Joint Breast Cancer Registry

3rd REPORT

JOINT BREAST CANCER REGISTRY

REPORT NO. 3

OCTOBER 2022

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Joint Breast Cancer Registry

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Foreword

Professor Kenneth Kwek
Deputy Group Chief Executive Officer (Innovation & Informatics)
SingHealth

The information from the entire journey of cancer patients as they seek care provides valuable insights to doctors, researchers, public health specialists and policy-makers in our efforts to win the race against cancer. This information resides in Registries which can shed light on many facets, such as on risk factors and cancer literacy from which targeted preventive measures and public health planning may be undertaken. They can identify unmet needs in cancer management so that attention can be directed to address them.

As the leading cancer in women, breast cancer impacts significantly on the health of women in Singapore and around the world. As Singapore's largest breast cancer specific database, the Joint Breast Cancer Registry has underpinned much research undertaken in SingHealth and our collaborators. From JBCR, we have learned much about this disease and the care of affected patients. This multi-institutional collaboration is an example of how we can enhance our Oncologic services for our patients by garnering technology and advances in cancer informatics.

With the growing emphasis on population health, JBCR is well placed to further not only our understanding of breast cancer but also its prevention in the general population and the targeted screening in high-risk women, as well as the long term care of cancer survivors and their family.

I commend all investigators and patients who have generously contributed to this registry and it is with great pleasure that I endorse this third report from the Joint Breast Cancer Registry.

Foreword to JBCR Report No. 2

Professor William Hwang
Chief Executive Officer
National Cancer Centre Singapore

It gives me great pleasure to pen this foreword for the 2nd Report of the Joint Breast Cancer Registry (JBCR). This is an excellent collaborative effort by specialists from multiple disciplines across all institutions in SingHealth to build a registry of breast cancer patients. There is tremendous potential to use this data to help inform healthcare providers, the public and policy makers. It will serve as a platform to lobby for resources, as well as to serve as a treasure trove for retrospective review and future planning.

I would like to congratulate Dr Wong Fuh Yong, Lian Wei Xiang and Dr Wong Ru Xin as well as all contributors of the JBCR for having put together this important work. This is an excellent example of how we can achieve more when we work together and I am very proud of them.

Acknowledgement

We would like to thank our Joint Breast Cancer Registry members who have contributed towards the Registry.

Wong Fuh Yong (PI)	NCC	Lim Sheng An	NCC	Koo Si-Lin	NCC	Wee Hwee Lin	NUS
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Lim Geok Hoon (Site-PI)	KKH	Lim Swee Ho	KKH	Lee Jung Ah	KKH	Wong Su Lin Jill	NCC
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Jain Amit	NCC	Tan Qing Ting	KKH				
Julie Liana bte Hamzah	SGH	Tan Ser Huey Janice	NCC				
Kuah Sherwin	TTSH	Tan Si Ying	SGH				
Koh Si Ya Natalie	NHC	Tan Yong Cheng Benjamin	SGH				
Koh Wee Yao	NUH	Tan Ying Cong Ryan Shea	NCC				

We would also like to express our appreciation to Yeo Sook Kwan for her unstinting support in the research administration of JBCR; and Phyu Nitar for her tireless maintenance of the core database that makes JBCR possible. We have also received immeasurable support by colleagues in Department of Cancer Informatics, NCCS, Data Coordinators in KKH and CGH as well as informatics colleagues in Ehints and IHIS.

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1. JBCR overview

The Joint Breast Cancer Registry (JBCR) is a prospectively maintained database of breast cancer patients managed in institutions of the Singapore Health Services Pte Ltd (SingHealth). The Database began in 2005 as a retrospective audit of patients treated with breast conserving therapy in NCCS. Over the subsequent years, JBCR expanded to include patients from SGH (2007), KKH (2010), CGH and SKH (2018), and NHC (2020). In addition, we have established various research collaborations with A*Star, Dukes-NUS, NTU and SMU. In the last year, JBCR has expanded to include TTSH and NUH (2021).

JBCR is conducted with ethics approval by SingHealth Centralized Institutional Review Board; CIRB 2019/2419 (2012/093/A), CIRB 2018/2449 (2014/894/A).

This report included 28,692 patients diagnosed from January 1960 to December 2019 in Changi General Hospital, Kandang Kerbau Women's and Children's Hospital, National Cancer Centre Singapore, Singapore General Hospital, and Sengkang General Hospital. 28,628 patients were included in the analysis (Figure 1-1).

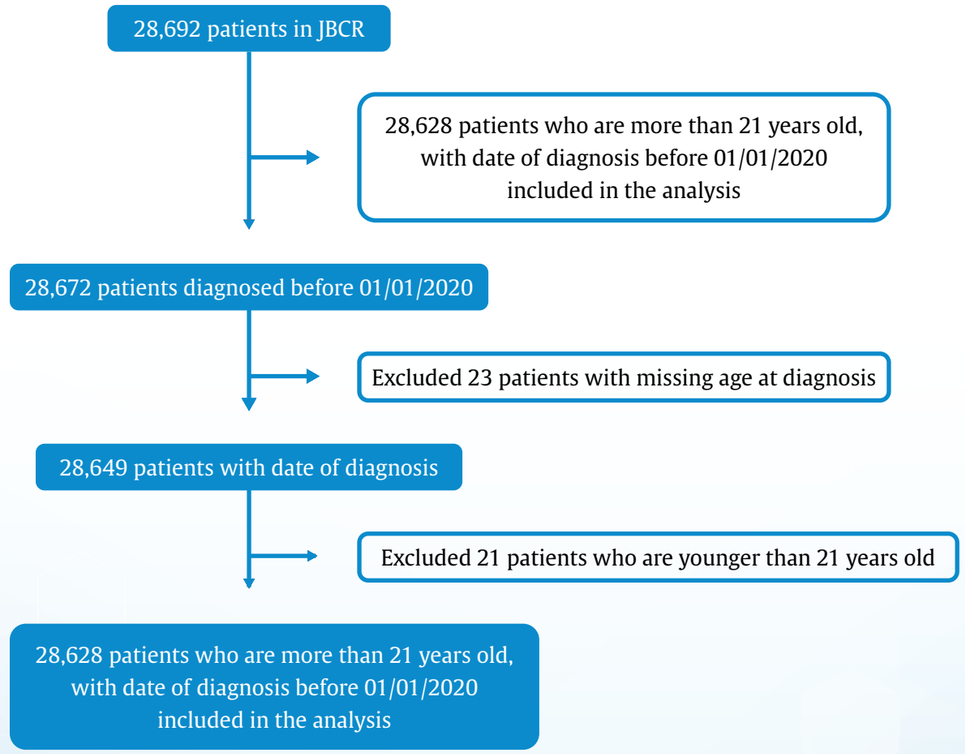


Figure 1-1. Joint breast cancer registry (JBCR) profile.

Using a combination of automatic data retrieval from existing clinical processes such as tumour boards and semi-automatic scripted retrieval from various clinical databases as well as manual data entry, in addition to a rigorous process of data verification, we endeavoured to keep JBCR accurate, detailed, up-to-date and as complete as possible. Completeness was defined as patients with complete information of the following variables: patient's identifier (name, NRIC, date of birth), stage, and tumour subtype (HER2 data is available for 91% of patients diagnosed after 2006). (Figure 1-2)

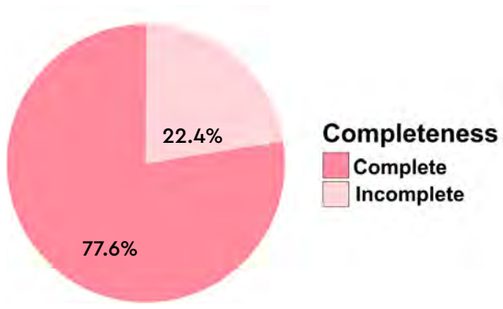


Figure 1-2. Completeness of JBCR database (n=28,628).

In this report, the JBCR cohort has been stratified into invasive and non-invasive breast cancer. Non-invasive cases include ductal carcinoma in situ (DCIS), lobular carcinoma in situ (LCIS), encysted papillary cancer, intraductal, benign and borderline phyllodes tumour. All other histologies were defined as invasive cancer.

There were 25,529 invasive breast cancer patients and 3,062 non-invasive breast cancer cases. Number of new cases diagnosed per year is shown in Figure 1-3.

Median follow-up for the whole cohort is 5 years (IQR: 2 – 11) with at least 16 thousand patients followed up for minimally 5 years and nearly nine thousand patients followed up for 10 years. (Figure 1-4 and Table 1-1).

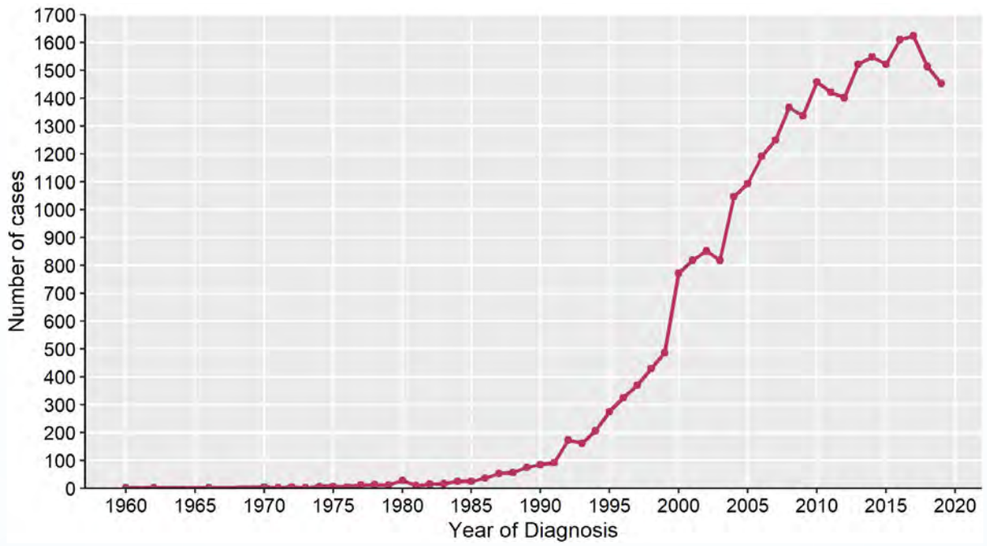


Figure 1-3. Number of newly-diagnosed cases each year.

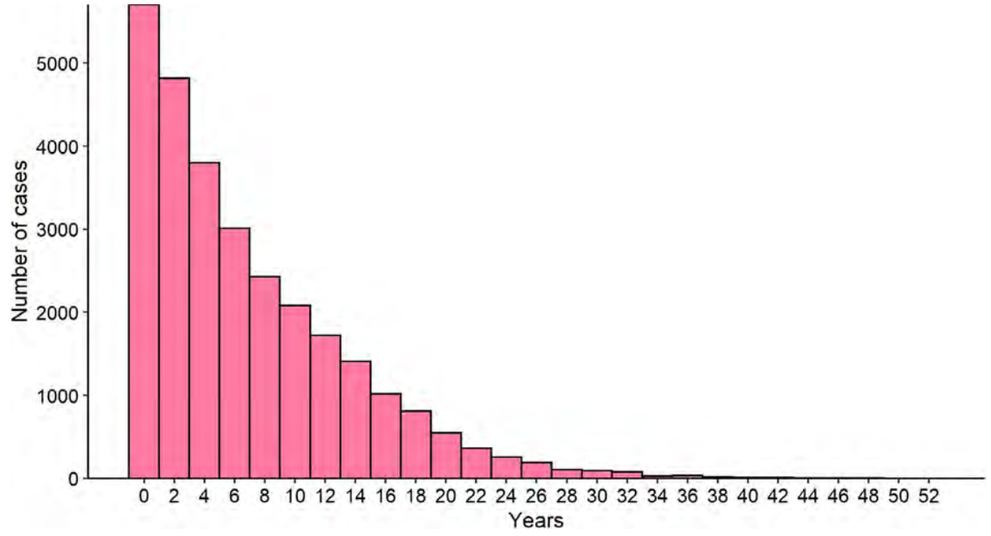


Figure 1-4. Histogram demonstrating relation between number of cases and follow-up duration (Total n=28,544; 84 missing data were excluded).

Table 1-1. Number of cases according to follow-up duration.

Duration of follow-up [years]	Number of cases (%)
≥ 2	22,836 (80)
≥ 5	16,078 (56)
≥ 10	8,783 (31)
≥ 15	4,229 (15)

INVASIVE BREAST CANCER

2. Demographics

2.1. Age and race

The average age at diagnosis is 54 years old (range, 21-103) with a gradual increase, starting from an average of 40 years old before the 1970s, to 56 years old in the latest decade. (Figure 2-1, 2-2)

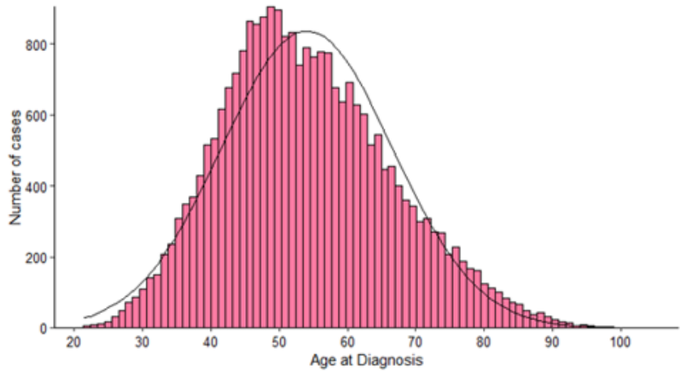


Figure 2-1. Histogram of age at diagnosis (Total n=25,527; 2 missing data were excluded).

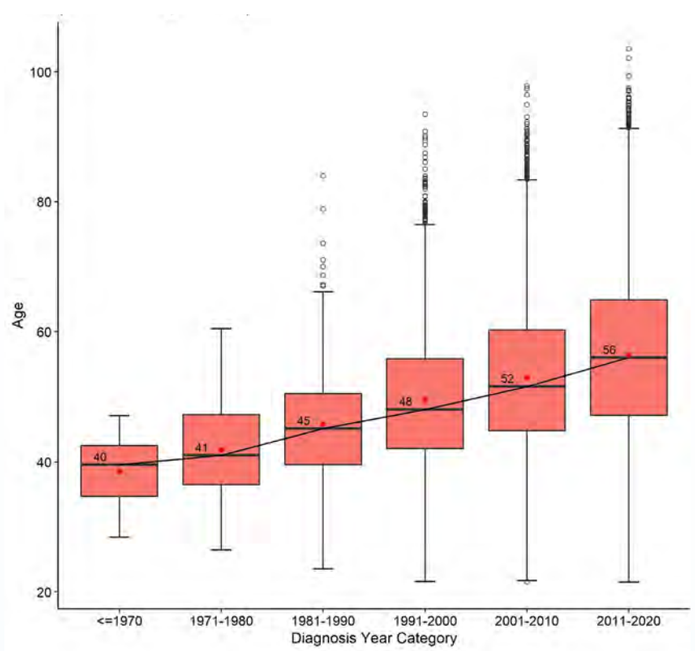


Figure 2-2. Boxplot of age by diagnosis year (Total n=25,257; 2 missing data excluded)

As local residents contributed to about 83% of the JBCR cohort, local data are represented separately whenever appropriate to better represent the nature of the disease and patient outcomes.

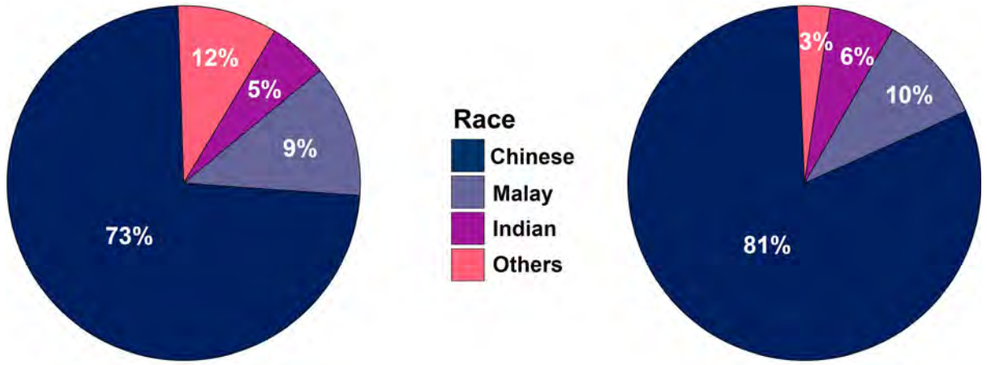


Figure 2-3. a) Distribution of the whole JBCR cohort by ethnicity (n=25,528, 1 unknown excluded). b) Distribution of Singaporean patients in the JBCR cohort by ethnicity (n=21,159)

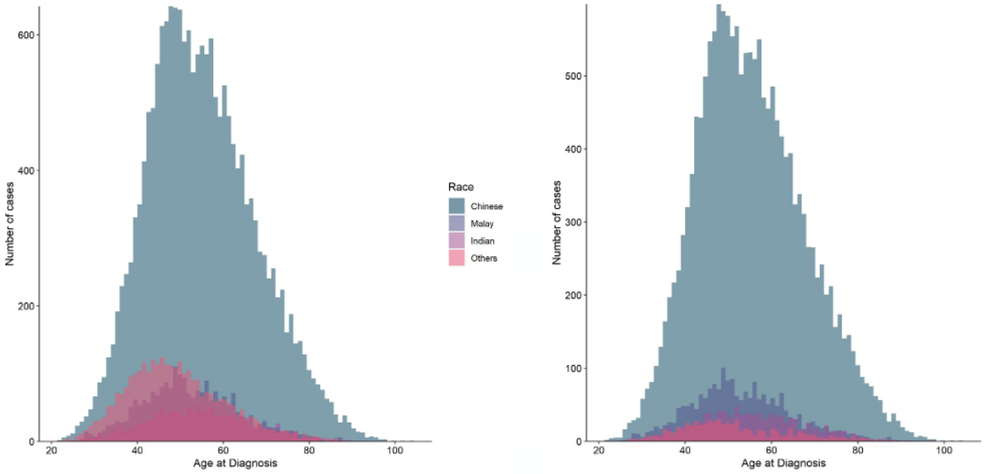


Figure 2-4. a) Distribution of age at diagnosis according to race in the whole cohort n=25,526, 2 missing data were excluded). b) Distribution of age at diagnosis according to race among Singaporean cohort (n=21,159).

Table 2-1. Age at diagnosis stratified by race.

Age at diagnosis stratified by race of whole JBCR cohort		
Race	Median age [years]	IQR
Chinese	53.9	45.9 - 63.2
Malay	51.3	4.5 - 59.9
Indian	54.4	46.1 - 63.4
Others	47.9	40.9 - 56.3

Age at diagnosis stratified by race of Singaporean residents only		
Race	Median age [years]	IQR
Chinese	53.9	45.9 - 63.2
Malay	51.3	4.5 - 59.9
Indian	54.4	46.1 - 63.4
Others	47.9	40.9 - 56.3

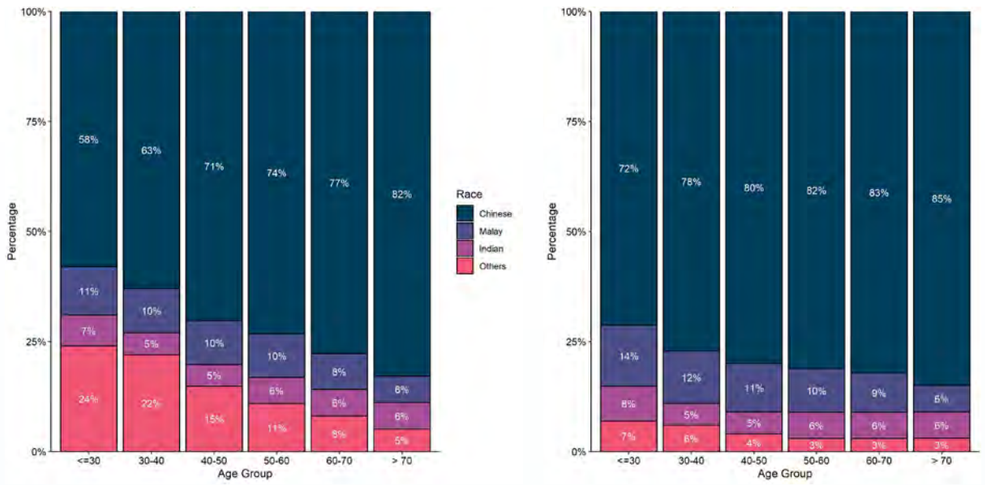


Figure 2-5. a) Distribution of patients' ethnicity by age group in the whole cohort (n=25,526; 2 missing data were excluded). b) Distribution of patients' ethnicity by age group among Singaporean cohort (n=21,159).

2.2. Menopausal status

Post-menopausal patients account for the majority of breast cancer patients in our JBCR cohort (Table 2-2). Among the 3 major races, 41% of Malays were premenopausal at diagnosis, compared to 61% and 62% for Chinese and Indian, respectively (Figure 2-6).

Table 2-2. Menopausal status at diagnosis in Singaporean cohort.

Menopausal status	n (%)
Premenopausal	4660 (34.4)
Perimenopausal	647 (4.8)
Postmenopausal	8103 (59.8)
Pregnancy-related	61 (0.5)
N/A	68 (0.5)

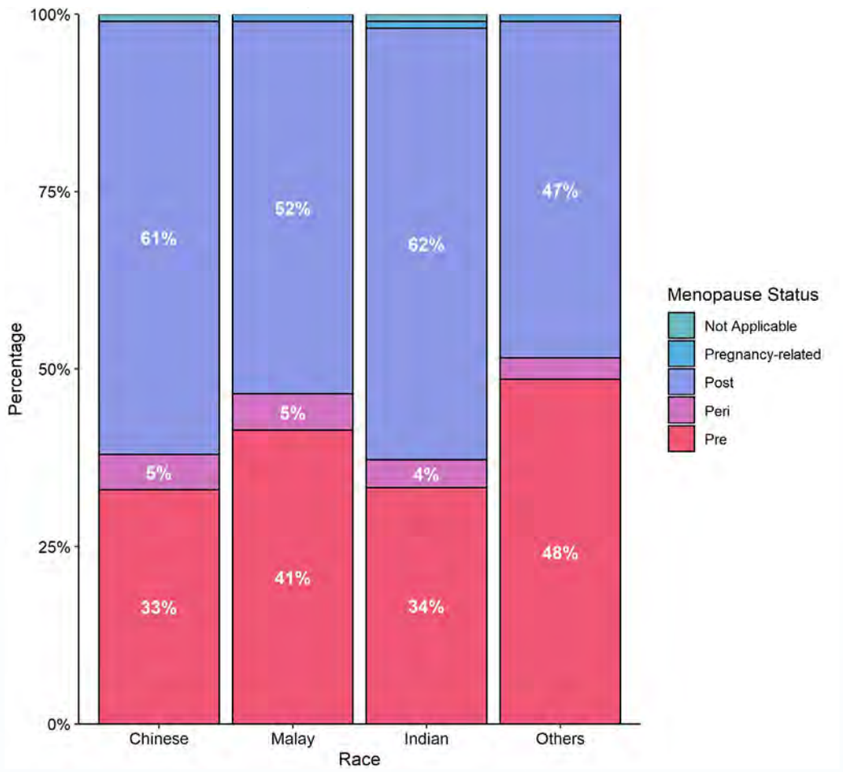


Figure 2-6. Distribution of patients' menopausal status stratified by race (n=13,539; 7620 missing data were excluded)

2.3. Presentation

Despite strong drive of screening mammogram, 77% (n=7120) of the cohort presented with clinically detectable cancers, while only 23% (n=2086) of the cases were detected radiologically. Majority of patients aged 40-70 years old among all 3 major races, in particular Malays (84% compared to 76% of Chinese or 77% of Indian patients, respectively), still presented clinically (Figure 2-7 and 2-8).

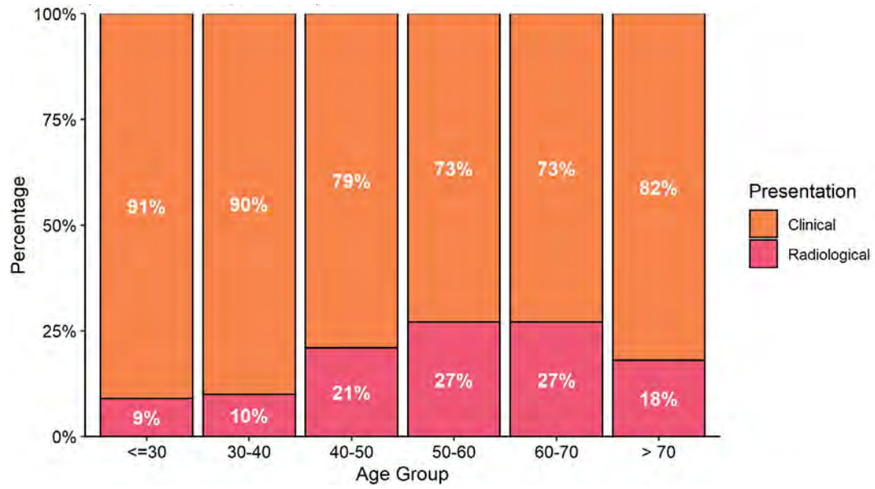


Figure 2-7. Type of presentation stratified by age group in Singaporean cohort (n=9,206; 78 unknown and 11,875 missing data were excluded).

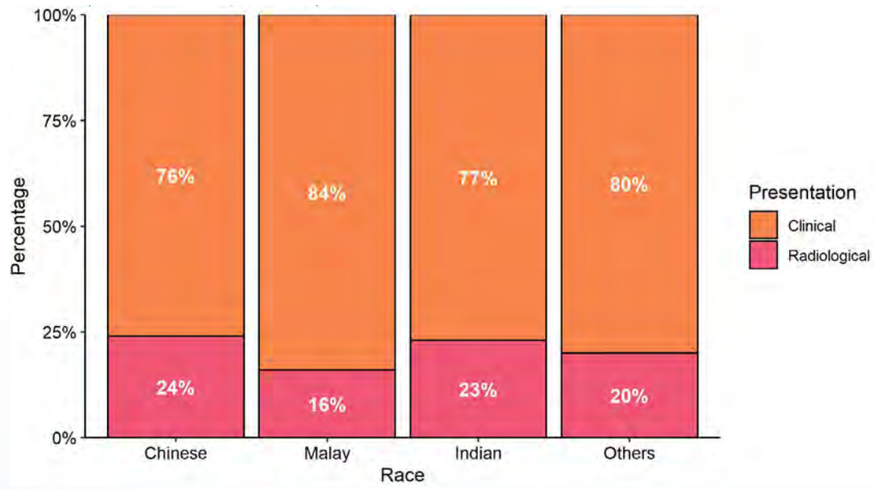
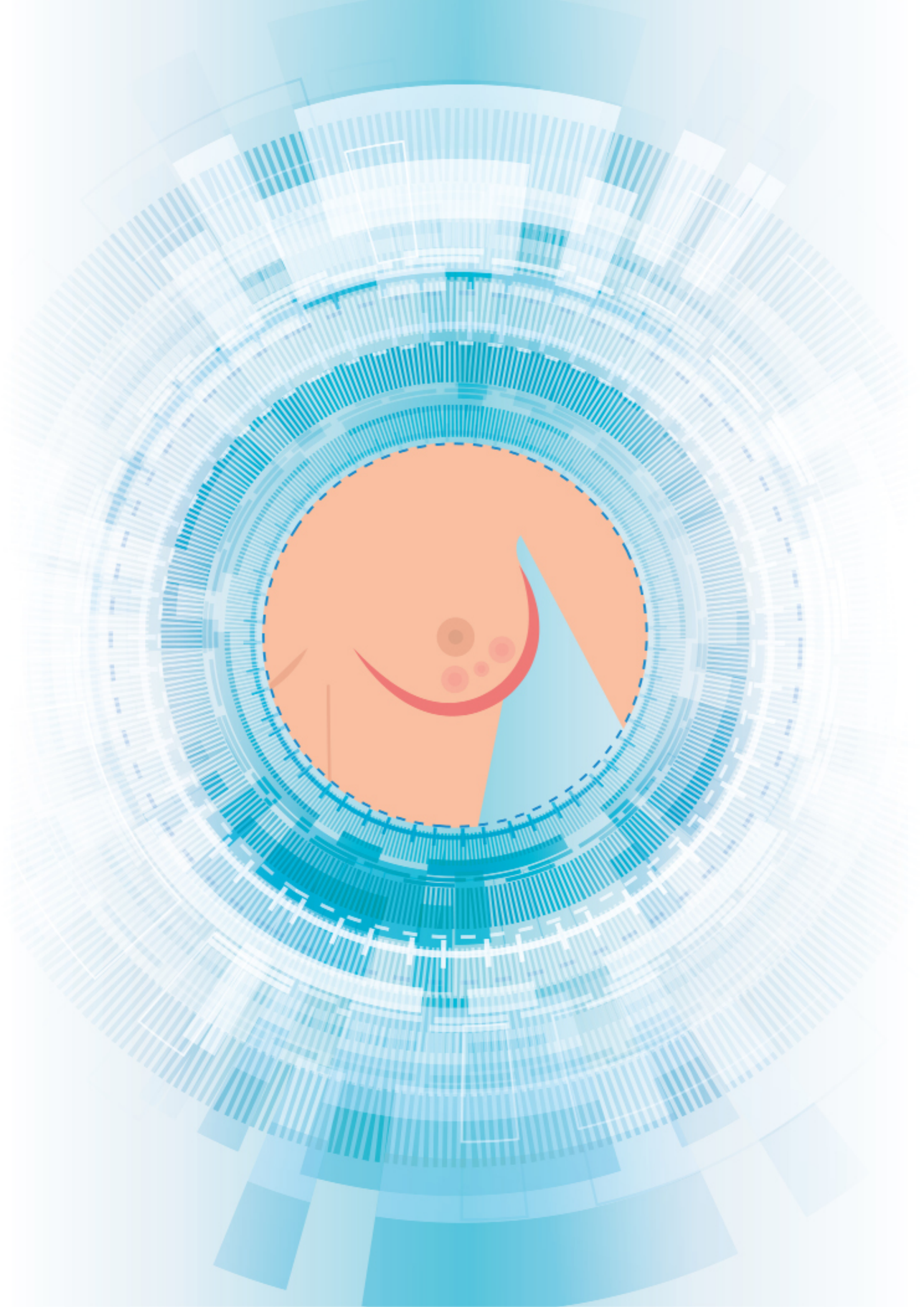


Figure 2-8. Type of presentation based on race in Singaporean cohort (n=9,206; 78 unknown and 11,875 missing data were excluded).



3. Tumour characteristics

3.1. Histology

Among all invasive cancers, invasive ductal carcinoma was the most common histology found in our cohort (74.25%), followed by invasive lobular carcinoma (4.55%). (Table 3-1)

Table 3-1. Various histology type in JBCR cohort.

Histology	n (%)
Invasive ductal carcinoma	20,394 (74.25)
Ductal carcinoma in situ	2,979 (10.85)
Invasive lobular carcinoma	1,250 (4.55)
Mucinous carcinoma	627 (2.28)
Mixed ductal and lobular carcinoma	369 (1.34)
Invasive papillary carcinoma	228 (0.83)
Malignant cystosarcoma phyllodes	156 (0.57)
Metaplastic carcinoma	143 (0.52)
Medullary carcinoma	139 (0.51)
Others	1,182 (4.30)

3.2. Histology subtype

Our institution adopted the definition of histology subtype outlined by Goldhirsch, et al.1 (Figure 3-1). Luminal A subtype is the most prevalent, while only 11% patients were ER/PR- and HER2+. Of note, about 18.4% of our JBCR cohort were unclassified as HER2 status was not available prior to 2006.

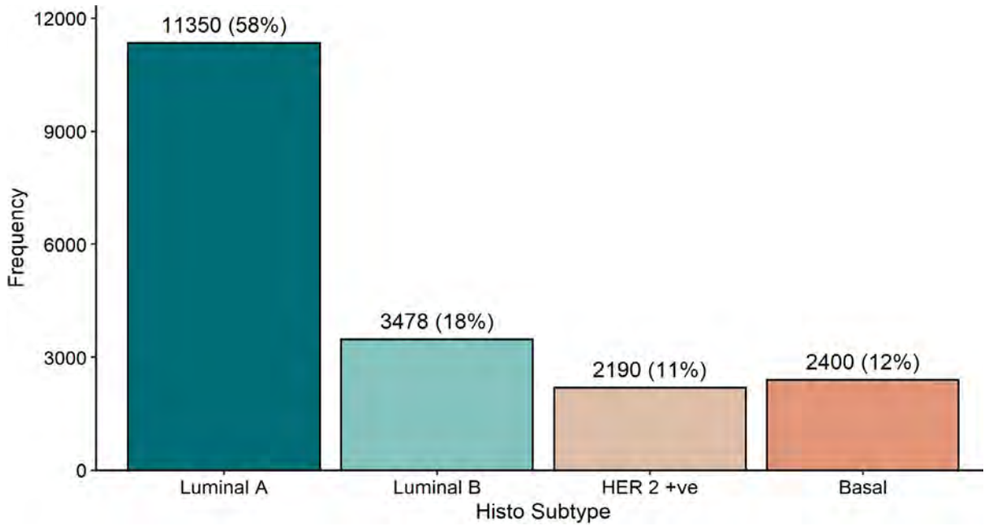


Figure 3-1. Distribution based on histology subtype (n=19,418; 6,111 missing data were excluded).

While luminal A is still the most prevalent subtype across all age group, it is observed that patients aged 30 or younger had the highest proportion of basal subtype compared to older patients (Figure 3-2).

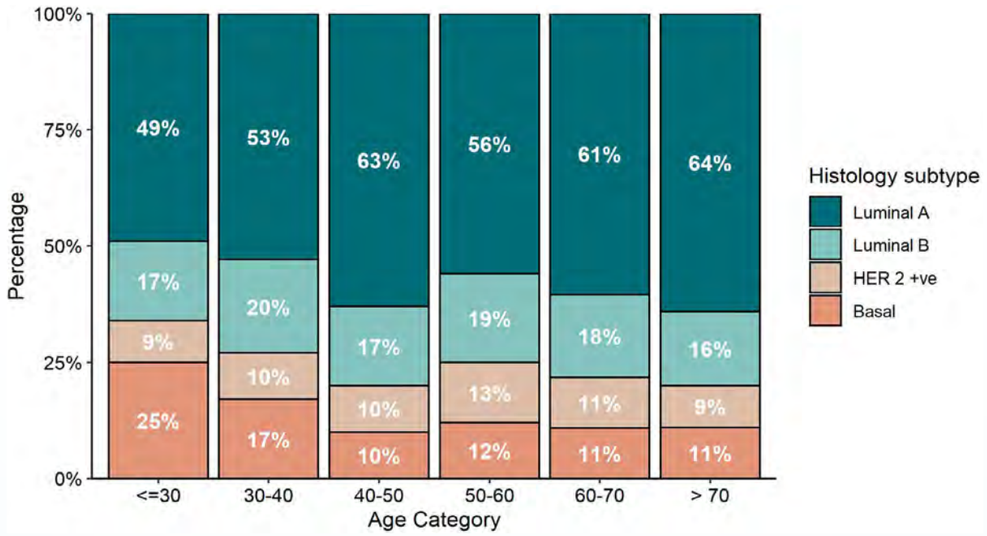


Figure 3-2. Distribution of histology subtype stratified by age group (n=16,054; 1,841 missing data were excluded).

Among the 3 major races in Singapore, the Chinese have the highest proportion of luminal A compared to the Malays (56%) and Indians (57%) (Figure 3-3).

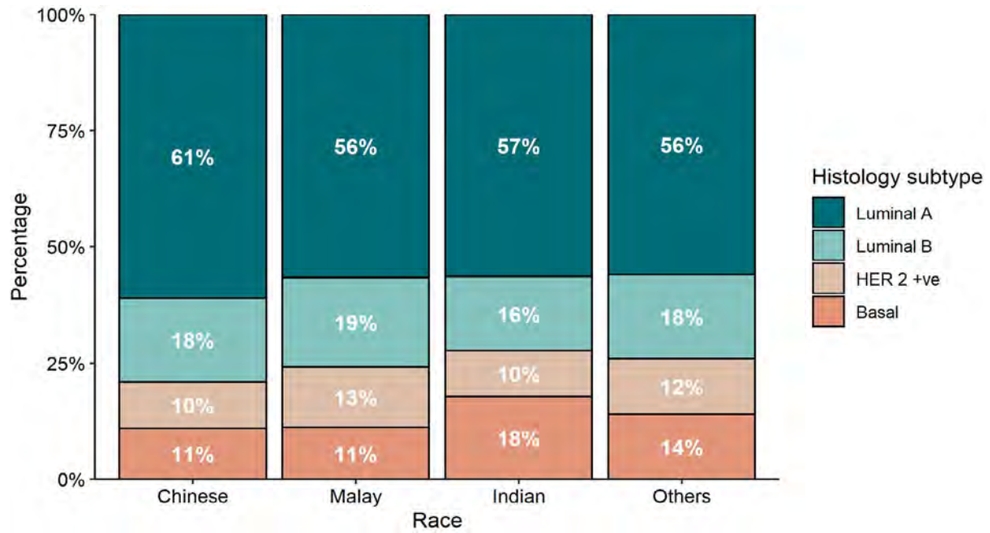


Figure 3-3. Distribution of histology subtype based on race (n=16,054; 1,841 missing data were excluded).

Screened tumours are more indolent with 68% being luminal A as compared to 60% of that in clinically detected cancers (Figure 3-4). Consistently, grade 1 tumours consist mostly of luminal A (91%), whereas 20% of grade 3 tumours were of basal subtype (Figure 3-5). Patients with stage I cancer also had the highest proportion of luminal A tumours (69%) compared to the more advanced stage 3 (51%) and stage 4 (50%), respectively (Figure 3-6).

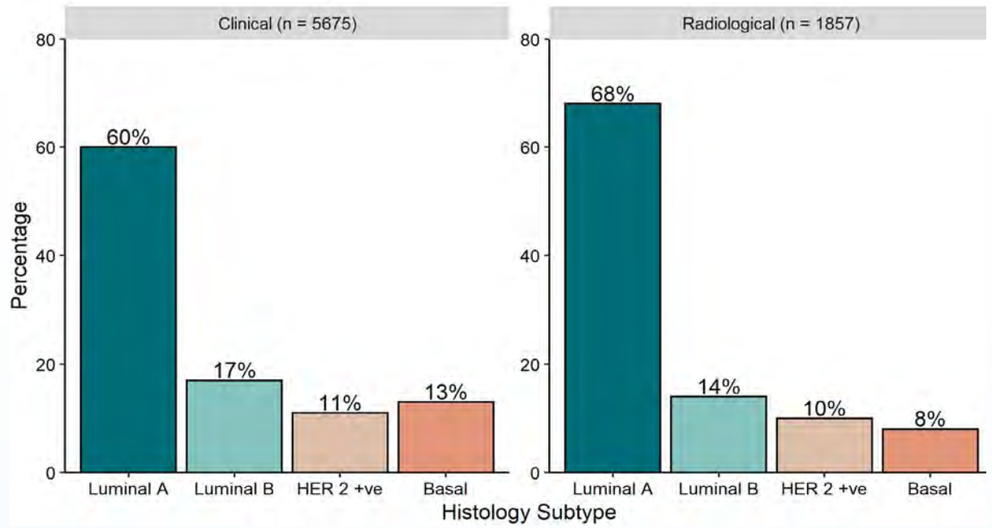


Figure 3-4. Distribution of histology subtypes based on mode of presentation (n=7,532; 10,303 missing data were excluded).

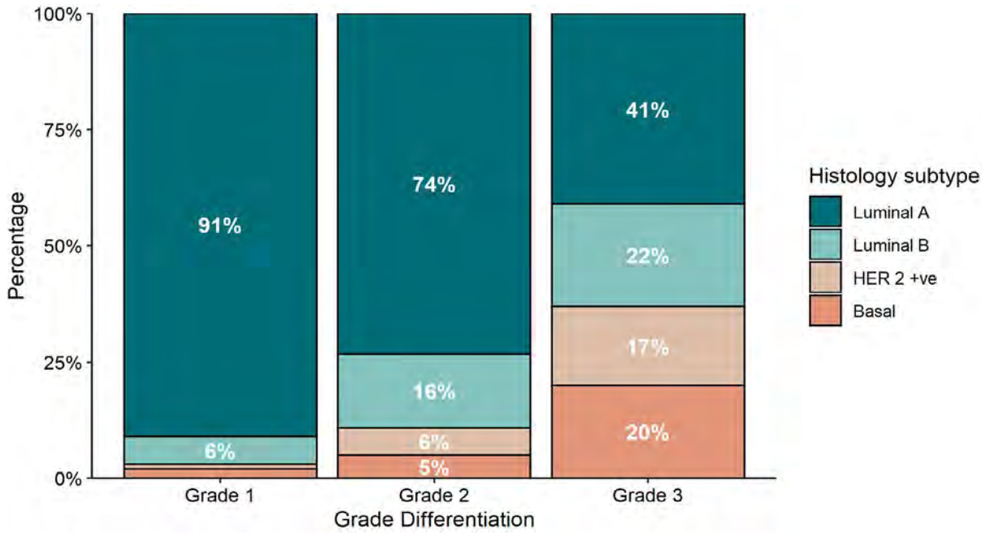


Figure 3-5. Distribution of histology subtype stratified by grade differentiation (n=14,424; 1,957 missing data were excluded).

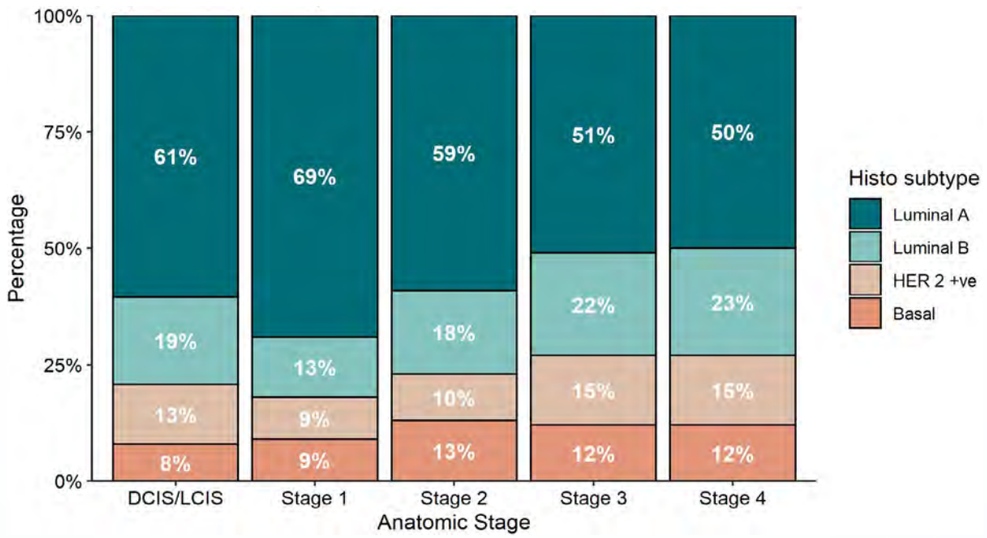


Figure 3-6. Distribution of histology subtype stratified by anatomic stage (n=15,818; 4,114 missing data were excluded).

3.3. Grade differentiation

Overall, majority of the cases were grade 3 (46%, n=9,592) (Figure 3-7). Most of the screen-detected tumours were of lower grade (grade 2; 48%) (Figure 3-8). Among all races, Malays have highest rate of grade 1 tumours (56%) compared to others (44-47%), and least proportion of grade 3 (9%, vs. 12% in other races) (Figure 3-9).

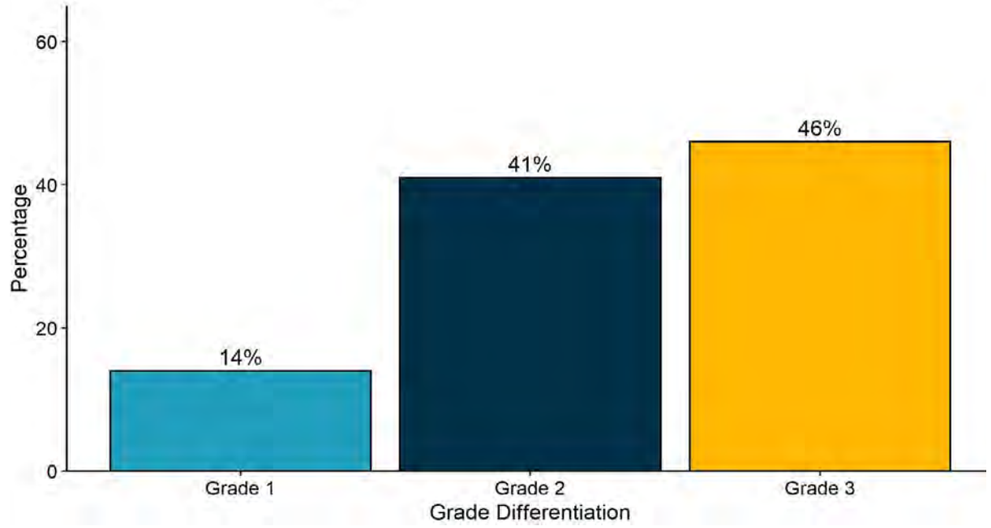


Figure 3-7. Distribution of cases be tumour grade (n=20,853; 4,676 missing data were excluded).

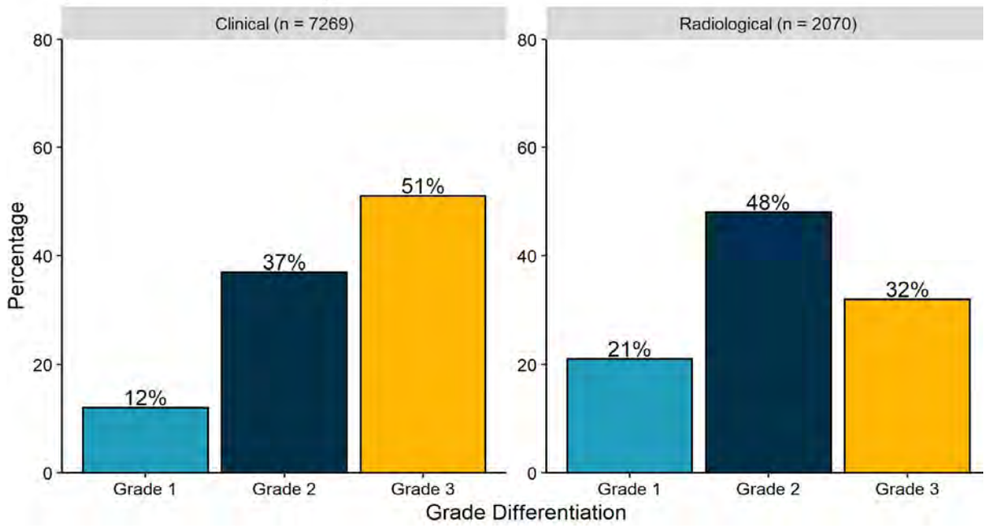


Figure 3-8. Distribution of grade based on the type of presentation (n=9,339; 15,381 missing data were excluded).

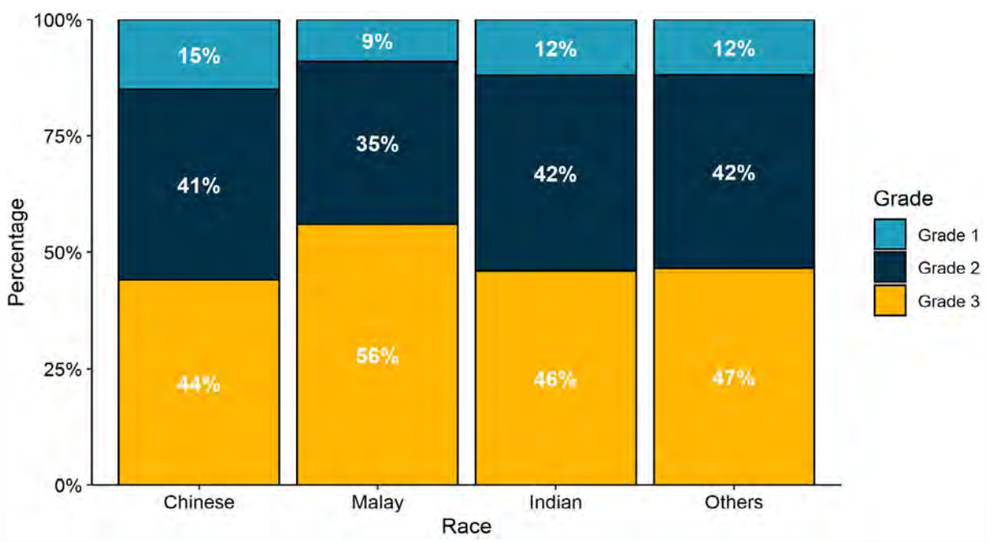


Figure 3-9. Distribution of grade differentiation based on race (n=20,852; 4,676 missing data were excluded).

3.4. Tumour size

The average tumour size at diagnosis for Singapore residents was 2.6cm (median = 2.2cm, IQR 1.4 – 3.5) (Figure 3-10).

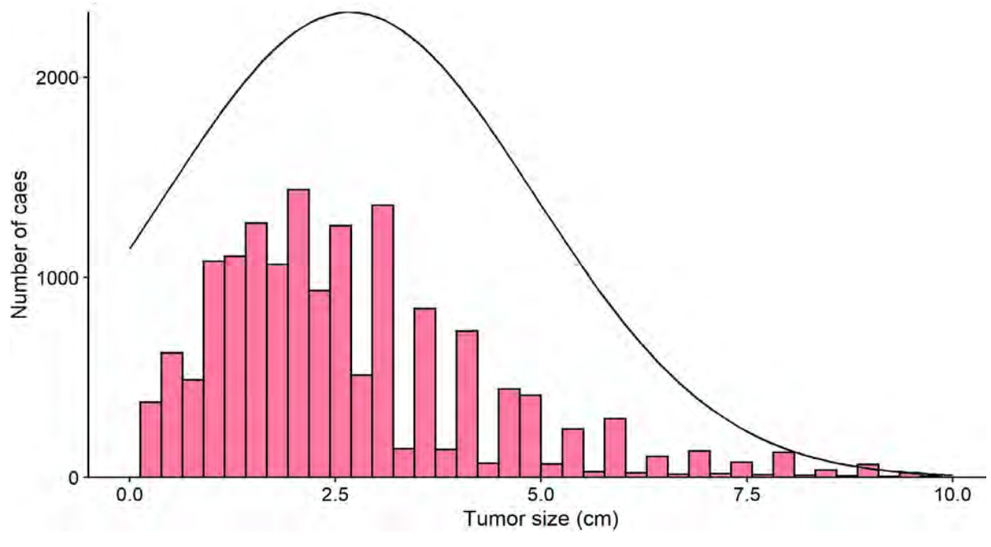


Figure 3-10. Histogram of tumour size [data shown here excluding patients with tumour size >10cm].

3.5. Nodal status

Majority of cases had no involved nodes (n=11,920; 58%) (Figure 3-11) and screen-detected patients were more likely to be node negative (69% vs. 51%) than those with clinical presentation (Figure 3-12). Patients with negative nodes were also less likely to undergo chemotherapy (Figure 3-13).

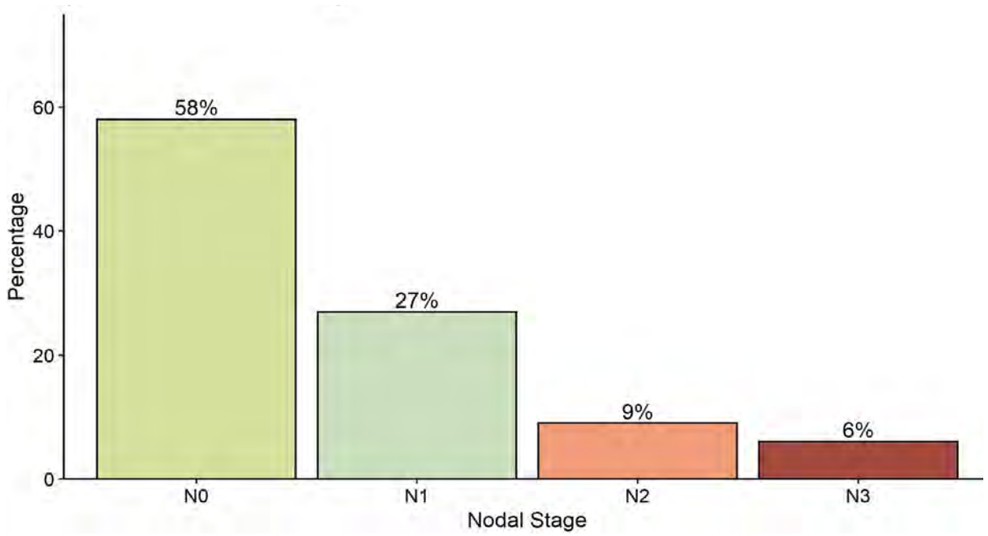


Figure 3-11. Distribution of nodal status (n=20,553; 4,976 missing data were excluded).

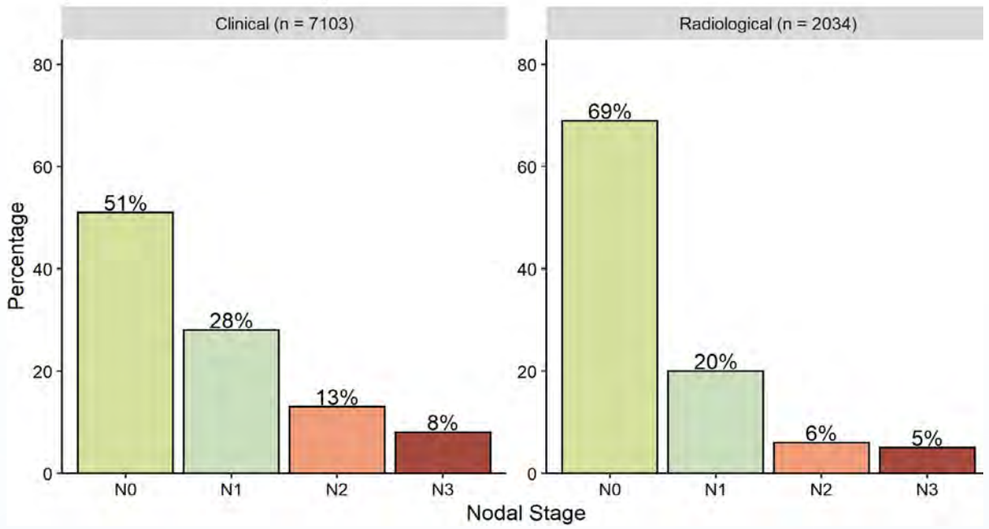


Figure 3-12. Distribution of nodal status based on the type of presentation (n=9,137; 16,318 missing data were excluded)

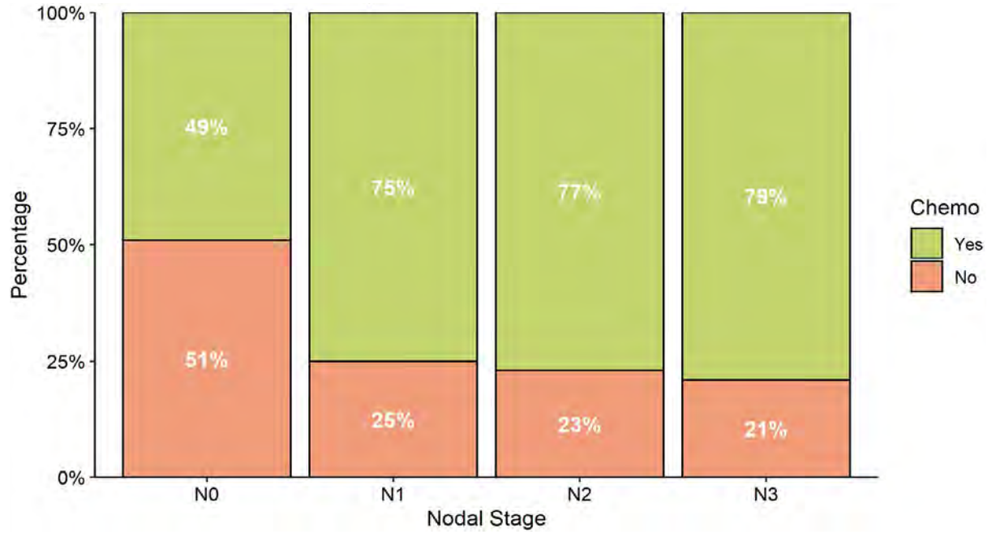


Figure 3-13. Proportion of patients who received chemotherapy (n=14,614; 10,915 data were excluded)

3.6. Staging

Since January 2018 we have shifted to the AJCC 8th edition staging system2. It consists of "anatomic staging", which is similar to the preceding AJCC 7th edition, and "prognostic staging", which takes biological risk factors such as tumour grade differentiation and receptor status also into account. For ease of illustration, we will only present anatomic staging in this JBCR report (Figure 3-14).

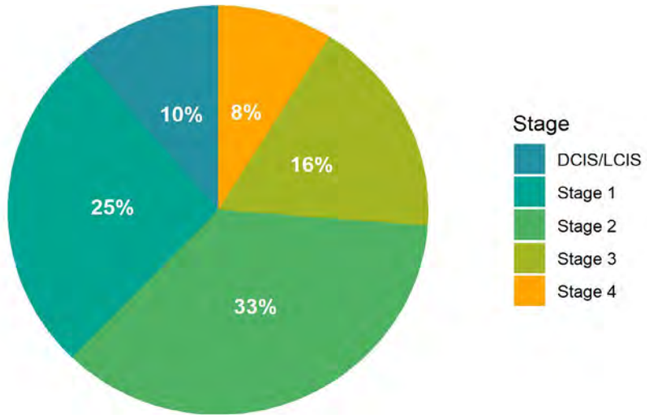


Figure 3-14. Cases distribution based on 8th AJCC staging (n=26,053; 2,575 missing data were excluded).

Among three major races, the Malays have the highest proportion of advanced stage (42%) compared to the Indians (33%) and the Chinese (23%) (Figure 3-15). Whilst patients were most commonly diagnosed at stage 2 across all age groups (Figure 3-16).

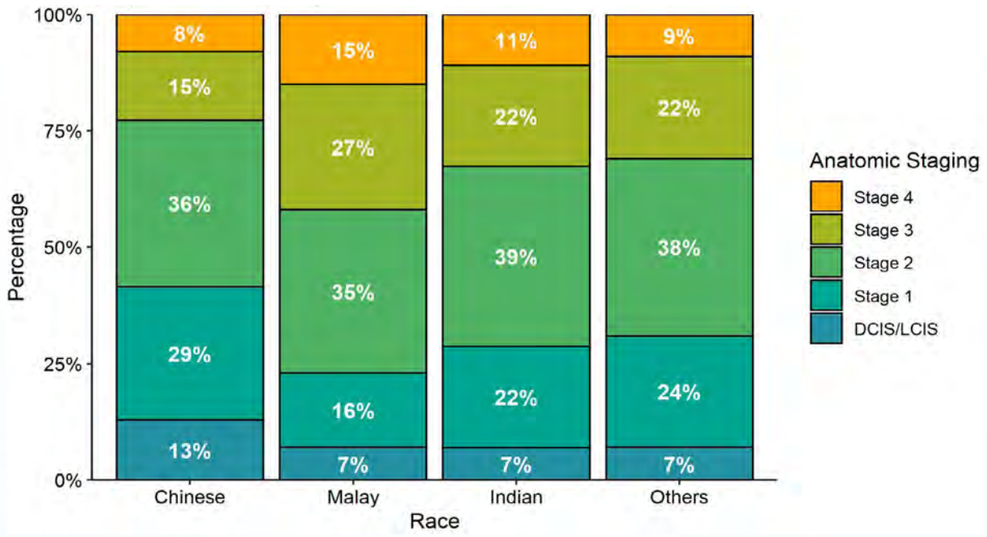


Figure 3-15. Distribution of TNM stage by race (n=26,050; 2,578 missing data were excluded).

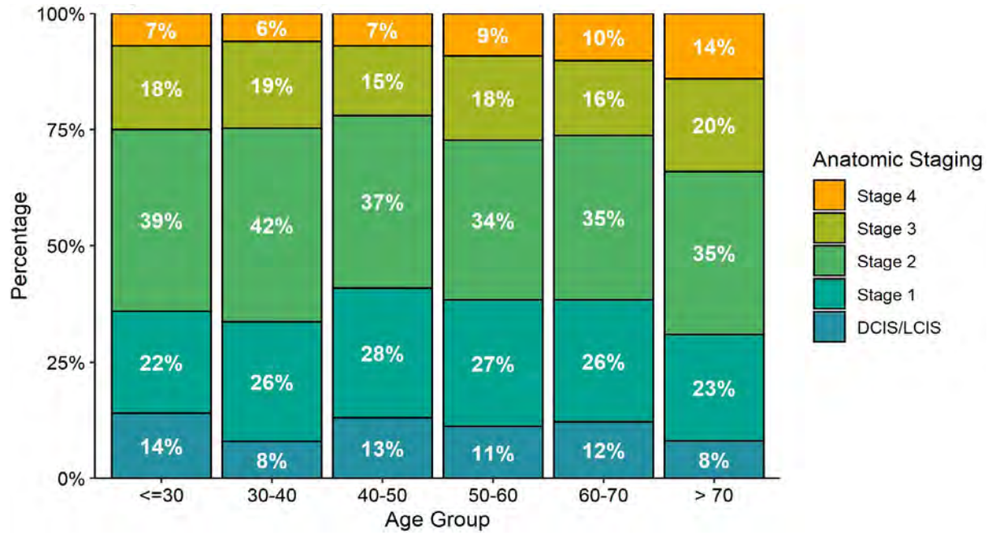


Figure 3-16. Distribution of TNM stage by age group (n=26,052; 2,576 missing data were excluded).

Approximately half of the screen-detected patients had stage 0 – 1 compared to 31% among clinically-detected ones (Figure 3-17).

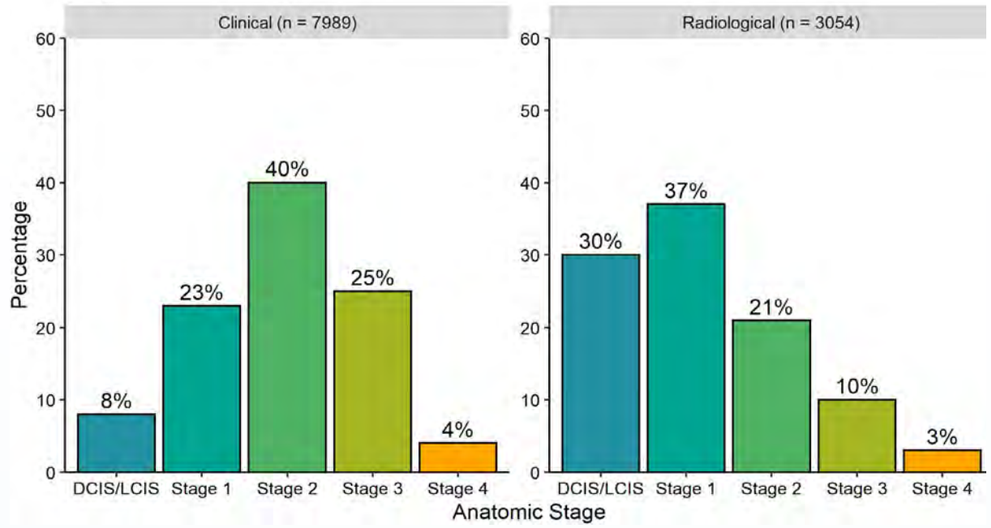


Figure 3-17. Distribution of TNM stage by type of presentation (n=11,043; 17,585 missing data were excluded).

4. Treatment

4.1. Breast surgery

Among 18,889 non-metastatic breast cancer patients treated with curative intent, 11,670 patients (61.8%) underwent mastectomy, 5,238 (27.7%) decided for breast-conserving surgery, and 1,981 (10.5%) did not go for any surgery (Figure 4-1). Most commonly performed reconstruction was TRAM (transverse rectus abdominis muscle) flap. Across diagnosis year, the proportion of mastectomy vs breast-conserving surgery remains, however, stable (Figure 4-2).

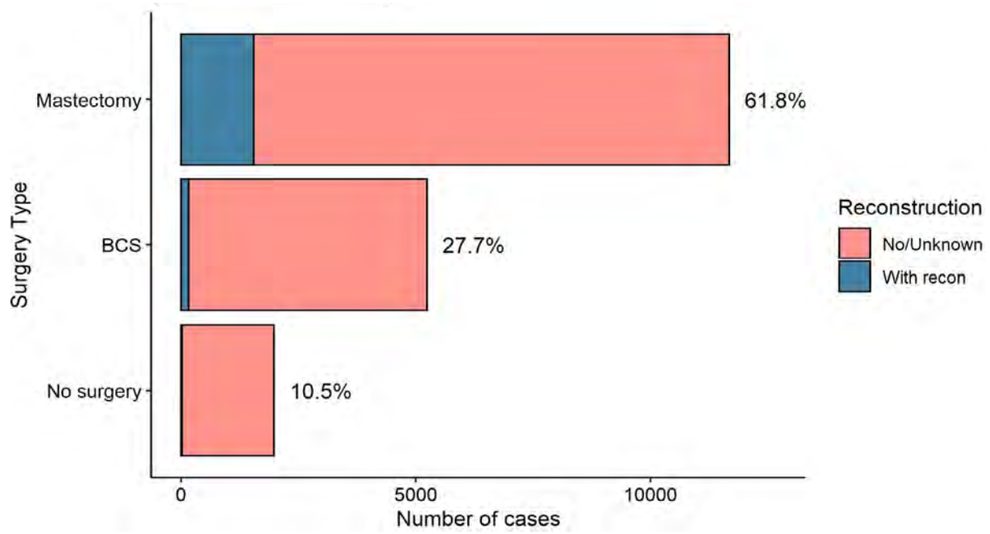


Figure 4-1. Type of surgery among non-metastatic breast cancer patients treated with curative intent (n=18,889).

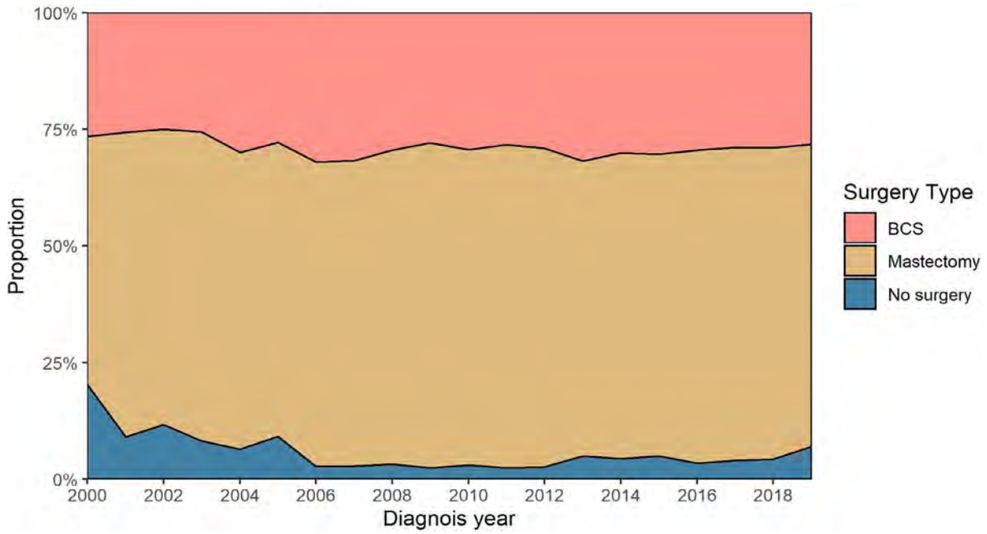


Figure 4-2. Distribution of type of surgery according to diagnosis year (n=16,480).

There was no difference in the proportion of type of surgery among all races in Singapore (Figure 4-3). It is noted that the older patients were, the more likely they decided to undergo mastectomy (Figure 4-4). Similar trend is observed among patients with more advanced stage, as tumour size was expectedly larger, requiring mastectomy (Figure 4-5, 4-6).

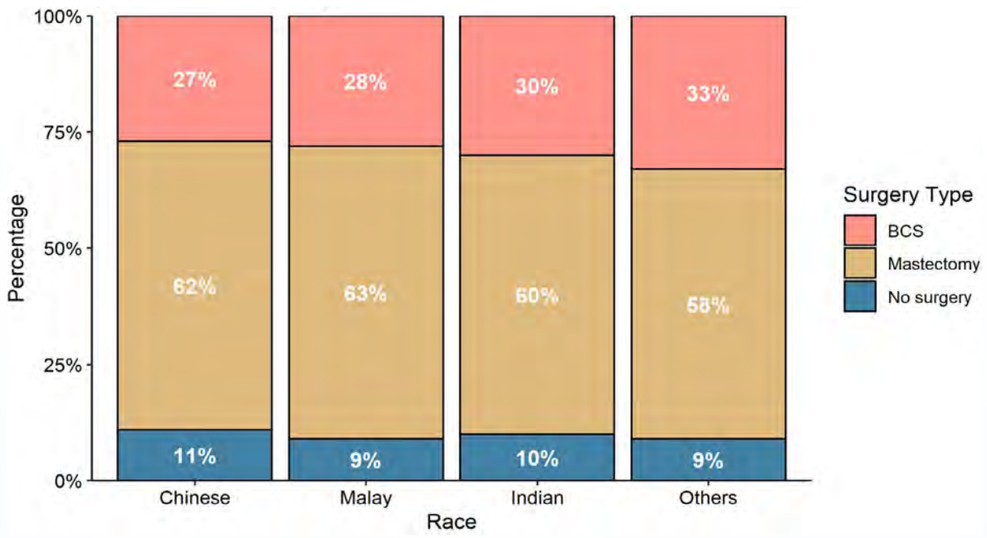


Figure 4-3. Distribution of type of surgery by race (n=18,889).

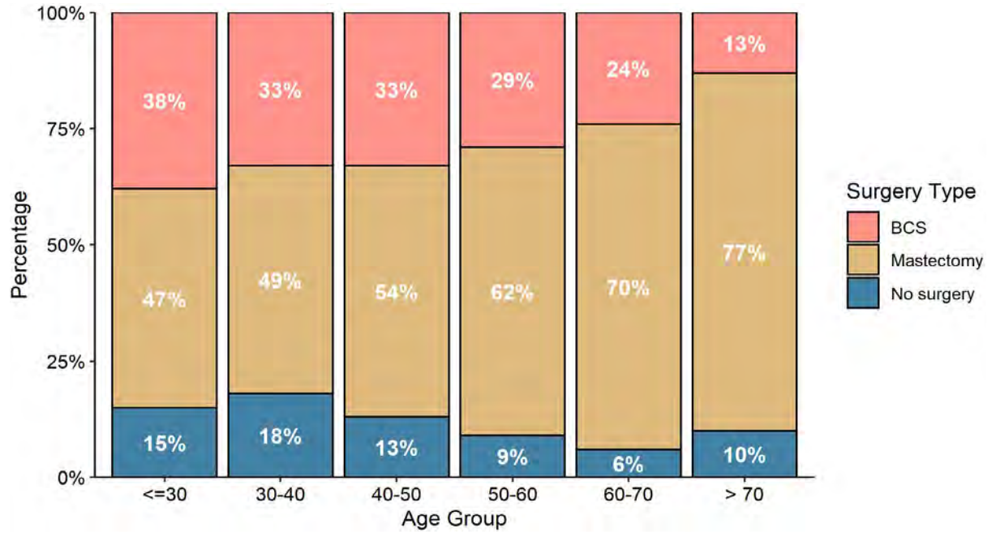


Figure 4-4. Distribution of type of surgery by age group (n=18,889).

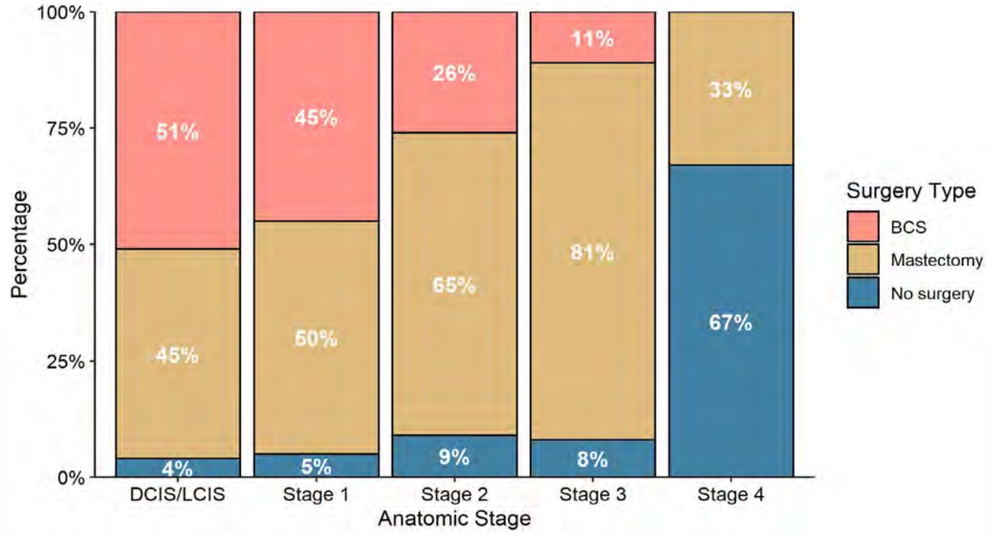


Figure 4-5. Distribution of type of surgery according to TNM staging (n=21,739; 1,587 missing data were excluded).

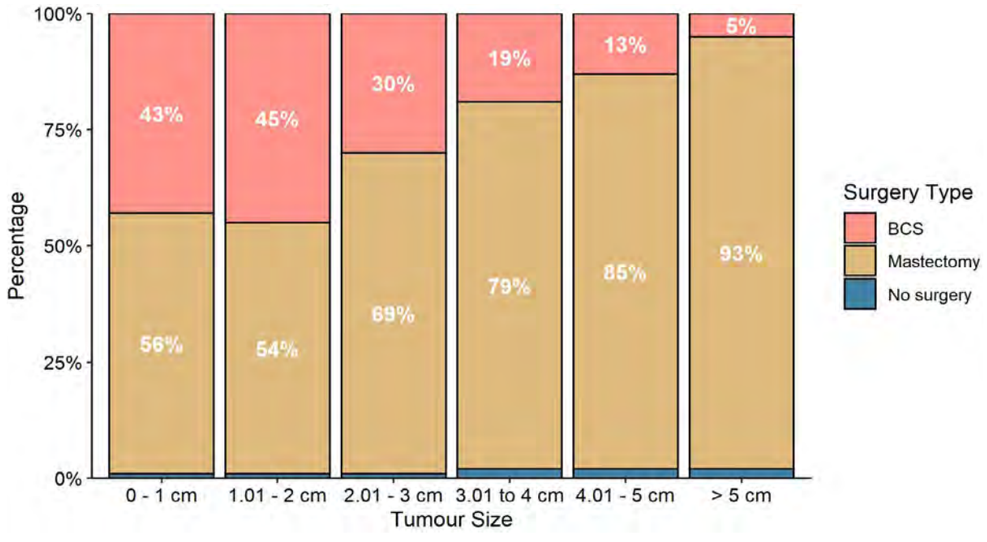


Figure 4-6. Distribution of type of surgery stratified by tumour size (n=13,772).

4.2. Chemotherapy (neoadjuvant and adjuvant)

Among 7,017 non-metastatic breast cancer patients with positive regional nodes, 67% underwent chemotherapy (Figure 4-7); and predominantly (73%) received anthracycline and taxane-containing drugs (Figure 4-8).

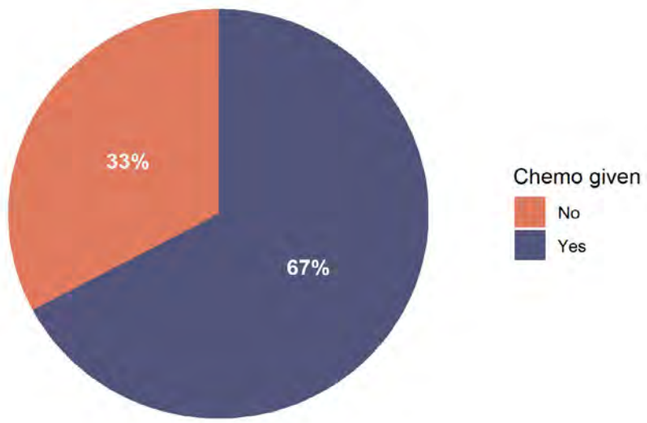


Figure 4-7. Proportion of non-metastatic nodal positive patients who underwent chemotherapy (n=7,014; 3 missing data were excluded).

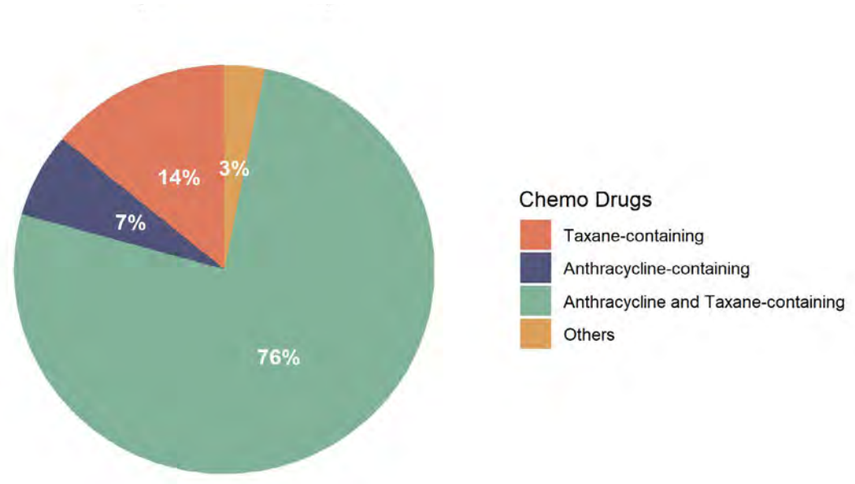


Figure 4-8. Distribution of type of chemotherapy drugs given (n=3,998; 3,019 missing data were excluded).

Among all races in Singapore, 76% of Malays received chemotherapy (Figure 4-9). Consistently, more patients with stage 2-3 and HER2+ or basal subtype went for chemotherapy compared to stage 1 and luminal A patients (Figure 4-10, 4-11).

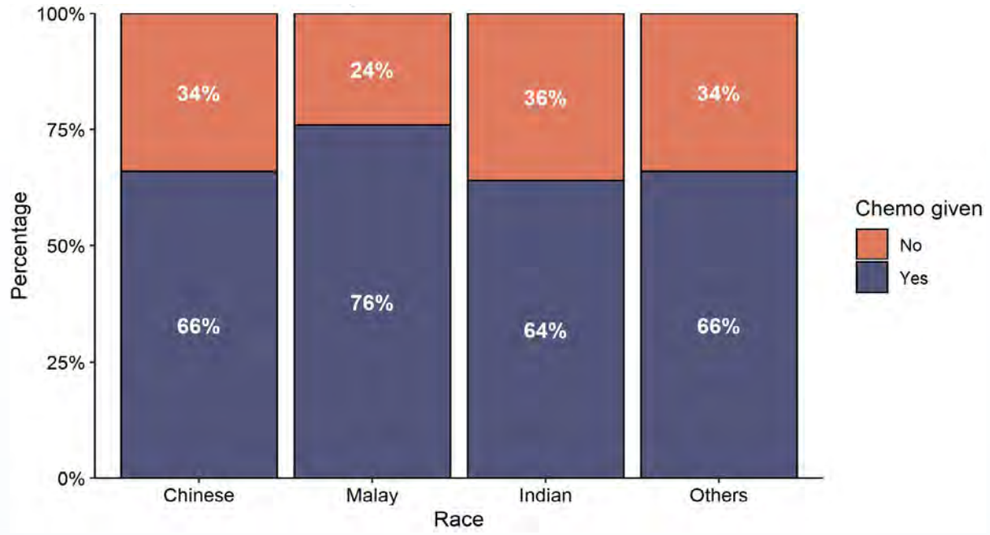


Figure 4-9. Proportion of patients who received chemotherapy stratified by race (n=7,014; 3 missing data were excluded).

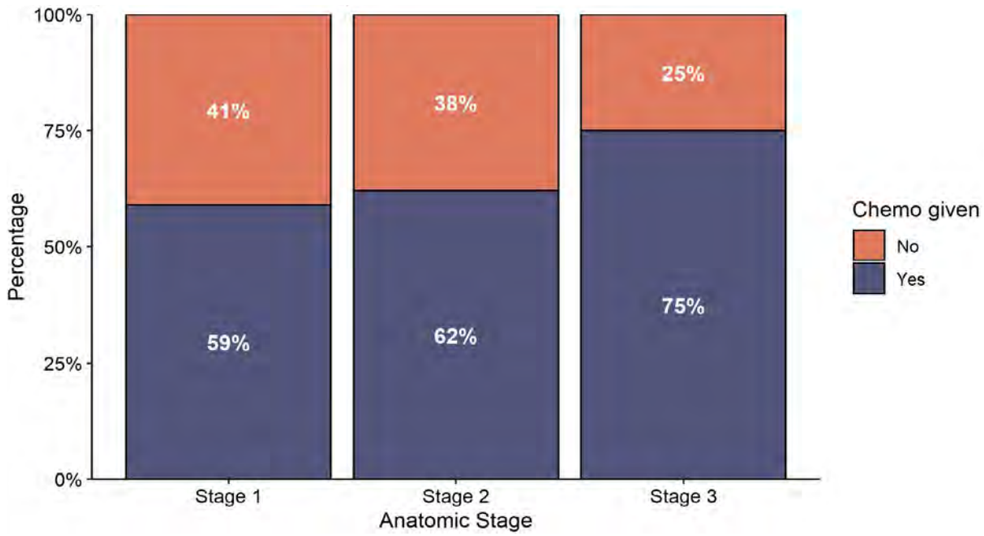


Figure 4-10. Proportion of patients who received chemotherapy stratified by TNM staging (n=6,946; 71 missing data were excluded).

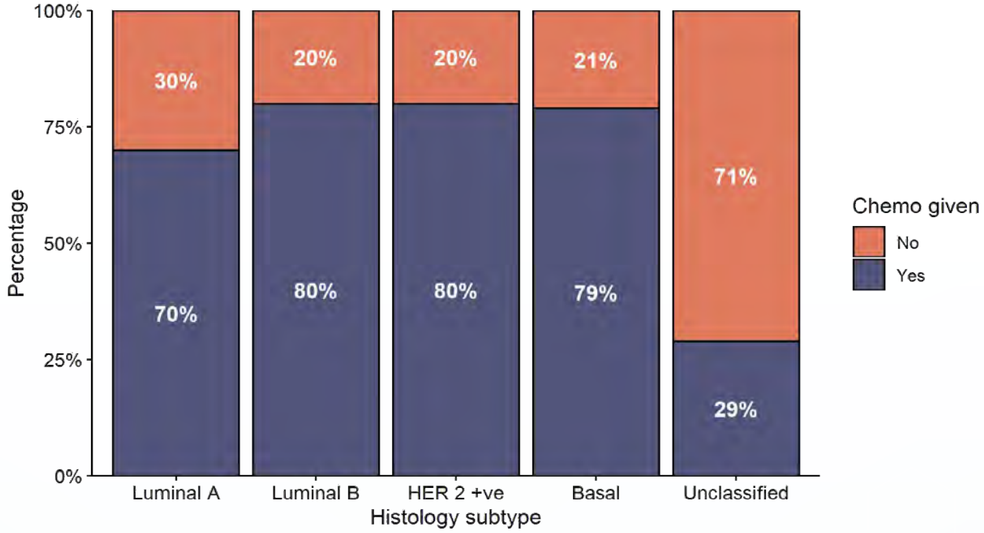


Figure 4-11. Proportion of cases who received chemotherapy stratified by histology subtype (n=7,014; 3 missing data were excluded).

4.3. Radiotherapy (RT)

Radiotherapy remains an integral part of breast cancer treatment. Adjuvant RT is indicated in patients after breast-conserving surgery. In patients who had mastectomy, RT is required only when tumour is 5cm or larger (at least T3), and/or at least 4 involved regional lymph nodes (at least N2 stage).

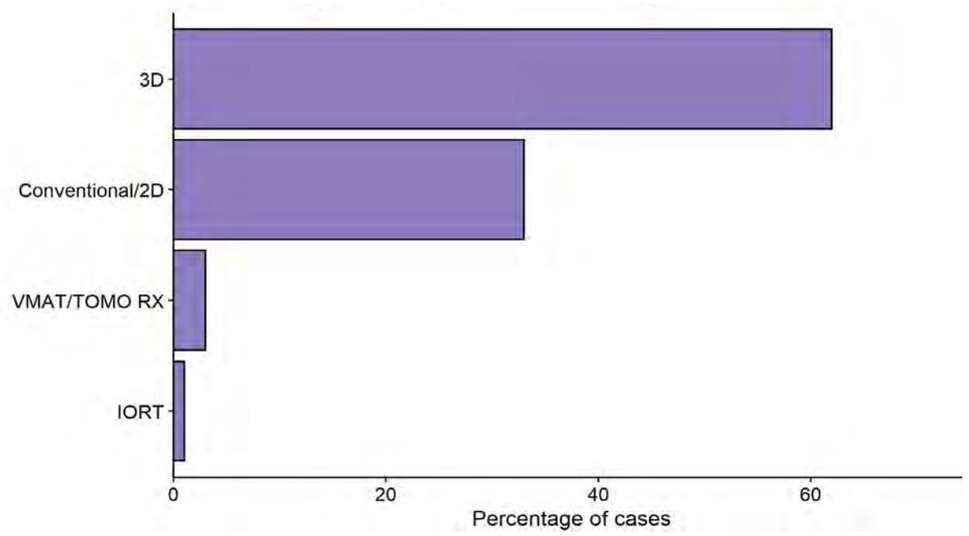


Figure 4-12. Proportion of RT technique (n=6,254).

Up till the 2010s, patients were most commonly treated with opposing tangential fields to the chest wall or breast [“conventional/2D”]. With evolving technologies, more accurate 3-dimensional planning techniques were introduced with the use of CT (computed tomography) scanning and planning [“3D”] (Figure 4-12, 4-13).

More advanced RT technique (2015-2020 using helical Tomotherapy®; 2020 onwards using VMAT [volumetric modulated arc therapy]) has been employed in patients with ≥N2 disease to include regional nodal irradiation to the internal mammary chain3-5.

Intraoperative Radiotherapy (IORT)6-8 and other partial breast irradiation techniques9-11 were used in the treatment of suitable patients with low risks breast cancer.

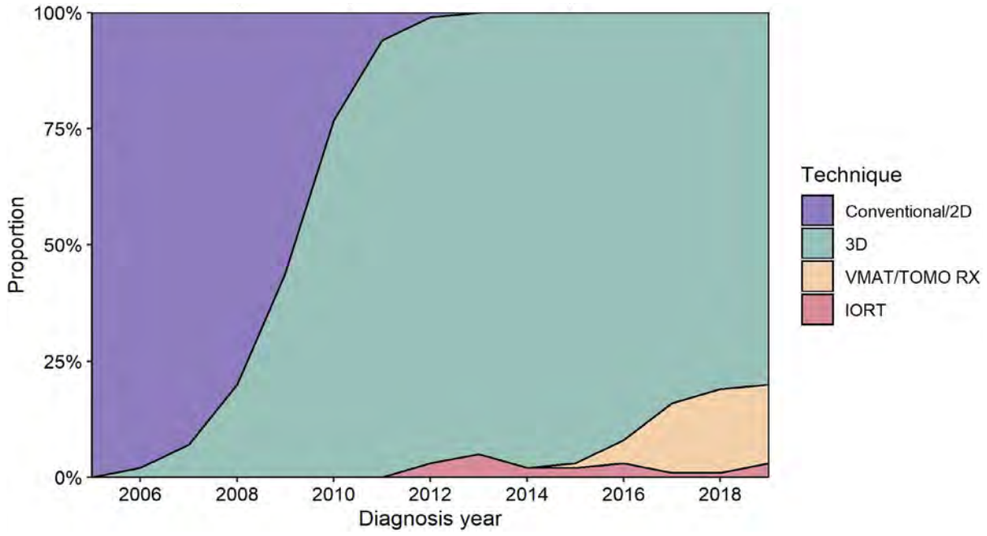


Figure 4-13. Proportion of RT technique employed by diagnosis year (n=5,817).

In older women (≥65 years old) with low-risk breast cancer, role of breast RT may be discussed12. Follow up data of the same study showed that omission of RT did not affect overall survival, however, there was statistically significant difference in 10-year ipsilateral breast tumor recurrence (no RT 9.8%, vs with RT 0.9%; HR 0.12, 95%CI 0.05-0.31, p<0.0001)13.

Moreover, RT dose fractionations have also evolved with time. In the past 50 Gy in 25 fractions were the norm. Subsequently, START hypofractionation consisting of 40 Gy in 15 fractions was implemented14 (Figure 4-14). Specific to RT to breast/chest wall only, since 2020 FAST FORWARD hypofractionation (26 Gy in 5 fractions) has taken the place to be the new standard15.

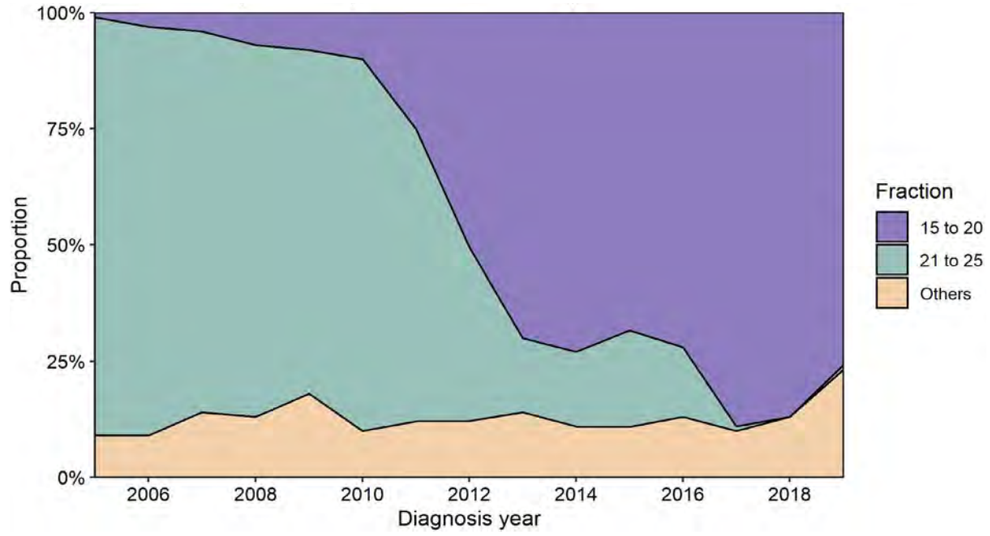


Figure 4-14. Proportion of various hypofractionation regimes by diagnosis year (n=6,945).

Figure 4-15 depicted that higher proportion of elderly patients did not receive RT despite BCS. This trend may be supported by the recent PRIME II study12,13. Of note, more elderly than younger patients chose mastectomy, which negates the need of adjuvant RT in early-stage cases. Consistent with current breast cancer management guideline (NCCN Guideline – Breast Cancer V2.2022)16 more post-mastectomy patients with locally advanced stage went for adjuvant RT than patients with early stage (Figure 4-16) and patients with locally advanced stage required RT to the regional nodes as well (Figure 4-17)3-5.

In addition, figure 4-16 and 4-17 also showed a small portion of DCIS patients who received RT despite mastectomy, as their histology unfortunately still showed positive margin.

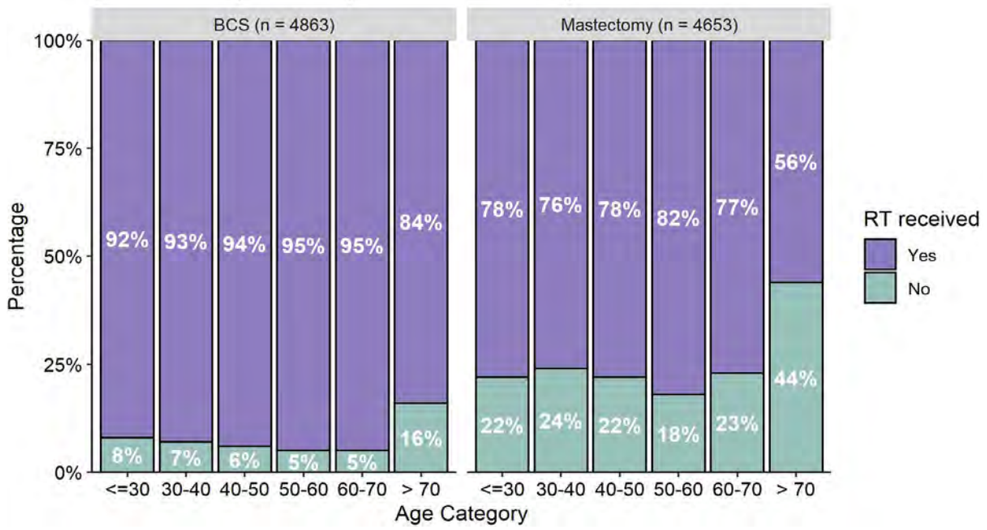


Figure 4-15. Proportion of patients receiving RT stratified by type of surgery and age group (n=9,516).

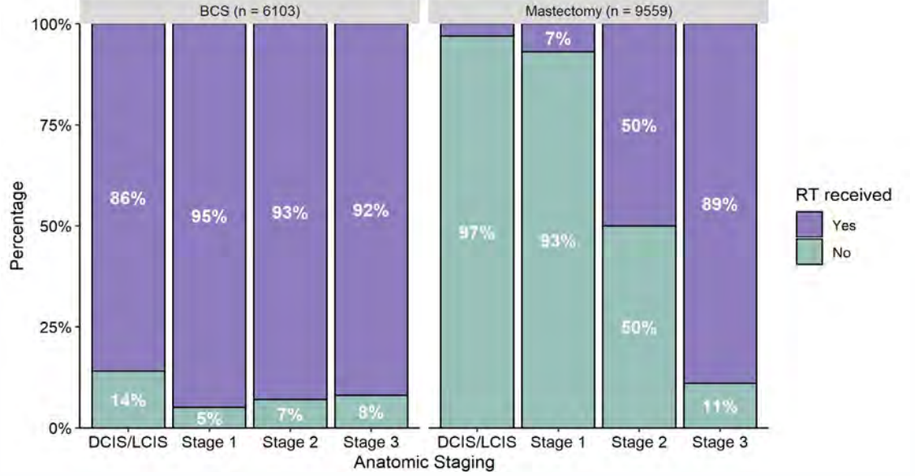


Figure 4-16. Proportion of patients receiving RT stratified by type of surgery and TNM staging (n=11,538).

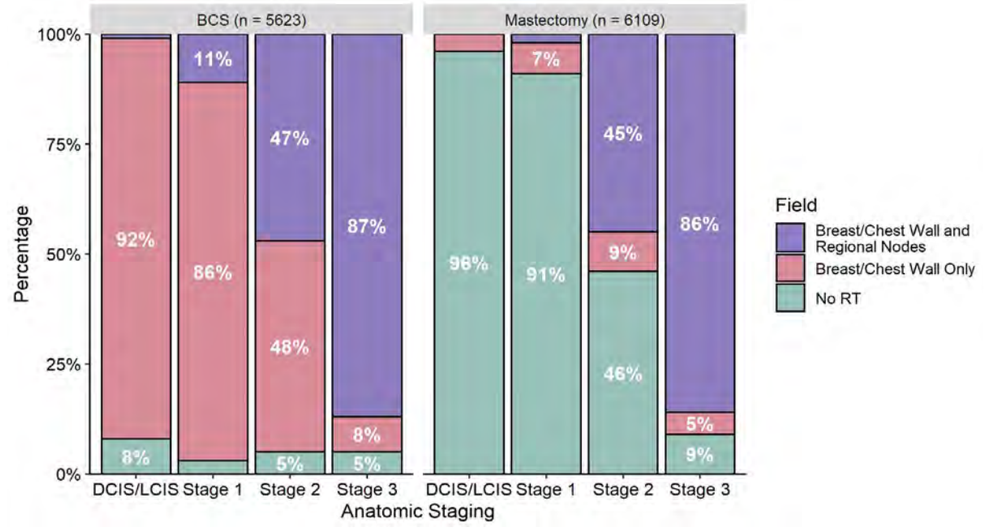


Figure 4-17. Proportion of RT fields stratified by type of surgery and TNM staging (n=9,627).

4.4. Targeted Therapy

Most HER2+ patients received targeted treatment together with their chemotherapy in the recent years (Figure 4-18). Consistently, there were higher proportion of patients with advanced than early stage who received targeted therapy (Figure 4-19) and that younger patients were more likely to take up targeted therapy than elderly (Figure 4-20).

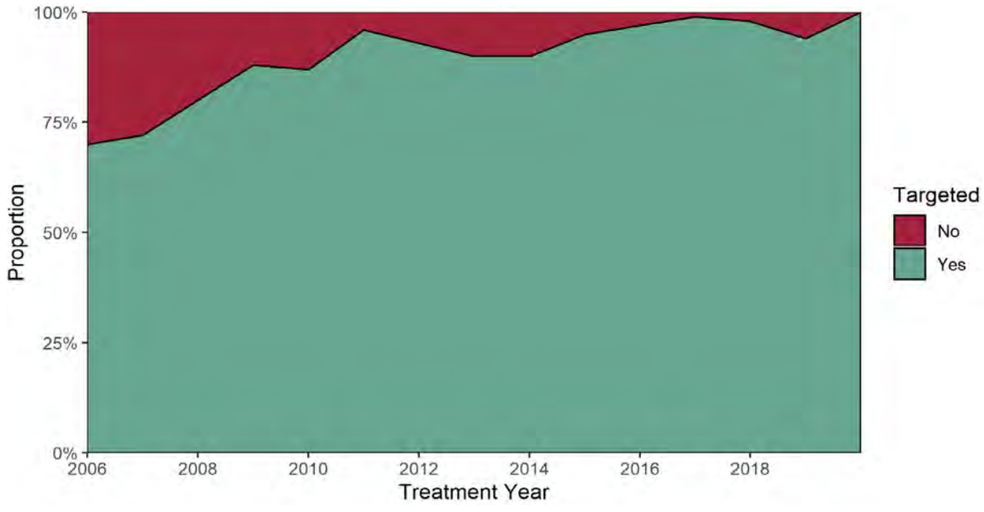


Figure 4-18. Proportion of HER2+ patients who received targeted and chemotherapy (n=2,131).

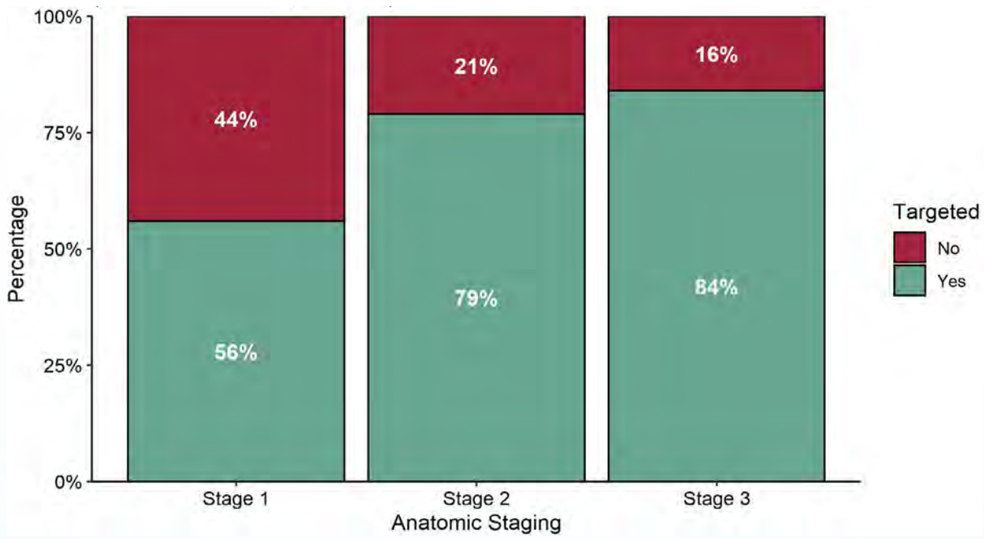


Figure 4-19. Distribution of HER2+-patients who received targeted therapy stratified by TNM staging (n=2,584).

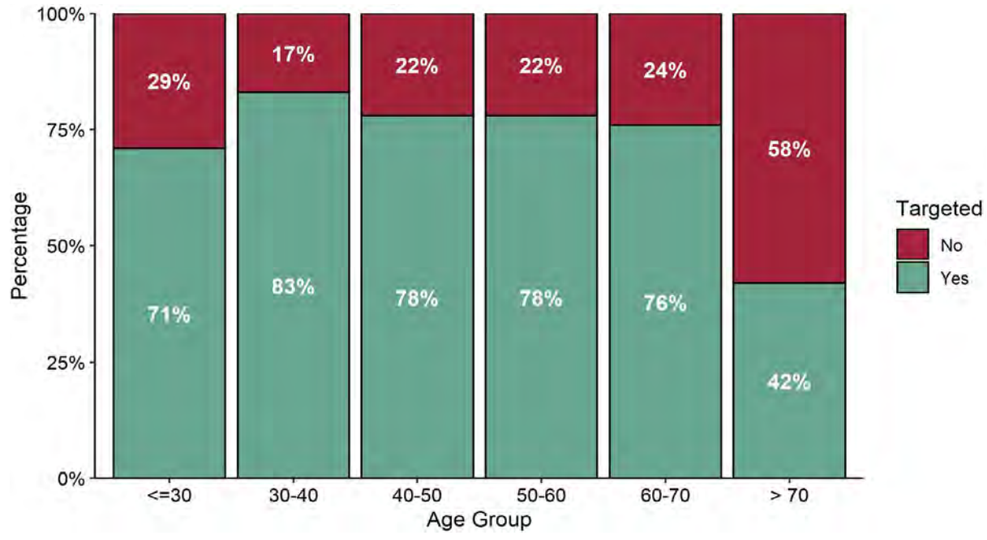


Figure 4-20. Distribution of HER2+-patients who received targeted therapy stratified by age group (n=2,627).

4.5. Endocrine Therapy

Prevailing breast cancer management guidelines (NCCN Guidelines Breast Cancer V2.2022)16 recommends the use of endocrine therapy for patients with ER+ and/or PR+ breast cancer. In the JBCR cohort, 88% of patients were compliant (Figure 4-23) and the most common drug taken was tamoxifen (Figure 4-24). Expectedly, aromatase inhibitors were more commonly taken by ≥50-year-old women (postmenopausal). (Figure 4-25).

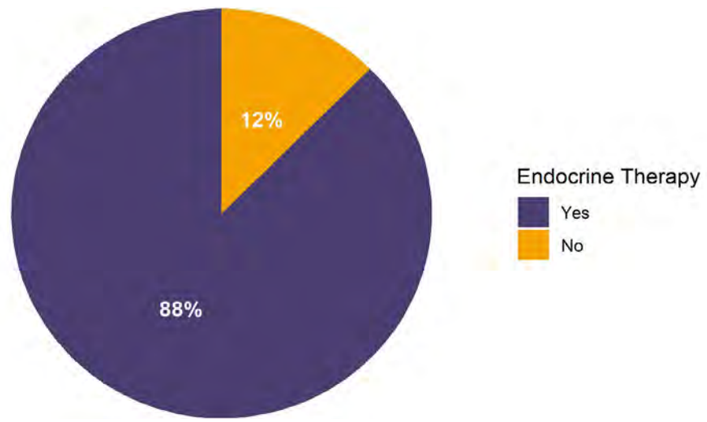


Figure 4-21. Proportion of ER+/PR+ patients who received endocrine therapy (n=12,255)

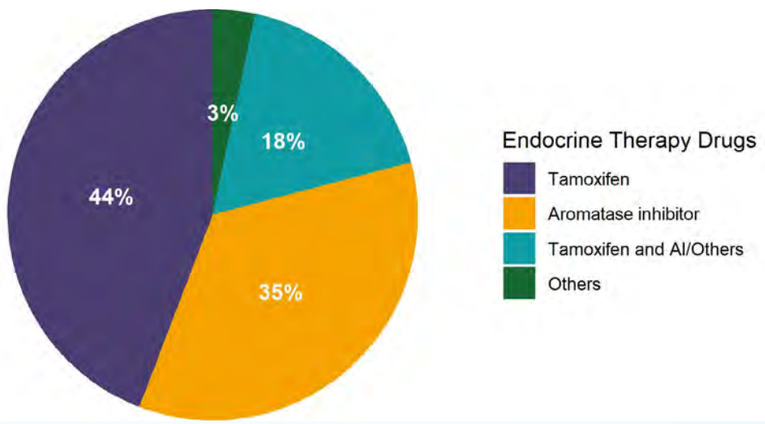


Figure 4-22. Distribution of type of endocrine therapy drugs taken by patients who required endocrine therapy (n=10,090)

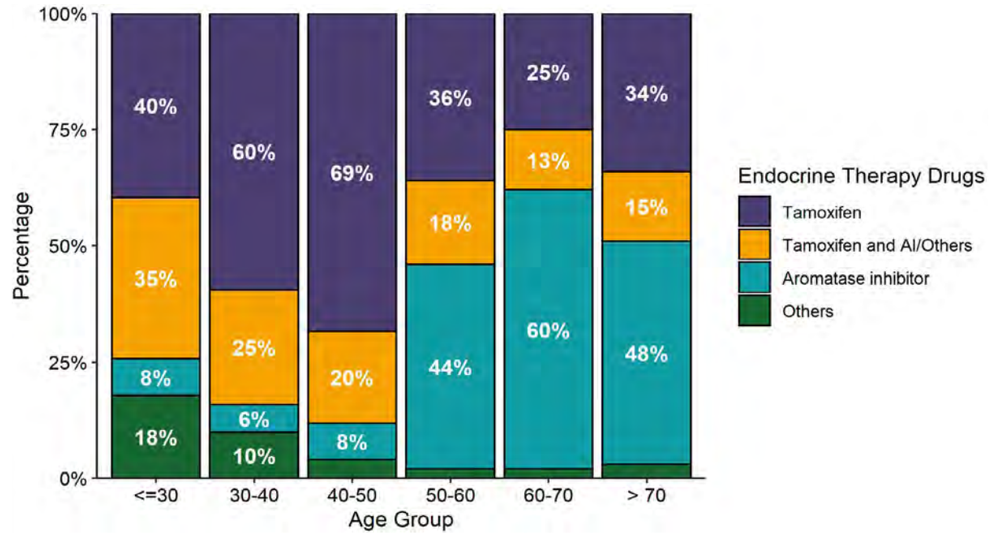


Figure 4-23. Proportion of ER+/PR+ patients who received endocrine therapy by age group (n=10,090)

5. Outcomes and survival

In this section we report the outcomes of Singaporean patients. Non-residents were excluded in survival analysis as survival events were not comprehensively available.

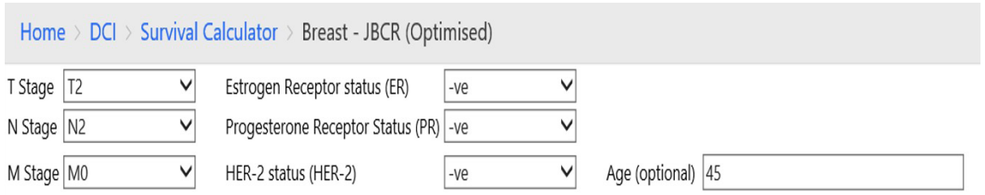
Overall survival (OS) was measured from date of diagnosis of the primary breast cancer to date of death from any cause. Disease-free survival (DFS) was determined from date of diagnosis to date of first occurrence of any recurrence arising from the primary breast cancer. Ipsilateral breast tumour recurrence (IBTR) was defined from date of diagnosis to date of first local recurrence arising from the primary breast cancer. Distant disease-free survival (DDFS) was measured from date of diagnosis to date of first distant failure arising from the primary breast cancer. Patients without the event under survival analysis are censored on the date of their last follow-up. Survival estimates were estimated using the Kaplan Meier method. Differences in survival between groups of patients were assessed using the log rank test.

Table 5 1. Definition of the survival end points

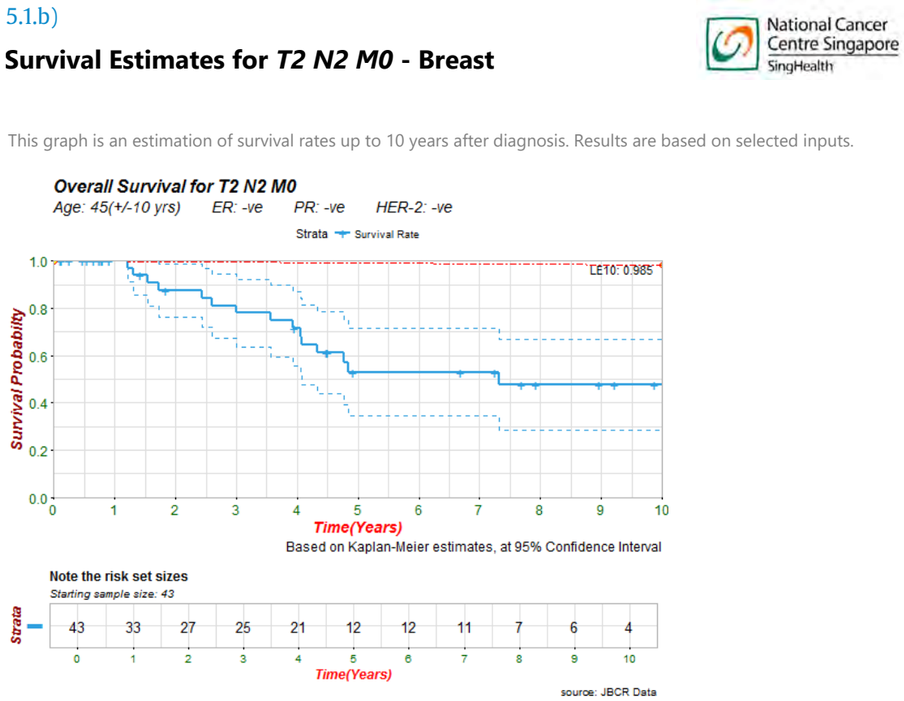
Survival	Survival End Point
OS	Death from any cause
DFS	First occurrence of any recurrence arising from primary breast cancer
IBTR	First local recurrence arising from primary breast cancer
DDFS	First distant failure arising from primary breast cancer

We have created an online calculator based on the JBCR cohort. This calculator performs real-time survival analysis by the Kaplan Meier method of a cohort of patients that can be defined by age, tumour staging, nodal staging, metastasis status, hormone receptor status and HER-2 status. Some snapshots of the online survival calculator are shown in Figure 5-1.

5.1.a)



5.1.b)



5.1.c)

In a group of 100 patients with the same characteristics as selected, **28** to **67** of them are likely to be alive 5 years from their diagnosis.

These estimates are based on the real world outcome of patients treated in our institutions. Your exact experience may differ within the limits of this prediction. Survival estimates can be unreliable the further into the future prediction is made as there are less patients to base this estimate on.

Figure 5-1. Snapshots of the online survival calculator. (a) Selection Criteria for outcomes estimation. (b) Survival curve of matched population. (c) Icon array for easy visual interpretation of outcomes.

5.1. Overall survival (OS)

Among three major races in Singapore, the Malays had the lower overall survival (Figure 5-2). Patients with basal breast cancer subtype have the worst overall survival (Figure 5-3). Expectedly, patients with grade 3, large tumour, high nodal stage or late stage had distinctly lower overall survival compared to patients with lower grade, small tumour, or early (nodal) stage (Figure 5-4, 5-5, 5-6, and 5-7).

Figure 5-2. Overall survival stratified by ethnic group

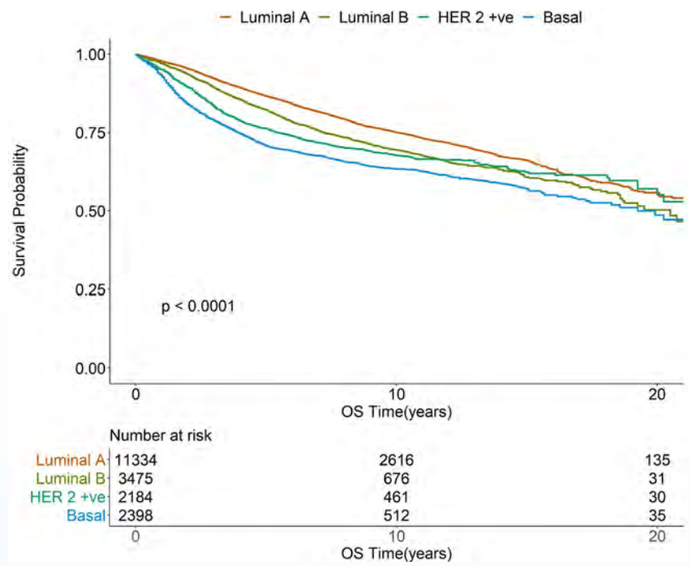


Figure 5-3. Overall survival stratified by histology subtype

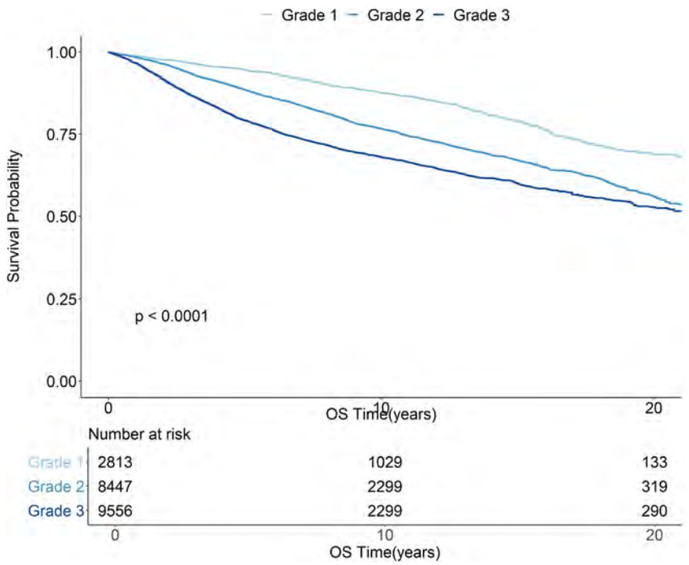


Figure 5-4. Overall survival stratified by histological grade differentiation

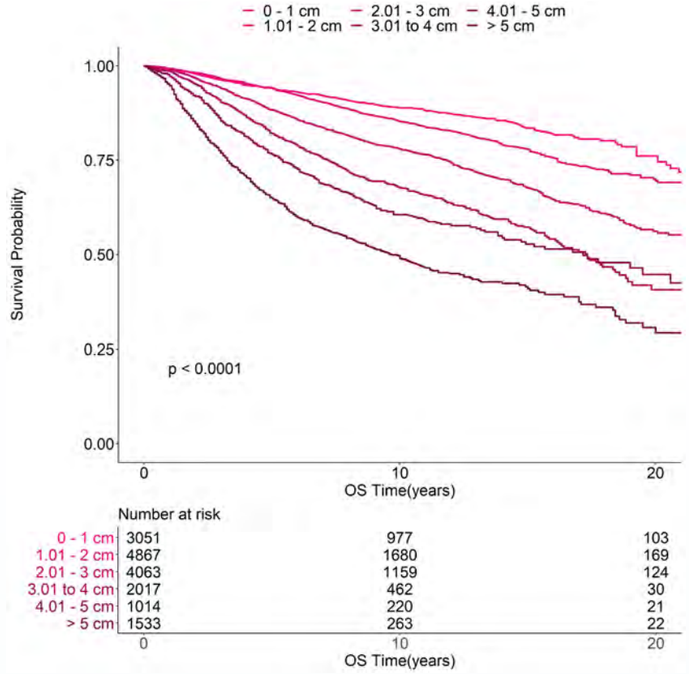


Figure 5-5. Overall survival stratified by tumour size

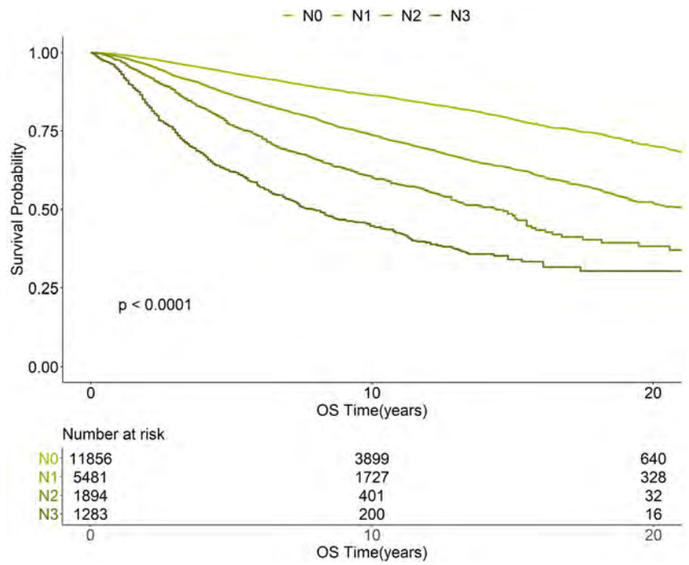


Figure 5-6. Overall survival stratified by nodal stage

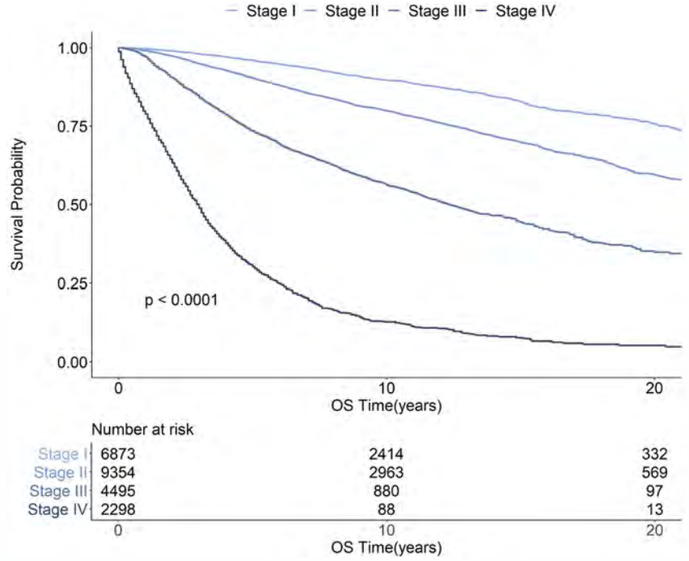


Figure 5-7. Overall survival stratified by anatomic stage

5.2. Disease-Free Survival (DFS)

Among three major races in Singapore, the Malays had the lower overall survival (Figure 5-2). Patients with basal breast cancer subtype have the worst overall survival (Figure 5-3). Expectedly, patients with grade 3, large tumour, high nodal stage or late stage had distinctly lower overall survival compared to patients with lower grade, small tumour, or early (nodal) stage (Figure 5-4, 5-5, 5-6, and 5-7).

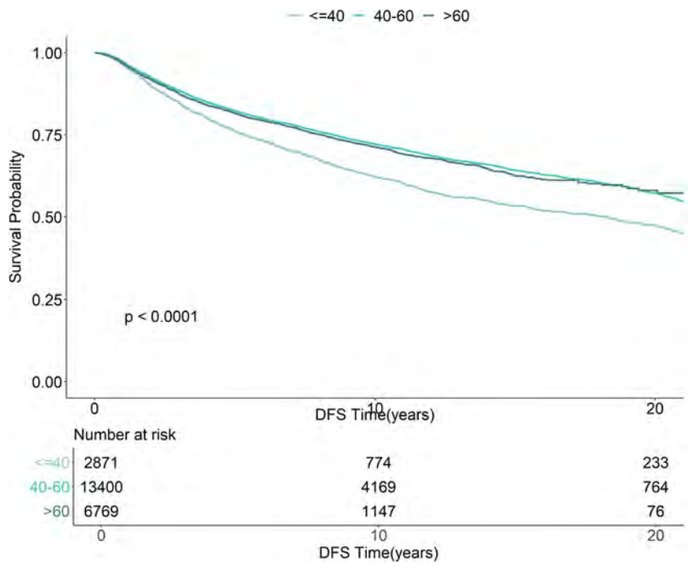


Figure 5-8. Disease-free survival stratified by age group

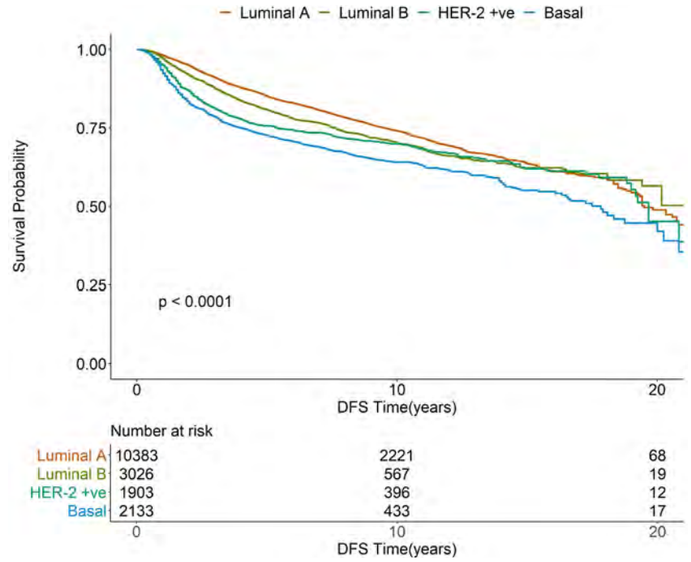


Figure 5-9. Disease-free survival stratified by histology subtype

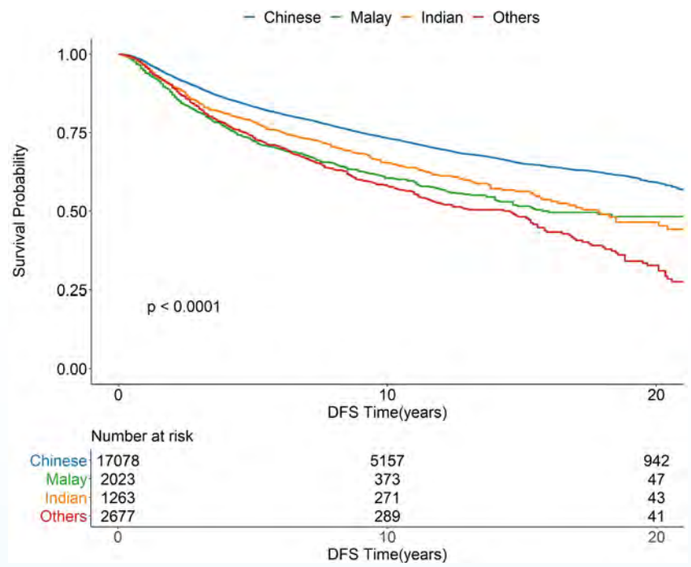


Figure 5-10. Disease-free survival stratified by racial group

5.3. Ipsilateral Breast Tumour Recurrence (IBTR)

Patients with higher stage (Figure 5-11) or basal subtype tumour (Figure 5-12) were more likely to develop local recurrences.

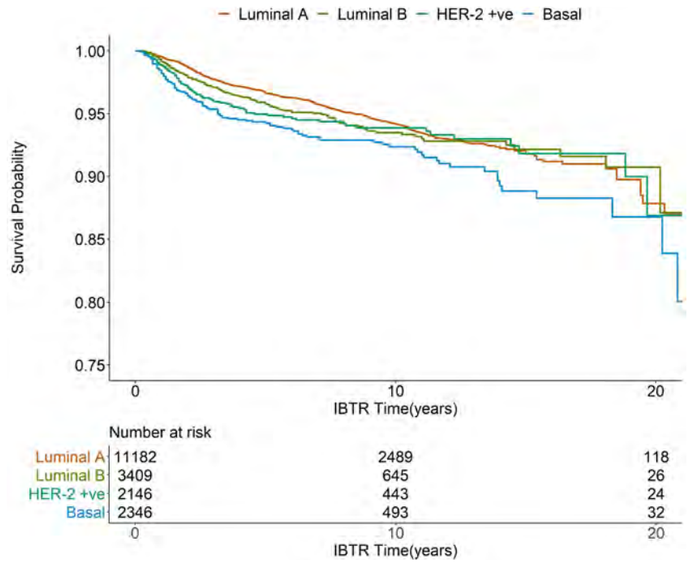


Figure 5-11. Ipsilateral breast tumour recurrence stratified by histology subtype

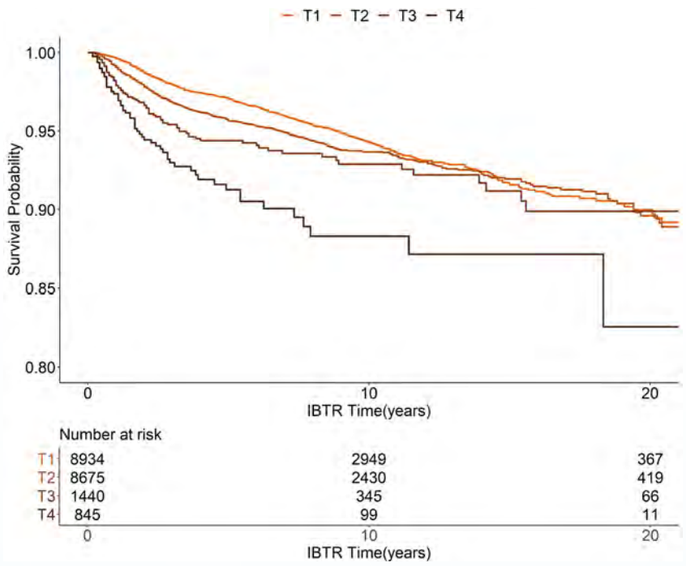


Figure 5-12. Ipsilateral breast tumour recurrence stratified by TNM stage

5.4. Distant Disease-Free Survival (DDFS)

The nodal disease burden strongly predicted for distant relapses (Figure 5-13). Among various histology subtypes, patients with basal subtype tumour had poorer survival compared to others (Figure 5-14).

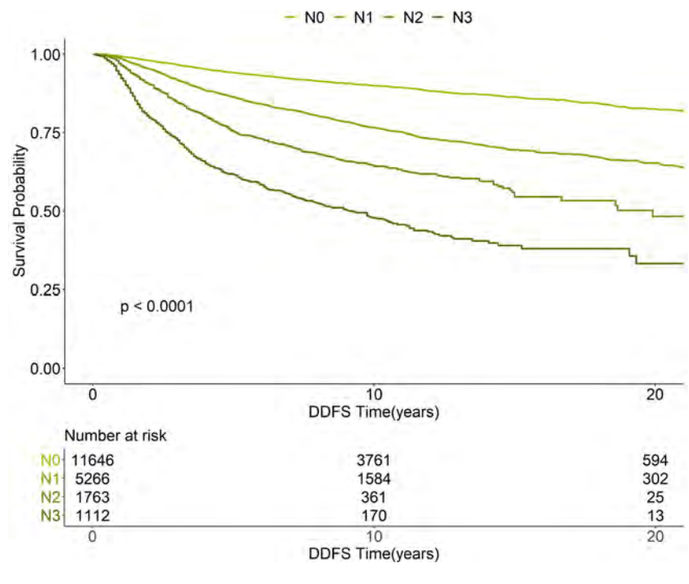


Figure 5-13. Distant disease-free survival stratified by nodal status

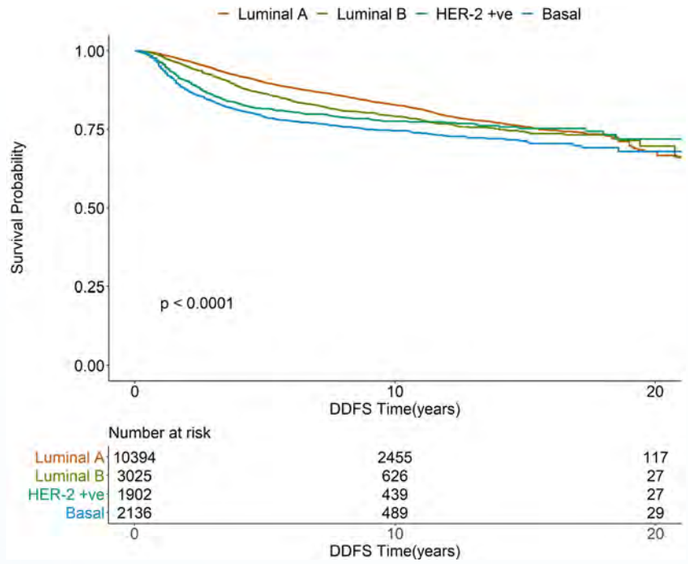


Figure 5-14. Distant disease-free survival stratified by histology subtype

PRE-INVASIVE BREAST CANCER

6. Pre-invasive cancers

Ductal Carcinoma In-Situ (DCIS) cases are presented separately due to the more indolent nature of the disease. There were about 3,000 DCIS cases, with a median age at diagnosis of 53 years (IQR:45 – 62; mean: 54, range: 21 – 95) (Figure 6-1). The median tumour size was 1.5 cm (IQR: 0.7 – 2.5; mean: 1.93, range: 0 – 25). 40% presented clinically, while majority (60%) were detected radiologically, likely due to national screening program. 89% of DCIS subjects were chinese (Figure 6-2). Half of the cohort underwent breast-conserving surgery, and about 45% opted for mastectomy with/without reconstruction (Figure 6-3, 6-4).

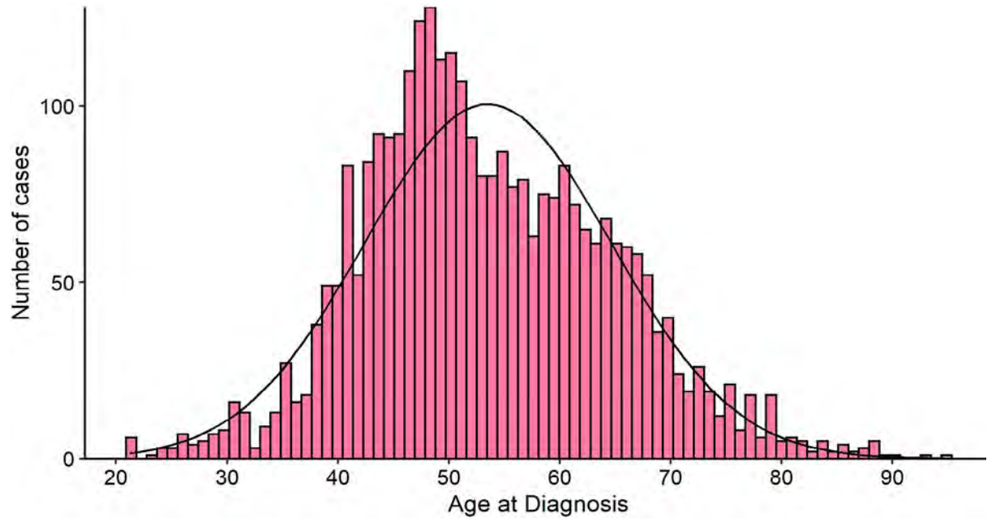


Figure 6-1. Histogram of age at diagnosis (n=3,062).

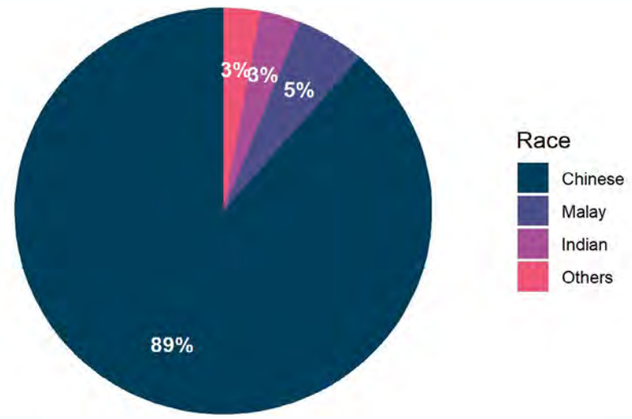


Figure 6-2. Distribution of different races among DCIS patients (n=2,815).

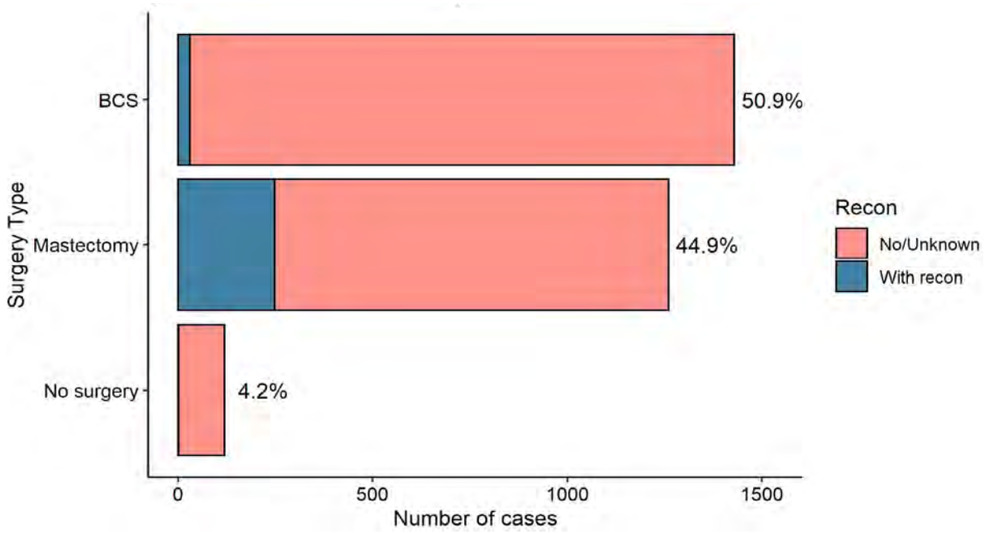


Figure 6-3. Proportion of surgery type (n=2,840)

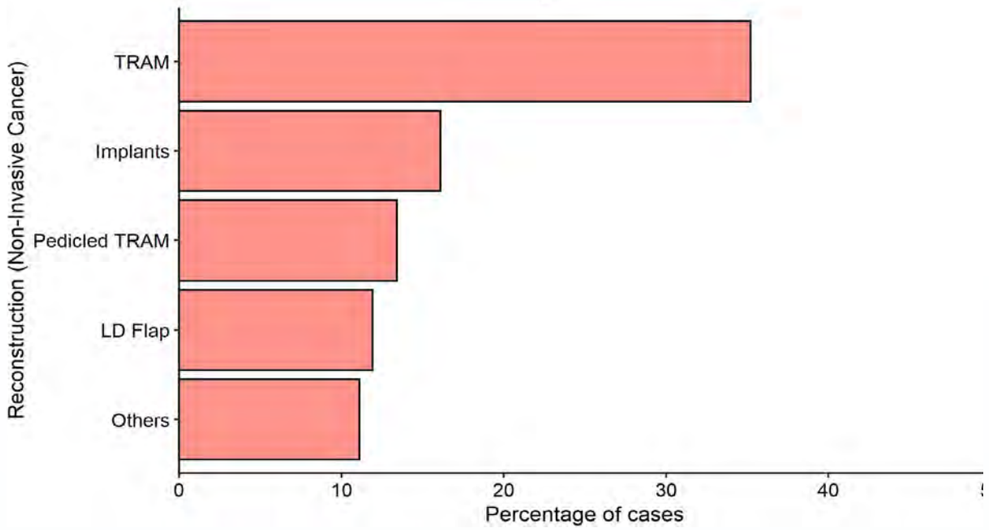


Figure 6-4. Distribution of type of reconstruction (n=266)

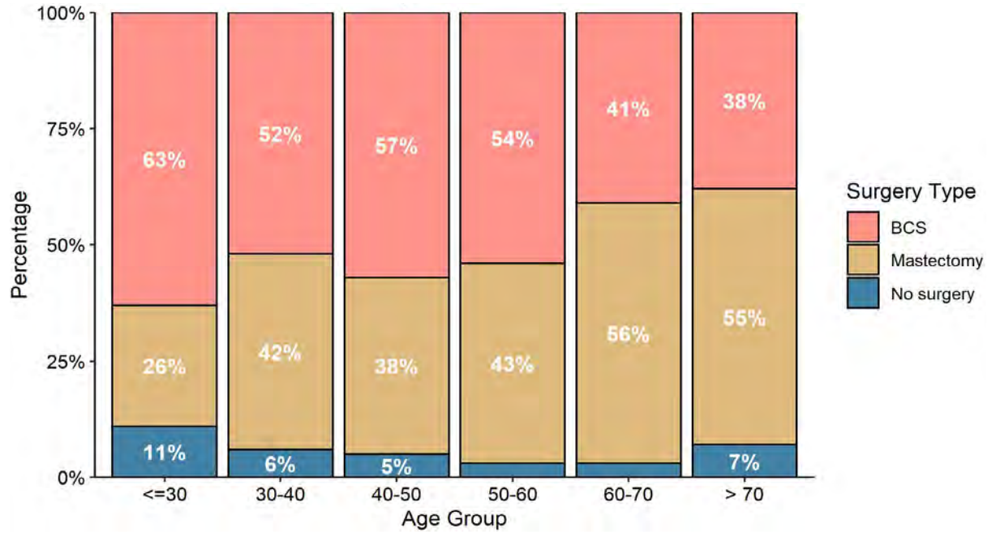


Figure 6-5. Distribution of surgery type based on age group (n=2,840)

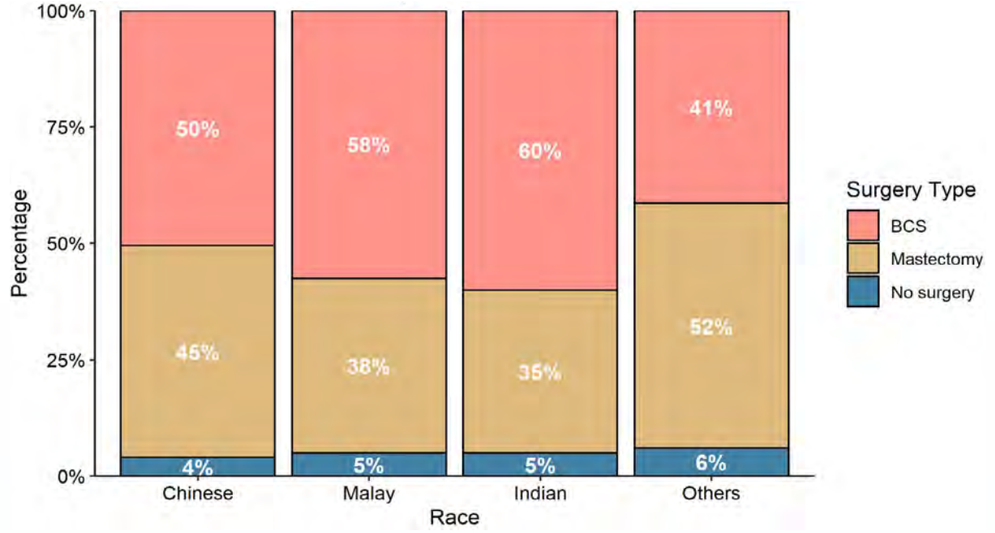


Figure 6-6. Distribution of surgery type based on race (n=2,840)

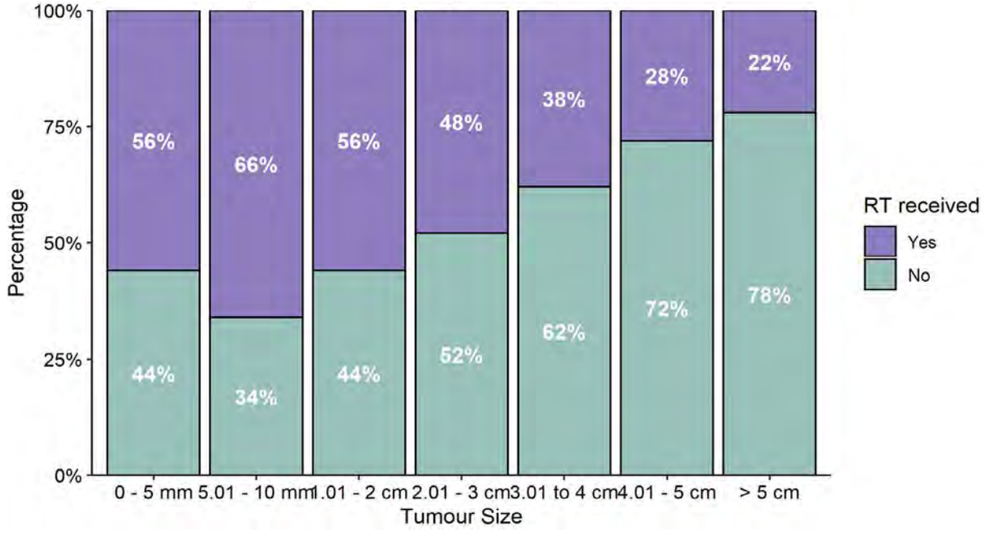


Figure 6-7. Proportion of DCIS patients who received RT by size group

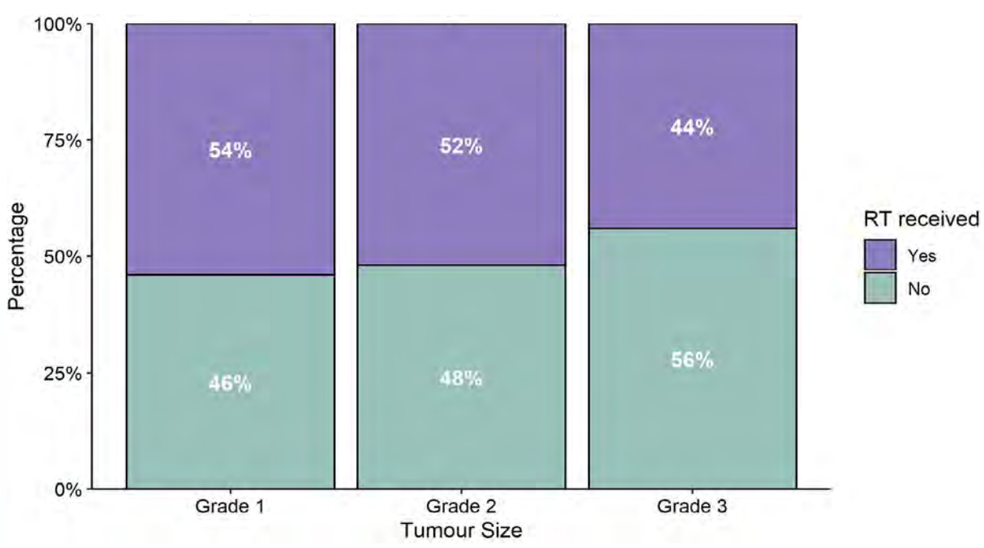


Figure 6-8. Proportion of DCIS patients who received RT by grade differentiation

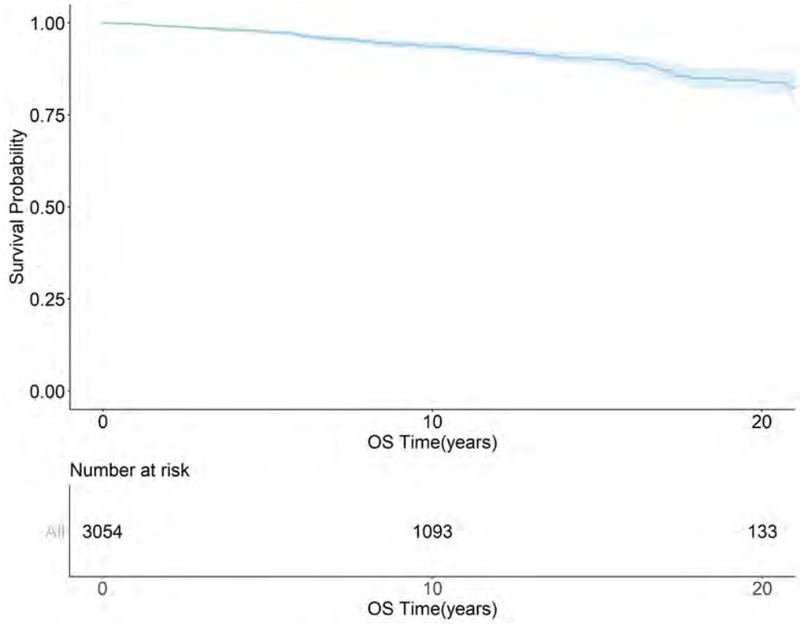


Figure 6-9. Overall survival

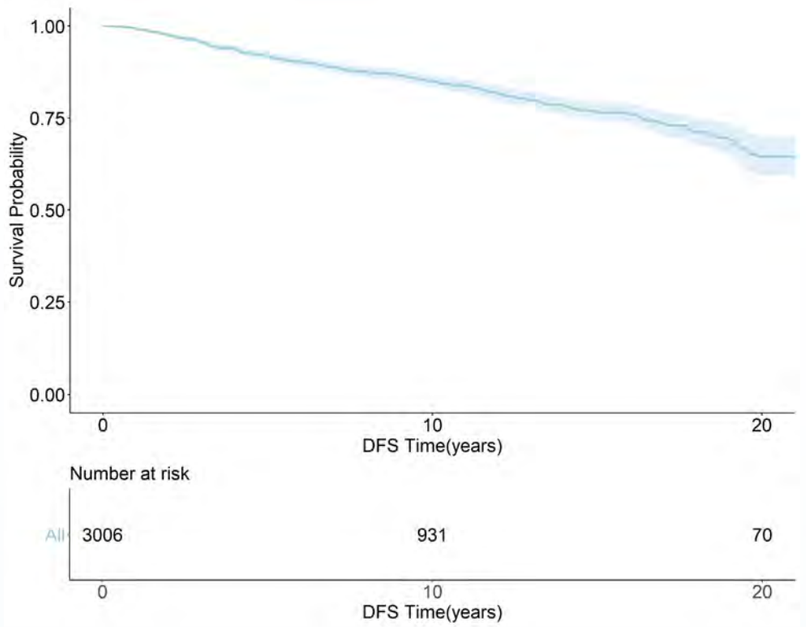


Figure 6-10. Disease-free survival

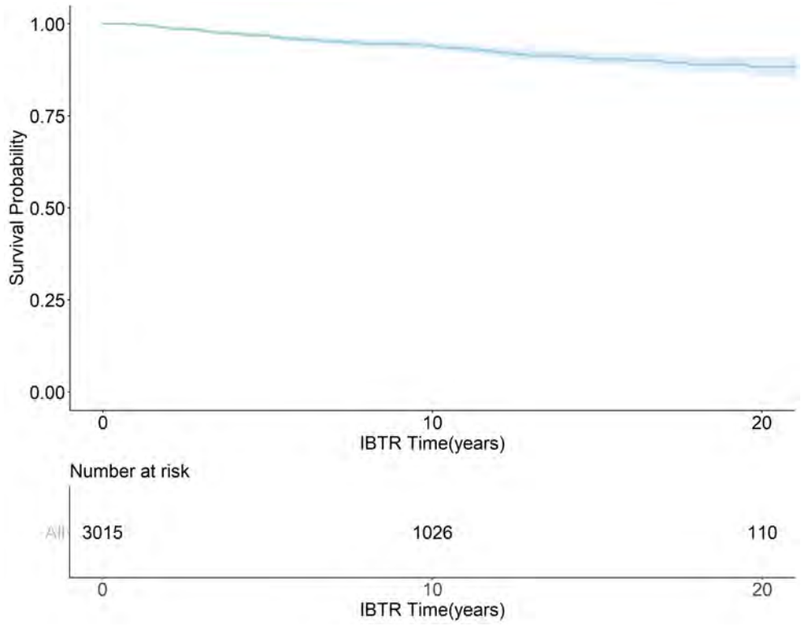


Figure 6-11. Ipsilateral breast tumour recurrence free survival (IBTR)

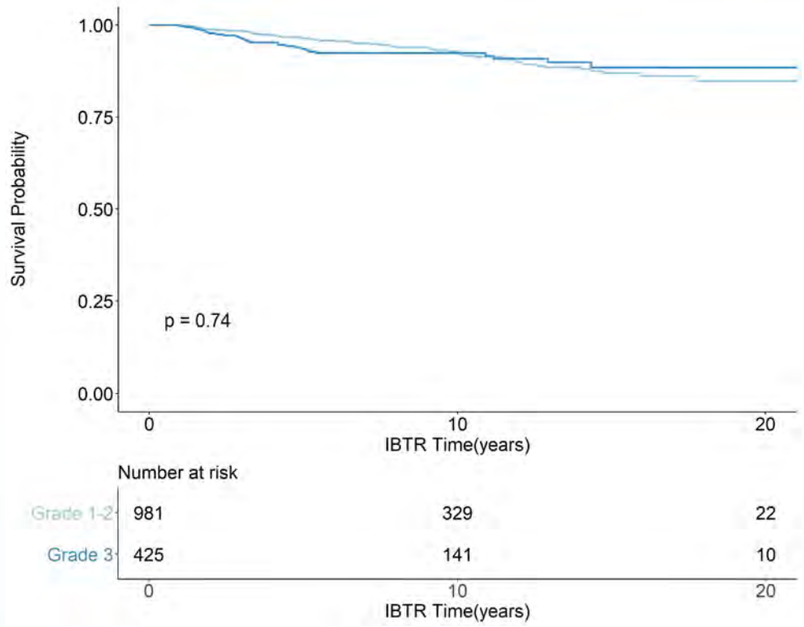


Figure 6-12. Ipsilateral breast tumour recurrence free survival (IBTR) of DCIS after breast-conserving surgery only, stratified by grade

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Related publications

We are grateful to our investigators and collaborators who have found JBCR useful. The following is a list of work that have used JBCR in part or in total.

1. Joshua S. H. Lim, Yirong Sim, Joanne Ngeow,Jeanette Yuen, Veronique K. M. Tan, Benita Kiat Tee Tan, Wei-Sean Yong, Chow Yin Wong,Sue Zann Lim, Julie Liana B. Hamzah,Si Ying Tan,Fuh Yong Wong, Preetha Madhukumar (2022) Male breast cancer: a Singapore perspective. ANZ J Surg 92(6):1440-1446.

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Ongoing studies

1. AI-driven Survival Modelling in Breast Cancer
2. Role of radiotherapy boost to supraclavicular fossa and internal mammary nodal chain in N2-3 disease
3. Chemotherapy Induced Febrile Neutropenia in Singapore Breast Cancer Patients
4. Improving Breast Cancer Risk Prediction in Singapore Women with a Hybrid Machine-Learning Model
5. Investigating the role and impact of discordant hormone receptor status in newly diagnosed breast cancer patients
6. Outcomes of Mucinous Breast Cancer
7. PREoperative therapy and Supportive Care in EarLy & Locally Advanced breast cancers – PreSCella
8. Retrospective review of imaging findings and surveillance outcomes after oncoplastic breast conserving surgery
9. Retrospective study on outcomes in metaplastic breast cancer
10. Retrospective study, a case series and study on encapsulated papillary carcinoma
11. Survival outcomes of Advanced Breast Cancer Patients in Singapore

APPENDIX
Appendix: List of Variables

PROPERTIES	VARIABLES		
Demographics	Name	Marital Status	Doctor in charge
	NRIC	Address 1	Referral
	Date of Birth	Address 2	with Consent
	Sex	Postal Code	
	Race		
Patient History	Menarche Age	Menopause Status	Presentation
	Parity	Age at Menopause	Chest size
	Age at First Child	Hormone Replacement	Cup size
	Breast Feeding	Smoker	Height
	Oral Contraceptive	Alcohol	Weight
Family History	Family History of Breast Cancer		
Surgery	Surgery Date	Reconstruction Dichotomous	
	Surgeon	Reconstruction Type	
	Breast Surgery Type		
Drug Treatment	Neo Adjuvant	Targeted Therapy Given	Hormonal Therapy Given
	Chemotherapy Given	Date of First Herceptin	Tamoxifen Duration
	Chemo Regimen	Date of Last Herceptin	
	Other Chemo Regimen		
Radiation Therapy	Radiation Given	Breast Dose	
	Radiation Start Date	Supraclavicular Dose	
	Radiation End Date	Axillary Dose	
	Radiation Field	Internal Mammary Dose	
Toxicity	Date of Assessment	Plexus Assessment	
	Symmetry of Breast	Heart Assessment	
	Edema of Breast	Lung Assessment	
	Skin Telangiectasia	Patient's satisfaction with cosmesis	
	Arm Edema	Doctor's assessment of cosmesis	

PROPERTIES	VARIABLES		
Recurrence	Fail Date	Date for IBTR	
	Type of Failure	Date for True Local Recurrence	
	Site of Metastasis	Date for Other Local Recurrence	
	Status	Date for Nodal Recurrence	
	Date for DDFS	Date for Contralateral Recurrence	
Death Registry	Date of Death		
	Cause of death		
	Death from Breast Cancer		
Patient Visit	First seen date		
	Last seen date		
Tumour Characteristics	Date of diagnosis	Comedo Necrosis	ER Intensity
	Tumour Side	Van Nuys Prognostic Index	ER Percentage
	Tumour Site	Clinical T Stage	ER Status
	Multi-focality	Clinical N Stage	PR Intensity
	Multi-centricity	Clinical M Stage	PR Percentage
	Histology	Clinical Staging	PR Status
	Differentiation	Pathological T Stage	HER2 Intensity
	Size Precise	Pathological N Stage	HER2 Percentage
	Size Category	Pathological M Stage	HER2 Status
	Margins Precise	Pathological Staging	FISH Status
	Margins Category	Overall TNM Staging	FISH Ratio
	Extensive Intraductal Component		
Lymph Nodes	SLN Biopsy	False Negative SLNB	Total number of nodes positive
	Number of SLN Positive	Non SLN Removed	Total number of nodes removed
	Number of SLN Removed	Axillary Clearance	

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