Supplementary Material 1. STROBE Checklist

	Item No	Recommendation	Page Number or Location
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5-6
Objectives	3	State specific objectives, including any prespecified hypotheses	6
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6-7
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	6-7
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	NA
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7-8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	7-8, Supplementary Material 2, Supplementary Material 3
Bias	9	Describe any efforts to address potential sources of bias	8-10
Study size	10	Explain how the study size was arrived at	6-7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7-8, Supplementary Material 2, Supplementary Material 3
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	8-10
		(*b*) Describe any methods used to examine subgroups and interactions	8-10
		(*c*) Explain how missing data were addressed	8-10
		(*d*) If applicable, explain how loss to follow-up was addressed	8-10
		(*e*) Describe any sensitivity analyses	8-10
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	10, Figure 1
		(b) Give reasons for non-participation at each stage	10, Figure 1
		(c) Consider use of a flow diagram	10, Figure 1
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	10-11, Table 1, Supplementary Material 5, Supplementary Material 9
		(b) Indicate number of participants with missing data for each variable of interest	10-11, Table 1, Supplementary Material 5, Supplementary Material 9
		(c) Summarise follow-up time (eg, average and total amount)	10-11, Table 1, Supplementary Material 5, Supplementary Material 9
Outcome data	15*	Report numbers of outcome events or summary measures over time	10-13
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	10-13, Table 1, Figure 4, Figure 5
		(*b*) Report category boundaries when continuous variables were categorized	7-8, Supplementary Material 2, Supplementary Material 3
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	10-13, Table 1, Figure 4, Figure 5
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	10-13, Figure 6, Supplementary Material 7
Discussion			
Key results	18	Summarise key results with reference to study objectives	13
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	16
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	13-16
Generalisability	21	Discuss the generalisability (external validity) of the study results	16
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	1

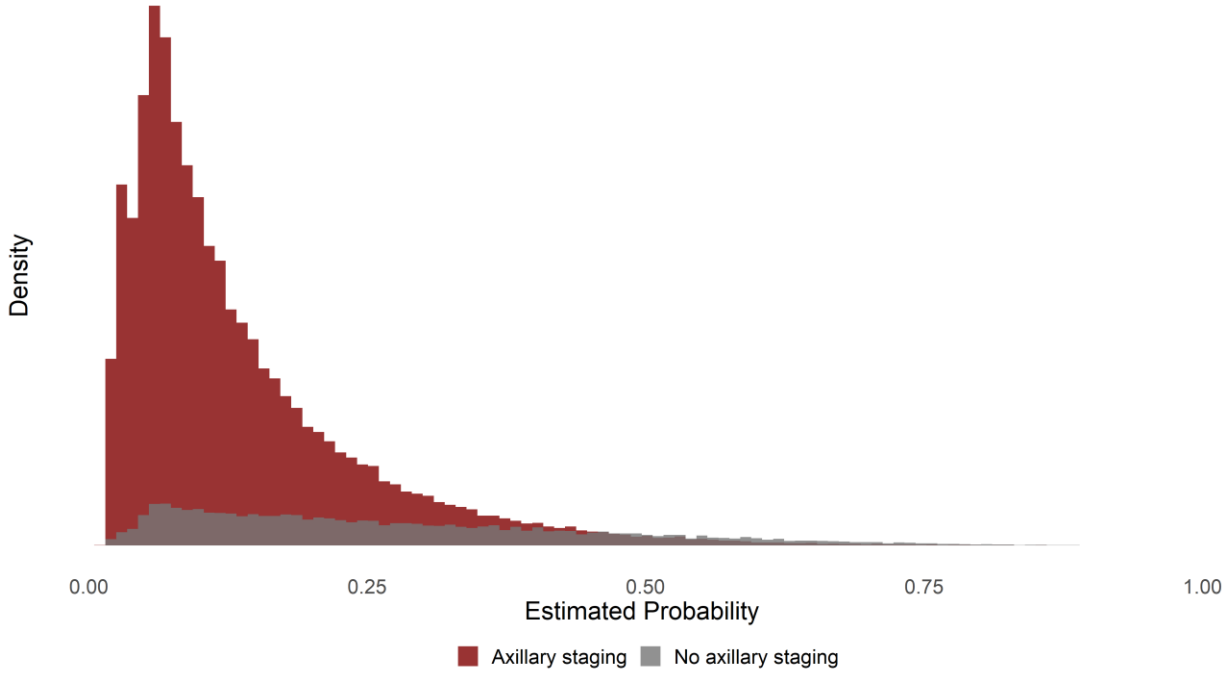
Supplementary Material 2. Histology definitions according to ICD-O-3 codes. Only invasive breast cancers were included in this study.

Included histology	**ICD-O-3 codes**
Cystic, mucinous, and serous neoplasms	8440-8499
Ductal and lobular neoplasms	8500-8549
Other	8000-8049, 8120-8389, 8430-8439, 8550-8559, 8560-8579, 8810-8839
Excluded histology	**ICD-O-3 codes**
Squamous cell neoplasms	8050-8089
Basal cell neoplasms	8090-8119
Nevi and melanomas	8720-8799
Soft tissue tumors and sarcomas	8800-8809
Osseous and chondromatous neoplasms	9180-9249
Nerve sheath tumors	9540-9579
Adnexal and skin appendage neoplams	8390-8429
Lipomatous neoplasms	8850-8889
Myomatous neoplasms	8890-8929
Complex mixed and stromal neoplasms	8930-8999
Fibroepithelial neoplasms	9000-9039
Blood vessel tumors	9120-9169

Supplementary Material 3. Handling of covariates and outcomes with SEER and NAACCR variable definitions.

Study Covariate/Outcome	**Type**	**Levels**	**SEER Variable Name**	**NAACCR Name**
Age	Continuous	Years	AGE_DX	Age at diagnosis
Year at diagnosis	Categorical	2005-2005	YEAR_DX	Year of diagnosis
Marital status	Categorical	• Married • Non-married	MAR_STAT	Marital Status at DX
Race	Categorical	• Black • Other • White	RACE1V	Race/Ethnicity
Histology	Categorical	• Cystic, mucinous, and serous neoplasms • Ductal and lobular neoplasms • Other	HISTREC	Histology Recode—Broad Groupings
Surgery type	Categorical	• Lumpectomy • Mastectomy	SURGPRIF	RX Summ—Surg Prim Site
Tumor grade	Categorical	• I • II • III • IV	GRADE	Grade
ER positive	Categorical	• Positive • Negative	ERSTATUS	ER Status Recode Breast Cancer (1990+)
PR positive	Categorical	• Positive • Negative	PRSTATUS	PR Status Recode Breast Cancer (1990+)
HER-2 status	Categorical	• Positive • Negative	HER2	Derived HER2 Recode (2010+)
Tumor size	Categorical	• <2cm • ≥2cm	CSTUMSIZE	CS Tumor Size
History of previous cancer	Categorical	• Yes • No	FIRSTPRM	First malignant primary indicator
Number of previous tumors	Categorical	• 1 • 2 • 3+	MALIGCOUNT	Total Number of In Situ/malignant Tumors for Patient

Vital status	Categorical	• Dead • Alive	STAT_REC	Vital Status recode
Cause of death	Categorical	• Alive • Breast cancer death • Non-breast cancer death	CODPUB	Cause of Death to SEER site recode
Follow-up time	Continuous	Months	SRV_TIME_MON	Survival months
Nodal staging strategy	Categorical	• Axillary staging • No axillary staging	CS3SITE	NAACCR Item #2900: CS Site-Specific Factor 3
Radiotherapy	Categorical	• Yes • No/unknown	Radiation recode (SEER Plus)	
Chemotherapy	Categorical	• Yes • No/unknown	Chemotherapy recode (SEER Plus)	



Supplementary Material 4. Distribution of propensity scores among elderly breast cancer patients.

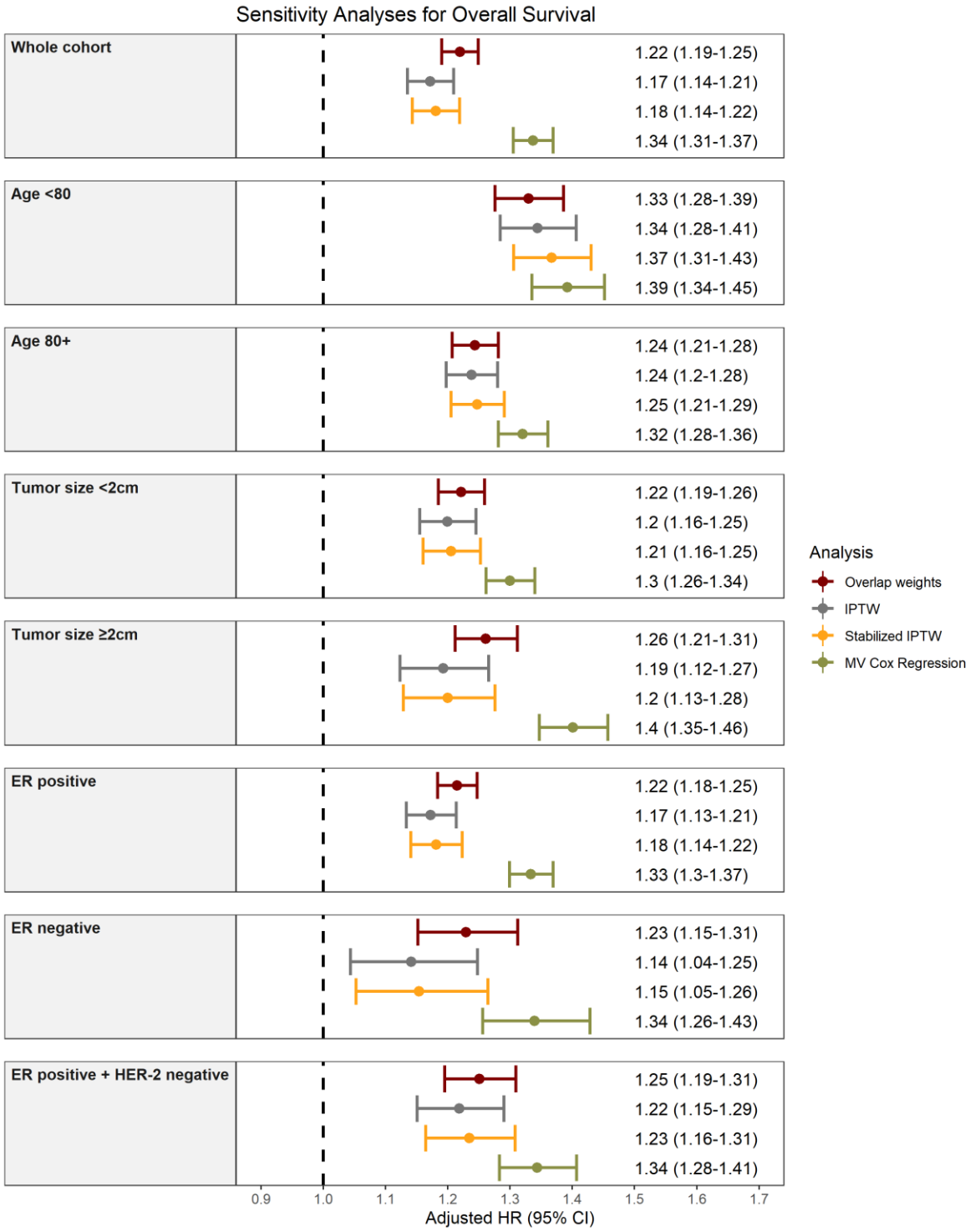
Supplementary Material 5. Patient characteristics for receipt of chemotherapy and radiotherapy.

Characteristic	Chemotherapy			Radiotherapy		
	No/Unknown (n=126765)	Yes (n=17564)	SMD	None/unknown (n=83093)	Yes (n=61236)	SMD
Age, mean (SD)	78.16 (5.90)	74.49 (4.04)	**0.727**	78.75 (6.20)	76.30 (4.95)	**0.437**
Year at diagnosis, no. (%)						
2005	10842 (8.6)	1194 (6.8)	0.087	7081 (8.5)	4955 (8.1)	0.053
2006	10862 (8.6)	1391 (7.9)		7218 (8.7)	5035 (8.2)	
2007	11007 (8.7)	1474 (8.4)		7382 (8.9)	5099 (8.3)	
2008	11175 (8.8)	1539 (8.8)		7405 (8.9)	5309 (8.7)	
2009	11482 (9.1)	1611 (9.2)		7575 (9.1)	5518 (9.0)	
2010	11318 (8.9)	1464 (8.3)		7387 (8.9)	5395 (8.8)	
2011	11699 (9.2)	1637 (9.3)		7599 (9.1)	5737 (9.4)	
2012	11824 (9.3)	1745 (9.9)		7892 (9.5)	5677 (9.3)	
2013	12106 (9.5)	1796 (10.2)		7990 (9.6)	5912 (9.7)	
2014	12146 (9.6)	1834 (10.4)		7770 (9.4)	6210 (10.1)	
2015	12304 (9.7)	1879 (10.7)		7794 (9.4)	6389 (10.4)	
Marital status, no. (%)						
Married	53942 (42.6)	9014 (51.3)	**0.176**	33056 (39.8)	29900 (48.8)	**0.183**
Non-married	72823 (57.4)	8550 (48.7)		50037 (60.2)	31336 (51.2)	
Race, no. (%)						
Black	9092 (7.2)	1841 (10.5)	**0.122**	6619 (8.0)	4314 (7.0)	0.045
Other	7542 (5.9)	1155 (6.6)		5225 (6.3)	3472 (5.7)	
White	110131 (86.9)	14568 (82.9)		71249 (85.7)	53450 (87.3)	
Histology, no. (%)						
Cystic, mucinous, and serous	5375 (4.2)	137 (0.8)	**0.224**	3451 (4.2)	2061 (3.4)	0.058
Ductal and lobular neoplasms	118245 (93.3)	17053 (97.1)		77401 (93.1)	57897 (94.5)	
Other	3145 (2.5)	374 (2.1)		2241 (2.7)	1278 (2.1)	
Surgery type, no. (%)						
Lumpectomy	81917 (64.6)	9204 (52.4)	**0.25**	35255 (42.4)	55866 (91.2)	**1.212**
Mastectomy	44848 (35.4)	8360 (47.6)		47838 (57.6)	5370 (8.8)	
Tumor grade, no. (%)						
I	40297 (31.8)	1638 (9.3)	**0.821**	23814 (28.7)	18121 (29.6)	0.052
II	61707 (48.7)	6672 (38.0)		38985 (46.9)	29394 (48.0)	
III	24216 (19.1)	9125 (52.0)		19845 (23.9)	13496 (22.0)	
IV	545 (0.4)	129 (0.7)		449 (0.5)	225 (0.4)	
ER positive, no. (%)	114609 (90.4)	11438 (65.1)	**0.638**	71909 (86.5)	54138 (88.4)	0.056
PR positive, no. (%)	99957 (78.9)	8969 (51.1)	**0.609**	61859 (74.4)	47067 (76.9)	0.056
Tumor size, no. (%)						
<2cm	89385 (70.5)	7855 (44.7)	**0.541**	53055 (63.9)	44185 (72.2)	**0.179**
>2cm	37380 (29.5)	9709 (55.3)		30038 (36.1)	17051 (27.8)	
History of previous cancer, no. (%)	95022 (75.0)	13804 (78.6)	0.086	59035 (71.0)	49791 (81.3)	**0.243**
Number of previous tumors, no. (%)						
1	77740 (61.3)	11405 (64.9)	0.083	47858 (57.6)	41287 (67.4)	**0.219**
2	36513 (28.8)	4745 (27.0)		25617 (30.8)	15641 (25.5)	
3+	12512 (9.9)	1414 (8.1)		9618 (11.6)	4308 (7.0)	
Nodal staging strategy, no. (%)						
Axillary staging	105018 (82.8)	16690 (95.0)	**0.396**	65817 (79.2)	55891 (91.3)	**0.345**
No axillary staging	21747 (17.2)	874 (5.0)		17276 (20.8)	5345 (8.7)	

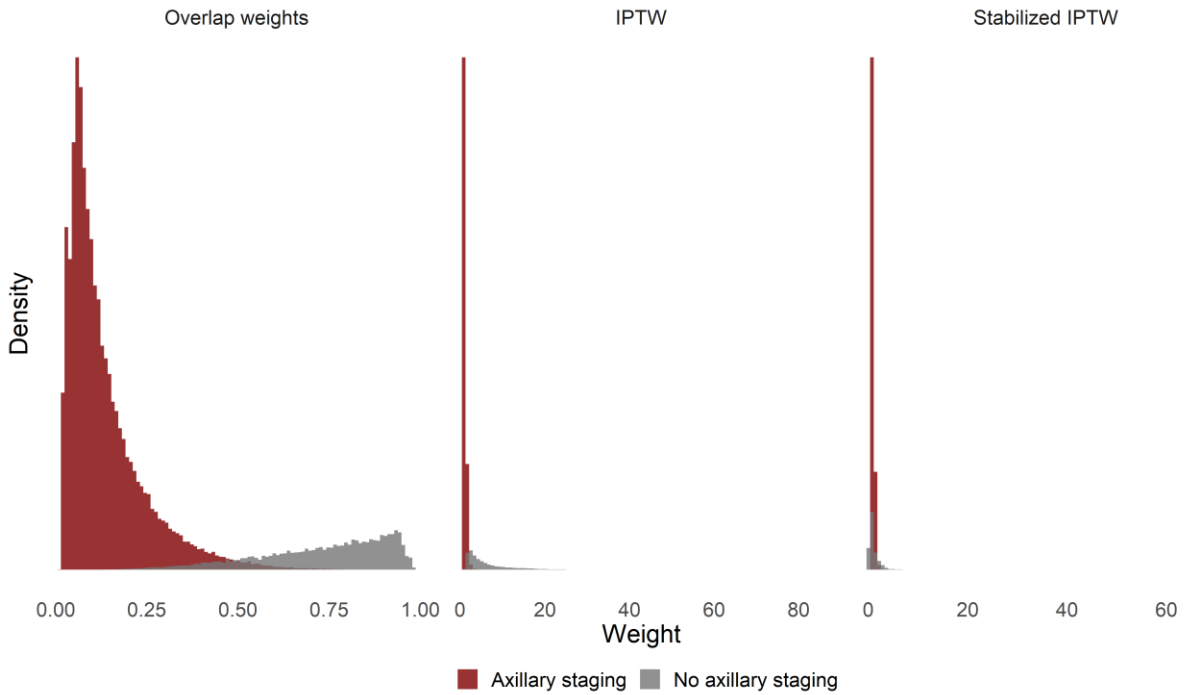
ER – estrogen receptor, PR – progesterone receptor, SMD – standardized mean difference

Supplementary Material 6. Comparison of subdistribution hazard ratio model and cause-specific hazard ratio model for breast cancer-specific survival. All estimates and 95% confidence intervals shown are overlap propensity score weighted and additional adjusted for receipt of chemotherapy and radiotherapy.

Exposure	Subdistribution hazard model	Cause-specific hazard model	
	Breast cancer death	Breast cancer death	Non-breast cancer death
No axillary staging	1.14 (1.08-1.21)	1.21 (1.14-1.28)	1.22 (1.19-1.25)



Supplementary Material 7. Sensitivity analyses for overall survival using propensity score weighting and multivariable Cox regression, with additional adjustment for receipt of radiotherapy or chemotherapy. Presented are subdistribution hazard ratios and 95% confidence intervals for no axillary staging compared to receipt of axillary staging. The ER+ and HER-2(-) subgroup only includes women diagnosed after 2010, when HER-2 status was available.



IPTW – inverse probability of treatment weighting

Supplementary Material 8. Distributions of propensity score weights by three methods.

Supplementary Material 9. Proportion of missing data in the final dataset prior to multiple imputation. The subgroup analysis including only patients diagnosed after 2010 when HER-2 status was available was imputed separately.

Characteristic	**Patients with missing data (N = 144,329)**
Age, no. (%)	0
Year at diagnosis, no. (%)	0
Marital status, no. (%)	7005 (4.9)
Race, no. (%)	236 (0.2)
Histology, no. (%)	0
Surgery type, no. (%)	86 (0.1)
Tumor grade, no. (%)	5657 (3.9)
ER positive, no. (%)	4972 (3.4)
PR positive, no. (%)	5694 (3.9)
HER-2 status, no. (%)	
Not 2010+ breast cancer	62577 (43.4)
2010+ breast cancer	3317 (2.3)
Tumor size, no. (%)	<10 (<0.1)[1]
History of previous cancer, no. (%)	0
Number of previous tumors, no. (%)	0
Vital status, no. (%)	0
Cause of death, no. (%)	0
Nodal staging strategy, no. (%)	0
Radiotherapy, no. (%)	0
Chemotherapy, no. (%)	0

[1]Suppressed for small cells