

What do cancer survivors believe causes cancer? (United States)

Kimberly S. Wold¹, Tim Byers^{2*}, Lori A. Crane³ & Dennis Ahnen⁴

¹Division of Cancer Prevention and Control, University of Colorado Cancer Center; ²Department of Preventive Medicine and Biometrics, University of Colorado School of Medicine, MS B119, 4200, East Ninth Avenue, Denver, CO 80262; ³Department of Preventive Medicine and Biometrics, University of Colorado Health Sciences Center; ⁴Division of Gastroenterology, University of Colorado School of Medicine

Received 25 March 2004; accepted in revised form 24 August 2004

Key words: cancer, attribution.

Abstract

Objective: To describe cancer survivors' beliefs about the causes of prostate, colorectal or breast cancers.

Methods: A survey of beliefs about cancer causation was completed by 670 cancer survivors (416 with breast cancer, 165 with prostate cancer and 89 with colorectal cancer) enrolled in a population-based study in Colorado. Categorical analysis was used to describe associations between participant's beliefs about the cause of their cancer type, both in themselves and in others, and personal characteristics, including gender, age, and familial cancer risk.

Results: Cancer survivors most frequently reported genetic factors, smoking, environmental factors (e.g., pollutants or occupation), and psychosocial factors (e.g., stress) as causing their type of cancer. Respondents underestimated the importance of behavioral factors that are known to be associated with increased cancer risk, such as obesity and physical inactivity, while overestimating the importance of stress and environmental pollution.

Conclusions: Cancer survivors' beliefs about what causes cancer are substantially different than those of experts. Because those affected by cancer should be well informed about the causes of cancer, educational efforts are needed, especially regarding the importance of factors that can be modified to reduce cancer risk.

Introduction

Cancer survivorship begins with a cancer diagnosis and extends throughout one's life [1]. There are now over ten million cancer survivors in the United States [2]. The levels of awareness and knowledge about the modifiable causes of cancer in this large group is an important consideration, both because cancer survivors can influence the levels of knowledge about cancer prevention in the broader population, and also because many of the same modifiable risk factors for cancer might also affect prognosis after cancer [3].

Despite the importance of knowledge of cancer causation among cancer survivors, very little is known about this. When asked what caused their disease,

cancer survivors have most commonly reported smoking, occupation, heredity, and stress [4–10]. Two studies have compared the beliefs of cancer survivors to those without cancer [4, 5], and one to the proven causes of cancer [6]. Survivors of breast cancer [7, 8] and ovarian cancer [9] have most frequently reported stress as a cause of their cancer, whereas lung cancer patients most frequently reported smoking [5]. Typically, these studies have been relatively small (including only 100–400 cancer patients) and have not been designed to compare opinions by gender, age, or cancer site [4–10].

Epidemiological studies have now identified several modifiable risk factors for breast cancer and colon cancer, but at this time modifiable risk factors for prostate cancer are unknown [11]. Up to one-third of both breast and colon cancer cases can be attributed to excess body weight and lack of physical activity [12]. Additionally, dietary habits (such as a diet low in fruits, vegetables, and fiber or high in fat), alcohol use, and smoking are recognized risk factors for the development

* Address correspondence to: Tim Byers, MD MPH, Department of Preventive Medicine and Biometrics, University of Colorado School of Medicine, MS B119, 4200, East Ninth Avenue, Denver, CO 80262. E-mail: Tim.Byers@UCHSC.edu

Table 1. Response rates and characteristics of responders and non-responders to the cancer survivors opinion survey, ($n = 794$)^a

Characteristic	Category	Non-responders $n = 124$		Responders $n = 670$		Response rate
		n	%	n	%	
Gender	Male	39	31.5	217	32.4	84.8
	Female	85	68.6	453	67.6	84.2
Age	< 50	24	19.4	89	13.3	78.8
	50–64	51	41.1	259	38.7	83.6
	65+	49	39.5	322	48.1	86.8
Race/Ethnicity	White	109	87.9	626	93.4	85.2
	Hispanic	7	5.7	28	4.2	80.0
	Other	8	6.5	16	2.4	66.7
Cancer Type	Breast	77	62.1	416	62.1	84.4
	Prostate	28	22.6	165	24.6	85.5
	Colorectal	19	15.3	89	13.3	82.4
Familial Risk Level	High	67	54.0	353	52.7	84.1
	Average	57	46.0	317	47.3	84.8
Education Level	< High school	9	7.3	22	3.3	71.0
	High school graduate	26	21.0	118	17.6	81.9
	Some college	47	37.9	229	34.2	83.0
	College graduate or beyond	42	33.9	301	44.9	87.8
Smoking History	Never smoked	52	41.9	328	49.0	86.3
	Former smoker	55	44.4	281	41.9	83.6
	Current smoker	17	13.7	61	9.1	78.2
Marital Status	Currently married	85	68.6	515	76.9	85.8
	Divorced/separated/widowed	33	26.6	135	20.1	80.4
	Never married/other	6	4.8	20	3.0	80.0

^a No statistically significant differences were found between responders and non-responders.

of colon cancer [13]. Alcohol use is also known to increase a woman's risk for breast cancer [14]. The risk of breast cancer is increased by hormonal factors throughout a woman's life, some of which are not easily modified such as early age of menarche, age of first childbirth, and late age at menopause. Others are more easily modifiable, such as the use of hormone replacement therapies [15]. Age, family history, and genetic factors are important risk factors for most cancers but they are not modifiable.

We conducted a survey to describe cancer survivors' beliefs about cancer causation by questioning a large cohort of people diagnosed with either prostate cancer, breast cancer, or colorectal cancer in Colorado in 1999 or 2000.

Materials and methods

Prostate, breast, and colorectal cancer survivors who were diagnosed in 1999 or 2000 in the state of Colorado, and who were enrolled in the Cancer Genetics Network

(CGN) at the University of Colorado Cancer Center were sent an opinion survey about the causes of cancer in the spring of 2003. The CGN is a collaborative network of eight cancer research centers across the United States, funded by the National Cancer Institute, to create a registry of cancer survivors and their first-degree relatives to support research in cancer causation and prevention.

The opinion survey consisted of 19 possible causes listed alphabetically, with two hormonal factors limited to women listed last. These factors were selected from factors generally known to be associated with these cancers, as well as from factors reported by previous research to be perceived by the public as important for these or other cancers [1–10]. Each survivor was asked to provide two opinions for each factor: whether the factor caused his or her own cancer, and whether the factor caused that same type of cancer in others. There were five response options: (1) definitely causes cancer, (2) probably causes cancer, (3) uncertain, (4) probably does not cause cancer, and (5) definitely does not cause cancer. For analysis, the five-point belief scale for each possible cancer

Table 2. Percentage of respondents who agree the following factors cause the same type of cancer in others by gender and cancer type

	Men, n = 217		Women, n = 453	
	Prostate n = 165	Colorectal n = 52	Colorectal n = 37	Breast n = 416
Behavioral factors				
Smoking cigarettes	76.4	75.0	81.1	80.8
Drinking alcohol	25.5	23.1	46.0	32.7
Too much fat in diet	49.7	48.1	54.1	51.0
Lack of fruits and vegetables in diet	38.8	53.9	64.9	48.8
Obesity or being overweight	39.4	40.4	43.2	48.1
Lack of exercise	27.9	26.9	16.2	29.1
Genetic factors				
Genetic factors	77.0	67.3	89.2	83.4
Family history of cancer	79.4	76.9	91.9	83.7
Environmental factors				
Environmental pollutants	58.2	69.2	78.4	73.3
Food additives	35.2	34.6	70.3	55.5
Occupation or type of work	60.0	63.5	64.9	58.2
Power lines	17.0	19.2	18.9	27.4
Other factors				
Stress	47.3	44.2	67.6	60.8
God's Will	10.9	9.6	5.4	9.1
Personality	9.1	17.3	18.9	16.1
Bad luck	9.1	7.7	13.5	5.8
Medical factors				
Medical X-rays	30.9	26.9	27.0	28.4
Infection	23.0	21.2	21.6	17.1
Physical injury to cancer area	23.0	26.9	21.6	20.0
Hormonal factors (women only)				
Menopause hormone replacements	–	–	35.1	65.9
Contraceptives	–	–	24.3	44.0

–^a– Indicates difference of proportions on either side is statistically significant at $p < 0.01$.

cause was collapsed into a three-point scale to agree (definitely or probably), disagree (definitely or probably), and uncertain. Those responders who chose not to answer a particular factor (approximately 10% for most factors) were assigned a response of 'uncertain' for that factor.

The analysis strategy was to describe the beliefs of cancer survivors, stratified by gender and cancer type. In addition, we wished to explore differences by age and by personal levels of familial and tobacco-induced cancer risk, as identified on previously-collected CGN questionnaires. We did not choose to conduct multivariate modeling across gender and cancer types as we regarded the opinions about these factors to be tied directly to both cancer type and gender. The Fisher's Exact Test was used to test the statistical significance of associations between level of belief (agree *versus* uncertain/disagree) and personal characteristics. Because of the large sample size of this survey and the many hypotheses being tested, we regarded a p -value of < 0.01 as statistically significant. The SAS system version 8

statistical software package was used to analyze the data [16].

Surveys, including a postage-paid self-addressed return envelope, were mailed to 794 cancer survivors in the Colorado CGN registry. All non-responders received a second mailed survey as well as a reminder phone call. Of the 794 survivors sent surveys, 670 (84%) responded. Response rates were largely unrelated to most personal characteristics (Table 1).

Results

Regardless of cancer type and gender, over 75% of cancer survivors agreed that genetic factors such as family history of cancer were a likely cause of the same type of cancer in others (Table 2). Next most frequently, cancer survivors reported that smoking cigarettes, environmental pollutants, and occupation were causal. Over 60% of women and 40% of men believed that stress was

Table 3. Percentage of respondents who agree the following factors cause the same type of cancer in others by gender, cancer type, and current age group^a

	Men, <i>n</i> = 165, Prostate		Women, <i>n</i> = 416, Breast	
	Young <i>n</i> = 53	Old <i>n</i> = 112	Young <i>n</i> = 83	Old <i>n</i> = 333
Behavioral factors				
Smoking cigarettes	79.3	75.0	86.8	79.3
Drinking alcohol	30.2	23.2	34.9	32.1
Too much fat in diet	62.3	43.8	56.6	49.6
Lack of fruits and vegetables in diet	47.2	34.8	56.6	46.9
Obesity or being overweight	50.9	33.9	60.2	45.1
Lack of exercise	32.1	25.9	37.4	27.0
Genetic factors				
Genetic factors	86.8	72.3	90.4	81.7
Family history of cancer	88.7	75.0	94.0	81.1
Environmental factors				
Environmental pollutants	79.3	– ^b –	86.8	– ^b –
Food additives	50.9	27.7	66.3	52.9
Occupation or type of work	67.9	56.3	65.1	56.5
Power lines	17.0	17.0	42.2	– ^b –
Other factors				
Stress	56.6	42.9	63.9	60.1
God's Will	7.6	12.5	18.1	6.9
Personality	15.1	6.3	21.7	14.7
Bad luck	5.7	10.7	10.8	4.5
Medical factors				
Medical X-rays	32.1	30.4	27.7	28.5
Infection	28.3	20.5	15.7	17.4
Physical injury to cancer area	28.3	20.5	14.5	21.3
Hormonal factors (women only)				
Menopause hormone replacements	–	–	61.5	67.0
Contraceptives	–	–	65.1	– ^b –

^a Young age grouping: Prostate 65 years of age and Breast 50 years of age.

–^b– Indicates difference of proportions on either side is statistically significant at $p < 0.01$.

a cause of their type of cancer in others. We found that 35% of female colorectal cancer survivors believed that taking hormone replacements causes colorectal cancer (whereas it actually reduces risk). Among colorectal cancer survivors, women were more likely than men to believe that food additives cause colorectal cancer (70% versus 35%; $p < 0.01$).

Table 3 compares beliefs between younger and older prostate and breast cancer survivors. For this analysis, younger breast cancer survivors were considered to be those under age 50 years, while younger prostate cancer survivors were those under age 65 years. (colorectal cancer survivors were omitted from this analysis and others due to the smaller number of respondents with this cancer type). Both for breast cancer and for prostate cancer, younger survivors were more likely to believe that environmental pollutants

caused their same type of cancer in others ($p < .01$); and younger breast cancer survivors were more likely than older breast cancer survivors to hold the belief that oral contraceptives and power lines cause breast cancer ($p < 0.01$).

When asked for their beliefs regarding the cause of their own cancer, cancer survivors most commonly reported genetic factors, environmental pollutants, and stress (Tables 4 and 5). Younger breast cancer and prostate cancer survivors (Table 5) were significantly more likely than older survivors to believe environmental pollutants and food additives played a role in their own cancer ($p < 0.01$). Younger breast cancer survivors were more likely than older breast cancer survivors to believe that God's Will and insufficient fruits and vegetables caused their breast cancer ($p < 0.01$).

Table 4. Percentage of respondents who agree the following factors caused their own cancer by gender and cancer type

	Men, n = 217		Women, n = 453	
	Prostate n = 165	Colorectal n = 52	Colorectal n = 37	Breast n = 416
Behavioral factors				
Smoking cigarettes	13.9	15.4	8.1	12.0
Drinking alcohol	3.0	11.5	8.1	6.7
Too much fat in diet	22.4	30.8	16.2	20.7
Lack of fruits and vegetables in diet	15.8	34.6	32.4	16.6
Obesity or being overweight	9.7	7.7	18.9	15.9
Lack of exercise	6.1	5.8	5.4	10.1
Genetic factors				
Genetic factors	58.8	53.9	64.9	53.1
Family history of cancer	51.5	51.9	62.2	46.6
Environmental factors				
Environmental pollutants	24.9	26.9	40.5	40.6
Food additives	17.6	21.2	37.8	31.5
Occupation or type of work	21.2	15.4	18.9	10.8
Power lines	3.6	0.0	2.7	3.6
Other factors				
Stress	22.4	21.2	46.0	39.7
God's Will	10.9	7.7	5.4	8.4
Personality	3.6	7.7	8.1	8.7
Bad luck	6.1	9.6	10.8	6.0
Medical factors				
Medical X-rays	9.7	7.7	8.1	8.9
Infection	9.1	11.5	8.1	5.1
Physical injury to cancer area	7.3	1.9	5.4	7.2
Hormonal factors (Women only)				
Menopause hormone replacements	–	–	5.4	– ^a 40.1
Contraceptives	–	–	2.7	– 20.9

–^a– Indicates difference of proportions on either side is statistically significant at $p < 0.01$.

Table 6 displays cancer survivors' beliefs regarding genetic factors and a family history of cancer stratified by their own personal familial cancer risk. There was no association between familial cancer risk level and opinions about the importance of genetic factors or family history in causing cancer. As expected, cancer survivors with higher familial risk were more likely to believe that genetic factors caused their own cancer; but even those cancer survivors at high familial risk were more likely to report that genetic factors were important causes of cancer in others than in themselves.

Table 7 displays cancer survivors' beliefs regarding the importance of tobacco use stratified by their own personal smoking history. Eventhough tobacco use is not known to be associated with increased risk for either prostate or breast cancer, most cancer survivors, regardless of their smoking history, reported the belief that smoking cigarettes causes these same types of cancer in other people. However, only about one sixth

of former smokers and only about one third of current smokers believed that smoking caused their own cancer.

Discussion

We found substantial differences between what cancer survivors believe causes cancer and what experts generally agree causes cancer. There is general agreement among experts that most cancers are caused by both genetic and behavioral factors, and that factors such as environmental pollution and stress play much smaller roles [11]. However, cancer survivors perceive the relative importance of these factors differently.

There is no scientific evidence that environmental pollutants, food additives, or power lines are important causes of cancer. Nonetheless, cancer survivors in this study often reported that factors such as pollution and food additives were important causes of their types of

Table 5. Percentage of respondents who agree the following factors caused their own cancer by gender, cancer type, and current age group^a

	Men, <i>n</i> = 165, Prostate		Women, <i>n</i> = 416, Breast	
	Young <i>n</i> = 53	Old <i>n</i> = 112	Young <i>n</i> = 83	Old <i>n</i> = 333
Behavioral factors				
Smoking cigarettes	13.2	14.3	10.8	12.3
Drinking alcohol	3.8	2.7	8.4	6.3
Too much fat in diet	28.3	19.6	28.9	18.6
Lack of fruits and vegetables in diet	20.8	13.4	28.9	– ^b – 13.5
Obesity or being overweight	17.0	6.3	20.5	14.7
Lack of exercise	7.6	5.4	13.3	9.3
Genetic factors				
Genetic factors	69.8	53.6	66.3	49.9
Family history of cancer	60.4	47.3	65.1	– ^b – 42.0
Environmental factors				
Environmental pollutants	34.0	20.5	65.1	– ^b – 34.5
Food additives	26.4	– ^b – 13.4	48.2	– ^b – 27.3
Occupation or type of work	30.2	17.0	12.1	10.5
Power lines	5.7	2.7	6.0	3.0
Other factors				
Stress	22.6	22.3	48.2	37.5
God's Will	7.6	12.5	18.1	– ^b – 6.0
Personality	7.6	1.8	13.3	7.5
Bad luck	5.7	6.3	8.4	5.4
Medical factors				
Medical X-rays	3.8	12.5	4.8	– ^b – 9.9
Infection	7.6	9.8	6.0	4.8
Physical injury to cancer area	7.6	7.1	3.6	– ^b – 8.1
Hormonal factors (women only)				
Menopause hormone replacements	–	–	3.6	– ^b – 49.3
Contraceptives	–	–	41.0	– ^b – 15.9

^a Young age grouping: Prostate 65 years of age and Breast 50 years of age.

–^b– Indicates difference of proportions on either side is statistically significant at $p < 0.01$.

Table 6. Percentage of respondents who agree that a family history or genetic factors cause the same type of cancer in others and their own cancer by gender, cancer type, and familial cancer risk level^a

	Prostate–Men, <i>n</i> = 165 Familial Cancer Risk		Breast–Women, <i>n</i> = 416 Familial Cancer Risk		Colorectal–Men & Women <i>n</i> = 89 Familial Cancer Risk	
	high <i>n</i> = 99	average <i>n</i> = 66	high <i>n</i> = 206	average <i>n</i> = 210	high <i>n</i> = 48	Average <i>n</i> = 41
Cancer in others						
Genetic factors	80.8	71.2	82.0	84.8	77.1	75.6
Family history of cancer	85.9	69.7	85.0	82.4	85.4	80.5
Their own cancer						
Genetic factors	68.7	– ^b – 43.9	59.7	46.7	66.7	48.8
Family history of cancer	65.7	– ^b – 30.3	59.7	– ^b – 33.8	64.6	46.3

^a Familial cancer risk level based on personal and family history of cancer.

–^b– Indicates difference of proportions on either side is statistically significant at $p < 0.01$.

Table 7. Percentage of respondents who agree that tobacco use causes the same type of cancer in others and their own cancer by gender, cancer type, and personal smoking history

	Prostate–Men, <i>n</i> = 165			Breast–Women, <i>n</i> = 416			Colorectal–Men Women, <i>n</i> = 89		
	Never smoked <i>n</i> = 63	Former smoker <i>n</i> = 89	Current smoker <i>n</i> = 13	Never smoked <i>n</i> = 231	Former smoker <i>n</i> = 144	Current smoker <i>n</i> = 41	Never smoked <i>n</i> = 34	Former smoker <i>n</i> = 48	Current smoker <i>n</i> = 7
Cancer in others									
Smoking cigarettes	82.5	70.8	84.6	84.4	79.9	63.4	76.5	79.2	71.4
Their own cancer									
Smoking cigarettes	7.9	15.7	30.8*	4.8	18.1	31.7**	8.8	12.5	28.6*

* *p* = 0.02 obtained from the Fisher’s Exact Test across the three personal smoking history categories.

** *p* < 0.0001 obtained from the Fisher’s Exact Test across the three personal smoking history categories.

cancer. Although radon is a proven carcinogen, we think it is unlikely that radon is thought of as an environmental pollutant, and in any case radon is not a risk factor for the types of cancer studied here. Women were more likely to perceive high risk from pollution and environmental sources than were men, even among those with colorectal cancer, who could be matched on cancer type. We found that younger survivors of breast and prostate cancers were more likely than older survivors to believe that pollutants were causal for their types of cancer, and that younger women were more likely than older women to believe that power lines were important causes of breast cancer. We did not ask study subjects for specific reasons why they thought each factor was related to cancer, so we can only speculate about those reasons. It seems possible, though, that younger cancer survivors may be searching for external causal factors because cancer typically affects older people, and/or that sources of (mis)information may differ by age.

Most cancer survivors in this survey correctly reported that a family history of cancer or genetic factors contribute to causing cancer. This finding confirms previous research [4, 6–10] and indicates that there is a general acceptance among cancer patients that genetics plays an important role in cancer risk. Surprisingly, however, there was not a substantial difference in the opinions about the importance of genetic factors by family history of cancer. Those with and without a personal family history were equally aware of the importance of genetic factors for these cancers. This is a similar observation made in a general population survey, in which awareness of the importance of familial risk for breast cancer did not differ much according to one’s own level of familial risk [17]. The perception of familial risk seems to not be sufficiently individualized. Even those with high familial risk were more likely to

believe that genetic causes or a family history of cancer was a more important cause of cancer among others than themselves. Possibly, cancer survivors do not recognize that their own family cancer history is strong enough to define them as having high genetic risk (it is important to note in this regard that the CGN has not directly informed cancer survivors of their familial risk level).

Fewer than half of the cancer survivors reported believing that physical inactivity, obesity, and poor diet were important causes of either breast cancer or colorectal cancer, despite substantial scientific data that these factors are important for both those cancers [18, 19]. The International Agency for Research on Cancer (IARC) has estimated that excessive body weight and physical inactivity account for about 20 to 25% of all cancers of the breast and colorectum [18], and that low intakes of fruits and vegetables may account for up to 12% of colorectal cancer [19]. Cancer survivors of all ages substantially underestimated the importance of obesity and physical inactivity. It is clear that the messages that obesity and the lack of physical activity cause cancer are not being heard or believed by cancer survivors. In contrast, survivors were much more likely to believe that unproven factors such as stress, environmental pollutants, food additives, and occupation type cause cancer. This is an observation that has been made previously in survey of knowledge about breast cancer causal factors among a population-based sample in Canada [20].

Most cancer survivors in this survey reported believing that smoking causes breast or prostate cancer, despite the fact that tobacco use is largely unrelated to these two cancers. Tobacco use is weakly associated with colorectal cancer, but the view was similar that tobacco was an important cause for all three cancers in this survey (75–81%). There seems to be a high level of

misperception about the nature of the cancer risk from smoking. The interpretation of the question of tobacco as a causal factor in respondents' own cancer is complex. Compared to never-smokers, current and former smokers were more likely to believe that smoking might have caused their own cancer, but even current smokers more often reported that they thought smoking was a risk factor for others than for themselves. It was surprising to find that even a small percentage of cancer survivors who reported never smoking cigarettes believed that smoking caused their cancer (5–9%). Possibly these non-smokers were referring to a perception of risk from second-hand smoke exposure. This observation is consistent with surveys of the general population, who have been found to be uninformed about the various health effects of tobacco [21], and who regard their own personal risk from tobacco to be less than the risk to other smokers [22].

Many cancer survivors believed that stress was a significant cause of cancer, a finding that confirms previous research [4–9], even though there is no scientific consensus that stress causes cancer. In our study, women were much more likely than men to report that stress caused either their own cancer or the same type of cancer in others. Adverse health effects of stress are frequently in the news, though, and if stress is thought to be generally an adverse phenomenon, then one could begin to believe that it may cause many different maladies, including cancer.

The present study has many strengths. This is the largest study to date of this question, the study population was obtained from a population-based registry in which family history and selected cancer risk factors were prospectively collected, the sample included both men and women, it included three cancer sites, and the response rate was high, and familial cancer risk was known. However, the racial and ethnic composition of the CGN is primarily White, non-Hispanic and the registry over sampled based on cancer family history; therefore, the majority of participants have higher than average familial risk. The cancer survivors who were included in this study, therefore, may not be representative of all cancer survivors. However, to our knowledge, this is the only study to describe the beliefs of a large cohort of American men and women, with either prostate cancer, colorectal cancer, or breast cancer.

Taken together our results indicate that efforts by public health organizations and health care providers to educate the public in general and cancer patients specifically about the causes of cancer need to be improved. The growing numbers of cancer survivors in the United States, now numbering over ten million, constitute an important group to carry-forward accurate

messages about cancer prevention for the wider population. In addition, attending to improving cancer risk factors might also favorably affect recurrence and survival among cancer survivors [3]. Therefore, educational efforts are needed to improve the understanding among cancer survivors that many modifiable factors, such as excess body weight, poor diet, and lack of physical activity, can reduce the burden and suffering from cancer.

Acknowledgements

We express our greatest appreciation to the University of Colorado Cancer Center and University of Utah Cancer Genetics Network staff, especially Jan Lowery. Without their help and support, this research project would not have been possible. This study was supported by Grant number U24 CA78174 from the National Cancer Institute, NIH.

References

1. NCI Office of Cancer Survivorship, (<http://survivorship.cancer.gov>).
2. Rowland J, Mariotto A, Aziz N, et al. (2004) Cancer survivorship – United States, 1971–2001. *MMWR* **53**: 526–529.
3. Brown J, Byers T, Doyle C, et al. (2003) Nutrition and physical activity during and after cancer treatment: an American Cancer Society guideline for informed choices. *CA Cancer J Clin* **53**: 268–291.
4. Linn MW, Linn BS, Stein SR (1982) Beliefs about causes of cancer in cancer patients. *Soc Sci Med* **16**: 835–839.
5. Faller H, Schilling S, Lang H (1995) Causal attribution and adaptation among lung cancer patients. *J Psychosom Res* **39**: 619–627.
6. Maskarinec G, Gotay CC, Tatsumura Y, Shumay DM, Kakai H (2001) Perceived cancer causes: use of complementary and alternative therapy. *Cancer Practice* **9**: 183–190.
7. Taylor SE, Lichtman RR, Wood JV (1984) Attributions, beliefs about control, and adjustment to breast cancer. *J Pers Soc Psychol* **46**: 489–502.
8. Stewart DE, Cheung AM, Duff S, et al. (2001) Attributions of cause and recurrence in long-term breast cancer survivors. *Psych-oncology* **10**: 179–183.
9. Stewart DE, Duff S, Wong F, Melancon C, Cheung AM (2001) The views of ovarian cancer survivors on its cause, prevention, and recurrence. *Medscape Women's Health J* **6**(5).
10. Risberg T, Wist E, Bremnes RM (1998) Patients' opinion and use of non-proven therapies related to their view on cancer aetiology. *Anticancer Res* **18**: 499–506.
11. Colditz G, Samplins-Salgado M, Ryan CT, et al. (2002) Harvard report on cancer prevention, volume 5: fulfilling the potential for cancer prevention: policy approaches. *Cancer Causes Control* **13**: 199–212.
12. Vainio H, Kaaks R, Bianchini F (2002) Weight control and physical activity in cancer prevention: international evaluation of the evidence. *Eur J Cancer Prev* **11**(suppl 2): S94–S100.

13. Giovannucci E (2002) Modifiable risk factors for colon cancer. *Gastroenterol Clin North Am* **31**: 925–943.
14. Byers T, Nestle M, McTiernan A, *et al.* (2002) American cancer society guidelines on nutrition and physical activity for cancer prevention: reducing the risk of cancer with healthy food choices and physical activity. *CA Cancer J Clin* **52**: 92–119.
15. Chlebowski R, Hendrix S, Langer R, *et al.* (2003) Influence of estrogen plus progestin on breast cancer and mammography in healthy postmenopausal women. *JAMA* **289**: 3243–3253.
16. SAS Institute Inc. The SAS System for Windows, Release 8.02. Cary, NC: 1999–2000.
17. Miesfeldt S, Cohn W, Ropka M, Jones S (2001) Knowledge about breast cancer risk factors and hereditary breast cancer among early-onset breast cancer survivors. *Familial Cancer* **1**: 135–141.
18. International Agency for Research on Cancer, World Health Organization (2002) *IARC Handbooks of Cancer Prevention: Weight Control and Physical Activity*. Lyon, France: IARC Press.
19. International Agency for Research on Cancer, World Health Organization (2003) *IARC Handbooks of Cancer Prevention: Fruits and Vegetables*. Lyon, France: IARC Press.
20. Buxton J, Bottorff J, Balneaves L, *et al.* (2003) Women's perceptions of breast cancer risk: are they accurate? *Can J Public Health* **94**: 422–426.
21. Weinstein N, Slovic P, Waters E, Gibson G (2004) Public understanding of the illnesses caused by cigarette smoking. *Nicotine Tob Res* **6**: 349–355.
22. Weinstein N (1998) Accuracy of smokers' risk perceptions. *Ann Behav Med* **20**: 135–140.