Original Article

J Prev Med Public Health 2022;55:243-252 • https://doi.org/10.3961/jpmph.21.426

pISSN 1975-8375 eISSN 2233-4521

Journal of Preventive Medicine & Public Health

Estimation of Utility Weights for Prostate-related Health States in Korea

Seon-Ha Kim[1], Minsu Ock[2], Min-Woo Jo[3], Sungchan Park[4]

[1]Department of Nursing, Dankook University, Cheonan, Korea; [2]Department of Preventive Medicine, Ulsan University Hospital, University of Ulsan College of Medicine, Ulsan, Korea; [3]Department of Preventive Medicine, University of Ulsan College of Medicine, Seoul, Korea; [4]Department of Urology, Ulsan University Hospital, University of Ulsan College of Medicine, Ulsan, Korea

Objectives: Very limited previous research has investigated the utility weights of prostate-related diseases in the general population in Korea. The purpose of this study was to calculate the utility of prostate-related health states in the Korean general public using the standard gamble (SG) method.

Methods: Seven health states for hypothetical prostate cancers, 1 for benign prostate hyperplasia, and 1 for erectile dysfunction were developed based on patient education material and previous publications. In total, 460 responses from the Korean general population were used to analyze the utility of prostate-related health states. Computer-assisted personal interviews were conducted, and utility values were measured using a visual analogue scale (VAS) and SG. Mean utility values were calculated for each prostate-related health state.

Results: The mean utility values of prostate cancer derived from SG ranged from 0.281 (metastatic castration-refractory prostate cancer) to 0.779 (localized prostate cancer requiring prostatectomy). The utility value of benign prostate hyperplasia was 0.871, and that of erectile dysfunction was 0.812. The utility values obtained using the SG method in all conditions were higher than the values obtained by VAS. There were no significant demographic variables affecting utility values in multivariate analysis.

Conclusions: Our findings might be useful for economic evaluation and utility calculation of screening and interventions for prostate-related conditions in the general population.

Key words: Prostatic neoplasms, Prostatic hyperplasia, Erectile dysfunction, Quality-adjusted life years, Quality of life, Korea

INTRODUCTION

Prostate cancer (PCa) is the most prevalent men malignancy and the second most common cause of cancer-related mortality in the United States and Europe [1-3]. The incidence of PCa has been increasing in recent years in northeast Asian countries including Korea and Japan [4,5], although remarkable racial and ethnic differences in incidence have been reported [3,6]. In Korea, the crude prevalence rate of PCa in 2016 was 272.8 per 100 000, ranking third after stomach cancer and colorectal cancer [7]. The prevalence of PCa in Korea has increased rapidly between 2000 and 2010, leading to a rapid increase in costs incurred by direct medical care and associated morbidity. The direct medical costs of PCa ranked 18th out of 26 cancer types in 2000, and 8th out of 194 in 2010 [8].

The prevalence of benign prostate hyperplasia (BPH) in Korea is 2105 per 100 000, and its incidence increases with age

Received: July 29, 2021 Accepted: December 10, 2021

Corresponding author: Sungchan Park
Department of Urology, Ulsan University Hospital, University of Ulsan College of Medicine, 877 Bangeojinsunhwangdo-ro, Dong-gu, Ulsan 44055, Korea
E-mail: scpark@uuh.ulsan.kr

[9]. BPH, with its resulting lower urinary tract symptoms (LUTS), is a common problem, especially for the elderly. With the increasing life expectancy globally, the prevalence of BPH is steadily increasing and it is becoming a major public health issue [10]. The incidence of erectile dysfunction (ED) also increases with age [11,12]. LUTS and ED are closely associated with each other in men [13-15]. Of men with BPH-related urinary symptoms from the United States, 71% had co-existing ED [15]. BPH-related symptoms can negatively impact quality of life.

Due to limited healthcare resources, healthcare policy-makers are interested in improving the efficiency and efficacy of early detection, treatment, and prevention. Therefore, economic evaluations are conducted for various healthcare interventions. As an economic evaluation method, cost-utility analysis compares cost and health outcomes measured by the utility of healthcare interventions. Utility is an index that combines quantitative and qualitative aspects of life [16]. Quality-adjusted life years (QALYs), one of the most commonly used indicators of utility measures, are calculated by multiplying the length of time spent in a particular health state by the utility weight associated with that health state [17].

Quality weights (utility weights) for prostate-related health states are required to estimate QALYs or evaluate the cost–utility of interventions for prostate-related conditions. There are 2 major methods for measuring quality weights: direct measurement using the standard gamble (SG), time trade-off (TTO), and rating scale (RS) techniques, and indirect measurement using pre-scored multi-attribute health state classification systems (e.g., the EuroQoL-5-Dimension [EQ-5D], Health Utility Index, and Short Form-6-Dimen sion) [18].

SG is a classic method for measuring cardinal utilities that is based directly on the fundamental axioms of utility theory [18]. The SG method has been used less frequently than the TTO or RS methods because it may be difficult for respondents to understand the concept of probability; however, in some studies, SG has been reported to be as feasible and valid for measuring social preferences as TTO [19-21]. Although RS methods such as the visual analogue scale (VAS) are quick and efficient, they are not suitable interval measures compared to the preferences measured by TTO or SG [18,19,22-24].

Although many studies have examined utility weights for PCa, the reported values for similar health states vary widely. The causes of this variability include the elicitation method, the study subjects (patients or the general public), and the description of the state of health [25]. Some evidence supports substantial differences in the utility value of hypothetical health states by race or country [26,27]. It is recommended that most countries develop their own population-based preference weights for the instruments used in economic evaluation. Although a prior study measured the utility weights of PCa by stage and duration of treatment in 160 Korean men aged 40 to 60 from the general population, that study measured utility based on TTO, in which health scenarios with descriptions of major clinical symptoms, treatments, and side effects of local, locally advanced, and metastatic PCa were presented [28]. That study was limited in the number of subjects, included men only, and was limited to only 3 PCa states. It had the advantage of investigating the intensive treatment period and the second-year period of the 3 cancer states; however, it had the limitation of evaluating 3 cancer states regardless of the treatment, even in the same stage [28]. Thus, the utility weights of prostate disease in the general population of Korea still require study. Studies on the utility weights of BPH and ED have not been conducted.

The purpose of the present study was to estimate the utility weights of prostate-related health states using the SG method in the Korean general public. Our findings will be useful in the economic appraisal of interventions for prostate-related conditions in Korea. The present study was performed as part of a larger research project evaluating the economics of cancer screening programs.

METHODS

Health States

Two investigators (MO & SP) created a draft of the prostate-related health states used in this study based on teaching materials at a tertiary hospital. One urologist from a tertiary teaching hospital reviewed and revised the draft of the scenario. In the scenario development stage, it was confirmed whether the content was understood by 2 laypersons. Based on their comments, additional explanations were added in parentheses for words that were difficult to understand (e.g., digital rectal examination, facial flushing, retrograde ejaculation).

The prostate-related conditions consisted of 7 PCa states, 1 BPH state, and 1 ED state. Each PCa health state was designed to reflect a specific cancer stage and common treatment regimens. A total of 9 hypothetical scenarios were considered: (1) localized PCa requiring prostatectomy; (2) localized PCa re-

quiring radiation therapy; (3) localized PCa requiring hormone therapy; (4) locally advanced PCa requiring combination therapy; (5) locally advanced PCa requiring hormone therapy; (6) metastatic PCa; (7) metastatic castration-refractory PCa; (8) BPH; and (9) ED. Each scenario consisted of 4 parts: diagnosis, possible symptoms, treatment strategies and complications, and prognosis (including psychological status). The content of all scenarios for prostate-related health states is described in Supplemental Material 1.

Study Participants and Survey Procedure

People over 19 years old living in Korea were the target population. A total of 509 people were recruited from the population using multi-level stratified quota sampling based on age, gender, and level of education. Participants were recruited in the streets of the selected region to meet the pre-determined quota.

Trained interviewers conducted the survey through computer-aided face-to-face interviewing. The content of the questionnaire can be clicked on the computer screen; in particular, the SG task was designed to visually show the degree of probability change according to how respondents chose the preferred alternative. The interviewers had experience conducting several valuation studies and underwent approximately 3 hours of training and practice before conducting the survey. The interviewers conducted a pilot test of the whole questionnaire among 2 ordinary people and then checked the questionnaire to see if there were any problems. There were no further modifications after the pilot test. The surveys were conducted from March to April of 2016.

After obtaining consent to participate in the study, potential participants were asked about gender, age, and level of education. Those who met the quota criteria valued 9 health state scenarios using the VAS and SG methods. Nine health states and death were evaluated by the VAS method, and only 9 health conditions were evaluated by the SG method. Nine health states were randomly presented for the VAS and SG valuation work. After valuation, participants were asked questions about income, outpatient visits in the past 2 weeks, hospitalization in the past 12 months, and current illnesses.

Valuation Methods

Respondents' preference for each health state was assessed using the VAS and SG approaches. The VAS was used to familiarize respondents with health status descriptions. In the VAS approach, respondents were asked to imagine living in the given state and then to display the corresponding score using a scale of 0 (worst imaginable state) to 100 (best imaginable state) points. In the SG valuation tasks, respondents were asked to choose whether the given health states were "better than death" or "worse than death." If the respondent evaluated a given health state as worse than death, the SG evaluation of the health state was terminated. If the respondent evaluated a health state as better than death, the respondent was asked to choose a preferred option of 2 alternatives: (1) living in a given state for the rest of life, or (2) receiving treatment with 2 possible outcomes, either returning to full health with a probability of p and living for the rest of one's life or dying immediately with a probability of 1-p [23]. The interviewers attempted to determine the respondents' point of indifference between a certain outcome of the target health state and receiving treatment with the uncertain prospect of 2 possible outcomes [29]. The probabilities for the 2 possible outcomes start at 50:50, and the probability changes according to the respondent's preferred alternative. The minimum probability interval was 5%.

Statistical Analysis

The number of inconsistencies was calculated to determine whether respondents properly assessed each health state. For each respondent, the utility values of the BPH state and 7 PCa states were compared and defined as inconsistent if the BPH utility value was lower than that of each PCa state. The inconsistency values for each respondent could range from 0 to 7. Data from respondents with an inconsistency value of 2 or less were used for final analysis.

The utility weights using the VAS method were calculated using the following formula: $(x-d)/(100-d)$, where x corresponds to the VAS value of the health state and d corresponds to the VAS value of death [24]. In the SG method, the utility weights of health states identified as better than death were given as the probability (p) of full health at the respondent's point of indifference, while for states worse than death, utility weights for all health states were censored at 0.

The mean, standard deviation (SD), and median utility weights of the 9 health states were calculated by the valuation method. The mean utility weights according to demographic factors and health conditions were compared using the Student t-test and analysis of variance.

Linear mixed analysis was performed to examine the effect of covariates on utility weight. The utility weights obtained us-

ing the SG method were regarded as dependent variables, and the demographic factors, clinical information, and health states were treated as independent variables. All statistical analyses were conducted using SAS version 9.2 (SAS Institute Inc., Cary, NC, USA). The *p*-values <0.05 were considered to indicate statistical significance.

Ethics Statement

The study was approved by Asan Medical Center's Institutional Review Board (approval No. S2016-0015), which waived the requirement for written consent. The study proceeded with oral informed consent.

RESULTS

Of the 509 surveyed subjects, the final analysis included 456 subjects, excluding 53 subjects with an inconsistency value of 3 or more. The average age of the 456 subjects was 45.5±14.1 years, and 48.5% were men. Of these, 9.7% had current diseases. The clinical and demographic characteristics of the respondents are shown in Table 1.

Table 1. Demographic and clinical characteristics of respondents

Characteristics	n (%)
Gender	
Men	221 (48.5)
Women	235 (51.5)
Age (y)	
19-29	85 (18.6)
30-39	79 (17.3)
40-49	101 (22.2)
50-59	87 (19.1)
≥60	104 (22.8)
Education level	
Middle school or below	41 (9.0)
High school	212 (46.5)
College or above	203 (44.5)
Monthly income (million Korean won)	
<3	96 (21.1)
3-5	220 (48.3)
>5	140 (30.7)
Ambulatory care visit in past 2 wk	
Yes	39 (8.5)
No	417 (91.4)
Hospitalization in past 12 mo	
Yes	10 (2.2)
No	446 (97.8)
Current illness	
Yes	44 (9.7)
No	412 (90.4)

The utility weights for prostate-related health states are shown in Table 2. The utility weight ranking of health states was the same in both VAS and SG methods. However, the mean utility weight obtained by SG was higher than that obtained by VAS for all health states. The difference in utility values between the 2 valuation methods ranged from 0.140 to 0.192. BPH was assigned the highest utility values (0.730 using VAS and 0.871 using SG), while metastatic castration-refractory PCa was assigned the lowest utility value (0.110 using VAS and at 0.281 using SG). The utility weight of ED was 0.664 in VAS and 0.812 in SG. The ranking of health state utility values was equal in both valuation methods. The utility values of PCa derived from SG were 0.779 (localized PCa requiring prostatectomy), 0.682 (localized PCa requiring radiation therapy), 0.663 (localized PCa requiring hormone therapy), 0.653 (locally advanced PCa requiring combination therapy), 0.645 (locally advanced PCa requiring hormone therapy), 0.349 (metastatic PCa), and 0.281 (metastatic castration-refractory PCa).

Table 3 presents comparisons of utility weights according to socio-demographic factors. The mean utility weights estimated by SG were not significantly different according to gender, age, educational level, outpatient visits, and admissions. However, respondents with a current disease tended to have a

Table 2. Utility values of prostate-related health states calculated using the VAS and SG methods

Health states	VAS	SG
1. Localized PCa requiring prostatectomy	0.639±0.167/0.661	0.779±0.233/0.850
2. Localized PCa requiring radiation therapy	0.532±0.163/0.556	0.682±0.249/0.750
3. Localized PCa requiring hormone therapy	0.475±0.177/0.464	0.663±0.257/0.700
4. Locally advanced PCa requiring combination therapy	0.478±0.139/0.490	0.653±0.245/0.700
5. Locally advanced PCa requiring hormone therapy	0.453±0.178/0.433	0.645±0.251/0.700
6. Metastatic PCa	0.200±0.155/0.200	0.349±0.258/0.300
7. Metastatic castration-refractory PCa	0.110±0.184/0.096	0.281±0.269/0.200
8. Benign prostatic hyperplasia	0.730±0.154/0.750	0.871±0.201/0.950
9. Erectile dysfunction	0.664±0.175/0.691	0.812±0.241/0.900

Values are presented as mean±standard deviation/median.
VAS, visual analogue scale; SG, standard gamble; PCa, prostate cancer.

Table 3. Utility values of prostate-related health states[1] calculated using the SG method according to socio-demographic factors

Variables	Health state 1	Health state 2	Health state 3	Health state 4	Health state 5	Health state 6	Health state 7	Health state 8	Health state 9
Gender									
Men	0.772±0.245	0.674±0.252	0.652±0.252	0.637±0.254	0.623±0.265	0.347±0.254	0.290±0.269	0.868±0.206	0.801±0.253
Women	0.785±0.221	0.690±0.246	0.674±0.261	0.668±0.236	0.665±0.235	0.351±0.263	0.272±0.269	0.873±0.196	0.823±0.229
Age (y)									
19-29	0.786±0.225	0.678±0.242	0.668±0.251	0.643±0.235	0.661±0.243	0.336±0.262	0.271±0.264	0.883±0.205	0.816±0.272
30-39	0.761±0.243	0.669±0.266	0.633±0.260	0.628±0.259	0.622±0.254	0.325±0.212	0.265±0.250	0.842±0.235	0.759±0.276
40-49	0.794±0.222	0.682±0.268	0.673±0.257	0.655±0.245	0.660±0.244	0.361±0.265	0.298±0.283	0.879±0.181	0.825±0.214
50-59	0.793±0.209	0.698±0.219	0.657±0.257	0.672±0.230	0.647±0.247	0.343±0.261	0.281±0.267	0.883±0.158	0.820±0.200
≥60	0.761±0.259	0.681±0.250	0.677±0.261	0.663±0.257	0.632±0.267	0.370±0.281	0.284±0.277	0.864±0.220	0.832±0.239
Education level									
High school or below	0.782±0.233	0.692±0.240	0.671±0.255	0.658±0.252	0.645±0.257	0.339±0.260	0.269±0.264	0.873±0.200	0.823±0.227
College or above	0.775±0.233	0.669±0.259	0.653±0.259	0.647±0.236	0.644±0.244	0.361±0.257	0.295±0.274	0.868±0.202	0.800±0.257
Monthly income (million Korean won)									
<3	0.794±0.247	0.703±0.243	0.684±0.257	0.664±0.272	0.651±0.265	0.346±0.271	0.258±0.271	0.868±0.218	0.831±0.238
3-5	0.773±0.218	0.666±0.246	0.647±0.254	0.634±0.233	0.634±0.241	0.343±0.244	0.279±0.248	0.877±0.187	0.811±0.273
>5	0.777±0.245	0.692±0.258	0.675±0.261	0.676±0.244	0.656±0.258	0.361±0.273	0.299±0.298	0.863±0.210	0.801±0.249
Ambulatory care visit in the past 2 wk									
Yes	0.796±0.245	0.705±0.255	0.694±0.266	0.692±0.271	0.714±0.231	0.333±0.252	0.265±0.281	0.885±0.169	0.878±0.191
No	0.777±0.232	0.680±0.249	0.660±0.256	0.649±0.242	0.638±0.252	0.350±0.259	0.282±0.268	0.869±0.203	0.806±0.244
Hospitalization in the past 12 mo									
Yes	0.755±0.239	0.635±0.254	0.605±0.250	0.620±0.330	0.600±0.220	0.455±0.288	0.495±0.385	0.820±0.221	0.695±0.332
No	0.779±0.233	0.683±0.249	0.664±0.257	0.654±0.243	0.646±0.252	0.346±0.258	0.276±0.264	0.872±0.200	0.815±0.238
Morbidity									
Yes	0.842±0.162*	0.737±0.222	0.735±0.208*	0.724±0.246*	0.716±0.199*	0.330±0.248	0.247±0.250	0.901±0.139	0.868±0.175*
No	0.772±0.238*	0.676±0.251	0.655±0.260*	0.646±0.244*	0.637±0.255*	0.351±0.260	0.284±0.271	0.867±0.206	0.807±0.246*

Values are presented as mean±standard deviation.
SG, standard gamble; PCa, prostate cancer.
[1]Health state 1: localized PCa requiring prostatectomy; Health state 2: localized PCa requiring radiation therapy; Health state 3: localized PCa requiring hormone therapy; Health state 4: locally advanced PCa requiring combination therapy; Health state 5: locally advanced PCa requiring hormone therapy; Health state 6: metastatic PCa; Health state 7: metastatic castration-refractory PCa; Health state 8: benign prostatic hyperplasia; Health state 9: erectile dysfunction.
*$p<0.05$.

Table 4. Linear mixed model for factors influencing utility weight

Factors	Utility by standard gamble		
	Coefficient	95% CI	
		LL	UL
Gender			
Men		Reference	
Women	0.015	-0.019	0.049
Age (y)			
19-29		Reference	
30-39	-0.026	-0.082	0.030
40-49	0.013	-0.041	0.067
50-59	-0.002	-0.060	0.057
≥60	-0.015	-0.078	0.049
Education level			
High school or below		Reference	
College and above	0.008	-0.033	0.049
Monthly income (million Korean won)			
<3		Reference	
3-5	-0.018	-0.069	0.034
>5	-0.005	-0.061	0.051
Ambulatory care visit in past 2 wk			
Yes		Reference	
No	-0.015	-0.084	0.053
Hospitalized in past 12 mo			
Yes		Reference	
No	0.040	-0.083	0.163
Morbidity			
Yes		Reference	
No	0.033	-0.111	0.018
Scenario			
Benign prostate hyperplasia		Reference	
Localized PCa requiring prostatectomy	-0.091	-0.114	-0.067
Localized PCa requiring radiation therapy	-0.188	-0.211	-0.165
Localized PCa requiring hormone therapy	-0.206	-0.229	-0.183
Locally advanced PCa requiring combination therapy	-0.217	-0.240	-0.193
Locally advanced PCa requiring hormone therapy	-0.225	-0.248	-0.202
Metastatic PCa	-0.516	-0.539	-0.492
Metastatic castration-refractory PCa	-0.581	-0.605	-0.558
Erectile dysfunction	-0.058	-0.081	-0.035

CI, confidence interval; LL, lower limit; UL, upper limit; PCa, prostate cancer.

higher utility weight for most health states than those without current disease. Table 4 shows the effect of covariates with utility weights obtained using the SG method. In multivariate analysis, no socio-demographic variables and health information had statistically significant effects on the utility weights of health states.

DISCUSSION

In the present study, quality weights for prostate-related health states (PCa, BPH, and ED) were elicited using SG and VAS from 456 respondents from the general public in Korea. The range of PCa quality weights was from 0.281 (metastatic castration-refractory PCa) to 0.779 (localized PCa requiring prostatectomy). A lower utility weight was estimated for more severe PCa states. The utility weight of BPH was 0.871, and the utility weight of ED was 0.812.

In the present survey, women were also recruited to evaluate hypothetical prostate-related health states. Prostate disease and ED only occur in men; however, economic evaluation includes preferences of the general population, including both men and women [30]. Therefore, in this valuation study, women were included as participants. Interestingly, there was no significant difference in utility weights according to gender for any health state.

We used 2 methods, VAS and SG, to calculate health state utility values in the general population. The VAS method is easy to administer and has little cognitive burden on respondents. However, as cardinal preferences obtained using the VAS are prone to biases, VAS should play a supplemental role when calculating utility alone [24]. SG is a classic method for measuring respondents' cardinal utilities under conditions of uncertainty [18]. However, subjects from the general population may have difficulty understanding the SG method, including its use of probability. Nonetheless, several studies have reported that the SG method is acceptable as a valuation method in Koreans [21,31]. In this study, respondents were first assessed with VAS and then with the SG method so that they could become familiar with health state scenarios. Computer-based visual aids were also used to help respondents understand tasks in the valuation process.

Previous PCa utility studies [28,32-34] have used different methodologies, scenarios, and subject groups, and a comparison of utility studies is presented in Table 5. In a study using the TTO method for Korean men, the utility weight was 0.727

Table 5. Comparison of prostate cancer status utility studies

Study	Utility of prostatic cancer mean score			Valuation method	Study subjects	Nation
	Local cancer	Locally advanced cancer	Metastatic cancer			
This study	0.663-0.779	0.645-0.653	0.281-0.349	SG (diagnosis, symptom, treatment and side effects, prognosis)	Population	Korea
Kim et al. [28]	0.653-0.727	0.451-0.545	0.149-0.321	TTO (symptom, treatment, and side effects)	Population	Korea
Gries et al. [33]		0.32-0.81		SG (sexual function, urinary function, bowel function, pain, and emotional well-being)	Population	USA
Gries et al. [33]		0.46-0.85		SG (sexual function, urinary function, bowel function, pain, and emotional well-being)	Patient	USA
Torvinen et al. [34]	0.87-0.90		0.59-0.74	Indirect method using EQ-5D	Patient	Finland
Bergius et al. [35]	0.912	0.897	0.855	Indirect method using 15-Dimension	Patient	Finland
Krahn et al. [36]		0.87-0.88		SG-(pain, energy, emotional well-being, social support, and relationship with doctor)	Patient	Canada

SG, standard gamble; TTO, time trade-off; EQ-5D, EuroQoL 5-Dimension.

for local PCa, 0.545 for locally advanced PCa, and 0.321 for metastatic PCa at 1 year after diagnosis [28]. These results are similar to our findings. Gries et al. [33] evaluated 18 prostate-specific states with 5 attributes (sexual function, urinary function, bowel function, pain, and emotional well-being) using the SG method. The range of mean value scores for prostate-specific health states was 0.32-0.81 in the general population and 0.46-0.85 in PCa patients [33]. In a Finnish study in which utility was measured using the 15-Dimension instrument for patients, the mean utility was reported as 0.912 for local cancer, 0.897 for locally advanced cancer, and 0.855 for metastatic cancer [35]. Krahn et al. [36] investigated the utility of pre-treatment at 2 months and 12 months after treatment in patients with localized PCa. The utility of patients who underwent radical prostatectomy was 0.87 after 2 months and 0.88 in patients receiving radiation therapy. In a study using EQ-5D in patients with PCa, the utility of local PCa patients in the first 6 months after diagnosis was 0.90; it was 0.74 in metastatic cancer patients and 0.59 in those receiving palliative treatment [34]. In a study conducted by Smith and Robert [37], the utility weight of the poor ED scenario was 0.91 for men with ED and 0.86 for men without ED, reflecting a statistically significant difference.

The EQ-5D is easy to measure because it consists of 5 items, and it is a preference-based tool with a social value set developed in Korea [21]. Utility values can be obtained by administering the EQ-5D tool to patients, but it is not easy to recruit patients with severe conditions such as metastatic castration-refractory PCa for each health state. In addition, the utility value of cancer status is estimated to be higher in patients than in direct estimates of the general population. This may be due to the adaptive effects of chronically ill patients [38] or the ceiling effect of preference-based tools such as the EQ-5D [39]. Our study has the advantage of obtaining utility values for a diverse range of prostate-related health states by adopting a direct evaluation method targeting the general population. These findings can be applied in more precise evaluations of the effectiveness of screening and intervention for each health state. In the present study, SG utility weights were higher than VAS values in all hypothetical health states, consistent with previous research reports [25,31,37,40].

In this study, most demographic variables did not affect the valuation of hypothetical scenarios. Respondents with current comorbidities reported higher values in several scenarios than those without comorbidities. However, comorbidities did not significantly affect the utility weights in multivariate analysis. It has been reported that patients with PCa [33] or ED [37] have higher utility values than people in the general population; however, the statistical significance of this difference is not known.

There are several limitations to this study. First, a limited number of health states were assessed in light of the cognitive burden on respondents. Consequently, the health status scenarios were fairly long and involved several possible situations that may have made the choices difficult for respondents. It is possible that respondents selectively viewed and evaluated some elements rather than the full text due to the length of the scenarios. Second, we could not determine the response rate and non-respondent characteristics because we did not collect information about subjects who refused the survey or

dropped out of the survey. To maintain the representativeness of respondents, we used a multistage stratified quota sampling method that accounted for the demographic variables of the general population in Korea. Thirdly, we considered the "worse than death" state as 0 without applying the SG method. The percentage of participants who responded "worse than death" was 7.5% for the metastatic PCa state, 12.5% for the metastatic castration-refractory PCa state, and less than 3.0% for the remaining states. If health states worse than death are also assessed by SG, the utility value of states would likely be lower, especially for severe health states.

Our study estimated the utility of 9 prostate-related conditions using the SG method in the general population of Korea. Estimated utility values and QALYs could be used to measure prostate-related disease burden. These findings could also be used to evaluate the cost-utility of various prostate disease interventions, including the PCa screening program.

SUPPLEMENTAL MATERIALS

Supplemental material is available at https://doi.org/10.3961/jpmph.21.426.

CONFLICT OF INTEREST

The authors have no conflicts of interest associated with the material presented in this paper.

FUNDING

This study was supported by a grant from the National R & D Program for Cancer Control, Ministry of Health and Welfare, Republic of Korea (No. 1520140).

ACKNOWLEDGEMENTS

None.

AUTHOR CONTRIBUTIONS

Conceptualization: Jo MW, Kim SH, Park S, Ock M. Data curation: Ock M, Park S. Formal analysis: Kim SH, Ock M. Funding acquisition: Jo MW. Methodology: Park S, Ock M, Kim SH. Writing – original draft: Kim SH. Writing – review & editing: Jo MW, Park S, Ock M.

ORCID

Seon-Ha Kim https://orcid.org/0000-0002-9417-396X
Minsu Ock https://orcid.org/0000-0001-9949-9224
Min-Woo Jo https://orcid.org/0000-0002-4574-1318
Sungchan Park https://orcid.org/0000-0002-2337-983X

REFERENCES

1. Jemal A, Ward EM, Johnson CJ, Cronin KA, Ma J, Ryerson B, et al. Annual report to the nation on the status of cancer, 1975-2014, featuring survival. J Natl Cancer Inst 2017;109(9):djx030.
2. Jemal A, Siegel R, Ward E, Hao Y, Xu J, Thun MJ. Cancer statistics, 2009. CA Cancer J Clin 2009;59(4):225-249.
3. Center MM, Jemal A, Lortet-Tieulent J, Ward E, Ferlay J, Brawley O, et al. International variation in prostate cancer incidence and mortality rates. Eur Urol 2012;61(6):1079-1092.
4. Won YJ, Jung KW, Oh CM, Park EH, Kong HJ, Lee DH, et al. Geographical variations and trends in major cancer incidences throughout Korea during 1999-2013. Cancer Res Treat 2018;50(4):1281-1293.
5. Kimura T, Egawa S. Epidemiology of prostate cancer in Asian countries. Int J Urol 2018;25(6):524-531.
6. Cronin KA, Lake AJ, Scott S, Sherman RL, Noone AM, Howlader N, et al, Annual report to the nation on the status of cancer, part I: national cancer statistics. Cancer 2018;124(13):2785-2800.
7. Jung KW, Won YJ, Kong HJ, Lee ES; Community of Population-Based Regional Cancer Registries. Cancer statistics in Korea: incidence, mortality, survival, and prevalence in 2015. Cancer Res Treat 2018;50(2):303-316.
8. Lee KS, Chang HS, Lee SM, Park EC. Economic burden of cancer in Korea during 2000-2010. Cancer Res Treat 2015;47(3):387-398.
9. Lee YJ, Lee JW, Park J, Seo SI, Chung JI, Yoo TK, et al. Nationwide incidence and treatment pattern of benign prostatic hyperplasia in Korea. Investig Clin Urol 2016;57(6):424-430.
10. Robert G, De La Taille A, Descazeaud A. Epidemiology of benign prostatic hyperplasia. Prog Urol 2018;28(15):803-812 (French).
11. Park HJ, Won JE, Sorsaburu S, Rivera PD, Lee SW. Urinary tract symptoms (LUTS) secondary to benign prostatic hyperplasia (BPH) and LUTS/BPH with erectile dysfunction in Asian men: a systematic review focusing on tadalafil. World J Mens Health 2013;31(3):193-207.

12. Roehrborn CG, Egan KB, Miner MM, Ni X, Wong DG, Rosen RC. Erectile dysfunction and lower urinary tract symptoms associated with benign prostatic hyperplasia (LUTS/BPH) combined responders to tadalafil after 12 weeks of treatment. BJU Int 2016;118(1):153-160.
13. Glina S, Santana AW, Azank F, Mello LF, Moreira ED Jr. Lower urinary tract symptoms and erectile dysfunction are highly prevalent in ageing men. BJU Int 2006;97(4):763-765.
14. Morant S, Bloomfield G, Vats V, Chapple C. Increased sexual dysfunction in men with storage and voiding lower urinary tract symptoms. J Sex Med 2009;6(4):1103-1110.
15. Rosen RC, Wei JT, Althof SE, Seftel AD, Miner M, Perelman MA, et al. Association of sexual dysfunction with lower urinary tract symptoms of BPH and BPH medical therapies: results from the BPH Registry. Urology 2009;73(3):562-566.
16. Dolan P, Gudex C, Kind P, Williams A. Valuing health states: a comparison of methods. J Health Econ 1996;15(2):209-231.
17. Whitehead SJ, Ali S. Health outcomes in economic evaluation: the QALY and utilities. Br Med Bull 2010;96:5-21.
18. Drummond MF, Sculpher MJ, Torrance GW, O'Brien BJ, Stoddart GL. Methods for the economic evaluation of health care programmes. Oxford: Oxford University Press; 2005, p. 147-173.
19. Torrance GW. Social preferences for health states: an empirical evaluation of three measurement techniques. Socioecon Plann Sci 1976;10(3):129-136.
20. Wee HL, Li SC, Xie F, Zhang XH, Luo N, Feeny D, et al. Validity, feasibility and acceptability of time trade-off and standard gamble assessments in health valuation studies: a study in a multiethnic Asian population in Singapore. Value Health 2008; 11 Suppl 1:S3-S10.
21. Kim SH, Lee SI, Jo MW. Feasibility, comparability, and reliability of the standard gamble compared with the rating scale and time trade-off techniques in Korean population. Qual Life Res 2017;26(12):3387-3397.
22. Bleichrodt H, Johannesson M. Standard gamble, time trade-off and rating scale: experimental results on the ranking properties of QALYs. J Health Econ 1997;16(2):155-175.
23. Torrance GW. Measurement of health state utilities for economic appraisal. J Health Econ 1986;5(1):1-30.
24. Torrance GW, Feeny D, Furlong W. Visual analog scales: do they have a role in the measurement of preferences for health states? Med Decis Making 2001;21(4):329-334.
25. Bremner KE, Chong CA, Tomlinson G, Alibhai SM, Krahn MD. A review and meta-analysis of prostate cancer utilities. Med Decis Making 2007;27(3):288-298.
26. Norman R, Cronin P, Viney R, King M, Street D, Ratcliffe J. International comparisons in valuing EQ-5D health states: a review and analysis. Value Health 2009;12(8):1194-1200.
27. Wittenberg E, Halpern E, Divi N, Prosser LA, Araki SS, Weeks JC. The effect of age, race and gender on preference scores for hypothetical health states. Qual Life Res 2006;15(4):645-653.
28. Kim Y, Hwang JS, Ahn J, Lee SM, Lee YJ, Shin S. Utilities for prostate cancer by cancer stage and treatment step in Korea. Korean J Health Econ Policy 2013;19(2):1-20 (Korean).
29. Kim SH, Jo MW, Ock M, Lee HJ, Lee JW. Estimation of health state utilities in breast cancer. Patient Prefer Adherence 2017; 11:531-536.
30. Claxton K, Walker S, Palmer S, Sculpher M. Appropriate perspectives for health care decisions; 2010 [cited 2021 Jul 1]. Available from: https://www.york.ac.uk/media/che/documents/papers/researchpapers/rp54_appropriate_perspectives_for_health_care_decisions.pdf.
31. Jo MW, Kwon DS, Kim SH, Kil SR, Lee SI. Validity and reliability of Korean EQ-5D valuation study using a computer-assisted standard gamble method. Korean J Health Promot 2010;10(3): 105-112 (Korean).
32. Krahn M, Ritvo P, Irvine J, Tomlinson G, Bremner KE, Bezjak A, et al. Patient and community preferences for outcomes in prostate cancer: implications for clinical policy. Med Care 2003; 41(1):153-164.
33. Gries KS, Regier DA, Ramsey SD, Patrick DL. Utility estimates of disease-specific health states in prostate cancer from three different perspectives. Appl Health Econ Health Policy 2017; 15(3):375-384.
34. Torvinen S, Färkkilä N, Sintonen H, Saarto T, Roine RP, Taari K. Health-related quality of life in prostate cancer. Acta Oncol 2013;52(6):1094-1101.
35. Bergius S, Torvinen S, Muhonen T, Roine RP, Sintonen H, Taari K. Health-related quality of life among prostate cancer patients: real-life situation at the beginning of treatment. Scand J Urol 2017;51(1):13-19.
36. Krahn MD, Bremner KE, Tomlinson G, Naglie G. Utility and health-related quality of life in prostate cancer patients 12 months after radical prostatectomy or radiation therapy. Prostate Cancer Prostatic Dis 2009;12(4):361-368.
37. Smith KJ, Roberts MS. Quality-of-life utility values for erectile function and sildenafil treatment. Clin Drug Investig 2005; 25(2):99-105.
38. Postulart D, Adang EM. Response shift and adaptation in chronically ill patients. Med Decis Making 2000;20(2):186-193.

39. Pickard AS, De Leon MC, Kohlmann T, Cella D, Rosenbloom S. Psychometric comparison of the standard EQ-5D to a 5 level version in cancer patients. Med Care 2007;45(3):259-263.

40. Morimoto T, Fukui T. Utilities measured by rating scale, time trade-off, and standard gamble: review and reference for health care professionals. J Epidemiol 2002;12(2):160-178.