Title: Health behaviors and mammogram utilization in the Childhood Cancer Survivor Study (CCSS)

Working Group and Investigators:
This study will be within Cancer Control Working Group (primary) and Psychology Working Group (secondary). Investigators will include:

Shoshana Rosenberg	srosenbe@hsph.harvard.edu	617-724-2512
Kevin Oeffinger	oeffingk@mskcc.org	
Chaya Moskowitz	moskowc1@mskcc.org	
Kevin Krull	kevin.krull@stjude.org	
Melissa Hudson	Melissa.Hudson@stjude.org	
Ann Mertens	Ann.Mertens@choa.org	
Tara Henderson	thenderson@peds.bsd.uchicago.edu	
Cheryl Cox	Cheryl.Cox@STJUDE.ORG	
Stephanie Smith	stephanie.smith2@gmail.com	
Annette Stanton	astanton@ucla.edu	
Wendy Leisenring	wleisenr@fhcrc.org	
Paul Nathan	paul.nathan@sickkids.ca	
Leslie Robison	Les.Robison@STJUDE.ORG	
Lindsay Frazier	Lindsay_Frazier@DFCI.HARVARD.EDU	

1. Specific Aims &Hypotheses:

Aim 1: Describe and compare patterns of health behaviors among women aged 25-39 who received chest radiation, women aged 40 and above, and siblings aged 40 and above, who responded to the Mammogram Practices Survey (MPS) and identify whether the following are predictors/determinants of mammogram utilization: modifiable lifestyle factors (BMI, physical activity, alcohol use, tobacco use), somatization/depressive/anxious symptoms, and healthcare practices (dental care, pap smears, routine doctor visits, participation in a long term follow-up (LTFU) program).

- **a)** Women at high risk for breast cancer who engage in healthy behaviors will be less likely to underutilize mammography.
- **b)** Women exhibiting moderate to extreme symptoms of somatization and anxiety will be less likely to underutilize mammography while those with moderate to extreme symptoms of depression will be more likely to underutilize mammography.

Aim 2: Evaluate associations between health coping and health behaviors, perceived breast cancer risk and health behaviors, and health locus of control and health behaviors.

a) Women who perceive a higher risk of breast cancer are more likely to engage in healthy behaviors.

b) Women who have a high internal locus of control will be more likely to engage in healthy behaviors.

c) Women who engage in active/planning coping will be more likely to engage in healthy behaviors.

2. Background and Significance:

It is well established that younger women treated with chest wall radiation therapy (RT), demonstrate an increased incidence of a primary breast cancer later in life.[1-5] Given the markedly greater risk of breast cancer, the Children's Oncology Group (COG), recommends that women treated with 20 Gy or more of radiation to the chest/mantle receive annual mammograms (in addition to an annual breast MRI) beginning either 8 years post-radiation treatment or at the age of 25 (whichever occurs later). [6]

Studies suggest however, that many of these high risk women are not being screened as recommended. In a study of 90 HL survivors, Diller et al. reported that fewer than half of women surveyed had received a mammogram within the past two years.[7] More recently, Oeffinger et al. found that in a sub-sample of women in the CCSS with a history of chest RT, only 36.5% of women between the ages of 25 and 39 had undergone mammographic screening within the previous two years.[8]

Health behaviors/modifiable risk factors, and mammography utilization: A number of studies have explored the relationship between health behaviors and mammographic screening. In one study, Wu et al. reported that women who met or went beyond physical activity guidelines were less likely to under-utilize screening mammography.[9] Similarly, in a cross-sectional study of Canadian women age 50-69, "infrequent physical activity" was found to be associated with not ever having undergone screening mammography.[10] Higher BMI has generally been found to be inversely related to mammography utilization, with obese women least likely to follow screening guidelines.[11]

Several studies have reported that women smokers are less likely to follow screening guidelines.[10, 12-16] In contrast, alcohol use has been found to be positively associated with mammography screening; in a recent meta-analysis, drinkers were 30% more likely to obtain a mammogram compared to non-drinkers. [15]

Most of the studies described above reflect practices in the general population, and include women who are over the age of 40. Studies which do focus on high risk populations generally consist of women who are considered "high risk" because of a family history of breast cancer; it is unknown if these findings are generalizable to other high risk populations such as childhood cancer survivors.

Significance and innovation: While prior studies conducted within the CCSS cohort have assessed health behavior and health behavior change as well as identified potential targets for intervention, this project is novel as it focuses on the link between primary (mammography) and secondary prevention (modifiable lifestyle factors/health behaviors) and targets a population specifically at high risk for breast cancer. Identifying whether there is a relationship between mammography utilization and other health behaviors can ultimately lead to broader, more comprehensive interventions for this high risk population, by taking into account both levels of prevention. Furthermore, a better understanding of how perceived breast cancer risk, coping, and health locus of control relate to health behaviors, including mammogram utilization, will guide the design of these comprehensive interventions, by helping to identify a useful theoretical framework upon which to build.

This project expands on prior analyses conducted using data from the MPS. Oeffinger et al. examined perceived breast cancer risk specifically as it relates to mammogram utilization.[8] In Aim 2, we are proposing to examine how perceived breast cancer is associated with other health behaviors, in addition to mammography. While Smith et al. explored how coping and health locus of control, among other factors, play a role in predicting mammogram utilization among women with positive vs. negative perceptions of mammography, this was restricted to women who received chest RT.[17] As part of Aim 2, we plan on evaluating these constructs in relation to other health behaviors, in addition to mammography, among both women who received chest RT and women who did not, as well as CCSS siblings who participated in the MPS.

3. Methods:

3.1 Study population: Survivors and siblings who completed the Mammogram Practices Survey (MPS). This includes survivors who received chest RT (n=551), survivors who did not receive chest RT (n=561), and sibling controls (n=622).

3.2 Study design: This is a cross-sectional study, using data captured during a one-time survey of mammogram practices among the CCSS cohort together with data on specific health behaviors captured from the 2007 survey. If data from the 2007 survey is unavailable for a particular individual, we will impute the missing data using available information from both the 2003 and 2007 surveys.

3.3 Covariate assessment:

Data from the 2007 survey will include:

Race
Age
Cancer diagnosis
Education level (A3)
Employment status (A4)
Household income (A6)
Health care utilization/frequency (B1-B3, B6)
Insurance status (B9)
Echocardiogram screening (C1)
Alcohol (N1-N6)
Tobacco (N7-N12)
Physical Activity (N15-N21)
BMI (A1-A2)
BSI-18 (L1-L23)

Data from the 2003 survey will include:

Any of the covariates listed above where data is unavailable from the 2007 survey.
Dental care (O17-O18)

Pap smear utilization will be assessed from a single item from the MPS ("When did you have your most recent Pap smear?").

3.4 Outcome assessment: **For Aim 1**, the primary outcome of interest is whether a woman reported receiving a mammogram within the past 2 years on the MPS.

For Aim 2:

Perceived cancer risk will be measured based on the response to a single question on the MPS – "How would you estimate your own chance of getting breast cancer in the future?" and will be modeled two ways: 1) continuous score (range: 1-5, higher scores=greater perceived risk) 2) dichotomized score, where high perceived risk="much more" and "more" (than the average woman)and same/lower perceived risk="same as", "less than" and "much less than" (then the average woman).[8, 18]

Coping: Planning and active coping (PAC) will be assessed using a single variable representing the mean score of the active-coping subscale (COPE-MPS items 2, 10, 19, 24) and planning (COPE-MPS items 7, 13, 15, 22) subscale.[17] We will model PAC two ways: 1) continuous score (range: 1-4) 2) dichotomized score, where high PAC="a lot" and low PAC="not at all", "a little bit", and "medium amount".[17]

Other COPE subscales, including denial (COPE-MPS items 3, 11, 16, 23), behavioral disengagement (COPE-MPS items 4, 9, 14, 20), mental disengagement (COPE-MPS items 1, 6, 12, 17), and acceptance (COPE-MPS items 5, 8, 18, 21) will be assessed individually and as composite mean scores (ie: scores for mental disengagement, behavioral disengagement, and denial , if highly correlated, can be combined

into a single mean score, representing a new variable, “avoidance.”) As with PAC, we will model the mean composite score 1) continuously and as 2) a dichotomized score.

COPE items are answered with reference to how respondents generally cope with a stressful experience.

Health locus of control: will be assessed using the three scales which make up the Multidimensional Health Locus of Control (MHLC): 1)internal 2) chance and 3)powerful others. Each of the three scales represent independent domains which are scored individually.[19] We will model health locus of control two ways: 1) continuous score (range of 6-36 for each scale) 2) dichotomized score, where internal locus of control will be dichotomized as: high internals=agree “moderately” or “strongly” and low internals=”disagree strongly”,” moderately”, or” slightly”, or agree “slightly.”[17]

3.5 Statistical analysis:

3.5.1 Descriptive statistics: Prevalence of tobacco use (current vs. former vs. never), risky/binge drinking , physical inactivity, overweight/obesity, somatization, depression, and anxiety (as measured by the BSI-18), will be calculated and compared between the following groups: 1) women who received chest RT and were between the ages of 25 and 39 when completing the MPS; 2) women who were aged 40 or older when completing the MPS (whether or not they received chest RT); 3) siblings aged 40 and above when completing the MPS. Frequency of pap smears (within the last 2 years), routine dental examinations, and visits to a healthcare provider (for routine or sick care), between the three groups will also be compared. Frequency of visits to a long term follow-up clinic will also be tabulated for survivors.

3.5.2 Association between health behaviors and mammogram utilization: To identify whether the health behaviors described above are associated with receiving a mammogram within the past 2 years, we will fit Poisson regression models, separately for each group, and compute prevalence ratios and corresponding 95% confidence intervals.

3.5.3 Health coping, perceived breast cancer risk, locus of control and health behaviors: To identify whether these constructs are associated with the health behaviors of interest, we will fit Poisson regression models (modeling dichotomized scores), separately for each group, and compute prevalence ratios and corresponding 95% confidence intervals and linear regression models (modeling continuous scores), separately for each group, and report beta coefficients and corresponding standard errors. Alternatively, for the linear regression analysis, adjusted means will be estimated and reported where clinically meaningful.

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4. Tables

Table 1. Sample characteristics

		Chest RT 25-39		CCSS women ≥40		CCSS siblings ≥40	
		N	%	N	%	N	%
Age at time of study							
25-29							
30-34							
35-39							
40-44							
45-50							
Race							
Living area							
Education							
Employment status							
Household income							
Insurance status							
Cancer diagnosis							
Age at diagnosis							
Mammogram within last 2 years							

Table 2. Health behaviors

	Chest RT 25-39		CCSS women ≥40		CCSS siblings ≥40	
	N	%	N	%	N	%
Tobacco use						
Ever						
Former						
Never						
Alcohol						
# of drinks on typical day						
Frequency						
Risky drinking						
Binge drinking						
Physical activity						
Met CDC guidelines						
Inactive lifestyle						
BMI						
Overweight						
Obese						
Pap smear within last 2 years[#]						
Dental care (visit within last year)[*]						
Visit to health care provider (at least 1 visit within last 2 years)						
Visit to LTFU program (within last 2 years)						
BSI-18 (T-score ≥ 63 on any subscale)						

Table 3a. Association between health behaviors and mammogram utilization, women who received chest RT, aged 25-39

	Unadjusted			Adjusted	
	PR (95% CI)	p-value		PR (95% CI)	p-value
Tobacco use					
Ever					
Former					
Never					
Alcohol					
# of drinks on typical day					
Frequency					
Risky drinking					
Binge drinking					
Physical activity					
Met CDC guidelines					
Inactive lifestyle					
BMI					
Overweight					
Obese					
Pap smear within last 2 years[#]					
Dental care (visit within last year)[*]					
Visit to health care provider (at least 1 visit within last 2 years)					

Visit to LTFU program (within last 2 years)					
BSI-18 (T-score ≥ 63 on any subscale)					

Table 3b. Association between health behaviors and mammogram utilization, women ≥40 years of age

	Unadjusted			**Adjusted**	
	PR (95% CI)	**p-value**		**PR (95% CI)**	**p-value**
Tobacco use					
Ever					
Former					
Never					
Alcohol					
# of drinks on typical day					
Frequency					
Risky drinking					
Binge drinking					
Physical activity					
Met CDC guidelines					
Inactive lifestyle					
BMI					
Overweight					
Obese					
Pap smear within last 2 years[#]					
Dental care (visit within last year)[*]					
Visit to health care provider (at least 1 visit within last 2 years)					
Visit to LTFU program (within last 2 years)					
BSI-18 (T-score ≥ 63 on any subscale)					

Table 3c. Association between health behaviors and mammogram utilization, siblings, ≥40 years of age

	Unadjusted			**Adjusted**	
	PR (95% CI)	**p-value**		**PR (95% CI)**	**p-value**
Tobacco use					
Ever					
Former					
Never					
Alcohol					
# of drinks on typical day					
Frequency					
Risky drinking					
Binge drinking					
Physical activity					
Met CDC guidelines					
Inactive lifestyle					
BMI					
Overweight					
Obese					
Pap smear within last 2 years[#]					
Dental care (visit within last year)[*]					
Visit to health care provider (at least 1 visit within last 2 years)					
Visit to LTFU program (within last 2 years)					
BSI-18 (T-score ≥ 63 on any subscale)					

Table 4a. Association between health behaviors and perceived breast cancer risk, women who received chest RT, aged 25-39

	Unadjusted			Adjusted	
	PR (95% CI)/β (se)	**p-value**		**PR (95% CI)/β (se)**	**p-value**
Mammogram within the last 2 years					
Tobacco use					
Ever					
Former					
Never					
Alcohol					
# of drinks on typical day					
Frequency					
Risky drinking					
Binge drinking					
Physical activity					
Met CDC guidelines					
Inactive lifestyle					
BMI					
Overweight					
Obese					
Pap smear within last 2 years[#]					
Dental care (visit within last year) [*]					
Visit to health care provider (at least 1 visit within last 2 years)					
Visit to LTFU program (within last 2 years)					
BSI-18 (T-score ≥ 63 on any subscale)					

Table 4b. Association between health behaviors and perceived breast cancer risk, women ≥40 years of age

	Unadjusted			Adjusted	
	PR (95% CI)/β (se)	**p-value**		**PR (95% CI)/β (se)**	**p-value**
Mammogram within the last 2 years					
Tobacco use					
Ever					
Former					
Never					
Alcohol					
# of drinks on typical day					
Frequency					
Risky drinking					
Binge drinking					
Physical activity					
Met CDC guidelines					
Inactive lifestyle					
BMI					
Overweight					
Obese					
Pap smear within last 2 years[#]					
Dental care (visit within last year) [*]					
Visit to health care provider (at least 1 visit within last 2 years)					
Visit to LTFU program (within last 2 years)					
BSI-18 (T-score ≥ 63 on any subscale)					

Table 4c. Association between health behaviors and perceived breast cancer risk siblings, ≥40 years of age

	Unadjusted			Adjusted	
	PR (95% CI)/β (se)	**p-value**		**PR (95% CI)/β (se)**	**p-value**
Mammogram within the last 2 years					
Tobacco use					
Ever					
Former					
Never					
Alcohol					
# of drinks on typical day					
Frequency					
Risky drinking					
Binge drinking					
Physical activity					
Met CDC guidelines					
Inactive lifestyle					
BMI					
Overweight					
Obese					
Pap smear within last 2 years[#]					
Dental care (visit within last year) [*]					
Visit to health care provider (at least 1 visit within last 2 years)					
Visit to LTFU program (within last 2 years)					
BSI-18 (T-score ≥ 63 on any subscale)					

Table 5a. Association between health behaviors and locus of control (3 subscales), women who received chest RT, aged 25-39

Internal		Unadjusted			Adjusted	
		PR (95% CI)/β (se)	p-value		PR (95% CI)/β (se)	p-value
	Mammogram within the last 2 years					
	Tobacco use					
	Ever					
	Former					
	Never					
	Alcohol					
	# of drinks on typical day					
	Frequency					
	Risky drinking					
	Binge drinking					
	Physical activity					
	Met CDC guidelines					
	Inactive lifestyle					
	BMI					
	Overweight					
	Obese					
	Pap smear within last 2 years[#]					
	Dental care (visit within last year) [*]					
	Visit to health care provider (at least 1 visit within last 2 years)					
	Visit to LTFU program (within last 2 years)					
	BSI-18 (T-score ≥ 63 on any subscale)					
Chance						
	Mammogram within the last 2 years					
	Tobacco use					
	Ever					
	Former					
	Never					
	Alcohol					
	# of drinks on typical day					
	Frequency					
	Risky drinking					
	Binge drinking					
	Physical activity					
	Met CDC guidelines					
	Inactive lifestyle					
	BMI					
	Overweight					
	Obese					
	Pap smear within last 2 years[#]					
	Dental care (visit within last year) [*]					
	Visit to health care provider (at least 1 visit within last 2 years)					
	Visit to LTFU program (within last 2 years)					
	BSI-18 (T-score ≥ 63 on any subscale)					
Powerful Others						
	Mammogram within the last 2 years					
	Tobacco use					
	Ever					
	Former					
	Never					
	Alcohol					
	# of drinks on typical day					
	Frequency					
	Risky drinking					
	Binge drinking					
	Physical activity					
	Met CDC guidelines					
	Inactive lifestyle					
	BMI					
	Overweight					
	Obese					
	Pap smear within last 2 years[#]					
	Dental care (visit within last year) [*]					
	Visit to health care provider (at least 1 visit within last 2 years)					
	Visit to LTFU program (within last 2 years)					

	BSI-18 (T-score ≥ 63 on any subscale)					

Table 5b. Association between health behaviors and locus of control (3 subscales), women, ≥40 years of age

Internal		**Unadjusted**			**Adjusted**	
		PR (95% CI)/β (se)	**p-value**		**PR (95% CI)/β (se)**	**p-value**
	Mammogram within the last 2 years					
	Tobacco use					
	Ever					
	Former					
	Never					
	Alcohol					
	# of drinks on typical day					
	Frequency					
	Risky drinking					
	Binge drinking					
	Physical activity					
	Met CDC guidelines					
	Inactive lifestyle					
	BMI					
	Overweight					
	Obese					
	Pap smear within last 2 years[#]					
	Dental care (visit within last year)[*]					
	Visit to health care provider (at least 1 visit within last 2 years)					
	Visit to LTFU program (within last 2 years)					
	BSI-18 (T-score ≥ 63 on any subscale)					
Chance						
	Mammogram within the last 2 years					
	Tobacco use					
	Ever					
	Former					
	Never					
	Alcohol					
	# of drinks on typical day					
	Frequency					
	Risky drinking					
	Binge drinking					
	Physical activity					
	Met CDC guidelines					
	Inactive lifestyle					
	BMI					
	Overweight					
	Obese					
	Pap smear within last 2 years[#]					
	Dental care (visit within last year)[*]					
	Visit to health care provider (at least 1 visit within last 2 years)					
	Visit to LTFU program (within last 2 years)					
	BSI-18 (T-score ≥ 63 on any subscale)					
Powerful Others						
	Mammogram within the last 2 years					
	Tobacco use					
	Ever					
	Former					
	Never					
	Alcohol					
	# of drinks on typical day					
	Frequency					
	Risky drinking					
	Binge drinking					
	Physical activity					
	Met CDC guidelines					
	Inactive lifestyle					
	BMI					
	Overweight					
	Obese					
	Pap smear within last 2 years[#]					
	Dental care (visit within last year)[*]					

	Visit to health care provider (at least 1 visit within last 2 years)					
	Visit to LTFU program (within last 2 years)					
	BSI-18 (T-score ≥ 63 on any subscale)					

Table 5c. Association between health behaviors and locus of control (3 subscales), siblings, ≥40 years of age

Internal		**Unadjusted**			**Adjusted**	
		PR (95% CI)/β (se)	**p-value**		**PR (95% CI)/β (se)**	**p-value**
	Mammogram within the last 2 years					
	Tobacco use					
	Ever					
	Former					
	Never					
	Alcohol					
	# of drinks on typical day					
	Frequency					
	Risky drinking					
	Binge drinking					
	Physical activity					
	Met CDC guidelines					
	Inactive lifestyle					
	BMI					
	Overweight					
	Obese					
	Pap smear within last 2 years[#]					
	Dental care (visit within last year) [*]					
	Visit to health care provider (at least 1 visit within last 2 years)					
	Visit to LTFU program (within last 2 years)					
	BSI-18 (T-score ≥ 63 on any subscale)					
Chance						
	Mammogram within the last 2 years					
	Tobacco use					
	Ever					
	Former					
	Never					
	Alcohol					
	# of drinks on typical day					
	Frequency					
	Risky drinking					
	Binge drinking					
	Physical activity					
	Met CDC guidelines					
	Inactive lifestyle					
	BMI					
	Overweight					
	Obese					
	Pap smear within last 2 years[#]					
	Dental care (visit within last year) [*]					
	Visit to health care provider (at least 1 visit within last 2 years)					
	Visit to LTFU program (within last 2 years)					
	BSI-18 (T-score ≥ 63 on any subscale)					
Powerful Others						
	Mammogram within the last 2 years					
	Tobacco use					
	Ever					
	Former					
	Never					
	Alcohol					
	# of drinks on typical day					
	Frequency					
	Risky drinking					
	Binge drinking					
	Physical activity					
	Met CDC guidelines					
	Inactive lifestyle					
	BMI					
	Overweight					
	Obese					
	Pap smear within last 2 years[#]					
	Dental care (visit within last year) [*]					

	Visit to health care provider (at least 1 visit within last 2 years)					
	Visit to LTFU program (within last 2 years)					
	BSI-18 (T-score ≥ 63 on any subscale)					

Table 6a. Association between health behaviors and active-planning coping[¥] women who received chest RT, aged 25-39

	Unadjusted			**Adjusted**	
	PR (95% CI)/β (se)	**p-value**		**PR (95% CI)/β (se)**	**p-value**
Mammogram within the last 2 years					
Tobacco use					
Ever					
Former					
Never					
Alcohol					
# of drinks on typical day					
Frequency					
Risky drinking					
Binge drinking					
Physical activity					
Met CDC guidelines					
Inactive lifestyle					
BMI					
Overweight					
Obese					
Pap smear within last 2 years[#]					
Dental care (visit within last year)[*]					
Visit to health care provider (at least 1 visit within last 2 years)					
Visit to LTFU program (within last 2 years)					
BSI-18 (T-score ≥ 63 on any subscale)					

Table 6b. Association between health behaviors and active-planning coping,[¥] women ≥40 years of age

	Unadjusted			**Adjusted**	
	PR (95% CI)/β (se)	**p-value**		**PR (95% CI)/β (se)**	**p-value**
Mammogram within the last 2 years					
Tobacco use					
Ever					
Former					
Never					
Alcohol					
# of drinks on typical day					
Frequency					
Risky drinking					
Binge drinking					
Physical activity					
Met CDC guidelines for PA					
Inactive lifestyle					
BMI					
Overweight					
Obese					
Pap smear within last 2 years[#]					
Dental care (visit within last year)[*]					
Visit to health care provider (at least 1 visit within last 2 years)					
Visit to LTFU program (within last 2 years)					
BSI-18 (T-score ≥ 63 on any subscale)					

Table 6c. Association between health behaviors and active-planning coping, siblings[¥] ≥40 years of age

	Unadjusted			Adjusted	
	PR (95% CI)/β (se)	**p-value**		**PR (95% CI)/β (se)**	**p-value**
Mammogram within the last 2 years					
Tobacco use					
Ever					
Former					
Never					
Alcohol					
# of drinks on typical day					
Frequency					
Risky drinking					
Binge drinking					
Physical activity					
Met CDC guidelines					
Inactive lifestyle					
BMI					
Overweight					
Obese					
Pap smear within last 2 years[#]					
Dental care (visit within last year)[*]					
Visit to health care provider (at least 1 visit within last 2 years)					
Visit to LTFU program (within last 2 years)					
BSI-18 (T-score ≥ 63 on any subscale)					

[#] From MPS

[*] From 2003 survey

[¥] Tables 6a-6c specify the "active-planning" COPE subscale. Tables will be similar for additional COPE subscales included in final analysis.