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Prostate Cancer

Regional Variations in Quality of Survival Among Men with Prostate Cancer Across the United Kingdom

David W. Donnelly [a,†,*], *Anna Gavin* [a,†], *Amy Downing* [b,c], *Luke Hounsome* [d], *Therese Kearney* [a], *Emma McNair* [e], *Dawn Allan* [f], *Dyfed W. Huws* [f], *Penny Wright* [b], *Peter J. Selby* [b,g], *Paul Kind* [h], *Eila Watson* [i], *Richard Wagland* [j], *Sarah Wilding* [b,c], *Hugh Butcher* [b], *Rebecca Mottram* [b,c], *Majorie Allen* [b,c], *Oonagh McSorley* [k], *Linda Sharp* [l], *Malcolm D. Mason* [m], *William R. Cross* [n], *James W.F. Catto* [o], *Adam W. Glaser* [b,c,g]

[a] *Northern Ireland Cancer Registry, Centre for Public Health, Queen's University Belfast, Belfast, UK;* [b] *Leeds Institute of Medical Research at St James's, University of Leeds, Leeds, UK;* [c] *Leeds Institute of Data Analytics, University of Leeds, Leeds, UK;* [d] *National Cancer Registration and Analysis Service, Public Health England, Bristol, UK;* [e] *Information Services Division, NHS National Services Scotland, Edinburgh, UK;* [f] *Welsh Cancer Intelligence and Surveillance Unit, Public Health Wales, Cardiff, UK;* [g] *Leeds Teaching Hospitals NHS Trust, Leeds, UK;* [h] *Academic Unit of Health Economics, University of Leeds, Leeds, UK;* [i] *Department of Midwifery, Community and Public Health, School of Nursing and Midwifery, Oxford Brookes University, Oxford, UK;* [j] *Faculty of Health Sciences, University of Southampton, Southampton, UK;* [k] *School of Nursing and Midwifery, Queen's University Belfast, Belfast, UK;* [l] *Institute for Health & Society, Newcastle University, Newcastle upon Tyne, UK;* [m] *Division of Cancer and Genetics, School of Medicine, Cardiff University, Cardiff, UK;* [n] *Department of Urology, St James's University Hospital, Leeds, UK;* [o] *Academic Urology Unit, University of Sheffield, Sheffield, UK*

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Abstract

Background: Prostate cancer incidence, treatment, and survival rates vary throughout the UK, but little is known about regional differences in quality of survival.
Objective: To investigate variations in patient-reported outcomes between UK countries and English Cancer Alliances.
Design, setting, and participants: A cross-sectional postal survey of prostate cancer survivors diagnosed 18–42 mo previously.
Outcome measurements and statistical analysis: Urinary, bowel, and sexual problems and vitality were patient reported using the Expanded Prostate Cancer Index Composite (EPIC-26) questionnaire. General health was also self-assessed. Regional variations were identified using multivariable log-linear regression.
Results and limitations: A total of 35 823 men responded, 60.8% of those invited. Self-assessed health was significantly lower than the UK average in Wales and Scotland. Respondents reported more urinary incontinence in Scotland, more urinary irritation/obstruction in Scotland and Northern Ireland (NI), poorer bowel function in Scotland and NI, worse sexual function in Scotland, and reduced vitality/hormonal function in Scotland, Wales, and NI. Self-assessed health was poorer than the English average in South Yorkshire and North-East and Cumbria, with more urinary incontinence in North-East and Cumbria and Peninsula, greater sexual problems in West Midlands, and poorer vitality in North-East and Cumbria and West Midlands. Limitations include difficulty identifying clinically significant differences and limited information on pretreatment conditions.

† These two authors are co-first authors.
* Corresponding author. Northern Ireland Cancer Registry, Centre for Public Health, Queen's University Belfast, Mulhouse Building, Grosvenor Road, Belfast BT12 6DP, Northern Ireland, UK.
Tel. +4428 9097 1623.
E-mail address: david.donnelly@qub.ac.uk (D.W. Donnelly).

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Conclusions: Despite adjustment for treatment, and clinical and sociodemographic factors, quality of survival among prostate cancer survivors varied by area of residence. Adoption of best practice from areas performing well could support enhanced survival quality in poorer performing areas, particularly with regard to bowel problems and vitality, where clinically relevant differences were reported.
Patient summary: We conducted a UK-wide survey of patient's quality of life after treatment for prostate cancer. Outcomes were found to vary depending upon where patients live. Different service providers need to ensure that all prostate cancer patients receive the same follow-up care.

1. Introduction

Prostate cancer is one of the most commonly diagnosed male cancers in the UK [1], with incidence and survival rates varying between and within the UK's four constituent countries (England, Scotland, Wales, and Northern Ireland [NI]) [1–3]. In particular, higher incidence and better survival are typically found in more affluent areas [1,4], possibly reflecting levels of active case finding through prostate-specific antigen (PSA) testing [5].

Treatment of prostate cancer also varies by NHS Hospital Trust within England [6] and between the four UK countries. Given that health-related quality of life [7] and urinary, bowel, sexual, and hormone-related problems [7–9] are treatment related, these patient-reported outcomes may also vary countywide. Despite this, little is known about regional differences in quality of survival. The National Prostate Cancer Audit reported some variation in outcomes for radical prostatectomy and radiotherapy patients by care providers within England and Wales [6]. However, these results were for localised disease only, while case-mix adjustment of results was not considered.

With many men living for long periods following their diagnosis, quality of survival has become increasingly important. Robust intelligence at regional and national levels may help identify improvements achievable through a wider application of practices adopted by the best performing areas. We have thus investigated variations in quality of survival between the four UK countries, and between Cancer Alliances within England.

2. Patients and methods

A cross-sectional postal survey of prostate cancer survivors was conducted as part of the Life After Prostate Cancer Diagnosis study [10].

2.1. Data collection

Men diagnosed with prostate cancer in the previous 18–42 mo were identified from cancer registries in England, Wales, and NI, and from cancer registry-verified hospital activity data in Scotland. All health boards/trusts in Scotland, Wales, and NI and 111 out of 136 English NHS trusts participated. Overall, 82% of eligible prostate cancer survivors were posted a questionnaire between October 2015 and November 2016. Two reminders were sent and a Freephone helpline was available. Men were requested to return completed surveys to an external provider (Picker Institute Europe). Stage at diagnosis, area-based quintile of socioeconomic deprivation (derived from the multiple deprivation measure for each nation [11–14]), and Cancer Alliance/Vanguard (CA) [15] of residence in England were added from cancer registration data.

2.2. Survey

The survey (Supplementary material) included questions on age, employment status, ethnicity, long-term conditions, height, and weight (used to calculate body mass index [BMI]), method of presentation, and treatment type. Method of presentation was categorised as PSA test only (available to men aged 50+ yr on request after they are made aware of its potential implications [16]), symptoms only (eg, urinating frequently, blood in urine, back pain, and joint pain), PSA with symptoms, and other. Treatment type(s) included surgery, external-beam radiotherapy (EBRT), androgen deprivation therapy (ADT), brachytherapy, systemic therapy (chemotherapy, abiraterone, and enzalutamide), and other treatment. Absence of treatment along with reported active surveillance or watchful waiting was categorised as receiving monitoring only.

Health-related quality of life was evaluated using the EQ-5D-5L [17], with responses coded as “no problems” and “with problems”. The EuroQol Visual Analogue Scale (EQ-VAS) [17] was used as a self-assessed health rating on a 0–100 scale, where higher scores represent better health.

Urinary, bowel, sexual, and vitality/hormonal functions were determined using the 26-item Expanded Prostate Cancer Index Composite (EPIC-26) questionnaire [18]. Reported prevalence of specific problems was based upon the proportion of men reporting moderate/big problems (or equivalents such as poor/very poor) to individual questions. Summary scores for EPIC-26 domains were calculated by averaging standardised scores assigned to each question's responses in that domain. The possible range of scores is 0–100, with 100 corresponding to no problems.

2.3. Statistical analysis

Item completeness varied by region; thus, to reduce bias resulting from only including cases with complete data [19], multiple imputation with chained equations [20] using all sociodemographic and clinical characteristics, and all EQ-5D-5L, EQ-VAS, and EPIC-26 questions and scores were utilised. Ten separate imputations were completed, with results combined using Rubin's rules [21].

The EPIC-26 and EQ-VAS scores were modelled using log-linear regression. Independent variables included CA/country, stage at diagnosis, method of presentation, treatment type, age, socioeconomic deprivation quintile, employment status, ethnicity, history of mental health problems, BMI, and number of physical and neurological comorbidities. The models were used to predict a case-mix–adjusted score for each CA/country by applying the UK distribution for each independent variable to the model. Robust standard errors were used to calculate confidence intervals for the adjusted mean scores and to determine significant differences from the UK and English averages, which were derived by combining the results for the smaller geographic areas. Analysis was conducted using Stata version 14.0 (StataCorp, College Station, TX, USA).

The study received the following approvals: Newcastle & North Tyneside 1 Research Ethics Committee (15/NE/0036), Confidentiality Advisory Group (15/CAG/0110), NHS Scotland Public Benefit and Privacy Panel (0516-0364), Office of Research Ethics Northern Ireland (16/NI/0073), and NHS R&D approval from Wales, Scotland, and Northern Ireland.

3. Results

3.1. Response rates and data completeness

A total of 35 823 prostate cancer survivors diagnosed in the previous 18–42 mo responded to the survey—a response rate of 60.8%, which ranged by country from 57.6% in NI to 64.4% in Wales. Within England, response rates were lowest in London CAs (47.7–48.6%) and highest in Thames Valley (65.0%; Table 1). Response rates were higher for men aged 55–85 yr from white ethnic groups and for those living in more affluent areas (Supplementary Table 1).

Completeness of data items ranged from 81.7% for the urinary irritation/obstruction score to just under 100% for age. Completeness varied by CA/country, with the greatest variation for stage at diagnosis (Supplementary Table 2). Data imputation had minimal impact on mean EQ-VAS and EPIC-26 scores (Supplementary Table 3).

3.2. Respondent and clinical characteristics

After imputation, mean age was 71.6 yr, ranging from 70.1 (NI) to 73.0 yr (Peninsula). Further respondent characteristics are presented in Table 1.

One-third (33.9%) of respondents were PSA-detected; however, this varied by country from 22.9% in Scotland to 37.0% in NI. Within England, North-West and South-West London (42.3%) and North-Central and North-East London (41.4%) had higher proportions of PSA-detected patients (Table 2 and Supplementary Fig. 1).

Almost two-thirds (64.0%) of respondents were diagnosed at stage I/II. East of England (68.9%), East Midlands (68.8%), and Wales (68.8%) had the highest proportion of stage I/II prostate cancers, while Scotland had the greatest proportion of stage IV disease (21.1%; Table 2 and Supplementary Fig. 1).

Three in 10 respondents (30.0%) reported having surgery. By country, this proportion was lowest in NI (15.6%), whilst there was considerable variation in surgery use within England (24.9% in East Midlands, 42.1% in Kent and Medway). Use of EBRT was highest in NI (49.2%) and lowest in Kent and Medway (25.8%). Use of ADT was highest in East Midlands (48.0%) and lowest in Kent and Medway (31.6%). Proportions of "monitoring only" ranged from 12.4% in Scotland to 20.7% in Kent and Medway (Table 2 and Supplementary Fig. 2).

3.3. Unadjusted question responses

Among respondents, 62.5% reported problems in at least one of mobility, self-care, usual activities, pain/discomfort, or anxiety/depression, with this proportion ranging from 56.7% in Surrey and Sussex to 66.7% in North-East and Cumbria. Reporting of moderate/big urinary problems ranged from 10.9% (Somerset, Wiltshire, Avon and Gloucestershire, and Surrey and Sussex) to 18.4% (North-East and Cumbria), while moderate/big bowel problems ranged from 6.2% (Kent and Medway) to 12.7% (NI). Very poor/poor ability to perform sexually was reported by 71.0% of South-East London respondents, increasing to 84.6% in Scotland. Moderate/big problems with lack of energy were reported by 18.4% of Kent and Medway respondents, rising to 31.6% in NI (Supplementary Table 5).

3.4. Case-mix–adjusted summary scores

3.4.1. By country

Mean UK wide scores were 76.1 for self-assessed health, 81.1 for urinary incontinence, 84.1 for urinary irritation/obstruction, 87.5 for bowel function, 22.0 for sexual function, and 78.4 for vitality/hormonal function (100 = no problems).

Compared with these averages, respondents reported significantly poorer self-assessed health in Wales (74.3, $p < 0.001$) and Scotland (75.3, $p = 0.037$), more urinary incontinence in Scotland (78.3, $p < 0.001$), more urinary irritation/obstruction in Scotland (82.9, $p = 0.005$) and NI (82.4, $p = 0.002$), poorer bowel function in Scotland (86.2, $p = 0.002$) and NI (84.8, $p < 0.001$), worse sexual function in Scotland (19.9, $p < 0.001$), and reduced vitality/hormonal function in Wales (76.6, $p < 0.001$), Scotland (76.8, $p < 0.001$), and NI (75.2, $p < 0.001$; Table 3).

3.4.2. Within England

Within England, mean scores were 76.3 for self-assessed health, 81.3 for urinary incontinence, 84.3 for urinary irritation/obstruction, 87.7 for bowel function, 22.2 for sexual function, and 78.7 for vitality/hormonal function.

Compared with the English average, poorer self-assessed health was reported in South Yorkshire (75.2, $p = 0.015$) and in North-East and Cumbria (74.8, $p = 0.003$). However, better than average health was reported in Kent and Medway (77.3, $p = 0.021$) and South-East London (77.6, $p = 0.037$). Respondents from North-East and Cumbria (79.4, $p = 0.006$) and Peninsula (79.8, $p = 0.014$) reported more urinary incontinence than in England, while below average levels of urinary incontinence were reported in Surrey and Sussex (83.1, $p < 0.001$). Survivors from South-East London (85.5, $p = 0.048$) reported better urinary irritation/obstruction than the English average, while those from West Yorkshire (89.5, $p < 0.001$) and Kent and Medway (88.6, $p = 0.035$) reported fewer bowel problems. Poorer than average sexual function was reported in the West Midlands (20.8, $p < 0.001$), while better functioning was reported in Surrey and Sussex (25.2, $p < 0.001$), South-East London (24.3, $p = 0.017$), and Kent and Medway (23.6, $p = 0.018$). Respondents from North-East and Cumbria (77.3, $p = 0.020$) and West Midlands (77.7, $p = 0.004$) reported poorer vitality/hormonal function, while this was better than average in West Yorkshire (79.8, $p = 0.019$) and Kent and Medway (79.8, $p = 0.009$; Fig. 1 and Supplementary Table 6).

Table 1 – Response rates and respondent characteristics at the time of survey by area of residence

Area of residence—country and Cancer Alliances/ Vanguards (England)	Number of respondents	Response rate (%)	Mean age	Proportion of prostate cancer survivors								
				Affluent[a]	Deprived[a]	Married	Employed	Retired	Non-white	Overweight	Obese	With previous history of mental health problems
UK	35 823	60.8	71.6	26.9	10.4	80.3	19.8	77.3	3.0	47.8	21.0	17.2
England	30 463	60.5	71.7	26.9	10.0	80.3	19.8	77.5	3.4	48.1	20.6	17.1
North-East and Cumbria	1114	61.5	72.0	24.7	19.2	80.5	15.0	81.0	0.9	48.7	23.1	18.0
Lancashire and South Cumbria	1203	61.2	71.4	28.2	10.4	79.6	18.0	79.2	0.8	49.0	20.3	16.2
West Yorkshire	1494	61.3	71.2	29.6	11.8	80.1	18.3	78.9	3.2	46.1	22.6	16.5
Humber, Coast and Vale	902	63.0	71.0	28.8	9.6	80.9	17.8	80.2	0.5	47.6	22.7	19.7
Cheshire and Merseyside	1255	59.1	71.5	32.6	14.9	78.1	20.0	77.0	0.8	47.7	19.1	18.4
Greater Manchester	1257	55.8	71.7	26.2	17.9	76.2	18.0	78.7	3.8	47.2	20.7	18.1
South Yorkshire, Bassetlaw, North Derbyshire and Hardwick	1302	64.5	71.9	22.5	16.7	80.1	16.3	81.0	2.1	47.6	21.3	17.0
West Midlands	3196	60.8	71.9	22.5	11.4	81.8	19.7	77.7	2.4	49.7	22.4	17.3
East Midlands	2655	62.7	71.6	27.2	7.7	81.5	18.4	78.6	2.0	48.5	23.0	16.5
East of England	4322	62.2	72.0	24.6	4.7	82.2	19.9	78.1	1.7	47.6	20.7	16.3
Somerset, Wiltshire, Avon and Gloucestershire	1616	64.5	72.1	30.6	4.7	81.5	19.0	78.9	0.8	47.5	19.2	16.4
Thames Valley	1561	65.0	71.5	53.9	2.0	83.6	25.7	71.9	3.2	47.1	17.7	15.1
North-West and South-West London	1138	48.4	70.8	22.0	14.3	73.3	27.4	68.1	20.2	48.5	14.8	19.9
North-Central and North-East London	971	48.6	71.2	9.1	36.1	71.7	21.7	74.2	20.6	44.4	22.7	16.9
South-East London	702	47.7	70.4	20.3	20.4	72.2	24.1	70.0	18.1	46.8	19.4	20.2
Peninsula	1184	63.5	73.0	8.9	5.3	82.1	17.6	80.6	0.3	47.1	20.9	17.2
Wessex	1874	64.0	72.6	29.0	4.0	81.2	17.0	81.0	0.7	49.2	18.6	17.0
Surrey and Sussex	1352	64.8	71.7	43.8	3.9	81.6	21.8	75.8	2.0	49.6	17.9	16.5
Kent and Medway	1365	60.4	70.6	20.5	6.7	81.1	24.0	73.5	1.0	50.2	20.8	16.7
Wales	2522	64.4	71.5	25.5	12.7	81.0	19.0	77.8	0.7	46.9	24.9	17.7
Scotland	1819	62.8	71.0	27.4	12.7	78.9	18.2	76.8	0.3	47.3	23.4	19.5
Northern Ireland	1019	57.6	70.1	28.6	11.0	80.5	23.5	70.6	0.3	44.6	20.8	16.7

[a] Resident in the most affluent and deprived areas of that country.

Table 2 – Proportion of prostate cancer survivors[a] with selected clinical characteristics by area of residence[b]

Area of residence—country and Cancer Alliances/ Vanguards (England)[c]	Number of respondents	Proportion of prostate cancer survivors[d]							
		Presented via PSA test only	Presented with symptoms only	Diagnosed at stage I/II	Diagnosed at stage IV	Treated with surgery	Treated with EBRT	Treated with ADT	Received monitoring only
UK	35 823	33.9	52.8	64.0	12.7	30.0	38.9	43.0	16.8
England	30 463	34.3	52.3	64.4	12.2	30.8	38.5	42.9	16.9
North-East and Cumbria	1114	24.9	60.6	64.5	16.1	29.4	35.8	42.2	18.9
Lancashire and South Cumbria	1203	31.8	55.0	60.1	14.8	32.1	41.9	46.0	13.8
West Yorkshire	1494	28.9	58.5	53.5	14.4	33.7	35.3	39.4	18.7
Humber, Coast and Vale	902	30.1	57.2	61.9	11.6	30.2	42.9	47.0	16.4
Cheshire and Merseyside	1255	34.0	52.0	62.7	10.2	26.9	40.5	42.4	18.6
Greater Manchester	1257	34.3	53.1	67.5	12.1	28.9	40.5	42.3	14.8
South Yorkshire, Bassetlaw, North Derbyshire and Hardwick	1302	27.2	57.9	62.6	12.4	28.7	40.0	38.4	18.6
West Midlands	3196	35.6	50.6	64.2	12.7	30.6	41.0	45.6	16.5
East Midlands	2655	33.0	53.3	68.8	11.8	24.9	40.5	48.0	18.0
East of England	4322	34.6	52.3	68.9	10.9	27.4	39.9	45.6	17.3
Somerset, Wiltshire, Avon and Gloucestershire	1616	34.1	53.4	58.5	13.3	31.5	38.2	44.3	14.9
Thames Valley	1561	37.3	49.6	64.8	12.6	37.5	34.4	41.0	15.5
North-West and South-West London	1138	42.3	42.1	67.2	11.4	35.0	39.0	37.8	16.9
North-Central and North-East London	971	41.4	44.5	66.4	11.1	37.5	35.8	36.2	13.6
South-East London	702	37.1	48.4	66.5	9.5	39.8	29.8	32.2	18.8
Peninsula	1184	34.0	54.4	60.8	13.0	33.6	41.2	44.1	15.5
Wessex	1874	34.5	52.1	65.4	11.4	27.2	40.6	46.4	15.6
Surrey and Sussex	1352	40.0	48.6	61.7	14.9	28.8	37.3	42.6	17.0
Kent and Medway	1365	37.4	48.7	65.1	9.6	42.1	25.8	31.6	20.7
Wales	2522	35.1	51.3	68.8	11.4	26.0	42.8	42.4	19.3
Scotland	1819	22.9	64.5	52.6	21.1	29.6	35.5	45.8	12.4
Northern Ireland	1019	37.0	52.0	63.2	13.4	15.6	49.2	42.7	17.3

ADT = androgen deprivation therapy; EBRT = external beam radiotherapy; PSA = prostate-specific antigen.

[a] Alive 18–42 mo after diagnosis.

[b] Graphical versions of these data are available in Supplementary Figs. 1 and 2, while confidence intervals for each proportion are available in Supplementary Table 4.

[c] n = 35 823 (see Table 1 for number of respondents by area).

[d] Patients may receive more than one treatment type.

Table 3 – Case-mix–adjusted predicted mean self-assessed health (EQ-VAS) and urinary, bowel, sexual, and vitality/hormonal function (EPIC-26) for prostate cancer survivors[a] by country of residence[b]

Country of residence[c]	Mean self-assessed health rating (EQ-VAS; 95% CI)	Mean functional outcome score (EPIC-26; 95% CI)				
		Urinary incontinence	Urinary irritation/obstruction	Bowel function	Sexual function	Vitality/hormonal function
UK	76.1 (76.0–76.3)	81.1 (80.9–81.3)	84.1 (83.9–84.3)	87.5 (87.4–87.7)	22.0 (21.8–22.3)	78.4 (78.2–78.5)
England	76.3 (76.2–76.5)	81.3 (81.1–81.6)	84.3 (84.1–84.5)	87.7 (87.6–87.9)	22.2 (22.0–22.5)	78.7 (78.5–78.9)$^{\uparrow}$
Wales	74.3 (73.7–75.0)$^{\downarrow\downarrow}$	81.2 (80.3–82.0)	83.7 (83.1–84.4)	86.9 (86.3–87.6)	21.7 (20.9–22.5)	76.6 (75.9–77.3)$^{\downarrow\downarrow}$
Scotland	75.3 (74.6–76.1)$^{\downarrow}$	78.3 (77.2–79.3)$^{\downarrow\downarrow}$	82.9 (82.1–83.7)$^{\downarrow}$	86.2 (85.4–87.0)$^{\downarrow}$	19.9 (18.9–20.9)$^{\downarrow\downarrow}$	76.8 (76.0–77.7)$^{\downarrow\downarrow}$
Northern Ireland	75.6 (74.7–76.6)	80.0 (78.8–81.3)	82.4 (81.4–83.5)$^{\downarrow}$	84.8 (83.6–85.9)$^{\downarrow\downarrow}$	21.4 (20.3–22.6)	75.2 (74.0–76.3)$^{\downarrow\downarrow}$

CI = confidence interval; EPIC-26 = Expanded Prostate Cancer Index Composite; EQ-VAS = EuroQol Visual Analogue Scale; ↑↑ = higher than UK average ($p < 0.001$); ↑ = higher than UK average ($p < 0.05$); ↓ = lower than UK average ($p < 0.05$); ↓↓ = lower than UK average ($p < 0.001$).

[a] Alive 18–42 mo after diagnosis.

[b] This area-based comparison was conducted using log-linear regression, with results presented as adjusted predicted mean scores. Adjustments were made for age, socioeconomic deprivation, employment status, marital status, ethnicity, comorbidities, history of mental health problems, body mass index, method of presentation, stage at diagnosis, and treatment types received. These scores differ from values determined directly from raw data. Higher mean scores represent better health or fewer difficulties in that domain.

[c] $n = 35\,823$ (see Table 1 for number of respondents by area).

3.4.3. Combined analysis

Including Wales, Scotland, and NI, along with the English CAs highlights similar regional variations. In general, men from Wales, Scotland, and NI report similar outcomes to, or worse outcomes than, those from CAs with below UK average outcome scores (Fig. 2 and Supplementary Fig. 3).

4. Discussion

We report the largest, and to our knowledge first, evaluation of regional variations in prostate cancer patient-reported outcomes across the UK. Prostate cancer survivors living in England reported better quality of survival than those from Wales, Scotland, or NI. Within England, poorer than average self-assessed health was reported in South Yorkshire and North-East and Cumbria, while those from North-East and Cumbria, Peninsula, and West Midlands reported greater than average difficulties in one or more functional outcomes. Given that regional variations were independent of clinical case mix, treatment type, and sociodemographic characteristics, these inequalities require explanation.

4.1. Service implications

CAs were introduced in England in 2016 [15], with a principal objective to reduce inequalities in cancer outcomes. The regional inequalities identified in this study reinforce the pressing importance for this remit to address not only survival, but also quality of that survival.

A contributory cause of regional outcome variation may relate to regional differences in care provision. Detailed comparison of care pathways and packages of support, including availability and use of specific therapeutic modalities and support services, such as access to specialist nurses, could identify factors linked to enhanced quality of survival.

Regional differences may also relate to variation in general population health, as the morbidities reported are common among older men [22]. Overall and healthy life expectancy among men aged 65 yr are lower in Scotland, Wales, and NI than in England [23,24], with the North of England also having lower overall and healthy life expectancy compared with the South (with some exceptions such as Northumberland) [25]. Additionally, specific conditions (eg, cardiovascular disease) are more prevalent in the North than in the South of England [26], and in Scotland and NI than in England [27], and vary by area-based socioeconomic status [28]. While these issues have broader service and public health implications, prostate cancer patients reporting functional problems as a result of conditions other than prostate cancer could still benefit from follow-up care.

4.2. Strengths and weaknesses

This study was population wide; thus, participation was not influenced by recruitment bias. However, 39.2% of patients did not respond to the survey, with regional variation in response rates and data completeness. In addition, a different participant identification process was utilised in Scotland, and not all the English NHS trusts managing prostate cancer participated. Cumulatively, this may have resulted in variation in outcome reporting as nonresponders may have different quality of life experiences than responders. However, given a response rate of over 60%, a sample size of approximately 35 800, and the utilisation of standardised/validated measures [29], this study has

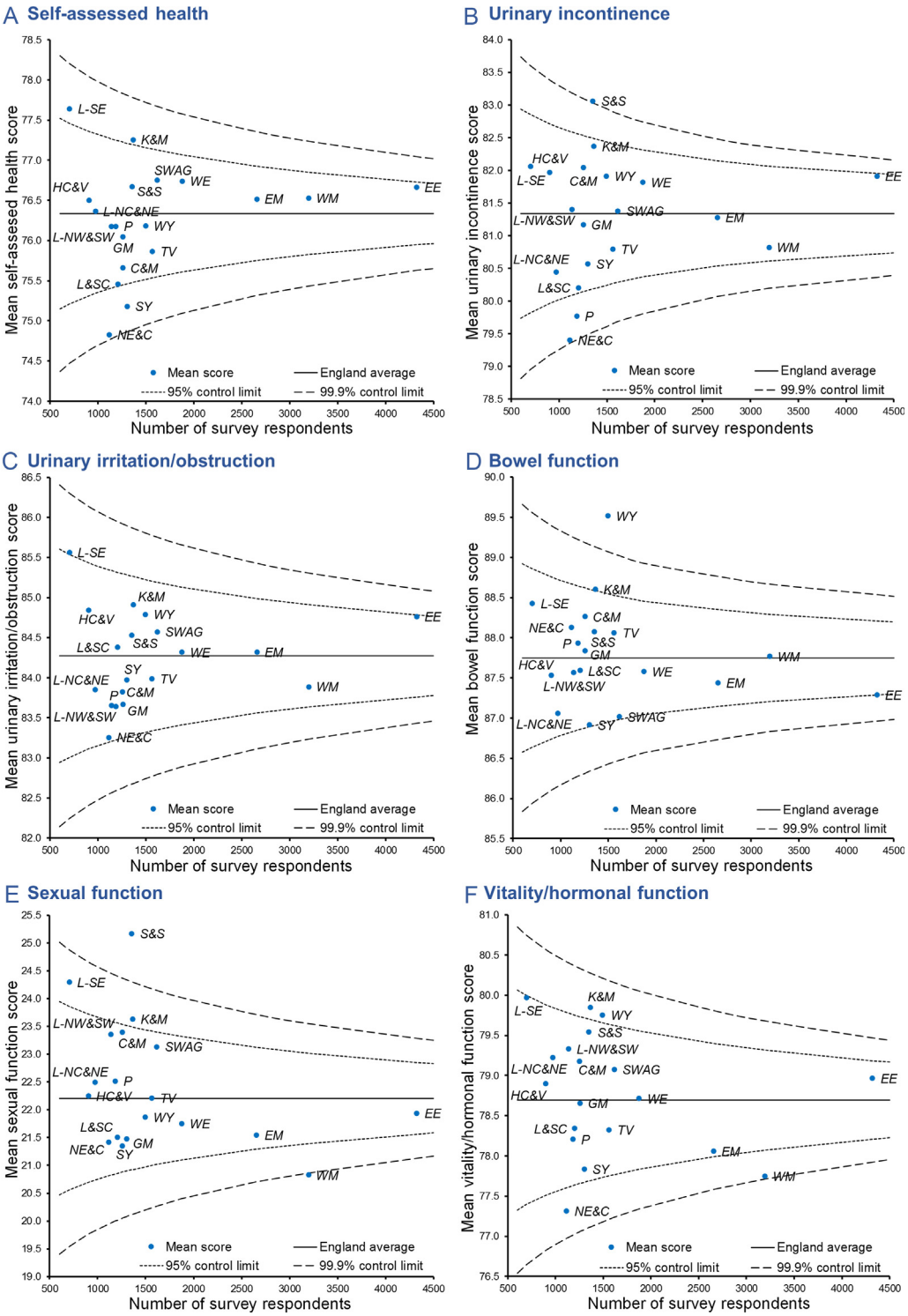

Fig. 1 – Case-mix–adjusted predicted mean self-assessed health (EQ-VAS) and urinary, bowel, sexual, and vitality/hormonal function (EPIC-26) for prostate cancer survivors [a]by area of residence: England only, with comparisons to English average. *n* = 35 823 (see Table 1 for the number of respondents by area). This area-based comparison was conducted using log-linear regression, with results presented as adjusted predicted mean scores. Adjustments were made for age, socioeconomic deprivation, employment status, marital status, ethnicity, comorbidities, history of mental health problems, body mass index, method of presentation, stage at diagnosis, and treatment types received. These scores differ from values determined directly from raw data. Higher mean scores represent better health or fewer difficulties in that domain. See Supplementary Fig. 4 for a map of the areas shown in this figure.

C&M = Cheshire and Merseyside; EE = East of England; EM = East Midlands; EPIC-26 = Expanded Prostate Cancer Index Composite; EQ-VAS = EuroQol Visual Analogue Scale; GM = Greater Manchester; HC&V = Humber, Coast and Vale; K&M = Kent and Medway; L-NC&NE = North-Central and North-East London; L-NW&SW = North-West and South-West London; L-SE = South-East London; L&SC = Lancashire and South Cumbria; NE&C = North-East and Cumbria; NI = Northern Ireland; P = Peninsula; S = Scotland; S&S = Surrey and Sussex; SWAG = Somerset, Wiltshire, Avon and Gloucestershire; SY = South Yorkshire, Bassetlaw, North Derbyshire and Hardwick; TV = Thames Valley; W = Wales; WE = Wessex; WM = West Midlands; WY = West Yorkshire. [a] Alive 18–42 mo after diagnosis.

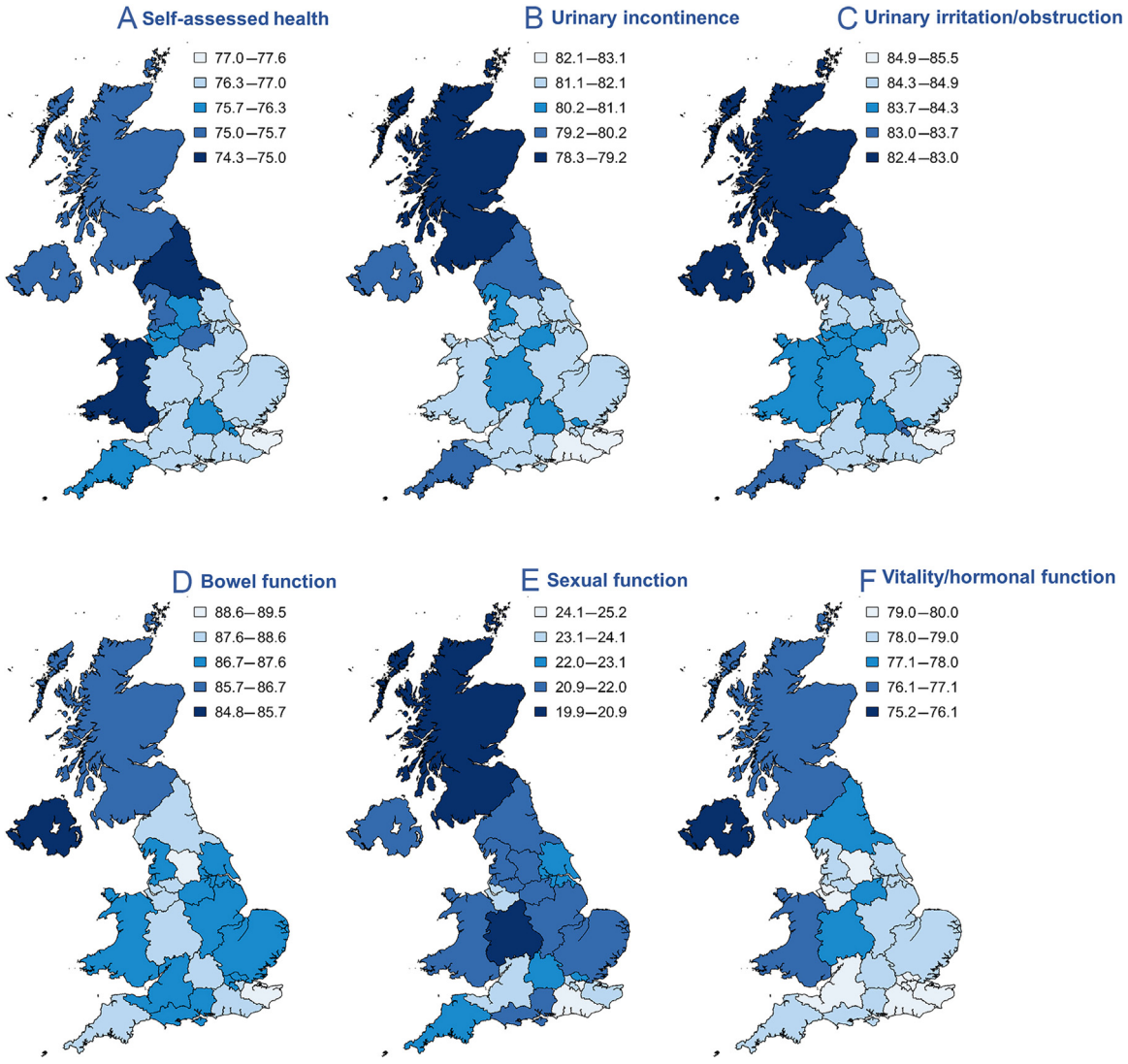

Fig. 2 – Case-mix–adjusted predicted mean self-assessed health (EQ-VAS) and urinary, bowel, sexual and vitality/hormonal function (EPIC-26) for prostate cancer survivors [a]by area of residence: UK wide. *n* = 35 823 (see Table 1 for the number of respondents by area). This area-based comparison was conducted using log-linear regression, with results presented as adjusted predicted mean scores. Adjustments were made for age, socioeconomic deprivation, employment status, marital status, ethnicity, comorbidities, history of mental health problems, body mass index, method of presentation, stage at diagnosis, and treatment types received. These scores differ from values determined directly from raw data. Higher mean scores represent better health or fewer difficulties in that domain. Funnel plots of these data are available in Supplementary Fig. 3.
EPIC-26 = Expanded Prostate Cancer Index Composite; EQ-VAS = EuroQol Visual Analogue Scale. [a] Alive 18–42 mo after diagnosis. The figure contains OS data (GB) and LPS Intellectual Property (NI) Crown copyright and database right 2018.

sufficient statistical power to allow meaningful interpretation and intercountry benchmarking.

The case-mix adjustment applied indicates that differences are unlikely to be related to treatment type, comorbidity, or socioeconomic status. However, this should only be interpreted in a broad sense, as adjustments were based on self-reported treatment with no adjustment possible for treatment intensity (eg, frequency, radiation fraction, and ADT type) or when patients finished treatment. The latter may be of particular relevance, as while the 18–42 mo time frame was chosen because it represents the period when initial treatment is complete and quality of life has begun to stabilise [9,10], a wide range of possible patient pathways and timelines exists. In addition to the above, information on quality of life before diagnosis or equivalent baseline population data was not available. Adjustments for background morbidity levels were thus limited to accounting for age, number of comorbidities, and BMI, which reduces the ability to establish causal links. Finally, the use of area-based socioeconomic deprivation measures and employment status at a single time point may not fully reflect individual-level socioeconomic status.

Whilst statistically significant differences were identified, there is no consensus as to what magnitude of difference is clinically meaningful for the EQ-VAS and EPIC-26 scores when applied across populations. For individual-level comparisons, the work of Skolarus et al. [30] for EPIC-26 and Pickard et al. [31] for EQ-VAS suggests that only

differences between the worst and best performing areas for bowel and vitality/hormonal function may qualify as being clinically relevant. In addition, it is important to note that conclusions about variations at a regional level may not necessarily reflect the experience of every patient.

4.3. Importance of patient-reported outcomes

There is a need to ensure that patient-reported outcomes are central and core components of cancer outcomes research, in order to increase the probability that conclusions are appropriately "patient centred". There are few examples of their use in national surveys that are comprehensive and adequately powered enough to provide robust data on regional variations. This study has tackled this issue in a common and complex cancer, and has demonstrated that this is feasible and necessary, with the generation of useful intelligence regarding variations between and within countries. Identification of such variations can lead to enhanced care provision though identification of differences in patient pathways in the best and worst performing areas.

5. Conclusions

Quality of survival among prostate cancer survivors varies across the UK, with poorer outcomes reported by men from Scotland, Wales, and NI than by men from England. Regional variation was also demonstrated within England. These findings highlight the need for further investigation to identify components of care pathways that predispose to good or poor outcomes, particularly with regard to bowel problems and vitality, where clinically relevant differences were reported. Action is required to ensure that outcomes are monitored and, where possible, improved so that the increasing number of men living with and beyond a diagnosis of prostate cancer are offered the best chance of achieving optimal quality of survival.

Author contributions: David W. Donnelly had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Study concept and design: Glaser, Gavin, Wright, Downing, Hounsome, Selby, Watson, Wagland, Kind, Huws, Butcher.
Acquisition of data: Mottram, Allen, Downing, Wright, McSorley, Kearney, Gavin, Glaser.
Analysis and interpretation of data: Donnelly, Downing, Wilding, Wright, Sharp, Catto, Cross, Mason, Kearney, McNair, McSorley, Allen, Gavin, Glaser.
Drafting of the manuscript: All authors.
Critical revision of the manuscript for important intellectual content: All authors.
Statistical analysis: Donnelly.
Obtaining funding: Glaser, Gavin, Wright, Selby, Watson.
Administrative, technical, or material support: Mottram, Kearney, Allen, McSorley.
Supervision: Glaser, Gavin.
Other: None.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at https://doi.org/10.1016/j.eururo.2019.04.018.

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