Health Status of Long-term Cancer Survivors: Results from an Australian Population-Based Sample

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Abstract

Background: **Despite considerable knowledge about the effect of cancer during the early stages of treatment and survivorship, understanding the longer-term effect of cancer has only recently become a priority. This study investigated the health implications of longer-term cancer survivorship in an Australian, population-based sample.**
Methods: **Using the Australian National Health Survey, 968 longer-term cancer survivors were identified, along with 5,808 age- and sex-matched respondents without a history of cancer. Four measures of health effect were compared (quality of life, health status, days out of role, and mental well-being), using polytomous and logistic regression analyses controlling for other selected chronic conditions. These models were applied across both groups overall, across groups stratified by presence/absence of cancer, and other chronic conditions, as well as by tumor site.**

Results: **Compared with matched respondents without cancer, longer-term cancer survivors reported significant decrements in health status, days out of role, and mental well-being (all $P < 0.02$), but not in quality of life. The likelihood of poor health outcomes (including quality of life) was much higher among survivors who also reported comorbid chronic conditions. Despite mixed results across tumor site, melanoma and prostate cancer survivors fared better across most outcomes.**
Conclusions: **Clear evidence of excess morbidity among Australian longer-term cancer survivors seems to be further exacerbated by the presence of comorbid chronic conditions. Consistent with recent U.S. studies, these results further support the importance of ongoing surveillance of the growing number of cancer survivors worldwide along with increased attention to interventions to improve long-term health outcomes.** (Cancer Epidemiol Biomarkers Prev 2006;15(10):1969–76)

Introduction

It is estimated that there are 22 million cancer survivors worldwide (1). An aging population combined with increases in early detection and improvements in treatment suggest that this number will continue to rise (1, 2). In Australia, a country with a population of 20 million, there are ~300,000 cancer survivors (3), with cancer projected to be the greatest contributor to burden of disease within the next decade (4).

Cancer survivorship is associated with significant morbidity, secondary to the physical and psychological sequelae of cancer and its treatment, with a growing literature that addresses the effect of cancer on the multidimensional aspects of health and health-related quality of life (2, 5, 6). Although we know a considerable amount about the effect of cancer during the early stages of treatment and survivorship, it is only recently that understanding the longer-term effect of cancer has become a priority (2, 7).

Two recent studies using population-based data from the U.S. National Health Interview Survey evaluated the health and disability (8) and burden of illness (9) associated with cancer survivorship. Hewitt and colleagues compared those with self-reported cancer to those without cancer and found significant decrements among those with cancer in self-rated health, psychological disability, activities of daily living, and among those under 65 years, health-related work limitations. Yabroff and colleagues compared self-reported cancer survivors to matched controls without cancer and found poorer outcomes among cancer survivors in self-rated health, a health utility index and days of lost productivity.

This article uses data from the Australian National Health Survey (NHS) to evaluate the health status of longer-term cancer survivors (those with a history of cancer but without a current diagnosis of cancer) compared with an age- and sex-matched group. Its purpose is to evaluate whether the decrements in health status observed among U.S. cancer survivors are also seen among Australian cancer survivors.

Materials and Methods

Data were sourced from the 2001 NHS conducted by the Australian Bureau of Statistics (10). This survey was designed to gather national benchmark information on a range of health-related issues and to enable the monitoring of trends in health over time. A confidentialized unit record file from the 2001 NHS was accessed via the Australian Bureau of Statistics Remote Access Data Laboratory facility (10). Information was collected from 17,918 private dwellings (response rate = 92%) between February and November 2001. The sample was spread across urban and rural localities throughout Australia. Nonprivate dwellings were excluded, as were sparsely settled areas. One adult age ≥18 years was randomly selected from each household to be interviewed about their own health (10).

The cancer-related questions examined in this study comprised a small subset of the total questionnaire. Respondents were asked "Have you ever been told by a doctor or nurse that you have cancer?" Those who answered "yes" to this question were then asked further questions about the type of cancer that they had. They were also asked "Including cancer which is in remission, do you currently have cancer?" However, no data were collected in the NHS on date of diagnosis of cancer or on the details of cancer treatment.

The relationship between current cancer and decreases in health status has already been well reported in the literature (2, 11, 12). Thus, we focused our analyses on longer-term cancer survivorship by excluding those with current cancer (~20% of the total cancer cases) based on responses to the cancer currency question above. Although it would have been preferable to define longer-term cancer survivors as those who were not in active treatment and who were a certain number of years after cancer diagnosis, this was not possible due to the lack of information on date of diagnosis and cancer treatment. Because the cancer currency question also includes those in remission, it is possible that this led to the exclusion of some respondents who would have met criteria for longer-term cancer survivorship had data on date of diagnosis and treatment been available. We also excluded all cases of nonmelanoma skin cancer from this study. Cases of non-melanoma skin cancer are not included in routine reporting of cancer data in Queensland (13), and treatment is considered relatively minor compared with other forms of cancer.

In addition to cancer, up to 19 long-term conditions were recorded for each respondent. For the purposes of this study, the comorbidities that were considered to be most relevant to the health status of cancer survivors were classified according to seven broad disease groupings, which were defined by the Australian Bureau of Statistics before dissemination of the confidentialized unit record file—diseases of the blood and blood-forming organs, endocrine, nutritional and metabolic diseases, mental and behavioral problems, diseases of the circulatory system, diseases of the respiratory system, diseases of the digestive system, and diseases of the musculoskeletal system and connective tissue. The number of "selected long-term conditions" was then calculated according to how many of these broad disease groupings a respondent had. Multiple conditions under the one disease grouping were counted once only. For analysis purposes, the number of long-term conditions was categorized as none, one or two, and three or more.

Standard demographic details (sex, age group, marital status, household income, education level) were collected in the NHS and included in this analysis.

Measures of Health Status. Four measures of health status were derived from information collected during the survey. The derivation of each of these measures is described below.

Quality of Life. A single question measure of quality of life developed by Andrews and Withey (14) was used in the NHS. Respondents were asked "How do you feel about your life as a whole, taking into account what has happened in the last year, and what you expect to happen in the future?" with response categories of "delighted," "pleased," "mostly satisfied," "mixed," "mostly dissatisfied," "unhappy," or "terrible."

Self-reported Health Status. Self-reported health status was assessed by asking "In general, would you say that your health is excellent, very good, good, fair or poor?," with the response categories as stated in the question.

Number of Days Out of Role in the Last 2 Weeks. Respondents were asked if they had more than half a day away from their work, school, or place of study in the last 2 weeks due to any injury or illness, and if so, the number of days. Respondents were also asked whether they had any other days during the last 2 weeks when they had to cut down on anything that they usually did because of their own injury or illness, and on how many days. The total number of days from these two questions was added together, with valid responses from 0 to 14 days.

Mental Well-being. Mental well-being was assessed using the Kessler Psychological Distress Scale (K10; ref. 15), consisting of 10 questions on the level of anxiety or depressive symptoms experienced during the previous 4 weeks. Questions are rated on a 1 to 5 scale, giving a total score between 10 and 50, with higher scores indicating an increased risk of anxiety or depressive disorder.

Statistical Analysis. Because age and gender are known to influence measures of health status (16, 17), the sample of cancer survivors was matched on age and sex with a comparison group (those with no prior history of cancer). Each case was matched with six randomly selected respondents with the same 5-year age group and sex who did not have cancer. Selection of different comparison groups obtained by repeating the randomization process did not alter the results reported in this study.

Bivariate comparisons between cases/comparisons and selected demographic characteristics (shown in Table 1) and measures of health status (Table 2) were made, with the statistical significance of differences assessed by the χ^2 test.

Multivariate analyses were then carried out by using a series of polytomous regression models based on the logit response function. Separate models were used for each of the four outcome measures of health status. After examining the distribution of the health outcome variables, responses were collapsed into three categories in each model (see Table 2 for final categories). The most "favorable" category within the various health outcomes was used as the reference class. Case/comparison status was the main independent variable of interest. The models were further adjusted for number of selected long-term conditions (other than cancer), as this variable had been identified as a potential confounder based on the bivariate analysis (Table 1).

To gauge the effect of cancer with regard to other long-term conditions, the data was then reanalyzed with respondents stratified by the presence or absence of cancer and other selected chronic diseases (with categories as shown in Table 3). Because the initial age and sex matching was based on all cases, these models were adjusted for both broad age group and sex.

Further analyses were then done by cancer type. We restricted the analyses by cancer type to those individual cancers (or groups of cancers) that had at least 40 cases in our sample. These cancers were melanoma, colorectal cancer, female breast cancer, prostate cancer, and cancers of the female reproductive organs, including cancer of the cervix, cancer of the uterus, and cancer of the ovaries (which had already been combined in the confidentialized unit record file). Persons who had been diagnosed with some other single form of cancer (e.g., colorectal, lung, stomach, etc.) were grouped together, as were the remaining respondents who had been diagnosed with more than one type of cancer.

Due to the smaller numbers when the data were broken down by type of cancer, we further collapsed the response categories for three of the four health outcome variables (self-assessed health status was left unchanged), as shown in Table 4. In these cases, the baseline category in each instance was retained, with the remaining response categories combined. This resulted in three of the multivariate analyses in Table 4 being based on logistic rather than polytomous regression models. Again, broad age groups were included as a potential confounder in this final set of models (sex was excluded to improve the fit of the models).

The suitability of all models was assessed using χ^2 goodness-of-fit tests with each model providing a reasonable fit to the data. All data analyses were done using SAS software version 8.2 (SAS Institute, Inc., Cary, NC).

Results

Characteristics of Cancer Survivors. A total of 968 respondents to the NHS were identified as long-term cancer survivors for the purposes of this study, and they were

Table 1. Characteristics of long-term cancer survivors and comparison subjects

Characteristic	Noncancer comparisons, % (n = 5,808)	Long-term cancer survivors, % (n = 968)	P*
Age, y			1.000 [†]
18-34	10.4	10.4	
35-49	22.4	22.4	
50-64	28.9	28.9	
≥65	38.2	38.2	
Sex			1.000 [†]
Males	31.7	31.7	
Females	68.3	68.3	
Social marital status			0.807
Married	55.3	54.9	
Not married	44.7	45.1	
Highest education level			0.932 [‡]
Tertiary qualification	21.7	21.3	
Year 11/12	19.1	19.0	
Year 10 or below	56.9	57.5	
Not stated	2.3	2.2	
Employment status			0.434
Employed full time	27.0	24.8	
Employed part time	15.3	16.7	
Unemployed	2.1	2.0	
Not in labor force	55.7	56.5	
Weekly household income			0.085 [‡]
$0−199	6.9	6.9	
$200-399	29.8	30.1	
$400−799	19.6	23.2	
$800-1,199	11.9	9.5	
$1,200−1,799	9.0	8.5	
$≥1,800	5.7	5.6	
Not stated	17.2	16.2	
Private health insurance			0.163 [‡]
Yes	50.6	53.1	
No	49.3	46.8	
Unknown	0.1	0.1	
Locality			0.156
Major city	65.1	61.9	
Inner regional	22.3	24.1	
Other	12.7	14.1	
Long-term comorbidities by major disease grouping			
Diseases of the blood and blood-forming organs	2.4	4.2	0.002
Endocrine, nutritional and metabolic diseases	17.2	19.2	0.128
Mental and behavioral problems	10.5	13.2	0.013
Diseases of the circulatory system	35.6	38.7	0.064
Diseases of the respiratory system	33.4	39.2	0.001
Diseases of the digestive system	11.5	16.1	<0.001
Diseases of the musculoskeletal system and connective tissue	51.5	58.6	<0.001
No. selected long-term comorbid disease groups			<0.001
None	20.5	13.5	
One or two	56.2	56.2	
Three or more	23.3	30.3	

*All P values are for two-sided χ^2 test.
[†]Cancer survivors and the comparison group were matched by 5-year age group and sex.
[‡]χ^2 test excludes ''not stated'' or ''unknown'' response categories.

matched by age and sex to 5,808 respondents with no reported history of cancer. No statistically significant differences were found between these cases and comparison subjects across a range of demographic variables (Table 1). Long-term cancer survivors were, however, more likely to report having multiple long-term conditions, with 30.3% of cases indicating that they had three or more of the selected long-term (noncancer) conditions, compared with 23.3% of the comparison group. Each of the seven major comorbidity disease categories was more prevalent among long-term cancer survivors than those who had never had cancer, although the differences for endocrine, nutritional, and metabolic diseases and diseases of the circulatory system were not statistically significant.

Health Outcomes by Long-term Cancer Survivorship. After adjustment for the number of noncancer chronic conditions, there were significant (P < 0.05) differences between long-term cancer survivors and the comparison group for self-assessed health status, number of days out of role, and mental well-being (Table 2). For these outcomes, long-term cancer survivors were consistently more likely to report poorer health outcomes than people who had no history of cancer. For example, relative to the reference category of excellent/very good health, cancer survivors were over 80% more likely (odds ratio, 1.84) to assess their health as fair or poor. There was no evidence of a significant difference in reported quality of life between long-term cancer survivors and the comparison group (Table 2).

Health Outcomes by Cancer Survivorship and Other Long-term Conditions. There was a highly significant relationship (P < 0.001) for each of the four health outcomes when respondents were grouped by presence/absence of cancer and other selected long-term conditions (Table 3). In each case, there was a strong trend toward a poorer health outcome when comparing persons with neither cancer nor any of the other selected conditions to those respondents with one or both of these characteristics. Using self-assessed health as an example,

respondents with cancer but none of the other selected long-term conditions were more than twice as likely (odds ratio, 2.08) as those with neither cancer or other conditions to rate their health as either fair or poor, in relation to the reference category of excellent or good health. The difference was even larger for those without cancer who nominated that they had at least one of the selected long-term diseases (odds ratio, 7.32), and greater again for those with both cancer and other chronic conditions (odds ratio, 14.10).

Health Outcomes by Type of Cancer Survivorship. The results of the analyses broken down by type of cancer are contained in Table 4. For the bivariate analyses, there was a very significant relationship between type of cancer and each of the health outcomes apart from quality of life. For self-assessed health status and number of days out of role in the last 2 days, these associations remained highly statistically significant after adjusting for age group and the number of selected long-term (noncancer) conditions in the multivariate models.

Persons who were previously diagnosed with colorectal cancer, breast cancer, cancer of the female reproductive organs, or other single cancers were all significantly more likely to have rated their health as fair or poor, rather than excellent or good, in relation to the noncancer comparison group (statistically significant odds ratios ranging from 1.67 for cancer of the female reproductive organs to 5.54 for ''other single cancers'').

With regard to number of days out of usual role, persons with breast cancer, cancers of the female reproductive organs or those in the ''other single cancers'' group were all between 60% and 65% more likely to have had >1 day out of their usual role during the past 2 weeks compared with those who had never had cancer.

Respondents who had previously been diagnosed with melanoma or prostate cancer were the most similar to the comparison group across the various health outcomes, with only one marginally significant difference recorded across the four health outcomes for either of these types of cancer. There were also no significant differences for persons with multiple cancers, although this seemed to be more as a result of the relatively small sample size for this group, as evidenced by the wide confidence intervals around the odds ratios.

Discussion

Australian cancer survivors, like their American counterparts (8, 9), experience significant decrements in their health. In this study of respondents to the Australian NHS, longer-term cancer survivors (those with a history of cancer, but without a current diagnosis of cancer) had poorer self-rated health, a greater number of days out of role in the last 2 weeks, and were at increased risk for mental health problems, compared with an age- and sex-matched comparison group. These results

Table 2. Health outcomes by long-term cancer survivorship

Health outcome	Noncancer comparisons ($n = 5,808$), %	Long-term cancer survivors ($n = 968$), %	P*
	Bivariate analysis		
Quality of life			0.103
Delighted/pleased	37.7	34.2	
Mostly satisfied/mixed/mostly dissatisfied	58.4	61.3	
Unhappy/terrible	4.0	4.6	
Self-assessed health status			<0.001
Excellent/very good	45.1	31.4	
Good	31.5	35.2	
Fair/poor	23.4	33.4	
No. days (d) out of role during the last 2 wk			<0.001
0-1	86.6	81.0	
2-7	6.5	8.6	
8-14	6.9	10.4	
Mental well-being (Kessler score)			0.001
Low risk (10-15)	67.4	61.4	
Moderate risk (16-29)	28.8	33.4	
High risk (30-50)	3.7	5.3	
	Polytomous regression models[†]		
		OR (95% CI)	
Quality of life	Reference category		0.450
Delighted/pleased		1.00	
Mostly satisfied/mixed/mostly dissatisfied		1.09 (0.95-1.27)	
Unhappy/terrible		1.13 (0.80-1.60)	
Self-assessed health status			<0.001
Excellent/very good		1.00	
Good		1.51 (1.28-1.79)	
Fair/poor		1.84 (1.53-2.21)	
No. days (d) out of role during the last 2 wk			0.001
0-1		1.00	
2-7		1.33 (1.03-1.71)	
8-14		1.46 (1.15-1.84)	
Mental well-being (Kessler score)			0.019
Low risk (10-15)		1.00	
Moderate risk (16-29)		1.20 (1.04-1.40)	
High risk (30-50)		1.34 (0.97-1.86)	

NOTE: Likelihood ratio tests for each of these models suggested adequate fit ($P > 0.05$).
Abbreviations: OR, odds ratio; 95% CI, 95% confidence interval.
*All P values are for two-sided χ^2 tests.
[†]Each health outcome is modeled separately. Models are also adjusted for number of selected long-term (noncancer) conditions.

Table 3. Health outcomes by cancer survivorship and other long-term conditions

Health outcome	No cancer, no other long-term conditions ($n = 1,191$)	Cancer, no other long-term conditions ($n = 131$)	No cancer, other long-term conditions ($n = 4,617$)	Cancer, other long-term conditions ($n = 837$)	$P*$
		Bivariate analysis			
	%	%	%	%	
Quality of life					<0.001
Delighted/pleased	47.9	40.5	35.0	33.2	
Mostly satisfied/mixed/mostly dissatisfied	49.7	58.0	60.6	61.8	
Unhappy/terrible	2.4	1.5	4.4	5.0	
Self-assessed health status					<0.001
Excellent/very good	70.6	55.0	38.6	27.7	
Good	23.6	35.9	33.6	35.1	
Fair/poor	5.8	9.2	27.9	37.2	
No. days (d) out of role during the last 2 wk					<0.001
0-1	94.3	87.8	84.6	79.9	
2-7	3.6	6.1	7.2	9.0	
8-14	2.1	6.1	8.1	11.1	
Mental well-being (Kessler score)					<0.001
Low risk (10-15)	77.8	68.7	64.8	60.2	
Moderate risk (16-29)	21.3	29.0	30.8	34.1	
High risk (30-50)	0.9	2.3	4.5	5.7	
		Polytomous regression models[†]			
		OR (95% CI)	OR (95% CI)	OR (95% CI)	
Quality of life	Reference category				<0.001
Delighted/pleased		1.00	1.00	1.00	
Mostly satisfied/mixed/mostly dissatisfied		1.38 (0.95-2.00)	1.60 (1.40-1.82)	1.72 (1.43-2.08)	
Unhappy/terrible		0.76 (0.18-3.27)	2.65 (1.76-4.01)	3.21 (1.94-5.31)	
Self-assessed health status					<0.001
Excellent/very good		1.00	1.00	1.00	
Good		1.99 (1.34-2.94)	2.40 (2.06-2.80)	3.56 (2.86-4.45)	
Fair/poor		2.08 (1.07-4.03)	7.32 (5.65-9.47)	14.1 (10.4-19.0)	
No. days (d) out of role during the last 2 wk					<0.001
0-1		1.00	1.00	1.00	
2-7		1.81 (0.83-3.96)	2.76 (1.99-3.84)	3.58 (2.42-5.29)	
8-14		3.12 (1.37-7.07)	4.16 (2.75-6.29)	6.03 (3.83-9.51)	
Mental well-being (Kessler score)					<0.001
Low risk (10-15)		1.00	1.00	1.00	
Moderate risk (16-29)		1.58 (1.05-2.38)	2.19 (1.86-2.56)	2.57 (2.09-3.17)	
High risk (30-50)		2.89 (0.79-10.6)	7.90 (4.26-14.6)	10.8 (5.51-21.0)	

NOTE: Likelihood ratio tests for each of these models suggested adequate fit ($P > 0.05$).
*All P values are for two-sided χ^2 tests.
[†] Each health outcome is modeled separately. Models are also adjusted for sex and age group.

were observed both in bivariate analyses as well as in multivariate analyses controlling for number of (noncancer) chronic conditions. Analyses by tumor site, again controlling for chronic conditions as well as age group, indicated a significant and negative effect of cancer history on self-rated health and days out of role among respondents with a history of breast, female reproductive or other single cancers, but not among those who had previously been diagnosed with melanoma or prostate cancer. Long-term survivors of colorectal cancer also indicated significantly poorer self-assessed health status, whereas those with breast or other single cancers were at increased risk in terms of their mental well-being.

Despite the differences that were found across the other three health outcomes, there was no significant difference with regard to results obtained for the quality of life measure, either for all long-term cancer survivors against the comparison group or by type of cancer. This finding is consistent with the growing literature on the effect of cancer on quality of life outcomes, which broadly suggests that for most good prognosis cancers, quality of life decrements seen around the time of diagnosis and treatment largely return to general population normative levels by 12 months posttreatment (2, 18). However, it is possible that the single-item measure of quality of life used in the NHS survey did not adequately capture the multidimensional nature of the quality of life construct. In fact, the other outcome measures used in this study could also be considered to be important aspects of quality of life, with the decrements seen across these supporting the importance of assessing multiple measures of morbidity when evaluating the long-term effect of cancer on health status.

Further analyses to elucidate the effect of noncancer chronic conditions on all four health status measures used in this study suggest that the significant influence these conditions have on health status may be even more powerful than the effect of cancer. What these results clearly indicate is that there is a lasting and excess morbidity associated with cancer, which is further exacerbated by the addition of comorbid chronic conditions. This was also reported by Hewitt et al. (8) who found a doubling of the likelihood of poor health and disability as a result of cancer, with a 5- to 10-fold increased likelihood of adverse health outcomes for survivors with comorbid conditions. As suggested elsewhere (2, 5, 19), these decrements in health are likely to be a result of the late effects of cancer and its treatment, along with the manifestations of underlying risk factors that are common to cancer as well as to other chronic conditions (i.e., smoking, physical inactivity, overweight/obesity).

The results of this study are consistent with those reported from two recent U.S. studies using data from the National Health Interview Survey (8, 9) each of which reported on two measures of health status comparable with those used in

Table 4. Health outcomes by type of cancer survivorship

Health outcome	Noncancer comparisons (n = 5,808)	Melanoma (n = 224)	Colorectal cancer (n = 112)	Breast cancer (n = 161)	Prostate cancer (n = 53)	Cancer of female reproductive organs (n = 239)	Other single cancers (n = 137)	Multiple cancers (n = 42)	P*
				Bivariate analysis					
	%	%	%	%	%	%	%	%	
Quality of life									0.428
Delighted/pleased	37.7	37.9	35.7	31.7	34.0	31.4	34.3	35.7	
Mostly satisfied/mixed/mostly dissatisfied/unhappy/terrible	62.3	62.1	64.3	68.3	66.0	68.6	65.7	64.3	
Self-assessed health status									<0.001
Excellent/very good	45.1	40.2	17.9	31.7	35.9	37.2	18.3	23.8	
Good	31.5	38.0	46.4	34.8	32.1	30.5	30.7	38.1	
Fair/poor	23.4	21.9	35.7	33.5	32.1	32.2	51.1	38.1	
No. days (d) out of role during the last 2 wk									<0.001
0-1	86.6	82.6	87.5	80.1	88.7	75.3	78.1	90.5	
2-14	13.4	17.4	12.5	19.9	11.3	24.7	21.9	9.5	
Mental well-being (Kessler score)									<0.001
Low risk (10-15)	67.4	67.0	65.2	61.5	75.5	54.4	56.2	59.5	
Moderate/high risk (16-50)	32.6	33.0	34.8	38.5	24.5	45.6	43.8	40.5	
				Logistic/polytomous regression models					
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)		
Quality of life	Reference category								0.732
Delighted/pleased		1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Mostly satisfied/mixed/mostly dissatisfied/unhappy/terrible		0.97 (0.74-1.29)	0.94 (0.64-1.40)	1.23 (0.88-1.73)	1.14 (0.64-2.03)	1.26 (0.95-1.68)	1.07 (0.75-1.53)	1.02 (0.54-1.94)	
Self-assessed health status									<0.001
Excellent/very good		1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Good		1.37 (1.00-1.86)	3.03 (1.78-5.15)	1.48 (1.00-2.20)	1.10 (0.56-2.15)	1.16 (0.84-1.61)	2.44 (1.47-4.06)	1.99 (0.88-4.49)	
Fair/poor		1.10 (0.75-1.60)	2.64 (1.49-4.69)	1.83 (1.20-2.77)	1.38 (0.68-2.80)	1.67 (1.18-2.35)	5.54 (3.36-9.13)	2.35 (0.99-5.58)	
No. days (d) out of role during the last 2 wk									0.002
0-1		1.00	1.00	1.00	1.00	1.00	1.00	1.00	
2-14		1.32 (0.92-1.89)	0.85 (0.48-1.50)	1.64 (1.10-2.46)	0.87 (0.37-2.07)	1.65 (1.20-2.26)	1.62 (1.06-2.47)	0.61 (0.21-1.74)	
Mental well-being (Kessler score)									0.066
Low risk (10-15)		1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Moderate/high risk (16-50)		0.96 (0.72-1.29)	1.16 (0.77-1.74)	1.48 (1.06-2.07)	0.76 (0.40-1.46)	1.21 (0.92-1.59)	1.48 (1.03-2.11)	1.37 (0.72-2.62)	

NOTE: Likelihood ratio tests for each of these models suggested adequate fit (P > 0.05).
*All P values are for two-sided χ^2 tests.

the current study, namely self-rated health and days lost productivity (9) or inability to work (8), and on a comparable measure of psychological problems (8). Despite the different study designs, one using a matched case/control design similar to that used in the current study (9) and the other selecting cancer and noncancer cases and controlling for demographic and medical variables (8), results are remarkably consistent across all studies. As with our study, Hewitt et al. (8) and Yabroff et al. (9) reported greater numbers of noncancer chronic conditions among those with cancer, and significant decrements in self-rated health and days lost productivity/inability to work, and psychological problems.

Yabroff et al. (9) also evaluated the influence of time since diagnosis, finding that the burden of disease was higher among cancer survivors than controls across all time points, including those diagnosed ≥11 years previously. Although the Australian NHS did not include a question on age at diagnosis, it asked whether the cancer was current. As our intent was to evaluate the health effect of cancer on longer-term survivors, we excluded those with current cancer. Although we were not able to stratify our sample by time since diagnosis, we do feel that our results speak to the longer-term survivorship, at least that which begins following the more acute diagnosis and treatment phase.

In terms of the assessment of days lost productivity/ inability to work, it is worth noting that this outcome measure was constructed differently in the Australian NHS. It asks about both days the respondent was unable to work and days that the respondent was unable to perform usual activities, and is thus applicable to the entire sample. This differs from the question in the U.S. National Health Interview Survey, where it is relevant only to those who are working. Thus, Hewitt et al. (8) and Yabroff et al. (9) had to exclude large numbers of nonworking, or nonworking-age adults, from the analyses of this outcome. Our data on days out of usual role cover our entire sample, and although consistent with findings from other studies (8, 9), provide even stronger support for the effect on lost productivity among cancer survivors, among whom there is a preponderance of older (nonworking) adults (16).

We found that, after adjusting for age and comorbid conditions, self-assessed health status was worse for those with colorectal cancer, cancer of the female breast, or the group of other single cancers compared with noncancer subjects. There were no statistically significant differences in health status for melanoma and prostate cancer patients compared with the comparison group. Yabroff et al. (9) found similar patterns, except that they found prostate cancer patients and those with multiple cancers also had significantly lower health status than the noncancer group. The difference may be because we were able to adjust for comorbid conditions and because of the much larger sample size of the NHIS data set that had increased statistical power to detect small differences. Because the treatment for most melanomas, particularly for thin melanomas, involves only surgical excision with curative intent, it may be that this, or the disease itself, would impact less upon health status once the melanoma is removed. For the internal cancers, however, treatment may involve not only extensive surgery, but also chemotherapy and radiation and these may leave lasting complications that impact upon the patient's health status.

It should be noted that the results will not completely reflect the experiences of all persons diagnosed with cancer, due to the household-based nature of the NHS. Persons with cancer who were residents in hospitals, nursing, or convalescent homes were outside the scope of the survey, and are likely to have different characteristics compared with those people who were diagnosed with cancer and living at home (20, 21). Results are also limited by the self-report nature of the data. In particular, our attempt to identify longer-term cancer survivors was hindered by the lack of information on

the date of cancer diagnosis and the unknown validity of the question regarding currency of cancer diagnosis. The data are also cross-sectional, and as such, causality cannot be inferred. Prospective cohort studies are the preferred design to more fully understand the effect of cancer over the longer-term, and indeed a number of such studies are currently under way in the United States and Australia (6, 22). Finally, it was not possible to determine whether the comorbid chronic conditions preceded cancer diagnoses or whether their development was somehow related to the effects of cancer or cancer treatment. This is an important distinction with regard to implications for health care policy and cancer management guidelines; however, it is one that cannot be addressed in the context of this study.

Overall, results from this population-based study of longer-term Australian cancer survivors show that they have significant decrements in health status, and that these are further exacerbated by the presence of comorbid conditions. These results are remarkably similar to those from two recent U.S. population-based studies, and, although exploratory, suggest that this is likely to be a consistent finding about cancer survivorship. In industrialized countries, as the population ages and treatment and early detection of cancer improve, there will be growing numbers of cancer survivors. Results from this study suggest that the long-term cancer survivor population is in need of increased attention from the health care system, attention that continues well beyond the 5-year survival point often used to indicate "cure." A number of recent reports on cancer survivorship have suggested that cancer, at least those sites with better survival profiles, be managed as chronic conditions (2, 5) with attendant shifts in the health care system to facilitate transition from acute/oncology settings to primary care, and increased attention to key areas of self-management such as lifestyle behaviors known to improve quality of life and function in cancer survivors (5, 11). Future research to evaluate the effect of new models of cancer care on health outcomes will be needed. Population-based health surveys will continue to provide one way of monitoring progress in improving outcomes for cancer survivors.

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