Age-dependent increased odds of cardiovascular risk factors in cancer survivors: Canadian Longitudinal Study on Aging cohort

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ABSTRACT

Background   This study compared the odds of self-reported and objectively measured cardiovascular (CV) risk factors in a sample of Canadian cancer survivors and individuals without cancer.

Methods   A nationally representative sample of 45- to 85-year-old cancer survivors (n = 6288) in the Canadian Longitudinal Study on Aging were compared with individuals without cancer (n = 44,051).

Results   The most prevalent risk factors in cancer survivors were all self-reported or easily measured in clinic: overweight or obesity (68.0%), former smoking (62.9%), fewer than 5 daily servings of fruits and vegetables (59.8%), hypertension (43.7%), and high waist circumference (47.0%). After adjustment for sex and education, the odds ratios of several CV risk factors varied by age in cancer survivors and the non-cancer controls. At ages 50 and 60, cancer survivors have increased odds of overweight or obesity, former smoking, hypertension, high waist circumference and truncal fat, diabetes, lung disease, and heart rate greater than 80 bpm compared with non-cancer controls. At age 70, odds did not differ for many risk factors; at age 80, no differences were evident. Without modification by age, low physical activity was more prevalent in cancer survivors (odds ratio: 1.27; 95% confidence interval: 1.17 to 1.39). There were no differences in the odds of CV risk factors measured by specialized equipment, including electrocardiography, carotid ultrasonography, spirometry, and dual-energy X-ray absorptiometry.

Conclusions   The odds of several easy-to-assess CV disease risk factors are higher among middle-aged, but not older, cancer survivors relative to the general Canadian population. Initial assessment of CV risk for middle-aged adults in the survivorship setting could be quickly and inexpensively performed using self-reported and easily measured metrics.

Key Words   Survivorship, cardiovascular risk factors, hypertension, obesity, smoking, physical activity

INTRODUCTION

In 2017, 206,200 Canadians were expected to be diagnosed with cancer, and thanks to increasingly effective treatment, approximately 810,000 Canadians were living cancer survivors who had been diagnosed in the preceding 10 years[1]. Given the reduction in cancer mortality rates in recent decades, it has been recognized that individuals diagnosed with cancers having high survival rates (for example, breast, prostate, testicular, sarcoma) will often die from cardiovascular (CV) disease rather than from cancer[2–5]. For example, diagnosis and treatment of breast

cancer increases the risk of CV disease–related death by up to 50% relative to the risk for age-matched women without breast cancer[6].

Given the significant risk of CV mortality after a cancer diagnosis and the growing number of cancer survivors, it is crucial to characterize CV morbidity in cancer survivors. Numerous modifiable risk factors—including hypertension, smoking, diabetes, physical inactivity, low fruit and vegetable consumption, and overweight or obesity—have been associated with an increased risk of CV disease in the general population[7]. Those risk factors can be easily assessed by self-report, but a number of objective

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measurements such as waist circumference, resting heart rate, electrocardiography, and carotid intima media thickness (IMT) have also been associated with CV risk[8–10]. However, the prevalence of the objective risk factors especially has not been well characterized in cancer-affected populations.

Identification of the risk factors that are the most common and that show increased odds in cancer survivors compared with the general population can help care providers to streamline risk assessment and can inform prevention, early detection, and management of CV disease in the survivorship setting. The purpose of the present analysis was to

■ describe the prevalence of self-reported and objectively measured CV disease risk factors in a nationally representative cohort of Canadian cancer survivors, and

■ determine the odds ratio of those risk factors in cancer survivors relative to individuals without a history of cancer.

METHODS

The Canadian Longitudinal Study on Aging (CLSA) is an ongoing population-based cohort study of 51,338 adults between the ages of 45 and 85[11]. The CLSA excluded residents of institutions, the 3 territories, some remote regions, federal First Nations reserves, and other First Nations settlements; non-English or non-French speakers; fulltime Canadian Armed Forces members; and individuals with cognitive impairment. A "comprehensive cohort" of 30,097 participants (from among the 51,338 total) provided self-reported information about health and health determinants through in-home computer-assisted personal interviews; they also participated in objectively measured physical assessments through in-person assessments at 11 data collection sites. A "tracking cohort" of 21,241 participants (from among the 51,338 total) provided only self-reported health and health determinant information through computer-assisted telephone interviews; they did not participate in data collection. Data collection occurs every 3 years; to date, the initial baseline assessment is complete and forms the basis of the present analysis. The University of Alberta's Research Ethics Board 2 provided approval for the analysis.

Study Sample

"Cancer survivors" were defined as individuals who reported a history of cancer other than non-melanoma skin cancer. Participants reporting a history of only non-melanoma skin cancer were not included in the cancer survivor group because that diagnosis tends to reduce the sensitivity of self-reporting of a cancer history[12] and has relatively less impact on long-term health. The CLSA did not collect information about the timing of a cancer diagnosis or the types of treatments received. Participants who did not provide valid responses to the questions used to identify cancer status or whose responses included confounders used in multivariate models were excluded from all analyses.

Variables

The CV risk factors included were those identified by the World Heart Federation[7] and a number of primarily objectively measured variables that have also demonstrated

prognostic value for CV disease. Table I provides details of measurement techniques and definitions. Objectively measured variables were obtained for the comprehensive cohort (*n* = 30,097 subset) only by trained CLSA staff at data collection sites. Detailed standard operating procedures are available at the CLSA Web site[16].

Analyses

Analytical weights provided by the CLSA were applied to all analyses as recommended by the CLSA for representativeness [17]. Descriptive statistics were calculated as weighted means with standard deviation or as weighted percentages with 95% confidence intervals. Demographics were compared between the groups using the independent samples *t*-test for continuous variables and the chi-square test for categorical variables. The prevalences of CV risk factors were calculated as weighted percentages. Univariate logistic regression was used to compare the prevalences of CV risk factors between groups, and unadjusted odds ratios (ORs) are presented. Multivariable logistic regression was also performed to adjust for key confounders, including age, sex, and education level (as a surrogate for socioeconomic status). Ethnicity was also explored, but did not appear to confound the relationships examined, and so was not included. We also hypothesized that cancer might modify the age-related trajectory of risk factors for CV disease. To explore that possibility, we conducted our analyses using an age-by-cancer-status interaction term. When the addition of an interaction improved the model fit (determined by the Akaike information criterion), age-specific adjusted ORs (adjusted for sex and education) for representative ages of 50, 60, 70, and 80 years are presented. When the addition of the interaction term did not improve model fit, ORs adjusted for age, sex, and education are presented. Analyses were conducted using the SAS software application (version 9.4: SAS Institute, Cary, NC, U.S.A.).

RESULTS

Of the 51,338 individuals total in the CLSA dataset, 999 (1.9%) were excluded from the present analyses for invalid responses about their history of cancer or education. The analyses therefore included 50,339 individuals, of whom 6288 were cancer survivors (12.5%). On average, cancer survivors had a similar body mass index, but were 6.4 years older than individuals without cancer (Table II). The most common types of cancer were breast (23.6%) and prostate (18.1%, Table II).

The most prevalent self-reported risk factors in cancer survivors were overweight or obesity (68.0%), former smoking (62.9%), fewer than 5 daily servings of fruits and vegetables (59.8%), and hypertension (43.7%, Table III). The prevalence of measured overweight or obesity (71.4%, Table III) was similar to self-report. Otherwise, carotid IMT (58.9%) and waist circumference (47.0%) measurements exceeding known risk thresholds were the only objectively measured risk factors as prevalent as the self-reported risk factors (Table IV).

In comparing the odds of risk factors between cancer and non-cancer groups, a significant age-by-cancer-status interaction was evident both for self-reported and measured hypertension and for self-reported and measured

TABLE I Techniques and definitions of cardiovascular risk factor measurement

Risk factor	Assessment type	Definition
Hypertension	Self-report	Any history
Uncontrolled hypertension	Average of 2nd–6th seated measurements at 60 s intervals (BpTRU device[a])	≥140/≥90 mmHg
Diabetes	Self-report	Any history
Overweight or obesity	Self-report and measured as BMI using height in metres and weight in kilograms	BMI ≥ 25.0 kg/m^2
High-risk waist circumference[10]	Measured at the level of the navel (men) or narrowest part of the waist (women)	>102 cm for men, >88 cm for women
Smoking status	Self-report	Categorized as current smoker, former smoker, or never-smoker
Servings of fruits and vegetables daily	Self-report SCREEN II[13] question: In general, how many servings of fruits and vegetables do you eat in a day?	Report of fewer than 5 servings daily
Physical activity	Self-report using the Physical Activity Scale for the Elderly[14]	Lowest relative to highest quartile for sample
Abnormal ECG	Measured by 12-lead electrocardiography (MAC 1600 Resting ECG System[b])	Abnormalities of heart rate, rhythm, electrical conductance
High-risk carotid intima media thickness	Highest average of up to 5 measurements on either side (Vivid i ultrasound system[b])	≥0.75 mm[8]
High- and very-high-risk resting heart rate	Average of the 2nd–6th seated measurements at 60 s intervals (BpTRU device[a])	>80 bpm and >90 bpm respectively[9]
Lung disease	Self-reported	History of emphysema, chronic bronchitis, COPD, or chronic changes in lungs attributable to smoking
COPD	Best of 3–8 measurements using an Easy on-PC spirometer[c]	FEV_1/FVC < 0.70
Trunk fat	Dual-energy X-ray absorptiometry	Highest relative to lowest quartile of fat in trunk region for sample
Lean mass	Dual-energy X-ray absorptiometry	Lowest relative to highest quartile of total lean mass (kilograms/height in metres squared) from whole study sample
Low grip strength	Maximum of 3 trials on dominant hand (Tracker Freedom grip dynamometer[d])	<30 kg for men, <20 kg for women
Low gait speed	Timed 4 m walk test	<0.8 m/s
Sarcopenia	Dual-energy X-ray absorptiometry, grip strength dynamometry, 4 m walk test	European Working Group on Sarcopenia in Older Persons criteria for low lean mass (appendicular lean mass/height^2 ≤ 7.23 kg/m^2 for men and 5.67 kg/m^2 for women) and gait speed < 0.8 m/s or low grip strength as already defined[15]
Osteoporosis and osteopenia	Dual-energy X-ray absorptiometry T score	–2.5 or less and less than –1.0 respectively

[a] VSM MedTech, Vancouver, BC.
[b] General Electric, Toronto, ON.
[c] ndd Medical Technologies, Andover, MA, U.S.A.
[d] JTECH Medical, Midvale, UT, U.S.A.
BMI = body mass index; ECG = electrocardiogram; COPD = chronic obstructive pulmonary disease; FEV_1 = forced expiratory capacity in 1 s; FVC = forced vital capacity.

overweight or obesity; for self-reported diabetes or lung disease, and current and former smoking status; and for measured waist circumference, resting heart rate, gait speed, and dual-energy X-ray absorptiometry–derived trunk fat and lean mass (Tables III and IV). For most of those variables, ORs were significantly higher for cancer survivors at age 50, with stepwise reductions by decade, such that by age 80, no differences in ORs were evident between cancer survivors and individuals without cancer. The exception to that pattern was that the odds of lowest-quintile lean mass and low gait speed were higher in cancer survivors at older

ages (Table IV). There was no evidence of age modification on the odds of poor diet and physical activity behaviours. The adjusted odds of cancer survivors being in the lowest quartile of physical activity was elevated (Table III). There was no difference in the adjusted odds for consuming fewer than 5 daily servings of fruits and vegetables (Table III). For several of the risk factors requiring specialized equipment (abnormal electrocardiogram, high-risk carotid IMT, measured chronic obstructive pulmonary disease, sarcopenia, low grip strength, osteopenia, and osteoporosis), the ORs were not modified by age, and the adjusted ORs were nonsignificant,

TABLE II   Weighted characteristics for the study sample

Characteristic	Cancer (*n*=6,288)		No cancer (*n*=44,051)		*p* Value
	Weighted	95% CI	Weighted	95% CI	
Mean age (years)	65.6	65.3 to 65.8	59.2	59.1 to 59.3	<0.001
Mean BMI[a] (self-report in kg/m^2)	27.8	27.7 to 28.0	27.7	27.7 to 27.8	0.19
Mean BMI[b] (measured in kg/m^2)	28.3	28.1 to 28.4	28.0	27.9 to 28.0	<0.01
Female sex (%)	56.0	54.6 to 57.3	50.7	50.2 to 51.2	<0.001
Marital status[a] (%)					<0.001
Single (never married)	7.1	6.5 to 7.9	7.9	7.6 to 8.1	
Married or common-law	70.4	69.0 to 71.4	75.7	75.2 to 75.9	
Divorced, separated, or widowed	22.5	21.4 to 23.6	16.5	16.1 to 16.8	
Education (%)					<0.001
Less than secondary school	8.3	7.6 to 9.1	5.7	5.5 to 5.9	
Secondary school diploma	11.7	10.9 to 12.7	10.6	10.4 to 10.9	
Some postsecondary	8.2	7.4 to 8.9	7.0	6.8 to 7.3	
Postsecondary degree or diploma	71.8	70.5 to 72.9	76.7	76.2 to 77.0	
Ethnicity (%)					<0.001
White	93.4	92.7 to 94.1	90.7	90.4 to 91.1	
Asian	1.1	0.8 to 1.4	2.6	2.4 to 2.8	
Indigenous	3.2	2.7 to 3.8	3.8	3.6 to 4.0	
Black	0.8	0.6 to 1.1	1.0	0.9 to 1.1	
Other	1.4	1.1 to 1.7	1.9	1.7 to 2.0	
Cancer type[c] (%)					—
Breast	23.6	22.4 to 24.7			
Prostate	18.1	17.1 to 19.1			
Melanoma	14.3	13.4 to 15.3			
Colon or rectum	10.5	9.6 to 11.4			
Female genital organs	9.3	8.6 to 10.1			
Bladder	3.8	3.3 to 4.2			
Non-Hodgkin lymphoma	3.8	2.8 to 3.8			
Ovary	3.2	2.7 to 3.6			
Thyroid	3.1	2.6 to 3.6			
Lung	2.9	2.5 to 3.3			
Kidney	2.8	2.4 to 3.2			
Lymphoid or hematopoietic	2.6	2.2 to 3.1			
Lip, oral cavity, or pharynx	2.1	1.7 to 2.5			
Leukemia	2.0	1.6 to 2.4			
Digestive organs	2.0	1.6 to 2.3			
Other[d]	6.1	5.5 to 6.8			

[a]   Missing data: BMI self-report (*n*=241) and marital status (*n*=14).
[b]   Measured in 29,266 participants.
[c]   Includes multiple cancer types for 12% of participants reporting more than 1 cancer type.
[d]   Cancers of the eye, brain, central nervous system, mesothelium, soft tissue, male genital organs, bone, articular cartilage, respiratory organs, intrathoracic organs, pancreas, endocrine system, and urinary tract, plus "don't know" and unspecified.
BMI = body mass index.

suggesting that there is no difference between cancer survivors and individuals without cancer (Table IV).

DISCUSSION

The coexistence of cancer and CV disease is a major public health concern that is likely to continue to increase in prevalence as the population ages[18]. Various factors associated with CV risk or health can be present and interact before a cancer diagnosis, during the active treatment period, and in the post-treatment survivorship setting[19]. Furthermore, numerous types of cancer treatment are associated with direct CV toxicity (for example, anthracycline chemotherapy, thoracic radiation, therapies targeting the human epidermal growth receptor, tyrosine kinase inhibitors, and immunotherapies), and the resulting manifestations are highly variable: left ventricular dysfunction, heart failure, cardiac structural or electrical abnormalities, hypertension, vascular thrombosis, and ischemia, among others[20–23]. The resulting patient-level CV morbidity is

TABLE III Weighted prevalence and odds of self-reported cardiovascular risk factors in cancer survivors compared with individuals without cancer

Risk factor	Cancer (n=6,288)		No cancer (n=44,051)		Unadjusted analysis		Age-specific adjusted analysis (adjusted for sex and education)								Age*cancer interaction p value
							50 Years		60 Years		70 Years		80 Years		
	W%	95% CI	W%	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	
Hypertension	43.7	42.4 to 45.1	32.0	31.5 to 32.4	1.65	1.56 to 1.75	1.43	1.28 to 1.60	1.26	1.18 to 1.35	1.11	1.04 to 1.19	0.98	0.88 to 1.09	<0.001
Diabetes	19.7	18.7 to 20.8	15.0	14.7 to 15.3	1.39	1.30 to 1.50	1.43	1.25 to 1.65	1.26	1.15 to 1.37	1.10	1.02 to 1.19	0.96	0.85 to 1.09	<0.01
Overweight or obesity	68.0	66.8 to 69.3	66.4	66.0 to 66.9	1.07	1.01 to 1.14	1.25	1.12 to 1.40	1.14	1.07 to 1.23	1.04	0.97 to 1.12	0.95	0.85 to 1.06	<0.01
Lung disease	7.7	7.0 to 8.4	5.0	4.8 to 5.2	1.58	1.41 to 1.76	1.71	1.39 to 2.11	1.43	1.26 to 1.64	1.20	1.07 to 1.35	1.01	0.84 to 1.21	<0.01
Smoking status[a]															
Current smoker	8.3	7.5 to 9.0	10.1	9.8 to 10.4	0.92	0.82 to 1.03	**1.27**	**1.06 to 1.51**	1.10	0.98 to 1.23	0.95	0.81 to 1.10	0.82	0.64 to 1.05	**0.04**
Former smoker	62.9	61.6 to 64.2	57.7	57.2 to 58.2	**1.22**	**1.14 to 1.30**	**1.15**	**1.02 to 1.29**	**1.14**	**1.06 to 1.22**	**1.12**	**1.05 to 1.21**	1.11	0.99 to 1.25	

Adjusted analysis (adjusted for age, sex, and education)

Risk factor	Cancer (n=6,288)		No cancer (n=44,051)		Unadjusted analysis		Adjusted analysis (adjusted for age, sex, and education)		Age*cancer interaction p value
	W%	95% CI	W%	95% CI	OR	95% CI	OR	95% CI	
Fruits and vegetables daily, <5 servings	59.8	58.4 to 61.2	59.2	58.8 to 59.7	1.02	0.96 to 1.09	1.06	0.996 to 1.13	0.44
Physical activity[b]									0.26
Lowest quartile	30.7	29.5 to 31.9	22.2	21.8 to 22.6	**2.17**	**2.00 to 2.36**	**1.27**	**1.17 to 1.39**	
Middle quartiles	50.5	49.2 to 51.9	48.2	47.8 to 48.7	**1.65**	**1.53 to 1.78**	**1.09**	**1.01 to 1.18**	

a   Relative to never-smoker.
b   Relative to highest quartile.
W% = weighted percentage; CI = confidence interval; OR = odds ratio.

TABLE IV Weighted prevalence and odds of objectively measured[a] cardiovascular risk factors in cancer survivors compared with individuals without cancer

Risk factor	Cancer (n=6,288)		No cancer (n=44,051)		Unadjusted analysis		Age-specific adjusted analysis (adjusted for sex and education)								Adjusted analysis (adjusted for age, sex, and education)		Age*cancer interaction p value
							50 Years		60 Years		70 Years		80 Years				
	W%	95% CI	W%	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	
Overweight or obesity	71.4	69.8 to 73.0	68.6	68.0 to 69.2	1.14	1.05 to 1.24	1.29	1.11 to 1.50	1.17	1.06 to 1.27	1.06	0.96 to 1.17	0.96	0.82 to 1.12			0.02
High waist circumference	47.0	45.2 to 48.8	39.3	38.7 to 39.9	1.37	1.27 to 1.48	1.36	1.19 to 1.56	1.24	1.14 to 1.35	1.13	1.03 to 1.23	1.02	0.89 to 1.18			0.01
Uncontrolled hypertension	16.3	14.9 to 17.6	13.2	12.8 to 13.6	1.28	1.15 to 1.42	1.26	1.03 to 1.55	1.11	0.98 to 1.26	0.98	0.87 to 1.09	0.86	0.72 to 1.03			0.02
Resting heart rate[b]																	<0.01
Very high	6.7	5.8 to 7.6	6.6	6.3 to 6.9	0.98	0.82 to 1.17	1.46	1.07 to 1.98	1.22	1.00 to 1.48	1.02	0.82 to 1.27	0.85	0.60 to 1.21			
High	16.2	14.9 to 17.5	14.7	14.3 to 15.2	1.07	0.93 to 1.23	1.42	1.10 to 1.83	1.28	1.09 to 1.50	1.15	0.98 to 1.35	1.04	0.80 to 1.34			
Moderate	62.7	60.9 to 64.4	64.6	64.0 to 65.2	0.94	0.85 to 1.06	0.97	0.78 to 1.20	1.02	0.89 to 1.17	1.08	0.95 to 1.22	1.14	0.94 to 1.28			
Trunk fat[c]																	<0.001
Highest quartile	26.5	24.9 to 28.1	23.9	23.4 to 24.5	1.38	1.24 to 1.55	1.58	1.30 to 1.91	1.27	1.13 to 1.44	1.02	0.89 to 1.17	0.82	0.66 to 1.02			
Middle 2 quartiles	51.7	49.9 to 53.6	48.9	48.3 to 49.5	1.32	1.20 to 1.46	1.20	1.01 to 1.42	1.13	1.01 to 1.26	1.07	0.95 to 1.20	1.01	0.84 to 1.22			
Lean mass[d]																	0.03
Lowest quartile	27.0	25.3 to 28.6	24.3	23.8 to 24.8	1.33	1.19 to 1.49	0.79	0.63 to 0.99	0.88	0.76 to 1.02	0.99	0.84 to 1.16	1.11	0.86 to 1.43			
Middle 2 quartiles	50.4	48.6 to 52.3	48.7	48.1 to 49.3	1.24	1.13 to 1.37	0.79	0.66 to 0.95	0.92	0.82 to 1.03	1.06	0.93 to 1.19	1.22	0.99 to 1.48			
Low gait speed	20.4	19.0 to 21.9	12.9	12.5 to 13.3	1.73	1.57 to 1.90	0.88	0.70 to 1.11	0.98	0.85 to 1.14	1.10	0.99 to 1.22	1.24	1.05 to 1.45			0.04
Abnormal ECG	35.1	33.3 to 36.8	27.7	27.2 to 28.3	1.41	1.30 to 1.53									1.08	0.99 to 1.17	0.92
High-risk carotid intima media thickness	58.9	57.0 to 60.8	48.2	47.6 to 48.9	1.54	1.42 to 1.67									1.00	0.92 to 1.10	0.08
COPD (measured)	10.7	9.4 to 12.0	7.6	7.3 to 8.0	1.45	1.26 to 1.68									1.08	0.93 to 1.26	0.41
Sarcopenia	3.7	3.0 to 4.4	2.0	1.8 to 2.2	1.91	1.54 to 2.37									1.06	0.85 to 1.32	0.11
Low grip strength	12.5	11.3 to 13.8	7.2	6.9 to 7.5	1.85	1.64 to 2.09									1.04	0.91 to 1.18	0.11
Bone mineral density																	0.79
Osteopenia	18.1	16.7 to 19.6	14.1	13.7 to 14.6	1.38	1.24 to 1.52									0.98	0.88 to 1.09	
Osteoporosis	5.1	4.2 to 5.9	3.5	3.3 to 3.7	1.56	1.30 to 1.87									0.92	0.76 to 1.12	

a Physical assessments were performed in 3,636 cancer survivors and in 25,757 individuals without a history of cancer.
b Relative to <60 bpm.
c Relative to lowest.
d Relative to highest.

W% = weighted percentage; CI = confidence interval; OR = odds ratio; ECG = electrocardiogram; COPD = chronic obstructive pulmonary disease.

therefore likely to manifest as a highly variable, complex, multifactorial disease process.

Characterization of the resulting CV morbidity in cancer survivors is required to inform prevention, early detection, and management of CV health in the survivorship setting. In the present study, we described the prevalence of a broad suite of self-reported and objectively measured CV risk factors in a representative sample of Canadians with a history of cancer, and we compared the odds of those risk factor prevalences with the odds in a group of individuals without cancer. Importantly, our results have actionable implications for clinicians engaged in survivorship care. One of the primary findings was that the CV risk factors that are the most prevalent in cancer survivors are self-reported or easily measured in clinic, thus lowering the barrier to detection. A second overarching finding was that, in our 45- to 85-year-old cohort, the odds for most of the CV risk factors studied are increased in younger, but not older, cancer survivors, thus highlighting a target population potentially requiring heightened monitoring for CV risk.

Many of the traditional modifiable risk factors identified by the World Heart Federation are related to lifestyle behaviours. A cancer diagnosis and subsequent treatment is associated with the potential for direct CV toxicity as well as for lifestyle toxicity[19]. "Lifestyle toxicity" refers to a worsening of lifestyle behaviours after a cancer diagnosis and treatment; it can include reductions in physical activity or diet quality, and increased body weight and psychological stress[19]. In the present analysis, nearly all of the lifestyle-related CV risk factors were elevated in cancer survivors, reinforcing the suggestion that lifestyle toxicity is a prevalent issue at any point after diagnosis—not only during active treatment, but also in the post-treatment survivorship period[19]. For example, consumption of fewer than 5 daily servings of fruits and vegetables was an extremely prevalent CV risk factor: approximately 60% in the CLSA cohort, including among cancer survivors. That risk factor is a long-established threshold associated with improved CV and general health[24] and thus represents an easily accessible target for CV risk management in the cancer survivorship setting. The odds of being in the lowest quartile of physical activity was 27% greater for cancer survivors than for individuals without cancer. Analysis of another Canadian dataset found that only cancer survivors who identified as currently having cancer, and not those with a past cancer status, were less likely to be active than were age-matched adults[25]. Timing of treatment might be an important effect modifier that warrants further attention. Risk factors closely related to diet and physical activity (overweight or obesity, and high waist circumference) were elevated in cancer survivors at representative ages of 50 and 60 years. Lastly, smoking as a single lifestyle behaviour is an extremely important target for CV risk in all populations, because it is thought to be independently responsible for 10% of all cases of CV disease in the general population[26]. Although 62.9% of the cancer survivors in our cohort reported being former smokers, smoking cessation is an actionable and important target for CV risk management in the 8.3% who report current-smoker status.

Self-reported hypertension and diabetes were the CV risk factors with the highest ORs (both 1.43). The "silent killer," hypertension, is also either undiagnosed or uncontrolled in 16% of cancer survivors. Diagnosis and management of hypertension is an aspect of CV risk management that should and could be easily improved in cancer survivors through increased awareness at all phases of the cancer trajectory. That finding has important health implications, because antihypertensive therapy has been shown to reduce the incidence of stroke by 35%–40%, myocardial infarction by 20%–25%, and heart failure by more than 50%[27]. Lifestyle modification is also an indispensable aspect of blood pressure management, because it can lower blood pressure and also enhance drug efficacy[27]. A combination of 2 or more of the following recommendations will achieve optimum results: 10-pound weight loss, increased consumption of fruits and vegetables, consumption of less than 2.4 g sodium per day, brisk walking for 30 minutes daily, and limitation of alcohol consumption to 2 drinks daily for men and 1 drink daily for women[27].

The 20% prevalence of diabetes among cancer survivors in the present analysis is also a significant cause for concern. Diabetes significantly increases the risk of death from coronary artery disease by 50%, peripheral vascular disease by 20%–30%, and stroke by 10%[28]. A healthy lifestyle is also important for the prevention and management of diabetes[28]. Results from the present study clearly identify the importance of diagnosis and treatment of hypertension and diabetes, including enhancement of healthy lifestyle behaviours, as a CV risk management technique in cancer survivors.

We also assessed a number of nontraditional CV risk factors to identify whether additional important assessment tools are available to monitor CV risk in cancer survivors. We observed no differences in the adjusted odds of measured risk factors requiring specialized equipment (electrocardiogram; carotid IMT; and measured chronic obstructive pulmonary disease, sarcopenia, and low grip strength) between cancer survivors and individuals without a history of cancer. For cancer survivors at specific ages, odds were increased for risk factors requiring simple measurements, including resting heart rate (ages 50 and 60) and low gait speed (from a 4 m walk test, age 80). The odds for dual energy X-ray absorptiometry–derived trunk fat and for waist circumference were both increased at ages 50 and 60, but the latter assessment, being simpler and less costly, is suggested for use in clinical practice. That finding can be used to save costs, resources, and time, at least in the initial assessment or screening for CV risk in cancer survivors. Of course, the assessments requiring specialized equipment, with their increased costs, will still provide valuable diagnostic information if the patient's history or preliminary assessment suggests a need for further investigation.

Based on the study results, we suggest that, for clinicians providing cancer survivorship care, assessment of CV risk for individuals less than 70 years of age should particularly focus on a careful medical and lifestyle behaviour history; assessment of resting heart rate, blood pressure, body mass index, and waist circumference; and careful screening for risk of diabetes, in addition to other standard risk assessments as indicated. Treatment plans for survivors should focus on lifestyle behaviour (diet, exercise, smoking) counselling or referrals, and antihypertensive medications for those with confirmed hypertension.

The present analysis is limited by the cross-sectional nature of the data and the inability to perform subgroup analyses for cancer type and treatment type. It is likely that CV risk factor prevalences were underestimated by survivorship bias. Individuals with the greatest CV risk might have been less likely to be included in the CLSA representative sample because of poor health or mortality. A strength of the analysis was the use of specialized measurements—including electrocardiography, carotid ultrasonography, spirometry, and dual-energy X-ray absorptiometry—for approximately 60% of the participants in the cohort. Those data represent a unique characteristic compared with prior publications that have exclusively used self-reported CV risk factors in larger cohorts.

CONCLUSIONS

The CV risk factors that are most prevalent in cancer survivors or that have elevated odds in cancer survivors compared with individuals without a history of cancer are self-reported or easily measured in clinic. In the 45- to 85-year-old nationally representative CLSA cohort, the CV risk was greatest in younger cancer survivors. Our findings can be used in the survivorship setting to guide an accessible and time-efficient preliminary CV risk assessment. An initial assessment of CV risk for middle-aged cancer survivors should consist of self-report of smoking status; daily servings of fruits and vegetables; physical activity; and personal history of diabetes, hypertension, and lung disease. Basic in-clinic measurements should consist of height and weight to assess overweight or obesity status, resting blood pressure and heart rate, and waist circumference. Diagnosis and appropriate management of hypertension and diabetes should receive particular attention. Treatment plans for the management of CV risk in cancer survivors should consider lifestyle (diet, exercise, smoking) behaviour counselling or referrals as indicated, and antihypertensive medications for those with confirmed hypertension.

CONFLICT OF INTEREST DISCLOSURES
We have read and understood *Current Oncology*'s policy on disclosing conflicts of interest, and we declare that we have none.

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