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A case-control study of lifetime occupational sitting and likelihood of breast cancer

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ABSTRACT

Purpose: Sedentary behavior may be a unique risk factor for some cancers, including breast cancer. The objective of this study was to determine the association between lifetime occupational sitting and likelihood of breast cancer.

Methods: A case-control study of 2,452 women was conducted in Alberta, Canada between 1995 and 1997. A comprehensive measure of lifetime physical activity assessed frequency and duration of sedentary jobs. Logistic regression estimated the odds of being diagnosed with breast cancer across quartiles of lifetime occupational sitting, by menopausal status and family history of breast cancer, and within body mass index categories and physical activity quartiles.

Results: There was no association between occupational sitting and breast cancer amongst premenopausal women and women with a family history of breast cancer. Unexpectedly, higher amounts of occupational sitting were associated with lower odds of breast cancer in postmenopausal women (top versus bottom categories of occupational sitting OR = 0.71, 95% CI: 0.52, 0.97), women without a family history of breast cancer (OR = 0.77, 95% CI: 0.60, 1.00), and women in the third highest quartile of total lifetime physical activity (OR = 0.57, 95% CI: 0.33, 0.97).

Conclusions: Occupational sitting levels were lower than would be expected in a contemporary study. Exposures may have been insufficient to make a determinable contribution to breast cancer risk.

Keywords: breast cancer; sedentary behavior; sitting time; case-control study.

INTRODUCTION

Sedentary behavior (commonly conceptualized as sitting time) has deleterious health consequences that are distinct from the beneficial effects of moderate- to vigorous-intensity physical activity.[1,2] Sedentary behavior has been independently associated with chronic disease-related risk factors such as central adiposity[3-5], insulin resistance[6-8] and inflammation[7] in healthy adults. These factors are also hypothesized to be operative in the development and progression of breast cancer.[9] To date, however, few studies have examined the association between self-reported sedentary behavior and breast cancer risk.

Neither television viewing (a ubiquitous leisure-time sedentary behavior) nor overall sitting time were associated with post-menopausal breast cancer in the National Institutes of Health – American Association of Retired Persons Diet and Health study.[10] Similarly, no statistically significant association between television viewing and breast cancer was found in a case-control study of 3,739 Indian women.[11] These studies, however, were limited by the use of crude, single-item questions to estimate sedentary behavior. A case-control study conducted in Poland found that accelerometer-assessed sedentary time was positively associated with breast cancer (top versus bottom quartiles OR = 1.81, 95 % CI: 1.26-2.60; P-trend = 0.001).[12] However, this study was methodologically limited by the collection of case accelerometer data after diagnosis. It is plausible that a cancer diagnosis would increase sedentary time; hence the association demonstrated by this study is uncertain.

In addition, three studies have compared participant self-reported occupational activity (generally categories comparing “sitting”, “standing”, “some walking and light lifting” and “heavy manual labor”) and breast cancer risk. A case-control study (246 cases treated at a Swiss hospital and 374 controls admitted to the same hospital for acute conditions) found that

occupational sitting increased the odds of breast cancer. For “mainly sitting” versus “mainly standing” work performed between the ages of 15 and19, there was a 67% increased likelihood of breast cancer (95% CI: 1.10, 2.50). Even higher odds were reported for occupations held between the ages of 30 and 39 years (OR = 2.22, 95% CI: 1.14, 4.76), and for ages 50 to 59 years (OR = 1.85, 95% CI: 0.98, 3.45).[13] However, no association between type of occupational activity categories and breast cancer risk was found in the European Prospective Investigation into Cancer and Nutrition, [14] nor in a large, prospective study of cardiovascular disease risk factors conducted in Norway.[15]

Occupational sitting is the principal contributor to total accumulated daily sitting time in working adults.[16] A recent Australian study used accelerometers to assess the activity levels of office, call centre and customer service workers, and found that 77% of work hours were spent sedentary.[17] Self-reported estimates of occupational sitting from the same study were, on average, approximately half an hour higher per day: the correlation between the accelerometer and self-report derived estimates of sitting time was reasonable (Pearson’s r = 0.39, 95% CI: 0.22, 0.53).[18] Studies that have utilised self-report measures of sedentary behaviour report that workers spend between three and five hours sitting at work each day.[19-21] Hence, occupational sitting may represent an important behavioural risk factor for chronic diseases associated with prolonged sedentary behaviour.

This study uses data from a case-control study of physical activity and breast cancer risk [22] to examine the association of self-reported lifetime occupational sitting time (hours/week/year) with odds of breast cancer, independent of total lifetime physical activity.

METHODS

This case-control study was conducted in Alberta, Canada, between 1995 and 1997. Ethics approval was received from the Alberta Cancer Board and the University of Calgary's institutional review boards. The recruitment protocol for this study has been previously reported.[22] In brief, 1,764 cases were identified through the Alberta Cancer Registry; 1,239 (78.3%) completed the study interview. Controls identified through random digit dialing were matched on age and place of residence; a total of 1,241 women completed the control interview (56.5% overall response rate). The final dataset included 1,222 cases and 1,230 controls (10 participants were missing interview data; participants reported no paid or volunteer job in their lifetime).

Data collection

In-person interviews collected information on sociodemographic factors, reproductive health, hormone use, breast health and lifestyle factors, while anthropometric measures were taken directly. A comprehensive measure of lifetime physical activity was used to assess occupational, household and recreational activity.[23] Recall and memory-probing aids were used, including a recall calendar and lists of examples of activities. Participants reported the different types of physical activity they performed in each setting, and rated the intensity of each activity (*light*, *moderate*, *heavy*). The frequency and duration of these activities were assessed by recording the number of years, months per year, weeks per month, days per week, and hours per day that each activity was performed. Within the occupation component of the questionnaire, participants were asked "What jobs (paid or volunteer) you have done for at least 8 hours per week for 4 months of the year over your lifetime?" Here, participants also reported the frequency and duration of time spent in jobs classed as *sedentary* (described as jobs spent mostly sitting), as well as jobs classed as *light*, *moderate* or *heavy*. Lifetime occupational sitting time was summarized as hours/week/year by: multiplying the duration of

each *sedentary* job (in years) x number of months per year x 4.33 x number of days per week x number of hours per day; adding together the values derived from all jobs held across the lifetime; dividing total time by 52; then dividing by age at interview.

Statistical analysis

The association between occupational sitting time and likelihood of breast cancer was assessed by plotting age-adjusted incident cases per two-hour increments of occupational sitting. The distribution was clearly non-linear, and usual transformations failed to approximate a normal distribution. Hence, lifetime occupational sitting was categorized into quartiles, according to the control distribution, and dose-response trends were not examined. The association between total lifetime occupational sitting and breast cancer was considered using unconditional logistic regression in Stata 10.1 (StataCorp, College Station, TX). Odds ratios were generated separately for pre- and post-menopausal women, and effect modification by family history of breast cancer, body mass index (BMI) and physical activity quartiles was also examined.

RESULTS

Cases and controls had similar sociodemographic, reproductive, medical and lifestyle factors.[22] Sixty-two percent of cases and 71% of controls reported having at least one job classified as *mainly sitting* in their lifetime. The distribution of lifetime occupational sitting ranged between 0 – 36.7 hr/wk/yr for cases and 0 – 30.4 hr/wk/yr for controls. There was no significant difference between mean lifetime occupational sitting for cases (4.2 hr/wk/yr, SD = 6.2 hr/wk/yr) and controls (4.5 hr/wk/y; SD = 6.2 hr/wk/yr).

The first analysis examined the influence of lifetime total occupational sitting on the odds of developing breast cancer, separately for pre- and post-menopausal women (Table 1). In fully adjusted models, there was no association between categories of occupational sitting and breast cancer in pre-menopausal women. Among post-menopausal women, however, quartiles 2 - 4 were associated with a statistically significant decrease in odds of breast cancer. When potential effect modification by family history of breast cancer was assessed, there was no significant association between occupational sitting and breast cancer amongst women who had a family history of the disease. However, amongst women with no family history, quartiles 2 and 3 demonstrated significantly lower odds. When the association was considered by BMI category, there were statistically significant lower odds demonstrated for quartiles 2 and 4 amongst obese (BMI ≥30 kg/m2) women. In the final series of models, statistically significant inverse associations between occupational sitting and breast cancer were found for quartile 3 for women who averaged less than 87.7 MET hr/wk/yr in physical activity; for quartiles 2 and 4 amongst women who averaged 114.7 – 146.0 MET hr/wk/yr; and for quartile 3 amongst women doing more than 146.0 MET hr/wk/yr.

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DISCUSSION

We isolated self-reported occupational sitting time from physical activity data collected by a case-control study conducted approximately 15 years ago, and examined its association with odds of breast cancer. Analyses showed no association for some subgroups of the study population and, unexpectedly, statistically significant inverse associations for other groups.

It is possible that sedentary behavior simply does not make a significant, independent contribution towards breast cancer risk. Previous investigations into the association between sedentary behavior and breast cancer, including two large, prospective studies, have produced mostly null results.[10,11,14] However, two case-control studies found some evidence of an association.[12,13] Although sedentary behavior has been associated with adiposity and metabolic dysfunction, little is known about its association with other hypothesized biological pathways to breast cancer, such as endogenous sex hormones.[9] If sedentary behavior does not affect circulating sex hormones, its influence on breast cancer etiology may be limited.

Another possible explanation for our findings is the very low exposure levels reported. These low levels may be due to misclassification, since respondents were asked to report detailed information about physical activity across their lifetime. In addition, study participants were in the workforce predominantly between 1960 and 1995, when levels of occupational sitting were likely much lower than today. It is possible that there is a threshold effect – a minimum amount of sedentary behavior necessary to induce deleterious health effects – that was not met by the women in this study. Neither leisure-time nor transportation-related sedentary behavior was assessed by this study; hence we were unable to consider the effect of total sitting time. Finally, participants with poorer health status may have spent less time in the workforce, and thus accumulated lower exposure to occupational sitting than participants who maintained good health throughout their lifetime.

Owen *et al.* have suggested that revisiting earlier studies of physical activity and health outcomes and conducting further analyses using sitting time as a distinct exposure variable may contribute to the growing evidence on the role of sedentary behavior in chronic disease.[2] However, as this study demonstrates, older studies may have recorded very low

levels of occupational sitting by today's standards. Technological changes that have automated many workplace practices have been commonly cited as contributing to the obesity epidemic.[24] Jobs that would now be classified as sedentary may have previously required significantly more energy expenditure through light-intensity activity. For example, many tasks associated with office work, such as filing, delivery of memorandums and photocopying, used to require standing and walking. Such tasks are now routinely done via computer; there is no requirement to move from a seated position. Whilst there have been no studies documenting changes in occupational sitting over time, time use survey data have clearly shown an overall increase in the total amount of sedentary behavior over previous decades. For example, in the United States of America between 1965 and 2009 total sedentary time increased by 43%.[25]

This study did not find evidence of an association between occupational sitting and likelihood of breast cancer. However, we have recently demonstrated positive associations between accelerometer-assessed sedentary time and breast cancer biomarkers (BMI, waist circumference, C-reactive protein, insulin), independent of moderate-vigorous physical activity and other confounders.[26] Hence, there is a need for further research to clarify whether sedentary behaviour affects breast cancer risk.

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CONFLICT OF INTEREST

None to declare.

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Table 1: Odds ratios for lifetime total occupational sitting time and breast cancer by menopausal status, family history of breast cancer, body mass index category and physical activity category, Alberta, 1995-1997

Lifetime total occupational sitting time (hr/wk/yr)		Cases (n=1,222)	Controls (n=1,230)	Age adjusted		Multivariable adjusted [a]	
				OR	95% CI	OR	95% CI
By menopausal status							
Pre-menopausal	0 hr/wk/yr	132	119	1.00		1.00	
	0.1 – < 2.2 hr/wk/yr	97	99	0.89	0.61, 1.29	0.98	0.66, 1.45
	2.2 – < 7.3 hr/wk/yr	109	117	0.83	0.58, 1.19	0.92	0.63, 1.34
	≥ 7.3 hr/wk/yr	124	140	0.80	0.56, 1.12	0.85	0.58, 1.24
Post-menopausal	0 hr/wk/yr	337	242	1.00		1.00	
	0.1 – < 2.2 hr/wk/yr	136	190	0.51	0.39, 0.68	0.57	0.43, 0.76
	2.2 – < 7.3 hr/wk/yr	135	173	0.56	0.42, 0.74	0.59	0.44, 0.79
	≥ 7.3 hr/wk/yr	152	150	0.73	0.55, 0.96	0.71	0.52, 0.97
By family history of breast cancer							
No family history	0 hr/wk/yr	373	311	1.00		1.00	
	0.1 – < 2.2 hr/wk/yr	183	251	0.61	0.48, 0.77	0.65	0.51, 0.84
	2.2 – < 7.3 hr/wk/yr	194	253	0.64	0.50, 0.81	0.70	0.54, 0.90
	≥ 7.3 hr/wk/yr	230	251	0.76	0.60, 0.96	0.77	0.60, 1.00
Family history	0 hr/wk/yr	89	47	1.00		1.00	
	0.1 – < 2.2 hr/wk/yr	50	34	0.76	0.43, 1.34	0.88	0.48, 1.60
	2.2 – < 7.3 hr/wk/yr	46	32	0.73	0.41, 1.31	0.80	0.44, 1.48
	≥ 7.3 hr/wk/yr	43	37	0.58	0.33, 1.04	0.61	0.32, 1.15
By body mass index category							
< 25.0 kg/m^2	0 hr/wk/yr	163	124	1.00		1.00	
	0.1 – < 2.2 hr/wk/yr	86	106	0.61	0.43, 0.89	0.68	0.47, 1.00
	2.2 – < 7.3 hr/wk/yr	107	112	0.72	0.50, 1.02	0.77	0.53, 1.11
	≥ 7.3 hr/wk/yr	111	108	0.76	0.53, 1.09	0.80	0.55, 1.17
25.0 – <30.0 kg/m^2	0 hr/wk/yr	148	131	1.00		1.00	
	0.1 – < 2.2 hr/wk/yr	82	92	0.79	0.54, 1.15	0.83	0.56, 1.25
	2.2 – < 7.3 hr/wk/yr	74	105	0.62	0.42, 0.91	0.69	0.43, 1.03
	≥ 7.3 hr/wk/yr	104	110	0.83	0.58, 1.20	0.85	0.56, 1.27
≥ 30.0 kg/m^2	0 hr/wk/yr	158	106	1.00		1.00	
	0.1 – < 2.2 hr/wk/yr	65	91	0.49	0.33, 0.73	0.55	0.36, 0.85
	2.2 – < 7.3 hr/wk/yr	63	73	0.60	0.39, 0.92	0.67	0.43, 1.05
	≥ 7.3 hr/wk/yr	61	72	0.59	0.39, 0.91	0.59	0.37, 0.95
By physical activity quartile							
< 87.7 MET hr/wk/yr	0 hr/wk/yr	66	42	1.00		1.00	
	0.1 – < 2.2 hr/wk/yr	43	51	0.54	0.31, 0.95	0.61	0.34, 1.08
	2.2 – < 7.3 hr/wk/yr	63	74	0.55	0.33, 0.92	0.56	0.33, 0.96
	≥ 7.3 hr/wk/yr	140	140	0.65	0.41, 1.02	0.66	0.41, 1.05
87.7 – <114.7 *MET hr/wk/yr*	0 hr/wk/yr	101	82	1.00		1.00	
	0.1 – < 2.2 hr/wk/yr	67	79	0.69	0.45, 1.07	0.76	0.48, 1.20
	2.2 – < 7.3 hr/wk/yr	64	76	0.67	0.43, 1.04	0.67	0.42, 1.06
	≥ 7.3 hr/wk/yr	74	71	0.83	0.53, 1.28	0.79	0.50, 1.25
114.7 – <146.0 *MET hr/wk/yr*	0 hr/wk/yr	127	100	1.00		1.00	
	0.1 – < 2.2 hr/wk/yr	61	84	0.57	0.38, 0.87	0.61	0.39, 0.95
	2.2 – < 7.3 hr/wk/yr	60	70	0.68	0.44, 1.05	0.86	0.54, 1.38
	≥ 7.3 hr/wk/yr	34	53	0.51	0.31, 0.84	0.57	0.33, 0.97
≥ 146.0 MET hr/wk/yr	0 hr/wk/yr	175	137	1.00		1.00	
	0.1 – < 2.2 hr/wk/yr	62	75	0.63	0.42, 0.94	0.67	0.44, 1.03
	2.2 – < 7.3 hr/wk/yr	57	70	0.61	0.40, 0.92	0.62	0.39, 0.97
	≥ 7.3 hr/wk/yr	28	26	0.80	0.44, 1.43	0.80	0.44, 1.48

[a] Adjusted for current age, educational level (quintiles), lifetime total physical activity (MET hr/wk/yr) (except when stratifying by physical activity quartile), caloric intake, ever alcohol consumption, smoking status, waist-hip ratio (quartiles), menopausal status (except when stratifying by menopausal status), total number of mammograms, first-degree family history of breast cancer (except when stratifying by family history of breast cancer), ever use of hormone replacement therapy, number of children breastfed.