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The association between television watching time and all-cause mortality after breast cancer

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Abstract

Purpose—Sedentary time is a rapidly emerging independent risk factor for mortality in the general population, but its prognostic effect among cancer survivors is unknown. In a multiethnic, prospective cohort of breast cancer survivors, we hypothesized that television watching time would be independently associated with an increased risk of death from any cause.

Methods—The Health, Eating, Activity and Lifestyle (HEAL) Study cohort included 687 women diagnosed with local or regional breast cancer. On average 30 ($\pm$ 4) months postdiagnosis, , women completed self-report assessments on time spent sitting watching television/videos in a typical day in the previous year. Multivariate Cox proportional hazards models were used to estimate hazard ratios (HR) and 95% confidence intervals (CI) for death from any cause (n=89) during the 7 years of follow-up.

Results—Television time (top tertile vs. bottom tertile) was positively related to risk of death (HR: 1.94, 95% CI: 1.02, 3.66, $p_{\text{trend}}=0.024$) but the association was attenuated and not statistically significant after adjustment for aerobic moderate-vigorous intensity physical activity (HR: 1.70, 95% CI: 0.89, 3.22, $p_{\text{trend}}=0.14$) and all covariates (HR: 1.39, 95% CI: 0.69, 2.82, $p_{\text{trend}}=0.48$).

Conclusion—In this first published investigation on this topic, we did not observe a statistically significant multivariate-adjusted association between television watching time and risk of death among women diagnosed with breast cancer.

Implications for Cancer Survivors—These results begin an evidence base on this topic that can be built upon to inform lifestyle recommendations for this expanding, aging population.

Keywords

Sedentary behavior; Exercise; Breast Neoplasm; Mortality; Physical activity

Introduction

Research indicates that engaging in regular moderate-vigorous intensity physical activity (MVPA) after a breast cancer diagnosis may reduce mortality risk [1–6]. It has been suggested that sedentary time—prolonged periods of sitting or reclining without whole body movement—displaces light activity and may have health consequences independent of simply lacking MVPA.[7] Among adults without cancer, sedentary time has been independently associated with an increased risk of all-cause mortality [8–14] and has been shown to be feasibly modified [15]. However, no published studies have evaluated sedentary time and mortality among cancer survivors, and research on this topic is needed to inform lifestyle recommendations for this expanding and aging population [16].

Building on our previously published research in the Health, Eating, Activity, and Lifestyle (HEAL) study of United States breast cancer survivors that demonstrated better survival for women engaging in postdiagnosis recreational MVPA [4], and to address this gap in the literature, we hypothesized that television watching time would be positively and independently related to risk of death from any cause.

Methods

Study participants

HEAL is a multi-ethnic prospective cohort study that enrolled 1,183 women with first primary breast cancer (*in situ* to regional stage) drawn from Surveillance, Epidemiology, and End Results (SEER) population-based cancer registries in New Mexico, Los Angeles County, and Western Washington. Details of the study design have been published [17]. Briefly, In New Mexico, we recruited 615 women aged 18 years or older, between July 1996 and March 1999. In Western Washington, we recruited 202 women aged 40–64 years, between September 1997 and September 1998 (the age range restriction was due to other ongoing breast cancer studies in the area). In Los Angeles County, we recruited 366 black women aged 35–64 years, between May 1995 and May 1998, who had participated in the Women's Contraceptive and Reproductive Experiences Study or who had participated in a parallel case-control study of *in situ* breast cancer.

In the HEAL Study, women completed assessments on average at 6($\pm$ 2) and 30 ($\pm$ 4) months after diagnosis. The response rate was 83% (944/1139 living participants) for the 30-month assessment [18], which included questions on television time. We excluded women who received treatment for subsequent recurrences or new primaries that occurred before their 30-month assessment (n=57) because active treatment may be associated with changes in television time. We also excluded women with *in situ* disease (n=197) due to their low mortality risk [19]. We further excluded women missing data on television time (n=2) and those lost to follow up (n=1). Our final sample included 687 women.

Data Collection

All-cause mortality—We used SEER registry data to determine vital status. Women were followed prospectively until death or December 31, 2007, whichever came first, and the average follow-up time from the 30-month assessment was 7 years.

Sedentary behavior—Participants reported the number of hours they spent sitting while watching television or videos (0, <1, 1–2, 3–4, 5–6, 7–8, 9+) during a typical 24-hour period separately for weekdays and weekends in the year prior to the 30-month postdiagnosis assessment. To calculate value for each participant for average television watching hours on weekdays, we assigned participants the median value of their category. The same process was repeated for average weekend television watching hours. To create an overall variable for television time/day, we used the following formula ((weekday median television hours x 5/7) + (weekend median television hours x 2/7)). We then classified television time into tertiles.

Physical activity (PA)—Physical activity was evaluated using the Modifiable Activity Questionnaire, which assessed the type, duration, and frequency of activities performed in the year prior to 30-month assessment. Given observed associations with mortality in our cohort [4], we chose to focus on postdiagnosis recreational MVPA and classified recreational MVPA into three categories (0, >0 and <9, 9 MET-h/wk).

Additional risk factors—Disease stage was obtained from cancer registry records. Detailed information on treatment and surgical procedures was obtained from SEER registry, physician, and hospital records. Height was measured 6-months postdiagnosis and weight at 30-months postdiagnosis. Body mass index (BMI) was calculated as weight (kg)/height (m²) and categorized into the World Health Organization's BMI categories (underweight <18.5; normal: 18.5 to <25; overweight: 25 to <30; obese: 30 to <40; very obese: 40 kg/m²), with an indicator variable being created for participants missing 30-month postdiagnosis weight (n=40). Women with and without measured weight were similar with respect to age and measured BMI at baseline. Six months postdiagnosis, birth date race/ethnicity, and education information was collected. 30-months postdiagnosis, participants reported current use of tamoxifen and information regarding menopausal status. Also at the 30-month assessment, participants reported whether they had been diagnosed by a physician with any of 18 chronic medical conditions (e.g., angina, arthritis, osteoporosis, chronic lung disease, diabetes, other cancers) and, if yes, whether such condition limited their current activities of daily living [20]. Medical comorbidity was calculated as the number of conditions that participants' reported as limiting their current activities of daily living. We then created a comorbidity summary score totaling the number of activity-limiting comorbidities (0; 1; 2). We considered each of these potential confounders in model development.

Statistical Analyses

Means, standard errors, and frequencies of demographic, clinical, and lifestyle characteristics were calculated by tertiles of television time. Cox proportional hazards models were fit using age as the underlying time metric. We estimated multivariate hazard ratios (HR) and 95% confidence intervals (CI) for death from any cause associated with television time. We included covariates that improved model fit and changed the magnitude of the HR by at least 10%. Although they did not act as confounders, we retained menopausal status, treatment, tamoxifen in the model for comparison to published literature. HRs were similar with and without these variables.

All statistical analyses were conducted using SAS (version 9.3., Cary, NC).

Results

Women in the top vs. bottom tertile of television time were older, more overweight, and less active (Table 1). These women were more likely to be Black non-Hispanic, have regional

disease, and have activity limiting comorbidities, and were less likely to be using tamoxifen. 89 deaths from any cause occurred during the 7 years following the 30 month post-diagnosis assessment. In this sample, television time was weakly correlated with MVPA ($r = -0.13$, $P < 0.0006$; data not shown).

Women in the top vs. bottom tertile of television time had a statistically significant increased risk of death in the unadjusted model (HR: 1.94, 95% CI: 1.02, 3.66, $p_{\text{trend}} = 0.024$), but this association was attenuated and no longer statistically significant after adjustment for MVPA (HR: 1.70, 95% CI: 0.89, 3.22, $p_{\text{trend}} = 0.14$) and after adjustment for all covariates (HR: 1.39, 95% CI: 0.69, 2.82, $p_{\text{trend}} = 0.48$) (Table 2).

Discussion

This study is the first to investigate the relationship of television time and survival after breast cancer. While we did observe a statistically significant univariate association, among survivors, this association was attenuated and not significant after adjustment for MVPA and other clinical characteristics. The lack of association of television time and death that we observed following adjustment for physical activity is consistent with the findings from a US study of over 1,000 postmenopausal women that assessed objectively-measured sitting time and biomarkers of breast cancer risk—BMI, waist circumference, C-reactive protein, fasting insulin, and insulin resistance [21], mechanisms that are also thought to be important for survival after breast cancer [22].

It is possible that there is no true independent association between postdiagnosis television time and mortality. HEAL survivors in the top tertile of television time reported an average 7 MET-hours/week of recreational MVPA, which is equivalent to 140 minutes/week of moderate activity. This level approximates the amount of activity recommended to all US adults for general health [23], and perhaps with this amount of recreational MVPA, television time may not have an independent effect on survival. Alternatively, television time at another chronological point after diagnosis might have more relevance for mortality, and this study focused on women who survived 30-months after diagnosis.

Our results also need to be interpreted in the context of the study's limitations. This study focused on television/video time, not total sedentary behavior. While the former is the most prevalent sedentary behavior and is the most common domain measured [24], it does not account for other domains, like computer screen time, or for total sedentary time, and we did not have direct evidence of validity or reliability of the television/videowatching questions asked. We also did not have a separate measure of computer screen time. The self-report nature of our television time and recreational MVPA measures may have resulted in exposure misclassification and attenuation of HRs observed. However, self-reported television time, using similar questions, similar response categories, and similar control for PA, has been significantly associated with mortality in large general adult populations of 4,500 to 240,000 participants [8–12, 25–26]. Light intensity PA was not assessed on the Modifiable Activity Questionnaire, so we were also not able to examine the role of light PA in the television time-mortality association and this would be of interest in future research.

With the limited number of deaths observed from the 30-month interview forward, we may have been underpowered to detect statistically significant associations at the magnitude of the HR observed and were not able to examine the association among clinically important subpopulations (i.e., by race/ethnicity, treatment, BMI, MVPA, etc.). Among adults without cancer, higher vs. lower sedentary time has been positively associated with mortality, with HRs ranging from 1.17–1.61 [8–14]. To explore this study question among future studies of breast cancer survivors, assuming an HR of 1.5 and a baseline risk in the population of ~

0.1, larger studies with 319 deaths will be needed. Future research may benefit from including validated self-report measures of sedentary time and PA that span multiple domains (home, workplace, transportation, social settings) and, when possible, complementing self-report measures with objective monitoring of sedentary time and PA.

Our study also had several strengths. We had extensive high-quality data on clinical characteristics and treatment abstracted from reliable sources (physician, hospital, and SEER records), and weight was objectively measured. Additionally, studying women 30-months postdiagnosis allowed us to separate out treatment effects. Further, our detailed, valid, and reliable PA assessment [27] allowed us to categorize women by their recreational MVPA levels and assess potential independent effects of television watching time. Finally, our sample was a multiethnic cohort of women seen in routine clinical practice versus tertiary cancer hospitals.

In summary, after adjustment for MVPA and other covariates, television watching time was not statistically significantly associated with an increased risk of death from any cause in this cohort of breast cancer survivors. These results begin an evidence base on this topic that can be built upon to inform lifestyle recommendations for this expanding, aging population. The potential prognostic effect of sedentary time on mortality should be investigated in larger samples of breast cancer survivors, such as pooled analyses of existing breast cancer patient cohorts [28] with relevant measures.

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Table 1

Demographic, Clinical, and Lifestyle Characteristics of Women in the Health, Eating, Activity and Lifestyle study (N=687)

Teriles of daily television watching time									
	T1 (0–1.4 h)			T2 (1.5–2.9 h)			T3 (3–9.5 h)	p-value ^a	
	No.	%	Mean (SE)	No.	%	Mean (SE)	No.	%	Mean (SE)
Number of participants	166			304			217		
Age ¹			56.1 (0.8)			57.3 (0.6)			60.3 (0.8)
Race/Ethnicity									
White, non-Hispanic	115	69		179	59		102	47	
Hispanic	22	13		41	13		19	9	
Black, non-Hispanic	23	14		74	24		94	43	
American Indian, Asian, Other	6	4		10	3		2	1	
Menopausal Status									
Postmenopausal	128	77		226	74		182	84	
Premenopausal	32	19		56	18		23	11	
Unknown	6	4		22	7		12	6	
Treatment									
No chemotherapy, no radiation	27	16		73	24		66	30	
Radiation	64	39		110	36		71	33	
Chemotherapy	19	11		37	12		28	13	
Radiation and Chemotherapy	56	34		84	28		52	24	
Stage									
Localized	123	74		223	73		145	67	
Regional	43	26		81	27		72	33	
Current Tamoxifen use									
No	67	40		154	51		112	52	
Yes	99	60		150	49		105	48	
Number of activity-limiting comorbidities									
None	138	83		236	78		132	61	
One	22	13		48	16		45	21	
Two or more	6	4		20	7		40	18	

	Teriles of daily television watching time						p-value ^a			
	T1 (0–1.4 h)			T2 (1.5–2.9 h)				T3 (3–9.5 h)		
	No.	%	Mean (SE)	No.	%	Mean (SE)		No.	%	Mean (SE)
MET-hours/week of postdiagnosis recreational physical activity			15.0 (1.8)			13.6 (1.0)			7.5 (1.0)	<0.0001
BMI ^b			26.2 (0.4)			28.1 (0.4)			29.3 (0.5)	<0.0001

^a p-values for chi-square tests for categorical variables and trend test for continuous variables

^b for the 646 women with measured weight 30 months after diagnosis

Table 2

Multivariate hazard ratios (HR) (95% confidence intervals (CI)) ^{a,b} for the association between postdiagnosis television watching time and death from any cause among breast cancer survivors in the Health, Eating, Activity and Lifestyle study (N=687)

	Tertiles of daily television watching time			<i>p</i> -trend
	Lower tertile (0–1.4 h)	Middle tertile (1.5–2.9 h)	Upper tertile (3.2–9.5 h)	
N	166	304	217	
Death from any cause	13	35	41	
Unadjusted HR	1.00	1.31 (0.69, 2.49)	1.94 (1.02, 3.66)	0.024
Adjusted for MVPA	1.00	1.39 (0.73, 2.64)	1.70 (0.89, 3.22)	0.14
Multivariate-adjusted HR ²	1.00	1.29 (0.67, 2.50)	1.39 (0.69, 2.82)	0.48

^a Age was used as underlying time metric

^b Adjusted for MVPA, race, menopausal status, treatment, tamoxifen, number of activity-limiting comorbidities, body mass index