Self-Reported Health Status Predicts Other-Cause Mortality in Men with Localized Prostate Cancer: Results from the Prostate Cancer Outcomes Study

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BACKGROUND: Guidelines recommend against treating localized prostate cancer (PCa) in men with a greater than10-year life expectancy. However, physicians have difficulty accurately estimating life expectancy.

OBJECTIVE: We used data from a population-based observational study to develop a nomogram to estimate long-term other-cause mortality based on self-reported health status (SRHS), race/ethnicity, and age at diagnosis.

DESIGN: This was an observational study.

SUBJECTS: Men diagnosed with localized PCa from October 1994 through October 1995 participated in the study.

MAIN MEASURES: Initial measures obtained 6 months after diagnosis included sociodemographic and tumor characteristics, treatment, and a single item on the SRHS, with response options ranging from excellent to poor. We used Surveillance, Epidemiology, and End-Results program data to determine date and cause of death through December 2010. We estimated other-cause mortality with proportional hazards survival analyses, accounting for competing risks.

KEY RESULTS: We evaluated 2,695 men, of whom 74 % underwent aggressive therapy (surgery or radiotherapy). At the initial survey, 18 % reported excellent (E), 36 % very good (VG), 31 % good (G), and 15 % fair/poor (F/P) health. Healthier men were younger, and more likely to be white, better educated, and to undergo surgery. At follow-up, 44 % of the cohort had died; 78 % of deaths were from causes other than PCa. SRHS predicted other-cause mortality; for men reporting E, VG, G, F/P health, the cumulative incidences of other-cause mortality were 20 %, 29 %, 40 %, and 53 %, respectively, p<0.001. Compared to a reference of excellent SRHS, multivariable hazard ratios (95 % CI) for other-cause mortality for men reporting VG, G, and F/P health were 1.22 (0.97-1.54), 1.73 (1.38-2.17), and 2.71 (2.11-3.48), respectively.

CONCLUSIONS: Responses to a one-item SRHS measure were strongly associated with other-cause mortality 15 years after PCa diagnosis. Men reporting fair/poor health had substantial risks for other-cause mortality, suggesting limited benefit for undergoing aggressive treatment. SRHS can be considered in supporting informed decision-making about PCa treatment.

KEY WORDS: prostatic neoplasms; cause of death; health status.
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Prostate cancers detected by prostate-cancer specific antigen (PSA) testing are often indolent.[1] Consequently, guidelines suggest observation (watchful waiting) for men with limited life expectancies (< 10 years) who are diagnosed with localized prostate cancer, because they are unlikely to realize any survival benefit from treatment.[2,3] However, studies consistently show that men with limited life expectancy often receive aggressive treatment for even low-risk, localized cancers.[4,5]

One explanation is that physicians have difficulty accurately estimating the effect of competing mortality risks on life expectancy.[6–8] Several comorbidity measures have been developed based on claims data,[9,10] but these tools are most widely used in health services research.[11] The American Urological Association (AUA) treatment guideline suggests using life-table analyses to inform treatment decisions,[2] but these population-based estimates exclude health status and may not be readily applicable to predicting the life expectancy of an individual patient.[12] Indeed, life tables have been shown to have limited predictive value for men undergoing radiation therapy[13] or radical prostatectomy.[6] While some multivariate predictive models, particularly those incorporating comorbidity, appear to accurately estimate life expectancy,[14–18] their performance for men with prostate cancer is variable or unknown.[19] Furthermore, many of these measures are not widely used in clinical practice.[20] Welch and colleagues showed that self-reported health status could better approximate "physiologic" age as a way of estimating treatment benefits for the elderly.[21] A meta-analysis has shown that a single item assessing general self-rated health can accurately predict overall mortality.[22]

We used self-reported health status and 15-year vital status data to estimate the risk of other-cause mortality among a population-based cohort of men with localized prostate cancer. We created a nomogram incorporating self-reported health status, age, and race/ethnicity to estimate other-cause mortality at 10 and 15 years after diagnosis.

METHODS

The Prostate Cancer Outcomes Study (PCOS) cohort was assembled using the Surveillance, Epidemiology and End-Results (SEER) program, which provides information on cancer incidence, treatment, and survival for a population-based sample of about 15 % of the United States. Details of the PCOS have been published elsewhere.[23] Briefly, the study used a rapid case ascertainment system to identify all men diagnosed with microscopically confirmed primary invasive adenocarcinoma of the prostate between 1 October 1994, and 31 October 1995. Patients were diagnosed in six SEER tumor registries covering the states of Connecticut, Utah, and New Mexico, and the metropolitan areas of Atlanta, Georgia; Los Angeles County, California; and King County, Washington (which includes Seattle). The Institutional Review Board of each PCOS site approved the study.

The PCOS randomly sampled a total of 5,672 subjects from the 11,137 eligible PCa cases. A pre-specified sampling strategy was employed that oversampled younger men, Hispanics, and blacks. We calculated sample weights as the inverse of the sampling proportions within each region–race–age group stratum. This permitted estimates of combined data across these strata that were appropriately weighted to the total number of eligible prostate cancer patients in the six SEER regions.[23] Overall, 3,196 men (56 %) completed a sociodemographic and health-related quality-of-life survey at 6 months after initial diagnosis. For the current analysis, we evaluated the 2,695 men diagnosed with clinically localized cancer who answered the health status question on the 6-month survey.

Data Collection. At the time of initial enrollment, investigators contacted patients by mail and/or telephone and requested them to complete a self-administered survey. Demographic and socioeconomic questions were used to determine race/ethnicity, employment status, educational level, household income, insurance coverage, and marital status. Additional questions asked about comorbidity (12 medical conditions likely to affect long-term quality of life based on the Charlson comorbidity index) and disease-specific and general health-related quality of life. We asked subjects to report their health status based on the single Medical Outcomes Study Short-Form 36 item[24]: "in general would you say your health is: excellent, very good, good, fair, or poor."

We identified subjects with clinically localized prostate cancer based on an SEER algorithm using clinical information abstracted from medical records. The algorithm defined T1 tumors as confined to the prostate with a normal digital rectal examination and no positive scans (magnetic resonance imaging, computed tomography, bone scan) or evidence of metastases. T2 tumors were defined as confined to the prostate, with abnormal or suspicious digital rectal examinations, but no positive scans or evidence of metastases. We used data from the SEER Person File, medical record abstractions, and survey responses to determine treatment received by the time of the 6-month survey.

We obtained vital status information from the SEER tumor registries in the spring of 2011 that provided follow-up through the end of 2010, roughly 15 years after study initiation. When a subject dies, registries obtain computerized death data files from their local departments of health and/or the National Death Index, with the underlying cause of death coded using established algorithms maintained by the National Center for Health Statistics.[25]

Statistical Analyses

We compared demographic and clinical variables according to health status reported on the 6-month survey. We collapsed the categories of fair/poor due to small samples sizes. We also compared overall, other-cause, and prostate-cancer specific mortality for the four health status groups. We used chi-square tests for categorical variables, weighted for the stratified sampling strategy.

We estimated overall mortality using the Kaplan-Meier method for each stratum defined by self-reported health status. We estimated cumulative incidence functions to compare the prostate cancer specific and other-cause (non-prostate cancer) mortality according to self-reported health status, while treating the other death type as a competing risk. Other-cause mortality was modeled with the proportional subdistribution hazards regression described by Fine and Gray,[26] with prostate cancer death treated as competing risk. The multivariable models included age, race/ethnicity, and self-reported health status as the pre-specified covariates, and were adjusted for sampling weights, SEER registry, primary treatment, insurance, education, marital status, employment, PSA level, and Gleason score. To fit a Fine and Gray model with sampling weights, generate nomograms (graphic arrangements of multiple linear scales such that an intersecting straight line enables values predicated on the linear scales to be read from an additional scale), and assess goodness of fit, we used the connection between Fine and Gray models and weighted Cox proportional-hazard models reported by Geskus.[27] We evaluated the model fit by using likelihood ratio tests to compare full and nested models. We

Table 1. Weighted Percentage Distributions of Demographic and Clinical Characteristics at Diagnosis by Categories of Initial Self-Reported Health status

Variables	Total (N=2,695)	Self-reported health status				p value
		Excellent (n=481)	Very good (n=974)	Good (n=840)	Fair/Poor (n=400)	
Registry						0.03
Connecticut	584	107 (22 %)	230 (23 %)	179 (21 %)	68 (17 %)	
New Mexico	290	55 (11 %)	84 (9 %)	94 (11 %)	57 (14 %)	
Seattle	169	32 (7 %)	60 (6 %)	55 (7 %)	22 (6 %)	
Utah	283	41 (9 %)	109 (11 %)	101 (12 %)	32 (8 %)	
Atlanta	374	59 (12 %)	134 (14 %)	105 (13 %)	76 (19 %)	
Los Angeles	995	187 (39 %)	357 (37 %)	306 (36 %)	145 (36 %)	
Primary treatment						< 0.001
Surgery†	1,331	307 (64 %)	530 (54 %)	367 (44 %)	127 (32 %)	
Radiotherapy‡	670	94 (20 %)	237 (25 %)	232 (28 %)	107 (26 %)	
ADT only	260	25 (5 %)	66 (7 %)	97 (11 %)	72 (18 %)	
Watchful waiting	434	55 (11 %)	141 (14 %)	144 (17 %)	94 (24 %)	
Age at diagnosis (median, quartiles)	68 (62, 73)	65 (60, 71)	67 (62, 72)	69 (63, 74)	70 (64, 75)	< 0.001
<50	45	9 (2 %)	20 (2 %)	14 (2 %)	2 (0 %)	
50-69	1,537	317 (66 %)	587 (60 %)	438 (52 %)	195 (49 %)	
70+	1,113	155 (32 %)	367 (38 %)	388 (46 %)	203 (51 %)	
Race						< 0.001
White	2,070	386 (80 %)	787 (81 %)	631 (75 %)	266 (67 %)	
Black	348	54 (11 %)	104 (11 %)	122 (15 %)	69 (17 %)	
Hispanic	277	41 (9 %)	83 (8 %)	87 (10 %)	65 (16 %)	
Insurance						< 0.001
Medicare	1,254	186 (39 %)	442 (45 %)	402 (48 %)	224 (56 %)	
Private/military	1,194	247 (51 %)	457 (47 %)	346 (41 %)	144 (36 %)	
Medicaid/other/none	47	7 (1 %)	9 (1 %)	23 (3 %)	8 (2 %)	
Unknown	200	41 (9 %)	66 (7 %)	69 (8 %)	24 (6 %)	
Education						< 0.001
< High school (HS)	539	52 (11 %)	151 (16 %)	197 (24 %)	139 (34 %)	
HS/some college	1,173	175 (36 %)	437 (45 %)	385 (46 %)	176 (44 %)	
College	406	99 (21 %)	168 (17 %)	112 (13 %)	27 (7 %)	
Advanced degree	544	149 (31 %)	209 (21 %)	135 (16 %)	51 (13 %)	
Unknown/refused	33	6 (1 %)	9 (1 %)	11 (1 %)	7 (2 %)	
Marital status						0.16
Married/partnered	2,150	396 (82 %)	795 (81 %)	662 (79 %)	297 (74 %)	
Single	522	81 (17 %)	172 (18 %)	170 (20 %)	99 (25 %)	
Unknown/refused	23	4 (1 %)	7 (1 %)	8 (1 %)	4 (1 %)	
Employment						< 0.001
Working full-time	617	176 (37 %)	251 (26 %)	162 (19 %)	28 (7 %)	
Working part-time	260	37 (8 %)	107 (10 %)	82 (10 %)	34 (9 %)	
Retired	1,701	256 (53 %)	583 (60 %)	564 (67 %)	298 (75 %)	
Other/refused	117	12 (2 %)	33 (4 %)	32 (4 %)	40 (10 %)	
PSA level (median, quartiles)	7.3 (5.3, 10.9)	7.3 (5.3, 10.9)	7.7 (5.5, 12.9)	7.7 (5.4, 13.5)	9.6 (5.6, 17.1)	<0.001
<4 ng/mL	252	44 (9 %)	79 (8 %)	78 (9 %)	51 (13 %)	
4–10 ng/mL	1,381	284 (59 %)	520 (53 %)	429 (51 %)	148 (37 %)	
>10 ng/mL	900	132 (27 %)	318 (33 %)	278 (33 %)	172 (43 %)	
Unknown	162	21 (4 %)	57 (6 %)	55 (7 %)	29 (7 %)	
Gleason score						<0.001
≤6	1,189	258 (54 %)	442 (45 %)	349 (42 %)	140 (35 %)	
7–10	627	95 (19 %)	203 (21 %)	205 (24 %)	124 (31 %)	
Unknown	879	128 (27 %)	329 (34 %)	286 (34 %)	136 (34 %)	
Comorbidity						<0.001
0	1,006	276 (58 %)	443 (45 %)	226 (27 %)	61 (15 %)	
1	880	150 (31 %)	353 (36 %)	285 (34 %)	92 (23 %)	
2	440	45 (9 %)	129 (13 %)	178 (21 %)	88 (22 %)	
3+	369	10 (2 %)	49 (5 %)	151 (18 %)	159 (40 %)	

Weighted for oversampling younger, Hispanic, and black men
PSA prostate-specific antigen
†Could also receive radiotherapy and/or androgen deprivation
‡Could also receive androgen deprivation

used the method of Gonen and Heller, which estimates the concordance index, to assess the discriminatory power of the multivariable model.[28] The concordance index has the same interpretation as Harrell's C statistic for survival data.[29] We used a two-sided p value of 0.05 to denote statistical significance. Statistical analyses were performed by R 3.0 with survey, mstate, rms, clinfun, and pec packages.[30–36]

RESULTS

Demographic and clinical characteristics from the initial survey, stratified by self-reported health status and weighted for the stratified sampling strategy, are shown in Table 1. Overall, 18 % of men rated themselves as being in excellent health, 36 % as very good health, 31 % as good health, and 15 % as fair/poor health. Compared to men reporting excellent health, those reporting only good or fair/poor health status at the time of diagnosis were more likely to be older, be of minority race, and have more comorbidities. The men reporting poorer health status were also less likely to have an advanced degree, be working fulltime, have private insurance, or undergo aggressive treatment.

When subjects were surveyed, 2,001 (74 %) had already attempted curative therapy with either surgery or radiotherapy. Compared to men who received either ADT or watchful waiting, men attempting curative therapy were younger, healthier, had higher socioeconomic status, lower PSA and Gleason scores, and higher self-reported health status and lower comorbidity scores (Appendix Table 4). Men undergoing surgery or radiotherapy also had significantly lower mortality, particularly from causes other than prostate cancer.

Figures 1, 2 and 3 are Kaplan-Meier curves showing the cumulative incidences of overall, other-cause, and prostate-cancer specific mortality stratified by self-reported health status. Self-reported health status was significantly associated with overall ($p<0.001$) and other-cause ($p<0.001$) mortality. Men reporting excellent health were significantly less likely than those reporting fair/poor health to die during follow-up ($p<0.001$) or to die from other causes ($p<0.001$). However, prostate cancer mortality was similar across health status strata. We observed the same results for men who had not undergone surgery or radiotherapy at the time of reporting health status (Appendix Fig. 5).

The weighted probabilities for overall, other-cause, and prostate-cancer specific mortality are shown in Table 2. By 15 years after diagnosis, 44 % of the cohort had died; 78 % of the deaths were due to causes other than prostate cancer. The proportions of subjects with overall and other-cause deaths increased with worsening self-reported health status. Overall mortality was 27 % among men reporting excellent health, with 74 % of the deaths from causes other than prostate cancer. However, among men reporting fair/poor health status, overall

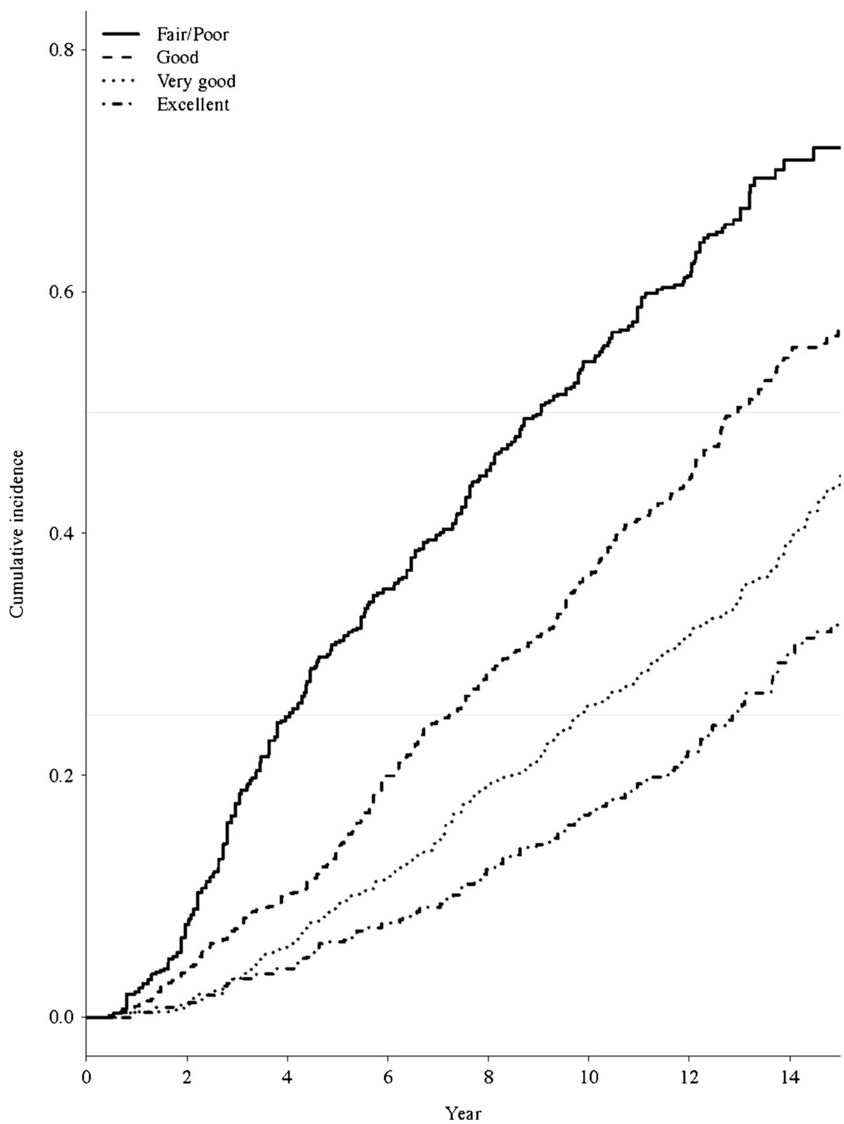

Figure 1. Competing risks cumulative incidence curve for overall mortality by initial self-reported health status.

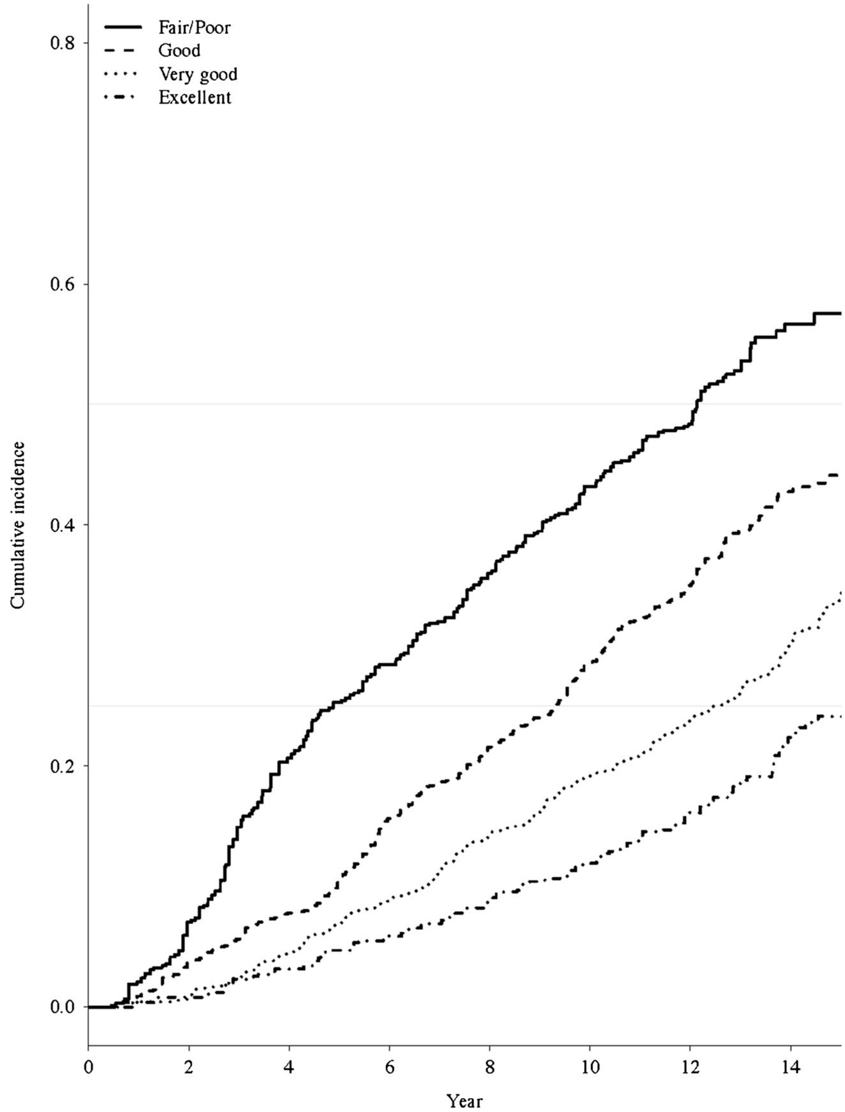

Figure 2. Competing risks cumulative incidence curve for other-cause mortality by initial self-reported health status.

mortality was 66 %, and 81 % of the deaths were from causes other than prostate cancer.

Results from the multivariable competing risks model for other-cause (non-prostate cancer) death are shown in Table 3. The likelihood ratio statistic for this model=764 (degrees of freedom=30), $p<0.0001$. Self-reported health status is significantly associated with other-cause death in this treatment-adjusted model. We also ran the model without adjusting for treatment and the hazards ratios for self-reported health status were essentially identical. Compared to a reference group of excellent health, the hazard ratios for other-cause death for men reporting very good, good, and fair/poor health were 1.22 (95 % CI 0.97, 1.54), 1.78 (1.42, 2.23), and 2.87 (2.24, 3.68), respectively.

We also ran the model substituting comorbidity counts for self-reported health status; the associated hazards ratios were similar to those for self-reported health status. However, self-reporting fair/poor health was associated with a greater risk for other-cause death (HR=2.71, 95 % CI 2.11, 3.48) than the highest comorbidity score (HR=2.06, 95 % CI 1.68, 2.51). The likelihood ratio (LR) tests for comparing models showed similar effects for adding to the simpler model either comorbidity (LR=85, $p<0.0001$) or self-reported health status (LR=58, $p<0.0001$). The multivariable model with age, race/ethnicity and self-reported health status yielded a concordance index of 0.73 (95 % CI 0.72–0.74).

The nomogram (Fig. 4) can be used to estimate the 10-year and 15-year probabilities for other-cause death for men with localized prostate cancer according to age at diagnosis, race and ethnicity, and self-reported health status. Increasing age and poorer self-reported health status were associated with increased risk for other-cause death. For example, a 69-year-old black man reporting fair/poor health status had just over a 30 % chance of other-cause death after 10 years and a greater than 50 % chance of other-cause death after 15 years. Meanwhile, the corresponding risks for a 69-year-old white man reporting excellent health were about 15 and 25 %, respectively.

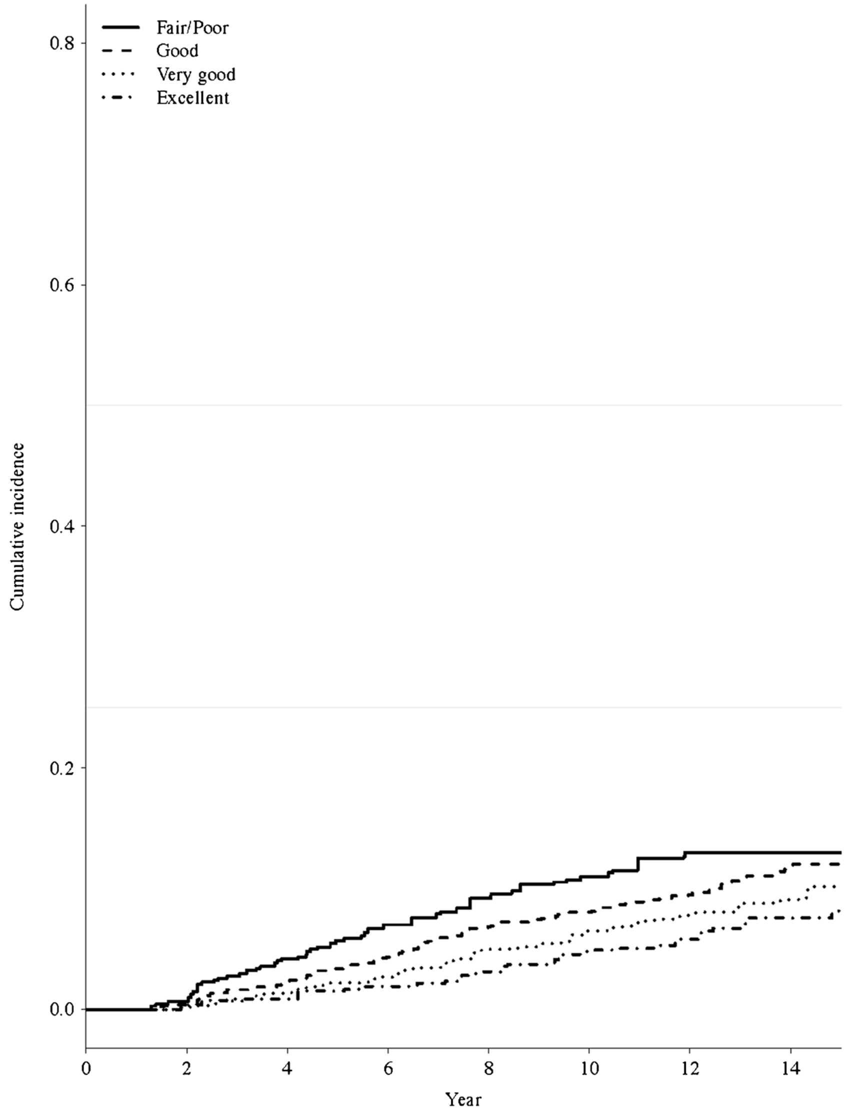

Figure 3. Competing risks cumulative incidence curve for prostate-cancer–specific mortality by initial self-reported health status.

DISCUSSION

We found a substantial 15-year overall mortality risk, mostly arising from non-cancer causes, among a population-based cohort of men with localized prostate cancer. Just over one-third of the men reported excellent health, while 15 % reported fair/poor health. The initial self-reported health status significantly correlated with overall and non-cancer mortality, with marked differences between men self-reporting excellent vs. fair/poor health. Self-reported health status was independently associated with non-cancer mortality and performed similarly to modeling with comorbidity counts. We developed a nomogram to predict 10-year and 15-year risks for other-cause deaths based on age at diagnosis, race and ethnicity, and self-reported health status.

Table 2. 15-year Mortality and Survival by Categories of Initial Self-Reported Health Status

Outcome	Number of events (N=2,695)	Self-reported health status				p value
		Excellent (n=481)	Very Good (n=974)	Good (n=840)	Fair/Poor (n=400)	
Overall mortality	1,190 (44 %)	130 (27 %)	365 (37 %)	432 (51 %)	263 (66 %)	<0.001
Prostate cancer death	263 (10 %)	34 (7 %)	86 (9 %)	92 (11 %)	51 (13 %)	
Other-cause death	927 (34 %)	96 (20 %)	279 (29 %)	340 (40 %)	212 (53 %)	
Alive	1,505 (56 %)	351 (77 %)	609 (63 %)	408 (49 %)	137 (34 %)	

Weighted for oversampling younger, Hispanic, and black men

Table 3. Multivariate Proportional Hazards Model for Predicting Other-Cause Deaths

Variables	Hazard Ratios (95 % CI)
Self reported health status	
Excellent	Reference
Very good	1.22 (0.97–1.54)
Good	1.73 (1.38–2.17)
Fair/Poor	2.71 (2.11–3.48)
Registry	
Connecticut	Reference
New Mexico	1.48 (1.17–1.85)
Seattle	1.33 (1.04–1.71)
Utah	1.19 (0.84–1.67)
Atlanta	1.59 (1.28–1.98)
Los Angeles	1.34 (1.09–1.64)
Primary Treatment	
Surgery (± radiotherapy, ADT)	Reference
Radiotherapy (± ADT)	1.17 (0.98–1.40)
ADT only	1.33 (1.04–1.70)
Watchful waiting	1.37 (1.10–1.71)
Age at diagnosis 60 to 72 years†	2.59 (2.19–3.06)
Race	
White	Reference
Black	1.05 (0.84–1.31)
Hispanic	0.69 (0.52–0.91)
Insurance	
Medicare	Reference
Private/military	0.93 (0.78–1.11)
Medicaid/other/none	1.15 (0.88–1.51)
Education	
<High school (HS)	Reference
HS/some college	1.11 (0.93–1.32)
College	0.71 (0.55–0.90)
Advanced degree	0.53 (0.42–0.68)
Marital status	
Married/partnered	Reference
Single	1.25 (1.06–1.47)
Employment	
Working full-time	Reference
Working part-time	0.84 (0.61–1.16)
Retired	1.25 (0.99–1.59)
Other	0.78 (0.46–1.30)
PSA† 5.4 to 13.2	0.99 (0.93, 1.05)
Gleason score	
≤6	Reference
7	1.26 (1.08–1.47)
8-10	1.23 (0.99–1.51)

†Modeled as continuous variable, values refer to lower and upper quartiles; hazard ratios represent comparison of upper vs. lower quartile
Weighted for oversampling younger, Hispanic, and black men
ADT androgen deprivation therapy

Prostate cancers are often indolent, and men with prostate cancer who are older or in poor health face much greater mortality risks from competing causes of death. These men are unlikely to realize a prostate-cancer survival benefit with aggressive treatment.[37,38] Consequently, treatment recommendations are predicated on whether the patient can be expected to have a 10-year to 15-year life expectancy.[2,3]

Although competing risks of mortality for men with localized prostate cancer are well recognized,[38,39] clinicians often poorly estimate life expectancy.[6,7] Adjusting life tables for comorbidity scores obtained from the SEER-Medicare database improves non-cancer survival estimates for recently diagnosed cancer patients.[16] Comorbidity-adjusted life expectancy varied considerably among Medicare beneficiaries, suggesting the importance of considering comorbidity in tailoring treatment decisions in older patients.[15] While life table and comorbidity counts can accurately estimate life expectancy, these measures have not been widely used in clinical practice for men with prostate cancer.[20] There are now online estimators, such as eprognosis (http://eprognosis.ucsf.edu) that can more readily support decision-making by enabling providers or patients to populate a risk calculator using validated prognostic indices derived from community-dwelling older adults. Risk scores are based on 11[18] and 12[17] multidimensional predictors, respectively. Our nomogram, derived from a population of men with localized prostate cancer, is based just on age, race/ethnicity, and a single question self-report health status measure. The nomogram could be a simpler way to engage patients in decision-making for prostate cancer treatment. However, an online application would likely be necessary for facilitating uptake, particularly in a clinic setting.

The nomogram is based on patient characteristics from a cohort assembled in the mid-1990s and cannot precisely estimate risks for men currently diagnosed with localized prostate cancer. We also did not validate the nomogram in other populations. However, we are unaware of any other large, population-based studies that measured self-reported health status and had sufficiently long follow-up to ascertain mortality. The nomogram should eventually be evaluated in more recently assembled cohorts collecting health status data, such as the Comparative Effectiveness of Surgery and Radiation in localized prostate cancer (CEASAR) study.[40]

Nevertheless, the nomogram can provide men with a gist understanding of their risk for non-cancer death.[41] Older men with localized prostate cancer who self-report fair or poor health have substantial risks for other-cause deaths and are unlikely to survive long enough to benefit from aggressive treatment. These men should strongly consider watchful waiting. Prostate cancer treatment decisions for men reporting intermediate levels of health, though, have become more complicated due to increasing recognition of overdiagnosis and overtreatment.[42] The choices are no longer just immediate active treatment vs. watchful waiting. Active surveillance, a strategy of closely monitoring low-risk cancers with PSA testing, digital rectal examination, and serial prostate biopsies, has emerged as a viable option that allows men the opportunity to avoid active treatment in the absence of cancer progression.[43] Men whose cancer progresses while on active surveillance will again face treatment decisions, which can be influenced by changes in health status—that could be captured by self-report.

Our study has some other potential limitations. The majority of men in PCOS underwent radical prostatectomy, which has been shown to reduce prostate cancer mortality in men with higher-risk cancers.[37,44] Treatment recommendations have changed over the past few decades, and more men with localized prostate cancers are being encouraged to consider observation.[2] This could mean higher prostate-cancer mortality rates, though that would differentially impact men reporting excellent health rather than poor health, because the latter would not

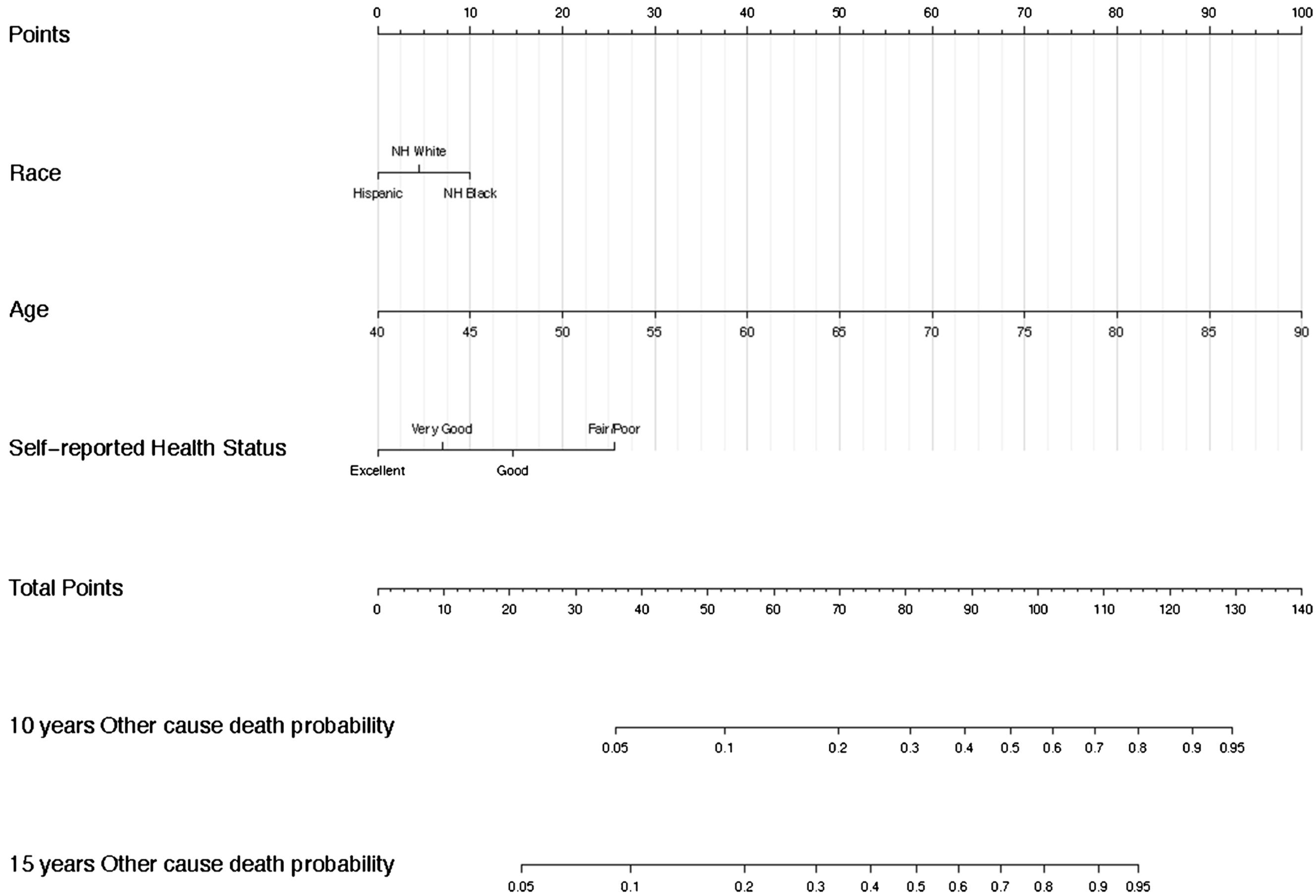

Figure 4. Nomogram for estimating 10-year and 15-year risk of other-cause mortality. Select the appropriate age, race/ethnicity, and self-reported health status and draw a straight line for each to the points' line. The sum of the points from age, race/ethnicity, and self-reported health status equals the total points. Drawing a straight line down from total points will indicate the 10-year and 15-year risks for other-cause death.

likely be offered surgery. Misclassifying cause of death could affect mortality estimates, but death certificate data for prostate cancer deaths have been shown to be accurate,[45] and the proportion of prostate cancer deaths was quite small.

Additionally, subjects completed the initial survey 6 months after diagnosis. The majority of subjects had already undergone treatment—which could lead to misclassifying self-reported initial health status, because treatment could have adversely affected quality of life, particularly for those undergoing surgery. However, we showed that men who underwent surgery or radiotherapy appeared significantly healthier at the time of being surveyed—based on both self-report and number of comorbidities—than men who had not been treated. Furthermore, the men who received surgery or radiotherapy were far less likely to die during follow-up, particularly from causes other than prostate cancer. When we modeled the association between self-reported health status and risk for other-cause death for the entire cohort, the hazard ratios were essentially identical with or without adjusting for treatment. We also showed that self-reported health status was significantly associated with death from causes other than prostate cancer in the subset of men who had not undergone surgery or radiotherapy. These findings all suggest that important misclassification, which would actually bias our results towards the null, was unlikely.

CONCLUSIONS

A substantial proportion of the population-based cohort of men diagnosed with localized prostate cancer in the mid 1990s died within 15 years of diagnosis; however, less than one-quarter of the deaths were due to prostate cancer. Men reporting fair/poor health were significantly more likely to die from causes other than prostate cancer, and were unlikely to survive long enough to benefit from aggressive treatment. A nomogram, based on just age, race/ethnicity, and the response to a single health-status question, can effectively stratify men with localized cancer for their risk of other-cause death at 10 and 15 years following diagnosis. This information could be used to support clinical decision-making for treating prostate cancer.

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APPENDIX

Table 4. Comparison of Subjects Reporting Active Treatment vs. Conservative Management on the 6-Month Survey

Variable	Number (Total N=2,695)	Surgery or radiotherapy n=2001	ADT/WW n=694	p value
Registry				<0.001
Connecticut	584	450 (23 %)	134 (19 %)	
New Mexico	290	188 (9 %)	102 (15 %)	
Seattle	169	115 (6 %)	53 (8 %)	
Utah	283	216 (11 %)	67 (10 %)	
Atlanta	374	326 (16 %)	48 (7 %)	
Los Angeles	995	706 (35 %)	290 (41 %)	
Self Reported Health Status				<0.001
Excellent	481	401 (20 %)	80 (11 %)	
Very good	974	767 (38 %)	206 (30 %)	
Good	840	599 (30 %)	242 (35 %)	
Fair/Poor	400	234 (12 %)	166 (24 %)	
Age in years (median, quartiles)	68 (62, 73)	66 (60, 71)	74 (69, 78)	<0.001
<50	45	45 (2 %)	0 (0 %)	
50–69	1,537	1345 (67 %)	193 (28 %)	
70+	1,113	611 (31 %)	501 (72 %)	
Race				0.70
White	2,070	1545 (77 %)	526 (76 %)	
Black	349	253 (13 %)	95 (14 %)	
Hispanic	276	203 (10 %)	73 (10 %)	
Insurance				<0.001
Medicare	1,254	881 (44 %)	372 (54 %)	
Private/military	1,194	936 (47 %)	258 (37 %)	
Medicaid/other/none	47	27 (1 %)	21 (3 %)	
Unknown	200	157 (8 %)	43 (6 %)	
Education				0.003
<High school (HS)	539	355 (18 %)	184 (26 %)	
HS/some college	1,173	877 (44 %)	296 (43 %)	
College	406	309 (15 %)	97 (14 %)	
Advanced degree	544	433 (22 %)	110 (16 %)	
Unknown/refused	33	27 (1 %)	7 (1 %)	
Marital status				<0.001
Married/partnered	2,150	1656 (83 %)	494 (71 %)	
Single	522	328 (16 %)	194 (28 %)	
Unknown/refused	23	17 (1 %)	6 (1 %)	
Employment				<0.001
Working full-time	617	542 (27 %)	74 (11 %)	
Working part-time	260	205 (10 %)	55 (8 %)	
Retired	1,699	1161 (58 %)	540 (78 %)	
Other/refused	119	93 (5 %)	25 (3 %)	
PSA level (median, quartiles)	7.8 (5.4, 13.1)	7.5 (5.3, 12.0)	9.3 (5.9, 21.1)	<0.001
<4 ng/mL	252	181 (10 %)	70 (10 %)	
4–10 ng/mL	1,381	1118 (58 %)	263 (38 %)	
>10 ng/mL	900	612 (27 %)	289 (42 %)	
Unknown	162	90 (5 %)	72 (10 %)	
Gleason score				<0.001
≤6	1,189	947 (47 %)	241 (35 %)	
7–10	627	462 (23 %)	166 (24 %)	
Unknown	879	592 (30 %)	287 (41 %)	
Comorbidity				<0.001
0	1,006	803 (44 %)	203 (29 %)	
1	880	662 (33 %)	218 (31 %)	
2	440	318 (16 %)	121 (18 %)	
3+	369	218 (11 %)	152 (22 %)	
Mortality outcomes				<0.001
Alive	1,506	1295 (65 %)	211 (30 %)	
Prostate cancer death	263	146 (7 %)	117 (17 %)	
Other-cause death	926	560 (28 %)	366 (53 %)	

ADT androgen deprivation therapy, WW watchful waiting, PSA prostate-cancer specific antigen
*Weighted for oversampling younger, Hispanic, and black men

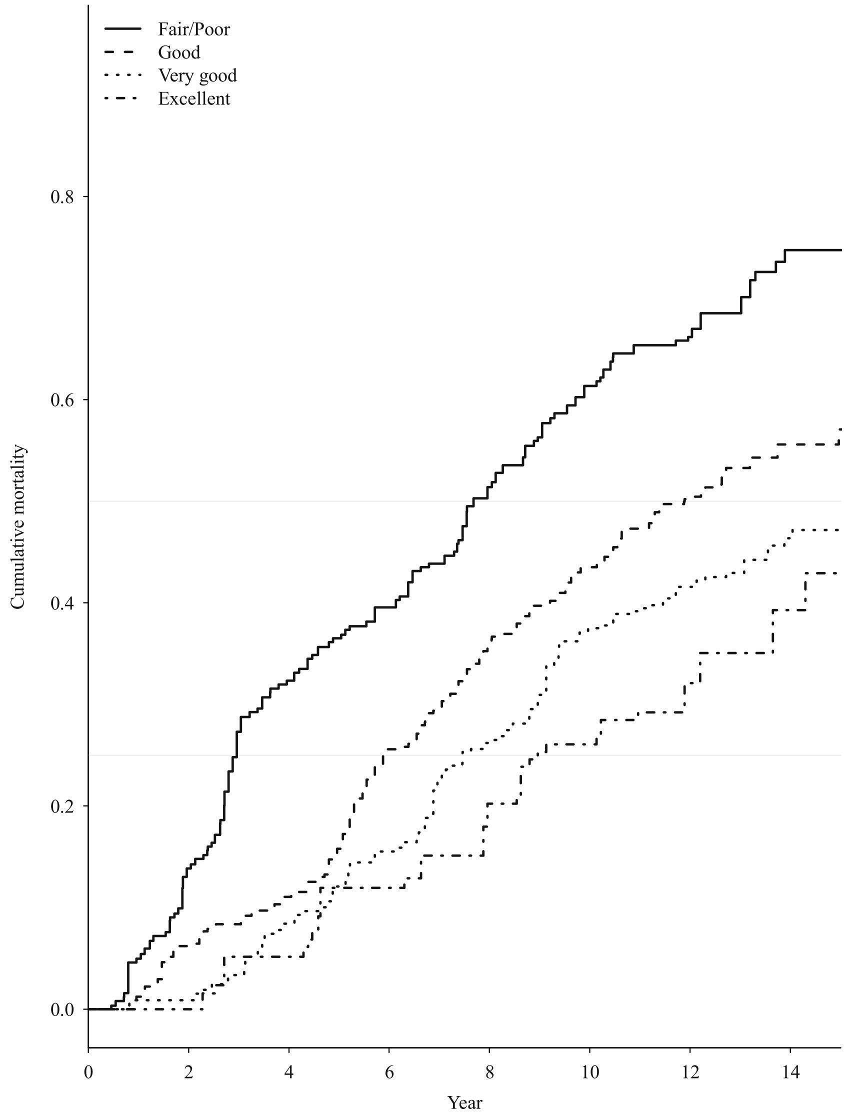

Figure 5. Competing risks cumulative incidence curve for other-cause mortality by initial self-reported health status in subjects who had not undergone surgery/radiotherapy at the time of reporting health status.