

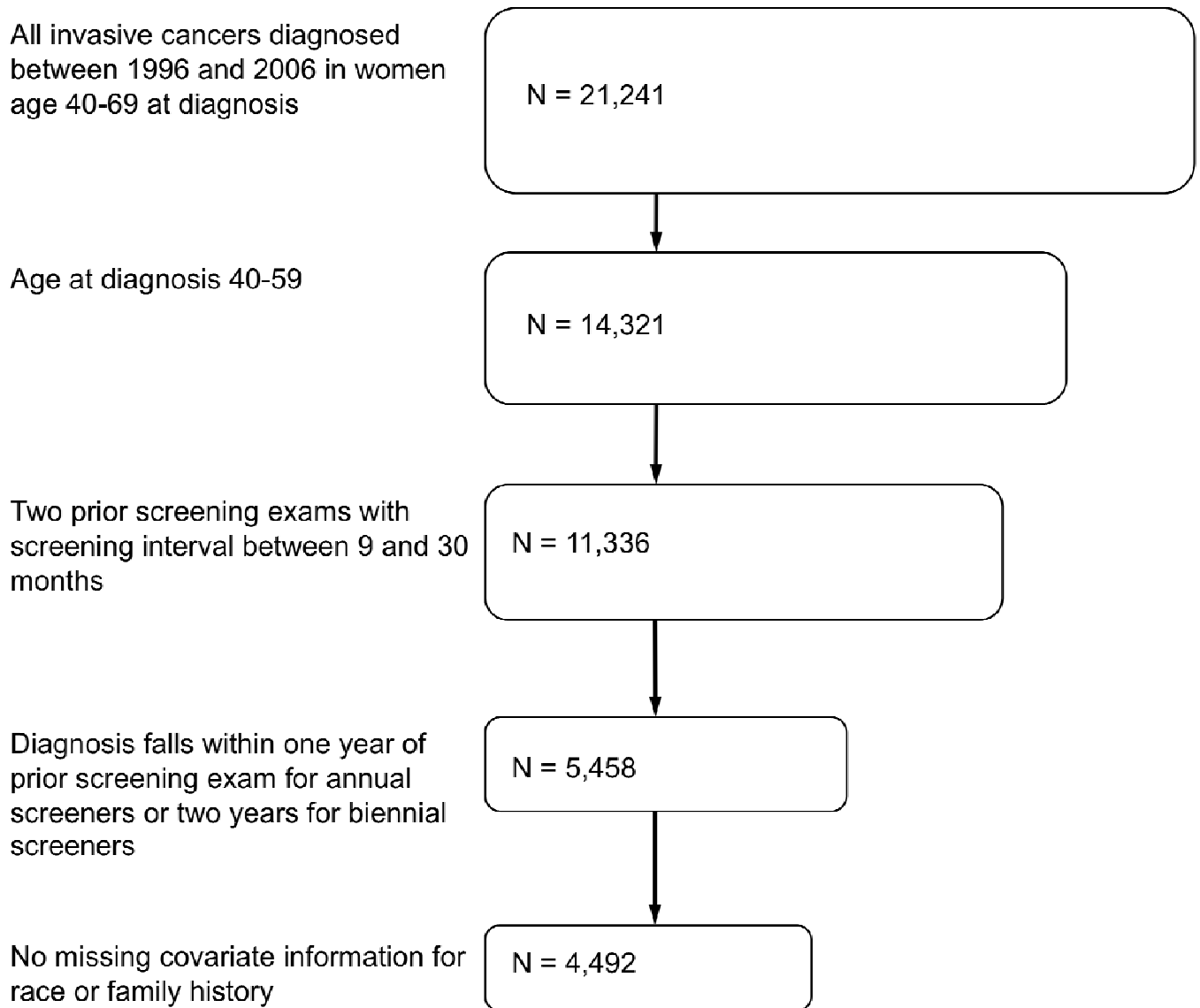
## **Appendix A**

### BSCS Mammography Registries

- 1) Carolina Mammography Registry
- 2) Colorado Mammography Project
- 3) New Hampshire Mammography Network
- 4) New Mexico Mammography Project
- 5) San Francisco Mammography Registry
- 6) Vermont Breast Cancer Surveillance System
- 7) Group Health Cooperative in western Washington.

## Appendix B

*Figure B.1.* Flow diagram summarizing inclusion and exclusion criteria for the cancer cohort and resultant sample sizes. Size of boxes is proportional to fraction of total number of cancers diagnosed among women aged 40-69 in 1996-2006 (N = 21,241).



## Appendix C

We used a model for cumulative FP probability that allows for variation as a function of covariates, radiologist, screening round number, and round at which a woman was censored. Our model for probability of a first FP at each round was:

$$\log \frac{p(Y_{ijk} = 1 | \bar{Y}_{ijk-1} = 0, X_{ijk}, S_{ij} = s, \alpha_i)}{1 - p(Y_{ijk} = 1 | \bar{Y}_{ijk-1} = 0, X_{ijk}, S_{ij} = s, \alpha_i)} = \gamma_s + \beta_0 1(k > 1) + \beta_1 k + X_{ijk} \delta + \alpha_i,$$

where  $Y_{ijk}$  is an indicator of an FP at the  $k$ th screening round for the  $j$ th woman, whose mammogram was interpreted by the  $i$ th radiologist;  $\bar{Y}_{ijk-1}$  is the history of FP results for the first  $k-1$  mammograms,  $S_{ij}$  is the number of screening rounds observed for this woman;  $X_{ijk}$  is a vector of covariates which can include woman- or mammogram-level variables;  $1(k > 1)$  is an indicator function that takes the value 1 when  $k > 1$  and the value 0 otherwise; and  $\alpha_i$  is a radiologist-specific random effect. In this model,  $\gamma_s$  represents variation in the FP probability for women with differing censoring times,  $\beta_0$  and  $\beta_1$  represent variation in FP probability across screening rounds, and  $\delta$  represents covariate effects. In our model for cumulative probability of FP mammography results, covariates included screening interval, age, year of first exam, hormone therapy use, family history of breast cancer, breast density, availability of comparison films, and BCSC registry.

The probability of a first FP at each screening round can be regarded as the discrete hazard in a discrete time survival model. Using the above model, discrete hazards can be estimated for all combinations of screening rounds and censoring times. We then marginalize over the distribution of censoring times to obtain an estimate of the FP probability at each round that would result from full participation by all women in that

screening round. The marginalized discrete hazards can then be aggregated to give the cumulative incidence of a FP, which is equivalent to the cumulative probability of a FP test result.

## Appendix D

In this study we observed women for 1-13 rounds of screening. At each round we characterized elapsed time since the most recent prior mammogram (screening interval). In Table D.1 we have provided the complete sample size for the number of mammograms available at each screening round and the number with a prior exam at an annual, biennial, or longer interval for the complete sample as well as stratified by age at first screening exam (40-49 and 50-59). “Annual” time to previous exam is defined as 9-18 months, “biennial” is defined as 19-30 months, and “longer than biennial” is defined as >30 months.

In addition to describing the number of mammograms available at each screening round, we examined the number of screening rounds each woman was under observation and the mean length of time women were under observation. For instance, of the 169,456 first mammograms included in our database, 80,830 were for women who were only observed for one screening round. The remaining 88,626 mammograms came from women who were observed for at least two screening rounds. In Table D.1 we provide the distribution of number of screening rounds available (censoring time) for each woman in our study and the mean length of follow-up available for women observed for 2 or more rounds. Length of follow-up is defined as the time between the first and last mammogram observed for a woman. We have also characterized the pattern of screening intervals for women with at least 2 rounds of screening. Screening pattern was defined as the combination of intervals between prior mammograms. For instance, of the 20,592 women observed for exactly 3 rounds of screening, 13,188 had annual intervals between the first and second and second and third mammograms, while 4,759 had biennial intervals between the first and second and second and third mammograms. “Annual” screening pattern is defined by all annual intervals at prior screening rounds, “biennial” pattern as all biennial intervals at prior rounds, and “combination” as a combination of annual, biennial, or longer than biennial intervals at prior rounds.

*Table D.1.* Number of screening mammograms observed at screening rounds 1 to 13 overall and stratified by time to the prior screening mammogram; and number of women censored after rounds 1 to 13 overall and stratified by pattern of screening mammography observed across prior screening rounds and mean length of follow-up for women censored at rounds 2 - 13.

Screening round	Number of mammograms	Time to previous exam			Number of women censored	Mean length of follow-up	Screening pattern			
		Annual	Biennial	Longer than biennial			Annual	Biennial	Combina-tion	
<b>All women</b>										
1	169,456	--	--	--	80,830	--	--	--	--	--
2	88,626	36,445	27,775	24,406	34,676	2.8	12,768*	11,787*	10,121*	
3	53,950	29,675	16,283	7,992	20,592	4.5	13,188	4,759	2,645	
4	33,358	21,671	8,908	2,779	13,322	5.9	9,420	2,887	1,015	
5	20,036	14,788	4,293	955	8,795	6.9	6,256	2,071	468	
6	11,241	9,194	1,766	281	5,421	7.8	3,802	1,403	216	
7	5,820	5,123	622	75	3,070	8.4	2,113	944	13	
8	2,750	2,535	193	22	1,668	9.1	1,049	619	0	
9	1,082	1,025	48	9	722	9.9	434	288	0	
10	360	343	16	1	262	10.7	159	103	0	
11	98	96	2	0	79	11.2	40	39	0	
12	19	19	0	0	16	11.5	4	12	0	
13	3	3	0	0	3	12.0	3	0	0	
<b>Women with first screening exam at age 40-49</b>										
1	135,604	--	--	--	64,864	--	--	--	--	--
2	70,740	28,198	22,659	19,883	28,125	2.8	10,366*	9,362*	8,397*	
3	42,615	23,248	13,049	6,318	16,737	4.5	10,710	3,834	2,193	
4	25,878	16,816	6,955	2,107	10,663	5.8	7,505	2,342	816	
5	15,215	11,317	3,238	660	6,923	6.9	4,904	1,654	365	

6	8,292	6,866	1,254	172	4,123	7.7	2,846	1,113	164
7	4,169	3,720	399	50	2,291	8.4	1,563	720	8
8	1,878	1,744	123	11	1,177	9.1	743	434	0
9	701	680	16	5	486	9.9	300	186	0
10	215	207	8	0	167	10.8	109	58	0
11	48	46	2	0	41	11.4	28	13	0
12	7	7	0	0	6	11.7	3	3	0
13	1	1	0	0	1	12.0	1	0	0
<b>Women with first screening exam at age 50-59</b>									
1	33,852	--	--	--	15,966	--	--	--	--
2	17,886	8,247	5,116	4,523	6,551	2.8	2,402*	2,425*	1,724*
3	11,335	6,427	3,234	1,674	3,855	4.6	2,478	925	452
4	7,480	4,855	1,953	672	2,659	5.9	1,915	545	199
5	4,821	3,471	1,055	295	1,872	7.0	1,352	417	103
6	2,949	2,328	512	109	1,298	7.9	956	290	52
7	1,651	1,403	223	25	779	8.4	550	224	5
8	872	791	70	11	491	9.0	306	185	0
9	381	345	32	4	236	9.8	134	102	0
10	145	136	8	1	95	10.5	50	45	0
11	50	50	0	0	38	11.1	12	26	0
12	12	12	0	0	10	11.4	1	9	0
13	2	2	0	0	2	12.0	2	0	0

\*For women censored after exactly 2 rounds of screening, screening pattern is based on the single interval between the first and second mammograms and “combination” indicates a longer than biennial interval (>30 months) between those exams.

## Appendix E

*Table E.1.* Distribution of Final BI-RADS Assessment for Mammograms with Initial BI-RADS Assessments of 0 (N = 44,992).

	N (%)
<b>Final BI-RADS assessment*</b>	
1: Negative	11,455 (25.5)
2: Benign finding(s)	10,849 (24.1)
3: Probably benign	9,843 (21.9)
0: Needs additional evaluation	5,541 (12.3)
4: Suspicious abnormality	4,524 (10.1)
5: Highly suggestive of malignancy	77 (0.2)
Missing final assessment	2,703 (6.0)



## Appendix F

Table F.1. Odds Ratios (OR) and 95% Confidence Intervals (CI) for odds of late stage cancer. Models were Additionally Adjusted for BCSC Registry.

		OR	95%CI		p-value
			Lower	Upper	
<b>Age 40-49</b>					
<b>Screening interval</b>	Annual	1.0 (Ref)	--	--	0.14
	Biennial	1.21	0.94	1.55	
<b>Family history of breast cancer</b>	Yes	1.0 (Ref)	--	--	0.89
	No	0.98	0.74	1.31	
<b>Race</b>	Non-Hispanic white	1.0 (Ref)	--	--	0.91
	Hispanic	0.85	0.50	1.45	
	Non-Hispanic black	1.30	0.74	2.29	
	American Indian/Alaska native	0.83	0.22	3.05	
	Asian/Pacific islander	1.07	0.59	1.92	
	Other/mixed	0.79	0.26	2.35	
<b>Age 50-59</b>					
<b>Screening interval</b>	Annual	1.0 (Ref)	--	--	0.17
	Biennial	1.16	0.94	1.41	
<b>Family history of breast cancer</b>	Yes	1.0 (Ref)	--	--	0.21
	No	1.16	0.92	1.45	
<b>Race</b>	Non-Hispanic white	1.0 (Ref)	--	--	0.34
	Hispanic	1.54	1.06	2.25	
	Non-Hispanic black	0.92	0.55	1.54	
	American Indian/Alaska native	1.22	0.48	3.12	
	Asian/Pacific islander	1.06	0.63	1.76	
	Other/mixed	0.74	0.28	1.92	