

Supplementary materials

Table S1 Univariable analysis of breast cancer-specific survival (BCSS) and overall survival (OS) in total patients.

Variables	BCSS			OS		
	n	HR (95% CI)	P-value	n	HR (95% CI)	P-value
Group			0.590			0.175
OBC	51	0.93 (0.70-1.22)	0.590	68	0.85 (0.67-1.08)	0.175
non-OBC	12,847	Reference	—	18,644	Reference	—
Year of diagnosis			<0.001			<0.001
2004-2009	10,260	Reference	—	15,020	Reference	—
2010-2014	2638	0.90 (0.86-0.94)	<0.001	3,692	0.89 (0.86-0.93)	<0.001
Age at diagnosis			<0.001			<0.001
18-49	3,877	Reference	—	4,340	Reference	—
≥50	9,021	1.20 (1.16-1.25)	<0.001	14,372	1.72 (1.66-1.77)	<0.001
Race			<0.001			<0.001
White	9,730	Reference	—	14,356	Reference	—
Black	2,294	1.67 (1.59-1.74)	<0.001	3,153	1.56 (1.50-1.62)	<0.001
Others ^a	848	0.82 (0.76-0.87)	<0.001	1,167	0.76 (0.72-0.81)	<0.001
Unknown	26	0.46 (0.31-0.68)	<0.001	36	0.43 (0.31-0.60)	<0.001
Marital status			<0.001			<0.001
Married	6,592	Reference	—	8,663	Reference	—
Not married ^b	5,875	1.45 (1.40-1.50)	<0.001	9,407	1.77 (1.72-1.82)	<0.001
Unknown	431	1.17 (1.06-1.29)	0.001	642	1.34 (1.23-1.45)	<0.001
Laterality			0.033			0.065
Left	6,634	Reference	—	9,581	Reference	—
Right	6,263	0.96 (0.93-1.00)	0.034	9,125	0.97 (0.95-1.00)	0.052

Only one side, NOS	1	0.78 (0.11-5.12)	0.800	6	3.30 (1.48-7.34)	0.003
Grade			<0.001			<0.001
1 and 2	4,211	Reference	—	7,482	Reference	—
3 and UD	8,220	2.65 (2.56-2.75)	<0.001	10,529	1.91 (1.86-1.97)	<0.001
Unknown	467	1.65 (1.50-1.81)	<0.001	701	1.39 (1.28-1.50)	<0.001
ER status			<0.001			<0.001
Positive	7,308	Reference	—	11,691	Reference	—
Negative	5,057	2.92 (2.82-3.03)	<0.001	6,181	2.23 (2.16-2.30)	<0.001
Others ^c	533	1.66 (1.52-1.81)	<0.001	840	1.59 (1.49-1.71)	<0.001
PR status			<0.001			<0.001
Positive	5,530	Reference	—	9,086	Reference	—
Negative	6,708	2.79 (2.69-2.89)	<0.001	8,582	2.17 (2.11-2.24)	<0.001
Others ^c	660	1.75 (1.61-1.90)	<0.001	1,044	1.65 (1.55-1.76)	<0.001
HER2 status			<0.001			<0.001
Positive	395	Reference	—	523	Reference	—
Negative	2,119	1.15 (1.03-1.28)	0.013	2,962	1.21 (1.10-1.33)	<0.001
Others ^d	10,384	1.25 (1.12-1.38)	<0.001	15,227	1.33 (1.21-1.45)	<0.001
Breast surgery type			<0.001			<0.001
Mastectomy	8,803	Reference	—	5,892	Reference	—
BCS	3,894	0.56 (0.54-0.59)	<0.001	12,563	0.59 (0.58-0.61)	<0.001
No surgery	201	1.67 (1.45-1.92)	<0.001	257	1.49 (1.32-1.69)	<0.001
Radiotherapy			<0.001			<0.001
Yes	6,486	Reference	—	8,604	Reference	—
No	6,412	1.19 (1.15-1.24)	<0.001	10,108	1.42 (1.38-1.46)	<0.001
No. of positive LNs			<0.001			<0.001
1-3	6,254	Reference	—	10,244	Reference	—
4-9	3,802	2.27 (2.18-2.36)	<0.001	5,054	1.84 (1.78-1.90)	<0.001

≥10	2,808	4.34 (4.15-4.54)	<0.001	3,376	3.21 (3.09-3.34)	<0.001
Unknown	34	1.32 (0.94-1.85)	0.227	38	0.91 (0.66-1.25)	0.560

Note: ^aIncluding American Indian/Alaskan native and Asian/Pacific Islander.

^bIncluding divorced, separated, single (never married), and widowed.

^cIncluding borderline and unknown.

^dIncluding borderline and unknown and not 2010+breast.

Abbreviations: AJCC, American Joint Committee on Cancer; BCS, breast-conserving surgery; CI, confidence interval; ER, oestrogen receptor; HER2, human epidermal growth factor receptor 2; HR, hazard ratio; LNs, lymph nodes; n, the number of deaths; OBC, occult breast cancer; PR, progesterone receptor; UD, undifferentiated.

Table S2 Clinicopathological characteristics of patients with OBC and non-OBC

in a 1:1 matched group.

Variables	OBC, n=397 (%)	non-OBC, n=397 (%)	P-Value ^a
Year of diagnosis			0.943
2004-2009	216 (54.41)	215 (54.16)	
2010-2014	181 (45.59)	182 (45.84)	
Age at diagnosis			0.636
18-49	109 (27.46)	115 (28.97)	
≥50	288 (72.54)	282 (71.03)	
Race			1.000
White	318 (80.10)	316 (79.60)	
Black	47 (11.84)	53 (13.35)	
Others ^b	31 (7.81)	25 (6.30)	
Unknown	1 (0.25)	3 (0.75)	
Marital status			0.269
Married	230 (57.93)	221 (55.67)	
Not married ^c	155 (39.05)	155 (39.04)	
Unknown	12 (3.02)	21 (5.29)	
Laterality			0.778
Left	203 (51.13)	206 (51.89)	
Right	193 (48.62)	191 (48.11)	
Only one side, NOS	1 (0.25)	0 (0.00)	
Grade			0.183
1 and 2	29 (7.31)	24 (6.05)	
3 and UD	113 (28.46)	100 (25.19)	
Unknown	255 (64.23)	273 (68.76)	
AJCC stage			0.130
II	244 (61.46)	223 (56.17)	
III	153 (38.54)	174 (43.83)	
AJCC N stage			0.386
N1	244 (61.46)	254 (63.98)	
N2	78 (19.65)	77 (19.40)	
N3	75 (18.89)	66 (16.62)	
No. of positive LNs			0.087
1-3	248 (62.47)	264 (66.50)	
4-9	75 (18.89)	77 (19.40)	
≥10	60 (15.11)	48 (12.09)	

Unknown	14 (3.53)	8 (2.01)	
ER status			0.151
Positive	229 (57.68)	217 (54.66)	
Negative	143 (36.02)	141 (35.52)	
Others ^d	25 (6.30)	39 (9.82)	
PR status			0.078
Positive	162 (40.81)	144 (36.27)	
Negative	206 (51.89)	211 (53.15)	
Others ^d	29 (7.30)	42 (10.58)	
HER2 status			0.722
Positive	46 (11.59)	48 (12.09)	
Negative	115 (28.97)	118 (29.72)	
Others ^e	236 (59.44)	231 (58.19)	
Breast surgery type			0.242
BCS	66 (16.62)	66 (16.62)	
Mastectomy	179 (45.09)	202 (50.89)	
No surgery	152 (38.29)	129 (32.49)	
Radiotherapy			0.523
Yes	195 (49.12)	186 (46.85)	
No	202 (50.88)	211 (53.15)	

Note: ^a*P*-value was assessed using a conditional logistic regression.

^bIncluding American Indian/Alaskan native and Asian/Pacific Islander.

^cIncluding divorced, separated, single (never married), and widowed.

^dIncluding borderline and unknown.

^eIncluding borderline and unknown and not 2010+breast.

Abbreviations: AJCC, American Joint Committee on Cancer; BCS, breast-conserving surgery; ER, oestrogen receptor; HER2, human epidermal growth factor receptor 2; LNs, lymph nodes; NOS, not otherwise specified; OBC, occult breast cancer; PR, progesterone receptor; UD, undifferentiated.

Table S3 Univariable and multivariable analysis of breast cancer-specific survival (BCSS) and overall survival (OS) in a 1:1 matched group.

Variables	Univariable				Multivariable			
	BCSS		OS		BCSS		OS	
	HR (95% CI)	P-value	HR (95% CI)	P-value	HR (95% CI)	P-value	HR (95% CI)	P-value
Group								
OBC	0.93 (0.70-1.22)	0.590	0.85 (0.67-1.08)	0.175	0.40 (0.27-0.50)	<0.001	0.41 (0.31-0.52)	<0.001
non-OBC	Reference	—	Reference	—	Reference	—	Reference	—
Year of diagnosis								
2004-2009	Reference	—	Reference	—	Reference	—	Reference	—
2010-2014	0.90 (0.86-0.94)	<0.001	0.89 (0.86-0.93)	<0.001	0.93 (0.77-1.11)	0.402	1.02 (0.88-1.17)	0.831
Age at diagnosis (years)								
18-49	Reference	—	Reference	—	Reference	—	Reference	—
≥50	1.20 (1.16-1.25)	<0.001	1.72 (1.66-1.77)	<0.001	1.25 (1.20-1.30)	<0.001	1.72 (1.66-1.78)	<0.001
Race								
White	Reference	—	Reference	—	Reference	—	Reference	—
Black	1.67 (1.59-1.74)	<0.001	1.56 (1.50-1.62)	<0.001	1.31 (1.25-1.37)	<0.001	1.25 (1.20-1.30)	<0.001
Others ^a	0.82 (0.76-0.87)	<0.001	0.76 (0.72-0.81)	<0.001	0.79 (0.73-0.84)	<0.001	0.77 (0.72-0.82)	<0.001
Unknown	0.46 (0.31-0.68)	<0.001	0.43 (0.31-0.60)	<0.001	0.49 (0.33-0.72)	<0.001	0.44 (0.32-0.61)	<0.001
Marital status								
Married	Reference	—	Reference	—	Reference	—	Reference	—
Not married ^b	1.45 (1.440-1.50)	<0.001	1.77 (1.72-1.82)	<0.001	1.32 (1.27-1.36)	<0.001	1.58 (1.54-1.63)	<0.001
Unknown	1.17 (1.06-1.29)	0.001	1.34 (1.23-1.45)	<0.001	1.13 (1.03-1.25)	0.009	1.26 (1.16-1.36)	<0.001
Laterality								
Left	Reference	—	Reference	—				

Right	0.96 (0.93-1.00)	0.034	0.97 (0.94-1.00)	0.052				
Only one side, NOS	0.78 (0.11-5.51)	0.800	3.30 (1.48-7.34)	0.003				
Grade								
1 and 2	Reference	—	Reference	—	Reference	—	Reference	—
3 and UD	2.66 (2.55-2.75)	<0.001	1.91 (1.86-1.97)	<0.001	1.78 (1.71-1.85)	—	1.45 (1.40-1.50)	—
Unknown	1.65 (1.50-1.82)	<0.001	1.39 (1.28-1.50)	<0.001	1.32 (1.03-1.25)	—	1.18 (1.09-1.27)	—
AJCC stage								
II	Reference	—	Reference	—				
III	2.95 (2.84-3.05)	<0.001	2.25 (2.19-2.32)	<0.001				
ER status								
Positive	Reference	—	Reference	—	Reference	—	Reference	—
Negative	2.92 (2.82-3.02)	<0.001	2.23 (2.16-2.30)	<0.001	1.52 (1.44-1.60)	<0.001	1.40 (1.34-1.46)	<0.001
Others ^c	1.66 (1.52-1.81)	<0.001	1.59 (1.49-1.71)	<0.001	1.25 (1.06-1.47)	0.009	1.23 (1.07-1.40)	0.003
PR status								
Positive	Reference	—	Reference	—	Reference	—	Reference	—
Negative	2.79 (2.69-2.89)	<0.001	2.17 (2.11-2.23)	<0.001	1.64 (1.56-1.72)	<0.001	1.44 (1.38-1.50)	<0.001
Others ^c	1.75 (1.61-1.90)	<0.001	1.65 (1.55-1.76)	<0.001	1.29 (1.11-1.51)	<0.001	1.23 (1.07-1.40)	0.002
HER2 status								
Positive	Reference	—	Reference	—	Reference	—	Reference	—
Negative	1.15 (1.03--1.28)	0.013	1.21 (1.10-1.33)	<0.001	1.76 (1.33-1.44)	<0.001	1.63 (1.49-1.79)	<0.001
Others ^d	1.25 (1.12-1.38)	<0.001	1.33 (1.21-1.45)	<0.001	1.48 (1.21-1.82)	<0.001	1.60 (1.36-1.88)	<0.001
Breast surgery type								
Mastectomy	Reference	—	Reference	—	Reference	—	Reference	—
BCS	1.77 (1.71-1.84)	<0.001	1.68 (1.63-1.73)	<0.001	1.39 (1.33-1.44)	<0.001	1.35 (1.31-1.39)	<0.001
No surgery	2.96 (2.57-3.41)	<0.001	2.51 (2.21-2.84)	<0.001	3.00 (2.58-2.49)	<0.001	2.43 (2.13-2.78)	<0.001
Radiotherapy								
Yes	Reference	—	Reference	—	Reference	—	Reference	—

No	1.19 (1.15-1.24)	<0.001	1.42 (1.38-1.46)	<0.001	1.23 (1.19-1.27)	<0.001	1.39 (1.35-1.43)	<0.001
No. of examined LNs								
1-3	Reference	—	Reference	—				
4-9	1.26 (1.18-1.36)	<0.001	1.10 (1.04-1.16)	<0.001				
≥10	1.47 (1.38-1.57)	<0.001	1.15 (1.10-1.20)	<0.001				
No. of positive LNs								
1-3	Reference	—	Reference	—	Reference	—	Reference	—
4-9	2.27 (2.18-2.36)	<0.001	1.84 (1.78-1.90)	<0.001	2.13 (2.04-2.22)	<0.001	1.79 (1.73-1.86)	<0.001
≥10	4.34 (4.15-4.54)	<0.001	3.21 (3.09-3.34)	<0.001	3.79 (3.62-3.97)	<0.001	2.92 (2.81-3.04)	<0.001
Unknown	1.31 (0.94-1.85)	0.109	0.91 (0.66-1.25)	0.560	0.98 (0.69-1.36)	0.843	0.80 (0.58-1.11)	0.179

Note: ^aIncluding American Indian/Alaskan native and Asian/Pacific Islander.

^bIncluding divorced, separated, single (never married), and widowed.

^cIncluding borderline and unknown.

^dIncluding borderline and unknown and not 2010+breast.

Abbreviations: AJCC, American Joint Committee on Cancer; BCS, breast-conserving surgery; CI, confidence interval; ER, oestrogen receptor; HER2, human epidermal growth factor receptor 2; HR, hazard ratio; LNs, lymph nodes; OBC, occult breast cancer; PR, progesterone receptor; UD, undifferentiated.

Table S4 Clinicopathological characteristics of OBC patients in different treatment groups.

Variables	Mastectomy group, n=153 (%)	BCS group, n=151 (%)	ALND-only group, n=54 (%)	SLND-only group, n=36 (%)	P-value ^a
Year of diagnosis					0.933
2004-2009	85 (55.56)	80 (52.98)	31 (57.41)	19 (52.78)	
2010-2014	68 (44.44)	71 (47.02)	23 (42.59)	17 (47.22)	
Age at diagnosis					0.003
18-49	50 (32.68)	26 (17.22)	8 (14.81)	6 (16.67)	
≥50	103 (67.32)	125 (82.78)	46 (85.19)	30 (83.33)	
Race					0.500
White	127 (83.01)	117 (77.49)	45 (83.33)	27 (75.00)	
Black	20 (13.07)	19 (12.58)	4 (7.41)	7 (19.44)	
Others ^b	6 (3.92)	14 (9.27)	5 (9.26)	2 (5.56)	
Unknown	0 (0.00)	1 (0.66)	0 (0.00)	0 (0.00)	
Marital status					0.154
Married	93 (60.78)	88 (58.28)	28 (51.85)	13 (36.11)	
Not married ^c	58 (37.91)	59 (39.07)	25 (46.30)	21 (58.33)	
Unknown	2 (1.31)	4 (2.65)	1 (1.85)	2 (5.56)	
Laterality					0.445
Left	72 (47.06)	82 (54.30)	30 (55.56)	21 (58.33)	
Right	81 (52.94)	69 (45.70)	24 (44.44)	15 (41.67)	
Grade					0.635
1 and 2	11 (7.19)	9 (5.96)	2 (3.70)	0 (0.00)	
3 and UD	39 (25.49)	36 (23.84)	13 (24.08)	7 (19.44)	
Unknown	103 (67.32)	106 (70.20)	39 (72.22)	29 (80.56)	
AJCC stage					0.022

II	82 (53.59)	83 (54.97)	28 (51.85)	29 (80.56)	
III	71 (46.41)	68 (45.03)	26 (48.15)	7 (19.44)	
AJCC N stage					0.071
N1	82 (53.60)	83 (54.97)	28 (51.85)	29 (80.56)	
N2	37 (24.18)	33 (21.85)	14 (25.93)	1 (2.78)	
N3	34 (22.22)	35 (23.18)	12 (22.22)	6 (16.67)	
ER status					0.501
Positive	83 (54.25)	89 (58.94)	34 (62.96)	16 (44.44)	
Negative	59 (38.56)	53 (35.10)	16 (29.63)	15 (41.67)	
Others ^d	11 (7.19)	9 (5.96)	4 (7.41)	5 (13.89)	
PR status					0.438
Positive	52 (33.99)	63 (41.72)	24 (44.45)	13 (36.11)	
Negative	87 (56.86)	74 (49.01)	23 (42.59)	17 (47.22)	
Others ^{c,d}	14 (9.15)	14 (9.27)	7 (12.96)	6 (16.67)	
HER2 status					0.990
Positive	19 (12.42)	17 (11.26)	6 (11.11)	5 (13.89)	
Negative	41 (26.80)	46 (30.46)	15 (27.78)	9 (25.00)	
Others ^e	93 (60.78)	88 (58.28)	33 (61.11)	22 (61.11)	
No. of positive LNs					0.003
1-3	80 (52.29)	80 (52.98)	31 (57.41)	34 (94.44)	
4-9	37 (24.18)	33 (21.85)	12 (22.22)	1 (2.78)	
≥10	32 (20.92)	31 (20.53)	10 (18.52)	0 (0.00)	
Unknown	4 (2.61)	7 (4.64)	1 (1.85)	1 (2.78)	

Note: ^aP-value was assessed using the Pearson's χ^2 test or Fisher's exact test.

^bIncluding American Indian/Alaskan native and Asian/Pacific Islander.

^cIncluding divorced, separated, single (never married), and widowed.

^dIncluding borderline and unknown.

^eIncluding borderline and unknown and not 2010+breast.

Abbreviations: AJCC, American Joint Committee on Cancer; ALND, axillary lymph node dissection; BCS, breast-conserving surgery; ER, oestrogen receptor; HER2, human epidermal growth factor receptor 2; LNs, lymph nodes; OBC, occult breast cancer; PR, progesterone receptor; SLND, sentinel lymph node dissection; UD, undifferentiated.

Table S5 Univariable analysis of breast cancer-specific survival (BCSS) and overall survival (OS) in OBC patients.

Variables	BCSS			OS		
	n	HR (95% CI)	P-value	n	HR (95% CI)	P-value
Year of diagnosis						
2004-2009	31	Reference	—	45	Reference	—
2010-2014	10	1.03 (0.48-2.21)	0.070	12	0.99 (0.49-1.99)	0.966
Age at diagnosis						
18-49	8	Reference	—	9	Reference	—
≥50	33	1.44 (0.66-3.11)	0.359	48	1.88 (0.92-3.84)	0.082
Race						
White	36	Reference	—	48	Reference	—
Black	4	0.75 (0.27-2.12)	0.591	7	0.98 (0.44-2.17)	0.962
Others ^a	1	0.42 (0.06-3.03)	0.387	2	0.60 (0.14-2.46)	0.474
Marital status						
Married	22	Reference	—	29	Reference	—
Not married ^b	17	1.19 (0.63-2.24)	0.596	26	1.41 (0.83-2.39)	0.209
Unknown	2	2.33 (0.55-9.98)	0.253	2	1.94 (0.46-8.18)	0.365
Laterality						
Left	22	Reference	—	30	Reference	—
Right	19	0.92 (0.50-1.71)	0.800	27	0.99 (0.56-1.60)	0.843
Grade						
1 and 2	1	Reference	—	1	Reference	—
3 and UD	14	2.51 (0.33-19.12)	0.373	19	3.40 (0.46-25.42)	0.233
Unknown	26	1.68 (0.23-12.39)	0.611	37	2.41 (0.33-17.56)	0.386
ER status						

Positive	15	Reference	—	21	Reference	—
Negative	21	2.11 (1.09-4.10)	0.027	30	2.12 (1.21-3.70)	0.008
Unknown ^c	5	2.25 (0.82-6.20)	0.116	6	1.92 (0.77-4.76)	0.160
PR status						
Positive	10	Reference	—	14	Reference	—
Negative	26	1.99 (0.96-4.12)	0.065	36	1.94 (1.05-3.60)	0.035
Unknown ^c	5	1.58 (0.54-4.63)	0.403	7	1.55 (0.63-3.85)	0.344
HER2 status						
Positive	1	Reference	—	1	Reference	—
Negative	9	3.84 (0.49-30.29)	0.202	10	4.29 (0.55-33.52)	0.165
Unknown ^d	31	2.45 (0.33-18.32)	0.382	46	3.20 (0.43-23.69)	0.254
Treatment strategy						
Mastectomy group	17	Reference	—	24	Reference	—
BCS group	12	0.67 (0.32-1.41)	0.292	14	0.55 (0.29-1.07)	0.077
ALND-only group	4	0.69 (0.23-2.04)	0.499	7	0.85 (0.37-1.98)	0.709
SLND-only group	8	2.42 (1.04-5.61)	0.040	12	2.59 (1.29-5.18)	0.007
No. of positive LNs						
1-3	11	Reference	—	18	Reference	—
4-9	9	2.17 (0.90-5.24)	0.084	15	2.20 (1.11-4.37)	0.024
≥10	19	5.21 (2.48-10.95)	<0.001	21	3.50 (1.87-6.57)	<0.001
Unknown	2	6.55 (1.44-29.88)	0.015	3	6.60 (1.92-22.80)	0.003

Note: ^aIncluding American Indian/Alaskan native and Asian/Pacific Islander.

^bIncluding divorced, separated, single (never married), and widowed.

^cIncluding borderline and unknown.

^dIncluding borderline and unknown and not 2010+breast.

Abbreviations: AJCC, American Joint Committee on Cancer; ALND, axillary lymph node dissection; BCS, breast-conserving surgery; CI, confidence interval; ER, oestrogen receptor; HER2, human epidermal growth factor receptor 2; HR, hazard ratio;

LNs, lymph nodes; n, the number of deaths; OBC, occult breast cancer; PR, progesterone receptor; SLND, sentinel lymph node dissection; UD, undifferentiated.

Table S6 Clinical outcomes of OBC in different treatment groups.

Variables	Treatment groups				P-Value	P-Value ^a					
	I. Mastectomy group (n=153)	II. BCS group (n=151)	III. ALND- only group (n=54)	IV. SLND- only group (n=36)		I vs. II	I vs. III	I vs. IV	II vs. III	II vs. IV	III vs. IV
5-year BCSS	88.41%	91.86%	90.96%	75.13%	0.023	0.588	0.785	<0.001	0.535	<0.001	0.004
5-year OS	84.27%	91.13%	85.84%	64.22%	<0.001	0.331	0.527	<0.001	0.125	<0.001	0.002

Note: ^aMultivariable analysis adjusted for oestrogen receptor (ER), progesterone receptor (PR) and number of positive lymph nodes by Cox's proportional hazard regression model.

Abbreviations: ALND, axillary lymph node dissection; BCS, breast-conserving surgery; OBC, occult breast cancer; SLND, sentinel lymph node dissection.

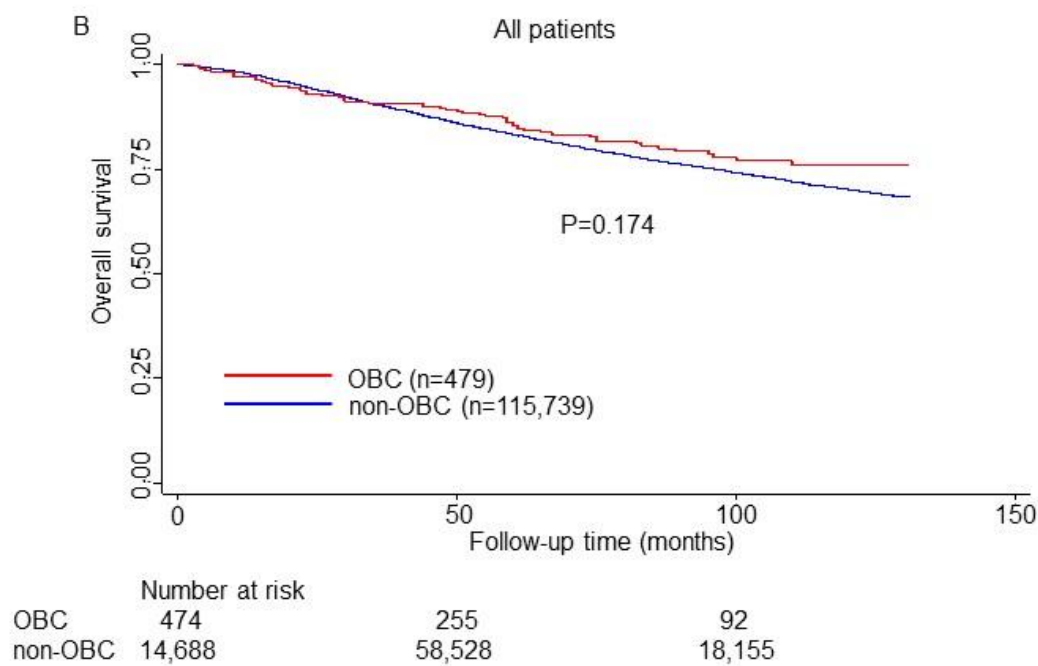
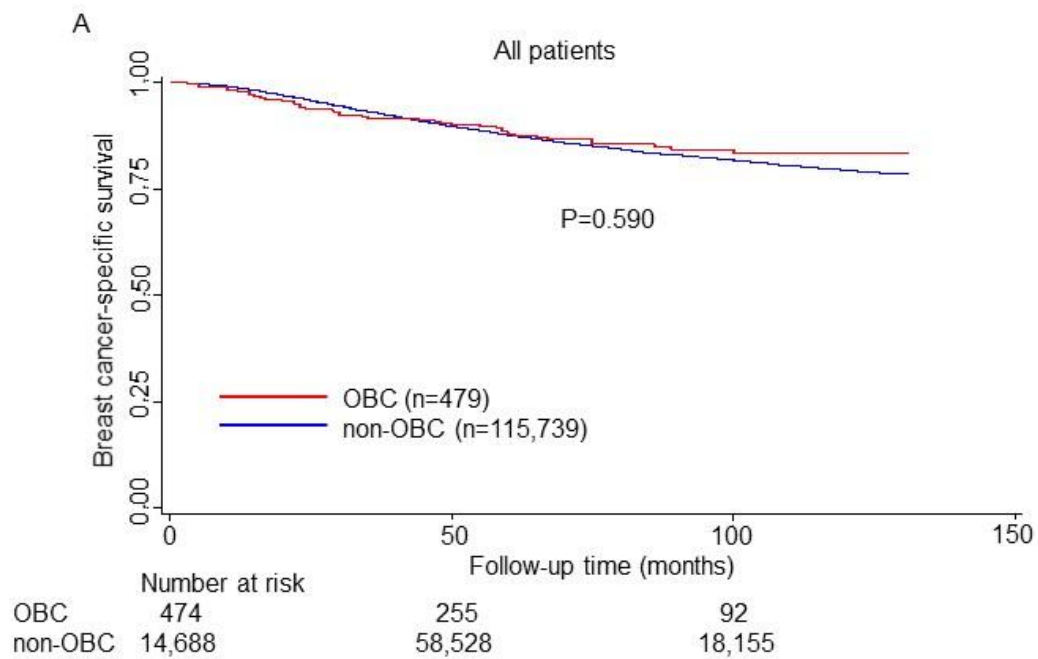


Figure S1 Kaplan-Meier survival curves for all patients.

Note: (A) Breast cancer-specific survival. (B) Overall survival. Log-rank tests were compared between OBC and non-OBC patients.

Abbreviations: OBC, occult breast cancer.