doi: 10.1111/hex.12301

Men's preferences and trade-offs for prostate cancer screening: a discrete choice experiment

Kirsten Howard BSc(Hons I) MPH MAppSci MHealthEc PhD,* Glenn P. Salkeld BBus MPH PhD,* Manish I. Patel MBBS,† Graham J. Mann MBBS PhD‡ and Michael P. Pignone MD MPH§

*Professor, Sydney School of Public Health, University of Sydney, Sydney, NSW †Associate Professor, Discipline of Surgery, University of Sydney, Sydney, NSW ‡Professor, Westmead Clinical School, University of Sydney at Westmead Millennium Institute for Medical Research, Westmead, NSW, Australia and §Professor, Department of Medicine, University of North Carolina at Chapel Hill, Chapel Hill, NC, USA

Correspondence
Kirsten Howard, BSc(Hons I), MPH, MAppSci, MHealthEc, PhD
Professor
Sydney School of Public Health
University of Sydney
Sydney, NSW 2006
Australia
E-mail: kirsten.howard@sydney.edu.au

Accepted for publication
14 October 2014

Keywords: discrete choice experiment, preferences, prostate-specific antigen screening, PSA

Abstract

Objectives Prostate cancer screening using prostate-specific antigen (PSA) remains controversial. In deciding about screening, men must weigh the benefits and harms: little is known about benefit: harm trade-offs men are willing to accept. The objective of this study was to assess men's preferences for PSA screening, and the trade-offs between benefits and harms men are willing to accept when deciding about screening.

Methods Preferences of 662 men aged 40–69 were assessed using a discrete choice experiment. PSA screening was described by six attributes: prostate cancer deaths, prostate cancer diagnoses, unnecessary biopsies from false-positive PSA tests, impotence, urinary incontinence/bowel problems and cost. A mixed logit model was used to examine the influence of attributes on men's preferences for PSA testing; benefit: harm trade-offs were also calculated.

Results Men's preferences were significantly influenced by test characteristics, particularly potential mortality benefit, unnecessary biopsies and likelihood of urinary incontinence or bowel problems; preferences were also influenced by age, prior PSA testing experience and perceived risk of prostate cancer. Men were willing to accept between 65 and 233 of 10 000 extra men with unnecessary biopsies, and between 31 and 72 of 10 000 extra men with incontinence/bowel problems to avoid one prostate cancer death.

Conclusions Differences in valuations of attributes and trade-offs acceptable to men of different ages suggest a one size fits all approach to PSA testing, regardless of age, may not reflect men's preferences. Our results can be used by policymakers to ensure screening programmes are in line with men's preferences and by clinicians and patients to facilitate informed discussions of the most relevant benefits and downsides of PSA screening for an individual man.

Introduction

Prostate cancer contributes significantly to both cancer incidence and mortality in men, leading to almost 240 000 cancer diagnoses and more than 29 000 deaths per year in the USA[1] and almost 19 000 diagnoses and 3300 deaths per year in Australia.[2] However, screening for prostate cancer using prostate-specific antigen (PSA) testing remains controversial. The recent European Randomised Study of Screening for Prostate Cancer (ERSPC) trial,[3] a multicountry PSA screening trial with over 180 000 patients with a median of 11-year follow-up, provides the best evidence of the benefits and harms of PSA screening and suggests screening offers a small reduction in prostate cancer-specific mortality,[3,4] but substantial potential harms: screened men have a substantially higher likelihood of prostate cancer diagnosis, including diagnosis of cancers that would not have become clinically apparent within the man's lifetime ('overdiagnosis'). Consequently, more men therefore experience attendant harms of diagnosis and treatment such as consequences of biopsies, and impotence and/or incontinence from treatments.[3–6]

Because of these potential benefits and downsides, PSA screening can be considered preference sensitive health care, that is, health care where there are significant potential trade-offs among positive and negative outcomes. Decisions regarding these interventions should necessarily reflect an individual's personal values and preferences and should be made after individuals have considered sufficient information to make an informed choice.[7] Indeed, almost all prostate cancer screening guidelines recommend discussion of the potential benefits and harms and an individualized, informed shared decision-making approach to prostate cancer screening decisions.[8–11]

Therefore, to make high-quality decisions about screening, men need to weigh potential benefits with potential risks, harms and costs. Decision aids are one means to facilitate informed decision making by providing a framework for values clarification;[12–14] multicriteria decision analyses are another.[15] Some decision tools for PSA screening recognize benefit: harm trade-offs,[16] and, as a part of values clarification, ask men to weigh up various factors in arriving at a choice. However, a recent study suggests that information may be weighted more heavily towards the pros of screening and therefore may not be adequate for men to consider and weigh up benefits and harms.[17,18]

Few studies to date have explicitly examined how men trade-off these benefits and harms in decision making about PSA screening.[19] Where that balance sits for an individual man is highly personal and driven by his own personal situation and experiences, such as age and medical history, and by his preferences about the extent of trade-offs between benefits and harms that are acceptable. Preferences of the individual are therefore paramount and can significantly influence the use of healthcare services, hence the increasing emphasis on involvement of patients in healthcare decisions.[20] In making a decision about prostate cancer screening, a man, in conjunction with his clinician, may use a variety of sources of information, including the preference of other men similar to him; this is what we seek to provide in this study.

This study therefore used a discrete choice experiment (DCE) to investigate how PSA screening characteristics, and men's sociodemographic characteristics, particularly age, influence preferences for PSA screening and the trade-offs between benefits and harms that men are willing to accept in deciding about screening.

Methods

Study Population and recruitment

This study examines Australian men's preferences, using a DCE for prostate cancer screening using PSA testing,[21] and reports the preferences of 662 men with no family history of prostate cancer.

The DCE was conducted as a web-based survey using an existing general public online research panel administered by an external organization (Survey Sampling International, SSI). From this panel, SSI alerted men aged 40–69 that the survey was available. Men who had been previously diagnosed or treated for prostate cancer were excluded, as they are not eligible for population-based screening. We used quota sampling to ensure adequate response numbers in each age group, and respondents were rewarded with points which they could redeem for goods, or donate to charity.

The discrete choice experiments

Men's preferences were assessed using a DCE,[22–24] a quantitative technique that assumes a healthcare intervention can be described by its characteristics (attributes). Attribute levels are varied systematically in a series of questions and respondents choose the option that they prefer for each question. DCEs can determine which attributes are driving preferences (e.g. for or against having a PSA test) and the trade-offs between attributes that people are willing to accept (e.g. the risk of complications a man is willing to tolerate in order to reduce mortality). We followed guidelines for the conduct of DCEs.[22,23]

Attributes and attribute levels

Attributes used to describe prostate cancer screening were based upon the literature,[3,4,25,26] and discussion with clinicians ($n = 6$); definitions of each attribute were provided to respondents before they completed the DCE. PSA screening was described by six attributes: (i) chance of death from prostate cancer, (ii) chance of diagnosis of prostate cancer (including overdiagnosed cancers in screened men), (iii) chance of unnecessary biopsies from false-positive PSA tests, (iv) chance of impotence, (v) chance of urinary incontinence or bowel problems and (vi) out of pocket cost (Table 1). The levels of attributes were based on a model of PSA test outcomes for men of various ages[5]

Table 1 DCE attributes and levels for different age groups (chance per 10 000 men, over 10 years)

Attribute	40–49 years		50–59 years		60–69 years	
Chance over the next 10 years*	Screened	Unscreened	Screened	Unscreened	Screened	Unscreened
Men who will die from prostate cancer	1, 3, 5	5	2, 5, 10	10	20, 30, 40	40
Men diagnosed with prostate cancer (including overdiagnosed cancers in screened men)	5, 10, 15	2	100, 150, 200	50	500, 750, 1000	250
Men who have unnecessary prostate biopsies from PSA test false alarms	10, 20, 30	0	300, 400, 500	0	1500, 2000, 2500	0
Men who experience on-going impotence	820, 835, 850	800	1350, 1375, 1400	1300	4000, 4150, 4300	3900
Men who experience on-going urinary incontinence or moderate to severe bowel problems	305, 310, 320	300	580, 600, 650	560	750, 800, 850	720
Approximate out of pocket cost to you over the next 10 years	\$0, \$1000, \$2500	\$0	\$0, \$1000, \$2500	\$0	\$0, \$1000, \$2500	\$0

*NB in the choice scenarios, risks were presented as natural frequencies x/10 000; denominators not presented here for brevity.

and the potential harms associated with treatments of prostate cancer, such as impotence and urinary or faecal incontinence.[26] Test attributes were presented as event chances over 10 years as natural frequencies using a denominator of 10 000 men who screen, or do not screen,[5] and the cost attribute was presented as the total direct out of pocket cost they would personally have to pay over the next 10 years for any diagnosis and treatment of prostate cancers that might be detected by screening (Table 1).

Study design and questionnaire

A two-step pilot study was conducted; 10 men completed the DCE in a face to face interview, and a further 106 men aged 40–69 completed an online pilot questionnaire. We included a consistency check in the pilot and only two of the 106 respondents failed this check, suggesting that men were able to understand and complete the 15 discrete choice questions. Men were asked which attributes they combined together when answering; as a result, we collapsed urinary and faecal incontinence into one attribute describing the harms as 'on-going urinary incontinence or moderate to severe bowel problems'. There was no difference in the model when respondents who failed the consistency check were included or excluded; therefore, we included them in the analysis. A mixed logit (ML) model of the pilot data was estimated, with parameters used to inform the priors for the final study design.

The final DCE design contained six attributes with three levels. We created d-efficient fractional factorial designs for each age group (*d*-error <0.0006, s-estimates 154–186) using NGENE design software (www.choice-metrics.com). Men completed 15 questions, choosing between three alternatives: two PSA screening options and one no screening option (Table 2). One question included a dominated screening option where the number of prostate cancer deaths, as well as harms and costs, was higher than the alternative screening option to assess men's understanding of the attribute levels. The study was approved by the University of Sydney Human Research Ethics Committee. Additional sociodemographic information, including education, income, employment, marital status and past experience with PSA testing or prostate biopsy, perceived risk of prostate cancer, and experience of erectile dysfunction was also collected.

Analysis

We used a ML model with a panel specification. All demographic variables were effects-coded. A ML model allows consideration of the full distribution of a parameter estimate and estimates 'random parameters'. 'Random parameter' implies that each individual has an associated parameter estimate on the specified distribution. Whilst the exact location of each individual's preferences on the distribution may not be known, estimates of 'individual-specific preferences' can be accommodated by deriving the individual's conditional distribution, based – within sample – on their choices (i.e. prior knowledge)[27] Additional discussion is available elsewhere.[22,24,27] We used a ML model with 2000 Halton draws; random parameters were specified for the attributes of the DCE, cost was modelled as a triangular distribution, and all other benefits and risk parameters were modelled as normal. The constant and demographic variables were modelled as non-random. To understand how men's preferences for screening differ by age, age group was dummy-coded and interactions were created between age group and each attribute describing benefits and risks and estimated separate attribute coefficients for each age group; interactions were also created between dichotomized income level and cost. The constant is interpreted as the underlying preference for screening compared to no screening, regardless of attribute levels. Interactions between attributes and other respondent characteristics (age, perceived risk, income, education, experience of PSA testing or prostate biopsy, experience of erectile dysfunction) were also examined before estimating the final choice model. The optimal utility function, allowing for segment analysis by age, was:

$$V_{screening} = \beta_0 + \beta_1 deaths \times Age40–49 + \beta_2 deaths \times Age50–59 + \beta_3 deaths \times Age60–69 + \beta_4 diagnoses \times Age40–49 + \beta_5 diagnoses \times Age50–59 + \beta_6 diagnoses \times Age60–69 + \beta_7 biopsies \times Age40–49 + \beta_8 biopsies \times Age50–59 + \beta_9 biopsies \times Age60–69 + \beta_{10} impotence \times Age40–49 + \beta_{11} impotence \times Age50–59 + \beta_{12} impotence \times Age60–69 + \beta_{13} incontinence \times Age40–49 + \beta_{14} incontinence \times Age50–59 + \beta_{15} incontinence \times Age60–69 + \beta_{16} cost \times Inc < 65K + \beta_{17} cost \times Inc < 65K + \beta_{18} Scr\ HighRisk + \beta_{19} Scr\ CurrPartner + \beta_{20} Scr\ HealthIns + \beta_{21} Scr\ Age + \beta_{22} Scr\ PSAEver + \beta_{23} BiopsyEver + \beta_{24} Scr\ EDEver + \beta_{25} Scr\ Education + \beta_{26} Scr\ Income$$

$$V_{NoScreening} = 0$$

Where

V – represents the observable utility for PSA screening or no screening;

β_0 – represents the alternative specific constant for screening;

$\beta_{1–15}$ – represent interaction effects between screening attributes and respondent age group;

$\beta_{16,17}$ – represent interaction effects and respondent income category (< $65 000 vs. > $65 000 per year);

$\beta_{18–26}$ – represent interaction effects between PSA screening and respondent characteristics (high perceived risk, having a current partner, having private health insurance, age, ever having a PSA test, ever having prostate biopsy, ever having erectile dysfunction, post-high school education, income)

For example, the reduced utility function for a respondent aged 40–49 with an annual income <$65 000 is shown below:

$$V_{screening} = \beta_0 + \beta_1 deaths + \beta_4 diagnoses + \beta_7 biopsies + \beta_{10} impotence + \beta_{13} incontinence + \beta_{16} cost + \beta_{18} Scr\ HighRisk + \beta_{19} Scr\ CurrPartner + \beta_{20} Scr\ HealthIns + \beta_{21} Scr\ Age + \beta_{22} Scr\ PSAEver + \beta_{23} Scr\ BiopsyEver + \beta_{24} Scr\ EDEver + \beta_{25} Scr\ Education + \beta_{26} Scr\ Income$$

$$V_{NoScreening} = 0$$

Models were evaluated for goodness of fit using the likelihood ratio chi-square statistic for the global test of zero model coefficients, the McFadden's pseudo R^2 and Akaike's information criterion (AIC). To achieve the most parsimonious model possible, without compromising model fit, each variable that was non-significant was removed and the model re-estimated. Model fit parameters, and log likelihood, were assessed after each respecification; non-significant attributes were removed from utility specifications when their continued inclusion resulted in a significant change in the log likelihood. The final model was selected on the basis of AIC after testing a number of different model specifications.

Trade-offs between attributes were calculated as marginal rates of substitution of harms: benefit (deaths avoided) and are interpreted as the additional chance of harms that would be accepted to avoid one extra death from prostate cancer. We also calculated the willingness to pay for each prostate cancer death avoided.[28,29] We checked the direction of estimated coefficients to verify whether they were consistent with *a priori* expectations and examined goodness of fit using pseudo R^2 and AIC. All analyses used NLOGIT version 4.01. (Econometric Software, Castle Hill, NSW, Australia, www.limdep.com/products/nlogit/).

Table 2 Example discrete choice scenario, 50–59 year old men. Please start this text on the line below. These health outcomes are presented as the chance in 10 000 men who are about the same age as you. These men either participate in annual PSA screening over the next 10 years (A or B), or do not take part in screening over the next 10 years (C). Choose the one you would most prefer, after weighing up the pros and cons of the different options

Chance over the next 10 years	A PSA screening (per 10 000 men)	B PSA screening (per 10 000 men)	C No screening (per 10 000 men)
Men who will die from prostate cancer	2/10 000	5/10 000	10/10 000
Men diagnosed with prostate cancer (including overdiagnosed cancers in screened men)	100/10 000	200/10 000	50/10 000
Men who have unnecessary prostate biopsies from PSA test false alarms	400/10 000	300/10 000	0/10 000
Men who experience on-going impotence	1350/10 000	1375/10 000	1300/10 000
Men who experience on-going urinary incontinence or moderate to severe bowel problems	580/10 000	650/10 000	560/10 000
Approximate out of pocket cost to you over the next 10 years	$2500	$1000	$0
Please pick the option you most prefer →	A □	B □	C □

Results

The DCE was completed by 662 men with no personal history of prostate cancer aged 40–69. Demographic characteristics are presented in Table 3. Respondents had a mean age of 55; 70% had a current partner, between 18% and 67% had ever had a PSA test, and between 3% and 10% had ever experienced a prostate biopsy. Of the 793 men who commenced the survey, 662 completed it, giving a completion rate of 83.4%.

Men's preferences

All 662 respondents were included in the discrete choice analyses. Table 4 shows the results of the final preference model. Each respondent completed 15 choices, giving a total of 9930 choice sets. Approximately 35% of men always chose one of the screening options; 8.5% of men always chose no screening; 63% of men chose a screening option in more than 10 of 15 questions; 15% of men chose screening 6–10 times, and 21% of men chose screening 5 or fewer times. Less than 0.5% of men who chose at least one screening option selected the screening alternative where the number of prostate cancer deaths, as well as harms and costs, was higher than the alternative screening option, suggesting men understood the task. The pseudo R^2 of 0.37 is approximately equivalent to an R^2 of 0.80, interpreted as explaining approximately 80% of the variation in the response variable.[24]

Influence of PSA test characteristics

Avoiding more prostate cancer deaths increased men's preference for PSA screening, with the likelihood of preferring PSA screening varying with age. Younger men valued mortality benefits more than did older men. (Table 4)

Men were less likely to prefer PSA screening over no screening as (i) the chance of needing biopsies increased, (ii) the chance of experiencing incontinence or bowel problems increased and (iii) out of pocket costs increased (Table 4). The negative influence of both incontinence/bowel problems and unnecessary biopsies was greater in younger men compared to older men. As cost increased, men were less likely to prefer screening; the influence of cost did not vary by age, but did vary slightly by income.

Table 3 Respondent characteristics

	All *n* = 662		40–49 *n* = 220		50–59 *n* = 221		60–69 *n* = 221	
	n	%	*n*	%	*n*	%	*n*	%
Mean age (SD)	55 (9)							
Education								
Did not complete high school	165	24.9	67	30.5	55	24.9	43	19.5
Completed high school/TAFE/technical/Trade	325	49.1	99	45.0	110	49.8	116	52.5
Completed university	172	26.0	54	24.5	56	25.3	62	28.1
Marital status								
Current partner	466	70.4	141	64.1	146	66.1	179	81.0
Divorced/widowed/single	196	29.6	79	35.9	75	33.9	42	19.0
Employment								
Full time	292	44.1	142	64.5	109	49.3	41	18.6
Part time/casual	84	12.7	16	7.3	24	10.9	44	19.9
Home/caring duties	17	2.6	8	3.6	7	3.2	2	0.9
Retiree/pensioner	203	30.7	21	9.5	56	25.3	126	57.0
Not working	66	10.0	33	15.0	25	11.3	89	40.3
Annual household income								
<$35 000	168	25.4	41	18.6	58	26.2	69	31.2
$35 000–$65 000	168	25.4	54	24.5	44	19.9	70	31.7
$65 001–$95 000	132	19.9	49	22.3	45	20.4	38	17.2
>$95 000	117	17.7	48	21.8	47	21.3	22	10.0
Did not answer	77	11.6	28	12.7	27	12.2	22	10.0
Have private health insurance	323	48.8	100	45.5	96	43.4	127	57.5
Perceived risk of prostate cancer								
Lower/much lower than average	191	28.9	63	28.6	48	21.7	80	36.2
About average	422	63.7	143	65.0	155	70.1	124	56.1
Higher/much higher than average	49	7.4	14	6.4	18	8.1	17	7.7
Know anyone outside family with prostate cancer	266	40.2	64	29.1	78	35.3	124	56.1
PSA test, ever	295	44.6	39	17.7	109	49.3	147	66.5
PSA test, previous 12 months	186	28.1	23	10.5	61	27.6	102	46.2
Prostate biopsy, ever	41	6.2	8	3.6	10	4.5	23	10.4
Prostate biopsy, previous 12 months	8	1.2	5	2.3	0	0.0	3	1.4
Erectile dysfunction, ever	217	32.8	41	18.6	68	30.8	108	48.9
Erectile dysfunction, current	151	22.8	23	10.5	42	19.0	86	38.9

A priori, we expected a higher risk of impotence to make men less likely to prefer PSA screening to no screening; we also examined whether men with current or previous experience of erectile dysfunction (ED) valued the impotence attribute differently compared to men who had not experienced ED. The likelihood of impotence did not significantly influence preferences for screening, and there was no significant difference between men who currently or had ever experienced ED compared to men who had not.

We also expected increases in prostate cancer diagnoses (including overdiagnosed cancers) to make men less likely to prefer PSA screening to no screening. However, the likelihood of being diagnosed with prostate cancer did not significantly influence preferences. The non-significant constant suggests that there was no underlying preference among respondents for or against screening in this respondent sample.

Influence of sociodemographic characteristics

Initially, sociodemographic characteristics were also stratified by age; as there were no significant differences in valuations across age groups, they were collapsed to maintain model parsimony. Men with high self-perceived risk

Table 4 Preferences of men for PSA screening compared to no screening

Attribute		Coefficient	95% CI
Constant		0.19	−0.06 to 0.44
Deaths (per extra death avoided)			
40–49	Mean	0.63*	0.53 to 0.72
	SD	0.50*	0.42 to 0.59
50–59	Mean	0.40*	0.34 to 0.46
	SD	0.32*	0.28 to 0.36
60–69	Mean	0.08*	0.07 to 0.10
	SD	0.04*	0.03 to 0.05
Diagnoses (per extra 100/10 000 men)			
40–49	Mean	−0.08	−1.16 to 1.00
	SD	3.26*	1.93 to 4.59
50–59	Mean	−0.02	−0.16 to 0.12
	SD	0.05	−0.17 to 0.28
60–69	Mean	−0.002	−0.03 to 0.03
	SD	0.08**	0.04–0.11
Biopsies (per extra 100/10 000 men)			
40–49	Mean	−0.99**	−1.69 to −0.29
	SD	0.20	−1.22 to 1.62
50–59	Mean	−0.17*	−0.25 to −0.08
	SD	0.23*	0.13 to 0.33
60–69	Mean	−0.06*	−0.08 to −0.04
	SD	0.06*	0.04 to 0.09
Impotence (per extra 100/10 000 men)			
40–49	Mean	−0.0009	−0.33 to 0.33
	SD	0.52*	0.44 to 0.61
50–59	Mean	−0.14	−0.32 to 0.05
	SD	0.02*	0.23 to 0.31
60–69	Mean	−0.01	−0.05 to 0.03
	SD	0.01*	0.02 to 0.05
Incontinence or bowel problems (per extra 100/10 000 men)			
40–49	Mean	−2.07*	−2.88 to −1.25
	SD	0.02	−0.11 to 0.15
50–59	Mean	−0.54*	−0.80 to −0.28
	SD	0.06	−0.007 to 0.12
60–69	Mean	−0.17***	−0.33 to −0.01
	SD	0.03	−0.05 to 0.11
Cost (per extra $100)			
Income <$65 000	Mean	−0.112*	−0.125 to −0.098
	SD	0.24*	0.23 to 0.25
Income >$65 000	Mean	−0.108*	−0.119 to −0.097
	SD	0.21*	0.20 to 0.22
Self-perceived risk of prostate cancer (high vs. average/low)	Mean	0.40***	0.004 to 0.79
Marital status (current partner vs. not)	Mean	0.07	−0.22 to 0.34
Private Health Insurance (vs. not)	Mean	0.61*	0.29 to 0.92
Age (per year)	Mean	−0.15*	−0.24 to −0.07
Ever had PSA test (yes)	Mean	0.27***	0.001 to 0.53
Ever had biopsy (yes)	Mean	0.58***	0.02 to 1.12
Ever experienced ED (yes)	Mean	0.53***	0.002 to 1.06
Education (post-high school qualification)	Mean	0.10	−0.22 to 0.42
Income (higher income category)(>$65 000 per year)	Mean	−0.08	−0.33 to 0.16

*$P < 0.001$; *** $P < 0.01$; **** $P < 0.05$.
McFadden's R^2 (pseudo R^2) = 0.37; Akaike's information criteria = 1.43, Log Likelihood = −6208.86.

of prostate cancer, who had private health insurance, had experienced previous PSA tests or previous prostate biopsy were all more likely to prefer PSA screening to no screening. Higher age was associated with a lower preference for PSA screening compared to no screening. Neither education nor income level was significantly associated with screening preference.

Benefit:harm trade-offs and willingness to pay

Acceptable benefit:harm trade-offs also varied significantly by age ($P < 0.0001$, for all paired comparisons of age groups) (Table 5). To avoid one prostate cancer death in 10 000 men screened, men aged 40–49 were willing to accept an additional 65 of 10 000 men experiencing unnecessary prostate biopsies and an extra 31 of 10 000 men experiencing incontinence or bowel problems. Compared to men aged 40–49, older men were more likely to accept significantly higher trade-offs, mainly because the harms were significantly less important for older men compared to younger men. For example, men aged 50–59 were willing to accept an extra 233 of 10 000 men experiencing unnecessary prostate biopsies and an extra 72 of 10 000 men experiencing incontinence or bowel problems to avoid one prostate cancer death, both of which are close to estimates reported in the European Randomised Study of Screening for Prostate Cancer (ERSPC).[3]

Younger men also had significantly higher ($P < 0.0001$ for all paired comparisons of age groups) willingness to pay to avoid prostate cancer deaths (Table 5). Men aged 40–49 were willing to pay between \$717 and \$768 over 10 years to avoid one prostate cancer death per 10 000 men screened, whereas men aged 60–69 were willing to pay between \$99 and \$110 over 10 years. There was no significant difference in WTP across income levels (greater than or less than \$65 000) with an age group ($P > 0.09$).

Discussion

Our results indicate men are willing and able to weigh up potential benefits and harms of PSA screening in deciding about prostate cancer screening. Avoidance of prostate cancer deaths, the likelihood of prostate biopsy and of incontinence or bowel problems all significantly influenced the choice to screen or not; the likelihood of prostate cancer diagnosis and of impotence did not. These results are consistent with the other stated preference study of PSA screening.[19] Preferences were also influenced by non-test-related factors such as age, prior PSA testing experience and perceived risk of prostate cancer. The extent of influence of PSA test attributes on preferences varied by age, as did the extent of trade-offs between benefits and harms that men were willing to accept to avoid prostate cancer death.

This study uses a DCE to examine the preferences of men for prostate cancer screening programmes, which, unlike other preference elicitation methods such as decision aids, explicitly quantifies the trade-offs between harms and benefits of PSA testing that men are willing to accept.[20] Depending on their age, men were willing to accept between 65 and 233

Table 5 Men's trade-offs: Willingness to accept extra men with harms (per 10 000 screened) to avoid one prostate cancer death; willingness to pay over 10 years to avoid one prostate cancer death in 10 000 men screened

	Extra men with unnecessary biopsies accepted. Mean (95% CI), (range)	Extra men with incontinence/ bowel problems accepted. Mean (95% CI), (range)	WTP (for income < \$65 000) Mean (95% CI), (range)	WTP(for income > \$65 000) Mean (95% CI), (range)
40–49 years	65 in 10 000 (59–70) Range: 2–158	31 in 10 000 (28–34) Range: 1–77	\$717 (\$660–\$774) Range: \$3–\$9790	\$768 (\$709–\$826) Range: \$2–\$8042
50–59 years	233 in 10 000 (224–242) Range: 1–751	72 in 10 000 (69–75) Range: 1–233	\$434 (\$399–\$467) Range: \$1–\$4576	\$476 (\$440–\$510) Range: \$1–\$4783
60–69 years	153 in 10 000 (149–158) Range: 39–285	54 in 10 000 (52–55) Range: 13–99	\$110 (\$101–\$119) Range: \$8–\$1336	\$99 (\$91–107) Range: \$9–\$1066

extra men with unnecessary prostate biopsies and between 31 and 72 extra men with incontinence/bowel problems to avoid one prostate cancer death. The number of extra cases of incontinence that men were willing to accept to prevent a cancer death was similar or more than the number expected per death prevented based upon the ERSPC trial.[3] Similarly, for men aged 50–59, the number of extra men with unnecessary biopsies was close to that expected per death prevented from ERSPC;[3] however, younger and older men were less willing to accept extra biopsies and, for some, were not willing to trade as many biopsies as would be needed from ERSPC to realize a benefit in terms of a death prevented (around 240 biopsies per death prevented).[3] Differences in valuations of attributes and extent of trade-offs that are acceptable to men of different ages suggest a one size fits all recommendation on PSA testing regardless of age may not reflect men's preferences.

Our results were consistent with those of one previously published stated preference study of PSA screening[19] with respect to the influence of mortality reduction, risk of unnecessary biopsies and costs, as well as some sociodemographic characteristics on men's preferences for screening. Although they also calculated trade-offs between attributes, they are not directly comparable to our estimates of benefit harm trade-offs. de Bekker Grob *et al.*[19] estimated men's willingness to accept worse prostate cancer mortality to avoid potential screening downsides, such as unnecessary biopsies and higher cost; we however have calculated the willingness of men to accept more potential downsides to avoid one prostate cancer death. This means the estimates are not directly comparable, but does suggest that men are willing and able to make trade-offs between perceived benefits and downsides of PSA screening.

A priori, we expected more prostate cancer diagnoses and impotence would both be associated with a lower preference for screening. However, neither attribute had a significant influence on men's preferences.

Considering prostate cancer diagnoses first: there is a common belief that all cancers found by screening are good because early detection affords the opportunity for early treatment.[30,31] As Gil Welch says '... the conventional wisdom is that looking for early cancer always makes sense...',[31] and because of that 'looking for cancer has become a cultural norm.'[31] However, by trying to detect disease earlier, we are also increasing the likelihood of diagnosing cancers that would never have become clinically apparent in a man's lifetime-overdiagnosed cancers.

However, communicating this concept of overdiagnosis is not easy. Increasing prostate cancer diagnoses did not significantly influence men's choices; it did not increase the likelihood of choosing screening, but neither did it mean that screening was less preferred. There are a number of possible explanations. The attribute was described as the total number of prostate cancer diagnoses, including overdiagnosed cancers in screened men, so did not explicitly describe overdiagnosed cancers. If the attribute had been presented as overdiagnosed cancers, rather than total cases of prostate cancer, it may have been valued differently. It is also possible that respondents simply did not understand the concept, and implications, of overdiagnosis. Overdiagnosed cancers were explained as follows: 'PSA screening increases your chances of being diagnosed with prostate cancer compared to not screening. But a reasonable number of these extra cancers would not have caused any symptoms. These cancers probably did not need to be diagnosed and treated; this is called "overdiagnosis"' There is little information in the literature regarding how consumers understand overdiagnosis, or about what level of overdiagnosis might be acceptable for different screening programmes;[32] so it is also possible that this level of prostate cancer diagnosis was considered an acceptable trade-off and therefore did not significantly influence men's choices. Further work is needed to better understand how men interpret and value overdiagnosis in this context.

Impotence also did not significantly influence men's choices; this did not differ with men's personal experience of erectile dysfunction. It is unclear whether men did not attach significant stigma to impotence, and it therefore was not considered important, or whether impotence is viewed as a treatable condition given the availability of pharmacotherapy. It is also possible that, relative to other potential harms such as incontinence and on-going bowel problems, impotence was simply viewed as less important. This lack of influence of impotence is consistent with other DCE results for treatment preferences for prostate cancer where the likelihood of impotence did not significantly influence men's choice of treatment.[33]

Study limitations

We acknowledge that our study has a number of limitations. It assesses men's stated preferences for PSA screening compared to no screening. Although we used rigorous stated preference design and analysis methods,[23,24,27] we cannot rule out that men's actual screening behaviour may be different to their stated choices. In DCEs, it is not feasible to include every attribute that is important to every respondent.[22] It is necessary to balance the number of attributes with the complexity of the task; additional attributes may have been relevant for some respondents, for example test frequency was included in de Bekker Grob,[19] whereas we included specific attributes for types of treatment harms by considering impotence and incontinence separately. Attributes were presented as natural frequencies with a denominator of 10 000, consistent with risk presentation literature.[5,12] They were presented explicitly as chances over a 10-year time horizon; it is possible that this time horizon may have influenced the valuation and the trade-offs between attributes. It is also possible that some men may have difficulty in translating the chance expressed per 10 000 into an estimate of their individual risk, although a denominator of 10 000 was specifically chosen because of the small chance of some events, particularly in younger men. To enhance face validity and ensure men saw chances of events that were appropriate to their age range, we used different levels of attributes for each age group; these differences in level range may have influenced the coefficients estimated. In addition, a different model specification, for example a generalized multinomial logit model which takes account of preference and scale heterogeneity, may have resulted in coefficients and trade-offs. Whilst the online panel is one of the largest in Australia, with over 1.5 million participants ranging from 18–90 + years of age, it is possible that respondents may not be fully representative of men in the general community. However, characteristics such as education level, income and previous PSA test experience, for which we have population level data, suggest that respondents were generally similar to the Australian population, with comparable proportions having university level qualifications[34] and PSA test use in the prior 12 months across all age groups.[35]

Despite these potential limitations, however, this study uses rigorous design and analysis methods to quantify men's preferences for PSA screening and to explicitly estimate the benefit: harm trade-offs acceptable to men considering PSA screening.

Conclusions

For some patients, the decision to screen or not screen is an easy one; for others, it is more difficult, and it is these patients who might benefit from more information about harms and benefits.[36] It is sometimes difficult to know where the balance might sit for each of us as individuals, and so patients might often revert to the 'what would you do, doctor?' question as a way of guiding their own decision making. Rather than relying on the preferences of physicians for where that balance lies, our results may help these patients by telling them how other men of similar age and risk value the trade-offs between benefits and harms of PSA testing. Our results can be used by both clinicians and patients to facilitate informed discussions of relevant benefits

and downsides of PSA screening for an individual man. Future research should examine whether feeding back this information from DCEs compared to other values clarification methods helps men in their decision making in this complex area.

Acknowledgements/Funding

The COMPASS study was supported by the Australian National Health and Medical Research Council (NHMRC) Program grant 633003 for Screening and Test Evaluation programme. Funders had no role in the design and conduct of the study; collection, management, analysis and interpretation of the data; and preparation, review or approval of the manuscript.

References

1 American Cancer Society. *Cancer Facts & Figures 2013*. American Cancer Society 2013 Available at: http://www.cancer.org/research/cancerfactsfigures/cancerfactsfigures/cancer-facts-figures-2013, accessed 2 February 2013.
2 Australian Institute of Health and Welfare. Prostate Cancer. Australian Cancer Incidence and Mortality workbooks [2012]; Available at: http://www.aihw.gov.au/acim-books/, accessed 28 December 2012.
3 Schroder FH, Hugosson J, Roobol MJ *et al*. Screening and prostate-cancer mortality in a randomized European study. *New England Journal of Medicine*, 2009; **360**: 1320–1328.
4 Andriole G, Grubb RL, Buys SS *et al*. Mortality results from a randomized prostate-cancer screening trial. *New England Journal of Medicine*, 2009; **360**: 1310–1319.
5 Howard K, Barratt A, Mann GJ *et al*. A model of prostate-specific antigen screening outcomes for low- to high-risk men: information to support informed choices. *Archives of Internal Medicine*, 2009; **169**: 1603–1610.
6 Chou R, Croswell JM, Dana T *et al*. Screening for prostate cancer: a review of the evidence for the U.S. Preventive Services Task Force. *Annals of Internal Medicine*, 2011; **155**: 762–771.
7 Dartmouth Atlas Project. Preference sensitive care. A Dartmouth Atlas Project Topic Brief. Internet 2011. Available at: http://www.dartmouthatlas.org/downloads/reports/preference_sensitive.pdf, accessed 2 October 2011
8 American Urological Association. Can Prostate Cancer be found early? [2009]; Available at: https://www.auanet.org/education/clinical-practice-guidelines.cfm, accessed 18 October 2011.
9 American Cancer Society. Can Prostate Cancer be found early? [2010]; Available at: http://www.cancer.org/docroot/CRI/content/CRI_2_4_3X_Can_prostate_cancer_be_found_early_36.asp?sitearea, accessed 18 October 2011.
10 Cancer Council Australia. Position statement – prostate cancer. 2011 Available at: http://www.cancer.org.au/policy/positionstatements/prostatecancer.htm, accessed 18 October 2011.
11 Moyer VA, U.S. Preventive Services Task Force. Screening for prostate cancer: U.S. Preventive Services Task Force recommendation statement. *Annals of Internal Medicine*, 2012; **157**: 120–134.
12 Elwyn G, O'Connor A, Stacey D *et al*. Developing a quality criteria framework for patient decision aids: online international Delphi consensus process. *BMJ*, 2006; **333**: 417.
13 O'Connor A, Bennett CL, Stacey D *et al*. Do patient decision aids meet effectiveness criteria of the international patient decision aid standards collaboration? A systematic review and meta-analysis. *Medical Decision Making*, 2007; **27**: 554–574.
14 O'Connor A, Bennett CL, Stacey D *et al*. Decision aids for people facing health treatment or screening decisions. *Cochrane Database of Systematic Reviews*, 2009; **July 8**: CD001431.
15 Cunich M, Salkeld G, Dowie J *et al*. Integrating evidence and individual preferences using a web-based multi-criteria decision analytic tool: an application to prostate cancer screening. *The Patient: Patient-Centered Outcomes Research*, 2011; **4**: 153–162.
16 Volk RJ, Hawley ST, Kneuper S *et al*. Trials of decision aids for prostate cancer screening: a systematic review. *American Journal of Preventive Medicine*, 2007; **33**: 428–434.
17 Hoffman RM, Lewis CL, Pignone MP *et al*. Decision-making processes for breast, colorectal, and prostate cancer screening: the DECISIONS survey. *Medical Decision Making*, 2010; **30** (5 Suppl): 53S–64S.
18 Hoffman RM, Couper MP, Zikmund-Fisher BJ *et al*. Prostate cancer screening decisions: results from the National Survey of Medical Decisions (DECISIONS study). *Archives of Internal Medicine*, 2009; **169**: 1611–1618.
19 de Bekker-Grob EW, Rose JM, Donkers B, Essink-Bot ML, Bangma CH, Steyerberg EW. Men's preferences for prostate cancer screening: a discrete choice experiment. *British Journal of Cancer*, 2013; **108**: 533–541.

20 Phillips KA, Van BS, Marshall D, Walsh J, Thabane L. A review of studies examining stated preferences for cancer screening. *Preventing Chronic Disease*, 2006; **3**: A75.
21 Howard K, Salkeld G, Mann GJ, Patel MI, Cunich M, Pignone MP. The COMPASs Study – Community Preferences for Prostate cAncer Screening. Protocol for a quantitative preference study. *BMJ Open*, 2012; **2**: e000587.
22 Lancsar E, Louviere J. Conducting discrete choice experiments to inform healthcare decision making: a user's guide. *Pharmacoeconomics*, 2008; **26**: 661–677.
23 Bridges JF, Hauber AB, Marshall DA *et al*. Conjoint analysis applications in health – a checklist: a report of the ISPOR Good Research Practices for Conjoint Analysis Task Force. *Value in Health*, 2011; **14**: 5.
24 Hensher DA, Rose JM, Greene WH. *Applied Choice Analysis. A Primer*, 1st edn. Cambridge: Cambridge University Press, 2005.
25 Draisma G, Boer R, Otto SJ *et al*. Lead times and overdetection due to prostate-specific antigen screening: estimates from the European Randomized Study of Screening for Prostate. *Journal of the National Cancer Institute*, 2003; **95**: 868–878.
26 Smith DP, King MT, Egger S *et al*. Quality of life three years after diagnosis of localised prostate cancer: population based cohort study. *BMJ*, 2009; **339**: b4817.
27 Hensher DA, Greene WH. The mixed logit model: the state of practice. *Transportation*, 2003; **30**: 133–176.
28 Hole A. A comparison of approaches to estimating confidence intervals for willingness to pay measures. *Health Economics*, 2007; **16**: 827–840.
29 Kleinman L, McIntosh E, Ryan M *et al*. Willingness to pay for complete symptom relief of gastroesophageal reflux disease. *Archives of Internal Medicine*, 2002; **162**: 1361–1366.
30 Welch HG, Schwartz LM, Woloshin S. *Overdiagnosed: Making People Sick in the Pursuit of Health*, 1st edn. Boston, MA: Beacon Press, 2011.
31 Welch HG. *Should I be Tested for Cancer? Maybe Not and Here's Why*. Berkeley and Los Angeles, CA: University of California Press, 2004.
32 Hersch J, Jansen J, Barratt A *et al*. Women's views on overdiagnosis in breast cancer screening: a qualitative study. *BMJ*, 2013; **346**: f158.
33 de Bekker-Grob EW, Bliemer MC, Donkers B *et al*. Patients' and urologists' preferences for prostate cancer treatment: a discrete choice experiment. *British Journal of Cancer*, 2013; **109**: 633–640.
34 Australian Bureau of Statistics. 6227.0 – Education and Work, Australia, May 2011. [2012]; Available at: http://www.abs.gov.au/AUSSTATS/abs@.nsf/allprimarymainfeatures/F586EB5CDA114053CA257B780017BA3D?opendocument, accessed 28 December 2012.
35 Medicare Australia. Medicare Item Reports for MBS 66655 and 66656. [2012]; Available at: https://www.medicareaustralia.gov.au/statistics/mbs_item.shtml, accessed 28 December 2012.
36 Welch HG. Making the call. *JAMA*, 2011; **306**: 2649–2650.