final manuscript.

COMPETING INTERESTS

None of the authors declare competing financial interests.

REFERENCES

- 1 Wei JT, Calhoun E, Jacobsen SJ. Urologic diseases in America project: benign prostatic hyperplasia. *J Urol* 2005; 173: 1256–61.
- 2 Litwin MS, Saigal CS, Yano EM, Avila C, Geschwind SA, *et al*. Urologic diseases in America Project: analytical methods and principal findings. *J Urol* 2005; 173: 933–7.
- 3 Scott WG, Scott HM. Annual costs of benign prostatic hyperplasia in New Zealand. *Pharmacoeconomics* 1993; 4: 455–68.
- 4 Saigal CS, Joyce G. Economic costs of benign prostatic hyperplasia in the private sector. *J Urol* 2005; 173: 1309–13.
- 5 Cheng CL, Kao YH, Lin SJ, Lee CH, Lai ML. Validation of the National Health Insurance Research Database with ischemic stroke cases in Taiwan. *Pharmacoepidemiol Drug Saf* 2011; 20: 236–42.
- 6 Wu MP, Weng SF, Hsu YW, Wang JJ, Kuo HC. Medical attendance for lower urinary tract symptoms is associated with subsequent increased risk of outpatient visits and hospitalizations based on a nationwide population-based database. *PLoS One* 2013; 8: e57825.
- 7 Kannan H, Radican L, Turpin RS, Bolge SC. Burden of illness associated with lower urinary tract symptoms including overactive bladder/urinary incontinence. *Urology* 2009; 74: 34–8.
- 8 Lin HJ, Weng SF, Yang CM, Wu MP. Risk of hospitalization for acute cardiovascular events among subjects with lower urinary tract symptoms: a nationwide population-based study. *PLoS One* 2013; 8: e66661.
- 9 Zamuner M, Laranja WW, Alonso JC, Simões FA, Rejowski RF, *et al*. Is metabolic syndrome truly a risk factor for male lower urinary tract symptoms or just an epiphenomenon? *Adv Urol* 2014; 2014: 203854.
- 10 Milsom I, Kaplan SA, Coyne KS, Sexton CC, Kopp ZS. Effect of bothersome overactive bladder symptoms on health-related quality of life, anxiety, depression, and treatment seeking in the United States: results from EpiLUTS. *Urology* 2012; 80: 90–6.
- 11 Karatas OF, Bayrak O, Cimentepe E, Unal D. An insidious risk factor for cardiovascular disease: benign prostatic hyperplasia. *Int J Cardiol* 2010; 144: 452.
- 12 Hwang EC, Kim SO, Nam DH. Men with hypertension are more likely to have severe lower urinary tract symptoms and large prostate volume. *Low Urin Tract Symptoms* 2015; 7: 32.
- 13 Shah M, Butler M, Bramley T, Curtice TG, Fine S. Comparison of health care costs and co-morbidities between men diagnosed with benign prostatic hyperplasia and cardiovascular disease (CVD) and men with CVD alone in a US commercial population. *Curr Med Res Opin* 2007; 23: 417–26.
- 14 Hu TW, Wagner TH. Health-related consequences of overactive bladder: an economic perspective. *BJU Int* 2005; 96 Suppl 1: 43–5.
- 15 Coyne KS, Sexton CC, Kopp ZS, Ebel-Bitoun C, Milsom I, *et al*. The impact of overactive bladder on mental health, work productivity and health-related quality of life in the UK and Sweden: results from EpiLUTS. *BJU Int* 2011; 108: 1459–71.
- 16 Huang LC, Ho CH, Weng SF, Hsu YW, Wang JJ, *et al*. The association of healthcare seeking behavior for anxiety and depression among patients with lower urinary tract symptoms: a nationwide population-based study. *Psychiatry Res* 2015; 226: 247–51.