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Population-based picture of breast reconstruction in Queensland, Australia

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Abstract

Background: Approximately 40% of women with invasive breast cancer will undergo a mastectomy. Clinical practice guidelines recommend breast reconstruction (BR) options should be discussed with all women who are to undergo a mastectomy. We sought to examine rates of BR, BR methods over time and to identify factors associated with the likelihood of receiving BR in Queensland.

Methods: This population-based study used linked data from the Queensland Oncology Repository for 12 364 women who underwent a mastectomy for invasive breast cancer from 2008 to 2017. Multivariate logistic regression was used to model predictors of immediate breast reconstruction (IBR) and delayed breast reconstruction (DBR).

Results: Overall, 2560 (20.7%) women had BR, with 9.8% having IBR and 10.9% having DBR. Factors associated with a reduced likelihood of IBR or DBR included older age ($P < 0.001$), living in a regional/rural area ($P < 0.001$) and having a mastectomy in a public versus private hospital ($P < 0.001$). Median time from mastectomy to DBR was 18.4 and 29.2 months for women attending a private versus public hospital, respectively ($P < 0.001$). Use of implant-based BR increased significantly with a corresponding decrease in autologous BR over time.

Conclusions: Significant disparities exist in rates of BR between public and private hospitals. Women living in regional and rural areas as well as those aged over 60 years continue to have lower rates of BR. Addressing the health system barriers and developing strategies to improve access to, and uptake of BR should be a priority.

Introduction

In Australia, over 19 000 women will be diagnosed with invasive breast cancer in 2019,[1] and approximately 40% will undergo mastectomy.[2,3] The positive benefits of breast reconstruction (BR), such as improved body image and social and emotional wellbeing, are well recognized.[4] Further, evidence suggests BR has neither negative effect on overall survival nor increased risk of recurrence.[5,6] Australian clinical practice guidelines recommend BR options should be discussed with all women who are to undergo a mastectomy.[7]

Using 12 months of data from the Breast Surgeons of Australia & New Zealand (BreastSurgANZ) Quality Audit (BQA) database, Flitcroft *et al*. reported national BR rates of around 18%, varying considerably between States and Territories.[8] This rate appears lower than those observed in the UK (23.3%),[9] Canada (23.3%),[10] France (27.4%)[11] and the USA (26.6%).[12] While the BQA does include immediate BR performed by plastic and reconstructive surgeons, there is a gap in recording delayed BR. This likely results in an underrepresentation of the true BR rate for studies using the BQA database.

Lower BR rates are observed for rural and disadvantaged women,[10,13–15] while rates are higher for women who had mastectomy in a private hospital,[11,13,14] are younger age, or have a higher level of education.[16]

BR can be immediate (IBR) or delayed (DBR). Guiding principles suggest the timing of BR should be discussed prior to mastectomy.[7] While most studies report IBR is more commonplace,[10,11,17] DBR may be necessary due to the need for post-mastectomy radiation therapy and/or chemotherapy, the presence of comorbidities (such as diabetes), psychological distress at the time of diagnosis impairing decision-making, or simply patient preference.[18]

Few population-based studies have reported on rates of, and factors associated with IBR and DBR over time. To address the lack of published BR studies inclusive of all surgical specialties, BR timing and BR methods, we used population-level data to investigate trends in IBR and DBR over time, and examined sociodemographic, clinical and hospital factors associated with BR in Queensland, Australia.

Methods

This retrospective population-based study used linked data from the Queensland Oncology Repository (QOR). QOR consolidates cancer patient information for Queensland from the Queensland Cancer Register and surgical treatment from the Queensland Hospital Admitted Patient Data Collection for Queensland public and private hospitals. QOR also includes data collected from other treatment systems and multidisciplinary team meetings primarily from public hospitals.

Study population

The study population included all women diagnosed with a new case of invasive breast cancer from 2008–2017. BR procedures were identified from the Australian Classification of Health Interventions 11th edition[19] and included the following codes: 4553002, 4553900, 4553300, 4553600, 4552700, 4552701 and 4554200.

Variables included

Variables included age, hospital (public or private) and number of comorbidities. Residence at the time of diagnosis was categorized as major city, inner regional, outer regional and remote/very remote based on the Australian Geographical Classification.[20] Socioeconomic status was assigned according to the Australian Bureau of Statistics Socio-Economic Indexes for Areas (SEIFA) and was categorized as affluent (deciles 9–10, middle (deciles 3–8) and disadvantaged (deciles 1–2).[21] Stage and lymph node status was assigned for 93% of cases. Hospital volume was categorized as (high ≥15 breast cancer surgeries per year and low <15 breast cancer surgeries per year). Year of diagnosis was categorized as 2008–2012 and 2013–2017.

Analysis

We calculated the number of days between mastectomy and BR with IBR defined as reconstruction procedure conducted at the time of mastectomy and DBR as reconstruction performed any time following mastectomy.

The statistical significance of bivariate comparisons between sociodemographic and clinical factors and IBR or DBR was estimated using the chi-square or Kruskal-Wallis test. Multivariate logistic regression models were constructed to examine factors independently associated with the likelihood of having IBR or DBR. For each model, we included age, Indigenous status, socioeconomic status, remoteness of residence, comorbidities, stage at diagnosis, hospital volume and type (public or private), and year of diagnosis. All analyses were conducted using Stata V15.1 (Stata Corp, College Station, TX, USA).

Ethical approval for this study was not required as all data were de-identified.

Results

Of 30 868 women diagnosed with invasive breast cancer from 2008 to 2017, 12 364 (40.1%) had a mastectomy, representing the cohort of interest. Median age at diagnosis was 59 years (range 21–96 years). Overall, 2560 (20.7%) had BR, with 9.8% (n = 1215) having IBR (47.5% of all reconstructions) and 10.9% (n = 1345) had DBR. Autologous BR decreased from 42.9% in 2008–2012 to 24.3% for 2013–2017 with a corresponding increase in the use of implant BR ($P < 0.001$) (Fig. 1a). Overall, the majority of IBR were implants (82.2%), whilst for DBR, implants accounted for 52.0% of BR ($P < 0.001$) (Fig 1b,c).

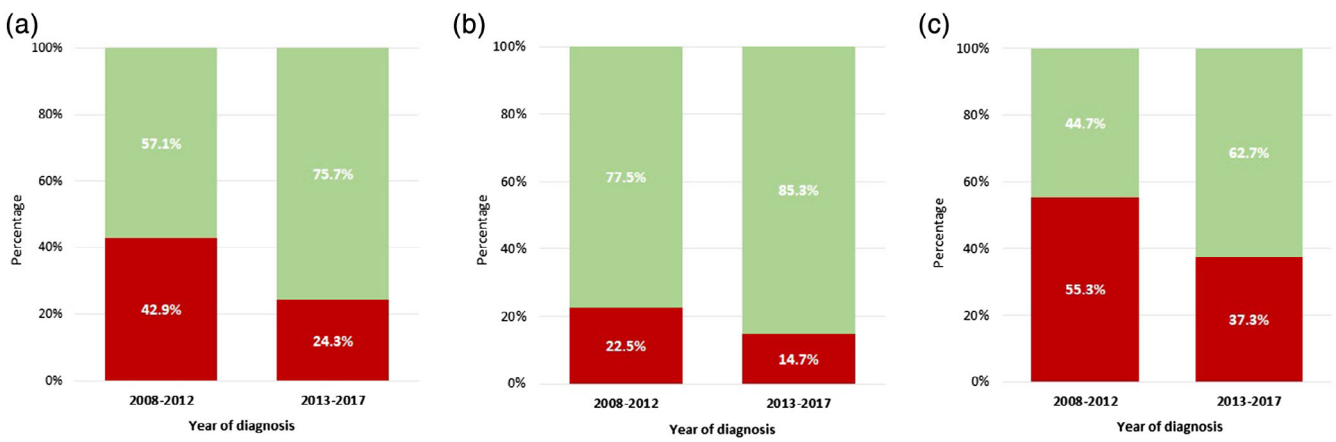

Fig 1. Changes in breast reconstruction surgery methods over time. (a) All breast reconstruction. (b) Immediate breast reconstruction. (c) Delayed breast reconstruction. (■), Autologous; (■), implant.

Table 1 Multivariate model showing factors associated with likelihood of receiving either immediate or delayed breast reconstruction

	Immediate reconstruction				Delayed reconstruction			
	n (%)	*P*-value†	Adjusted OR (95% CI)	*P*-value‡	*n* (%)	*P*-value†	Adjusted OR (95% CI)	*P*-value‡
Total mastectomy (*n* = 12 364)	1215 (9.8)				1345 (10.9)			
Age at diagnosis		<0.001		<0.001		<0.001		<0.001
<40 (*n* = 860)	184 (21.4)		1.63 (1.30–2.04)		266 (30.9)		2.91 (2.41–3.51)	
40–49 (*n* = 2515)	451 (17.9)		1.39 (1.18–1.65)		536 (21.3)		1.81 (1.56–2.10)	
50–59 (*n* = 2774)	364 (13.1)		Ref		361 (13.0)		Ref	
60–69 (*n* = 2986)	183 (6.1)		0.46 (0.38–0.56)		166 (5.6)		0.40 (0.33–0.49)	
70+ (*n* = 3229)	33 (1.0)		0.09 (0.06–0.12)		16 (0.5)		0.04 (0.02–0.06)	
Indigenous status§		0.01		0.69		0.004		0.006
Non-Indigenous (*n* = 12 089)	1201 (9.9)		Ref		1330 (11.0)		Ref	
Indigenous (*n* = 270)	14 (5.2)		0.88 (0.49–1.61)		15 (5.6)		0.47 (0.27–0.81)	
SES		<0.001		<0.001		<0.001		0.46
Affluent (*n* = 1434)	254 (17.7)		Ref		198 (13.8)		Ref	
Middle (*n* = 7908)	853 (10.8)		0.80 (0.67–0.96)		895 (11.3)		1.08 (0.90–1.30)	
Disadvantaged (*n* = 3022)	108 (3.6)		0.44 (0.33–0.58)		252 (8.3)		1.00 (0.79–1.26)	
Residential location		<0.001		<0.001		0.001		<0.001
Major city (*n* = 7745)	949 (12.3)		Ref		903 (11.7)		Ref	
Inner regional (*n* = 3094)	125 (4.0)		0.45 (0.37–0.57)		311 (10.1)		1.00 (0.85–1.17)	
Outer regional (*n* = 1275)	129 (10.1)		1.03 (0.83–1.29)		114 (8.9)		0.71 (0.57–0.88)	
Remote/very remote (*n* = 250)	12 (4.8)		0.46 (0.25–0.86)		17 (6.8)		0.48 (0.28–0.80)	
Comorbidities		<0.001		<0.001		<0.001		<0.001
0 (*n* = 10 300)	1153 (11.2)		Ref		1266 (12.3)		Ref	
1 (*n* = 1442)	55 (3.8)		0.51 (0.38–0.69)		67 (4.7)		0.61 (0.47–0.80)	
2+ (*n* = 622)	7 (1.1)		0.24 (0.11–0.52)		12 (1.9)		0.37 (0.21–0.67)	
Stage at diagnosis		<0.001		<0.001		0.01		<0.001
Localized (*n* = 5923)	772 (13.0)		Ref		644 (10.9)		Ref	
Regional (*n* = 5418)	349 (6.4)		0.39 (0.34–0.46)		619 (11.4)		0.75 (0.66–0.85)	
Distant (*n* = 259)	7 (2.7)		0.14 (0.06–0.30)		19 (7.3		0.46 (0.28–0.75)	
Unknown (*n* = 764)	87 (11.4)		0.73 (0.55–0.96)		63 (8.3)		0.77 (0.58–1.03)	
Total mastectomy (*n* = 12 364)	1215 (9.8%)				1345 (10.9)			
Pre-mastectomy chemotherapy		<0.001		0.002				
Yes (*n* = 1316)	258 (19.6)		Ref		N/A	N/A	N/A	N/A
No (*n* = 11 048)	957 (8.7)		0.74 (0.62–0.90)					
Adjuvant therapy						<0.001		<0.001
No (*n* = 5310)	N/A	N/A	N/A	N/A	339 (6.4)		Ref	
Yes (*n* = 7054)					1006 (14.3)		1.45 (1.25–1.68)	
Laterality		<0.001		<0.001		0.33		<0.001
Unilateral (*n* = 10 131)	604 (6.0)		Ref		1089 (10.8)		Ref	
Bilateral (*n* = 2233)	611 (27.4)		3.75 (3.26–4.33)		256 (11.5)		0.76 (0.65–0.89)	
Hospital type¶		<0.001		<0.001		<0.001		<0.001
Private (*n* = 6316)	915 (14.5)		Ref		758 (12.0)		Ref	
Public (*n* = 6048)	300 (5.0)		0.32 (0.27–0.37)		587 (9.7)		0.78 (0.69–0.89)	
Hospital volume		<0.001		0.69		0.32		0.12
Low (<15 per year) (*n* = 743)	37 (5.0)		Ref		76 (10.2)		Ref	
High (15+ per year) (*n* = 11 621)	1178 (10.1)		1.08 (0.74–1.58)		1269 (10.9)		0.80 (0.61–1.06)	
Diagnosis period		<0.001		0.06		<0.001		<0.001
2008–2012 (*n* = 5850)	485 (8.3)		Ref		801 (13.7)		Ref	
2013–2017 (*n* = 6514)	730 (11.2)		1.14 (0.99–1.31)		544 (8.4)		0.57 (0.51–0.65)	

†Pearson's chi-square test for bivariate association.

‡*P*-value from Wald's joint test of coefficient for multivariate logistic regression.

§Indigenous status unknown for five patients.

¶Hospital where mastectomy was performed.

CI, confidence interval; OR, Odds ratio; SES, socioeconomic status.

Immediate breast reconstruction

In the adjusted model, the likelihood of IBR increased with decreasing age ($P < 0.001$) (Table 1). Women living in a disadvantaged area were nearly 60% less likely to have IBR (odds ratio (OR) 0.44, 95% confidence interval 0.33–0.58) and those living in remote/very remote locations were also less likely to have IBR (OR 0.46, 95% CI 0.25–0.86). Women who had their mastectomy in a public versus private hospital were 70% less likely to have IBR (OR 0.32, 95% CI 0.27–0.37).

Delayed breast reconstruction

Factors associated with a higher likelihood of DBR (Table 1) included being aged <40 or 40–49 years compared to 50–59 years (OR 2.91, 95% CI 2.41–3.51 and OR 1.81, 95% CI 1.56–2.10, respectively). Indigenous women were about 50% less likely to have DBR compared to non-Indigenous women (OR 0.47, 95% CI 0.27–0.81). Increasing remoteness was associated with a decreased likelihood of DBR ($P < 0.001$). The likelihood of DBR was also lower for women

Table 2 Multivariate model† examining factors associated with time from mastectomy to reconstruction greater than the median‡

	Odds ratio (95% CI)	*P*-value
Age at diagnosis		0.52
<40	1.27 (0.83–1.95)	
40–49	1.33 (0.91–1.96)	
50–59	1.30 (0.87–1.94)	
60–69	Ref	
Indigenous status		0.61
Non-Indigenous	Ref	
Indigenous	0.75 (0.25–2.29)	
Socioeconomic status		0.23
Affluent	Ref	
Middle	1.09 (0.77–1.54)	
Disadvantaged	1.42 (0.91–2.23)	
Residential location		0.29
Major city	Ref	
Inner regional	0.89 (0.65–1.21)	
Outer regional/remote and very remote	0.72 (0.48–1.09)	
Adjuvant treatment		0.04
No	Ref	
Yes	1.37 (1.02–1.83)	
Hospital type§		<0.001
Private	Ref	
Public	3.52 (2.73–4.53)	
Diagnosis period		<0.001
2008–2012	Ref	
2013–2017	0.37 (0.29–0.48)	

†Model additionally adjusted for stage at diagnosis.

‡Based on median time from mastectomy to reconstruction of 21.7 months.

§Hospital where reconstruction was performed.

CI, confidence interval.

who had their mastectomy in a public versus private hospital (OR 0.78, 95%CI 0.69–0.89).

Time and pathway to delayed breast reconstruction

Median time from mastectomy to DBR was 21.7 months (range 0.5–129 months) and was significantly longer for public versus private hospital patients (29.2 and 18.4 months), respectively ($P < 0.001$). Having BR in a public versus private hospital was significantly associated with time to reconstruction being greater than the median (OR 3.52, 95% CI 2.73–4.53) (Table 2). Women diagnosed in the more recent period (2013–2017) were about 60% less likely to have had their reconstruction within the median time (OR 0.37, 95% CI 0.29–0.48) compared to those diagnosed from 2008 to 2012.

Figure 2 shows the pathways from mastectomy to DBR for 1345 women by the period of diagnosis. The most common pathway was mastectomy and BR in a private hospital (52.3%). We observed a small increase in the proportion of women having both mastectomy and BR in a public hospital. However overall, there were no statistically significant changes in pathways over time ($P = 0.61$).

Discussion

In this population-based study of 12 364 women who had a mastectomy, an overall BR rate of 20.7% was observed. This is significantly higher than the 6.9% reported for Queensland in an earlier national study of Australian BR rates.[8] The likely reason for the variation lies in the study cohorts. The earlier study used data from the BQA database,[8] (a database that is mandatory for all BreastSurgANZ Society members), and while it does include some BR performed by plastic and reconstructive surgeons, there is a gap in recording DBR. Our study included state-wide data from QOR spanning a 10-year period inclusive of all surgical specialties and reconstruction timing.

Our overall BR rate is similar to a Canadian study (23.3%)[10] and a state-based US study (21.1%),[22] but lower than a recent nationwide study from France (27.4%).[11] Our IBR and DBR rates were 9.8% and 10.9%, respectively. Other studies using similar cohorts (i.e. women with invasive cancer only) have reported IBR rates between 8% and 24%.[10,17,23,24] The DBR rates in this study are similar to those reported in some USA and Canadian studies,[10,17] but again lower than those observed (17.8%) in France.[23]

Factors impacting likelihood of receiving breast reconstruction

We found the likelihood of IBR was significantly higher for younger compared to older women. Only 3.5% of women aged 60+ years had IBR compared to 16.2% of women under 60 years. In a

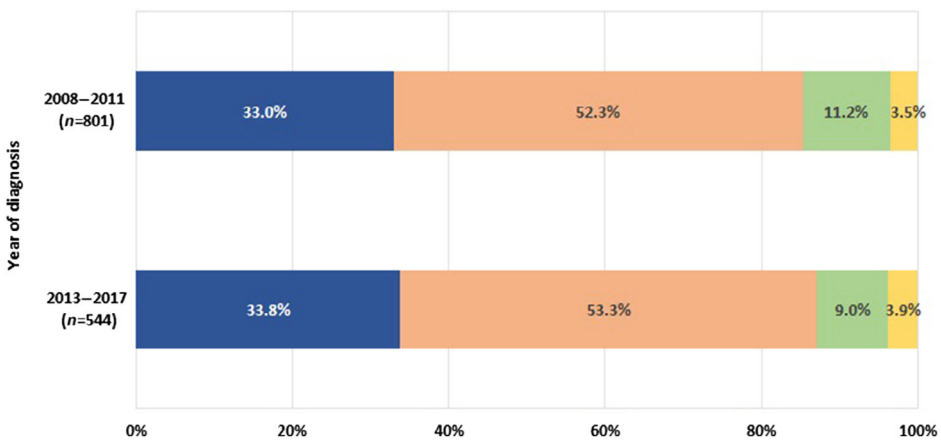

Fig 2. Hospital pathway from mastectomy to delayed breast reconstruction by period of diagnosis. (■), Public to public; (■), private to private; (■), public to private; (■), private to public.

review of BR, Platt and colleagues concluded that being aged >50 years was consistently associated with a reduced likelihood of having BR.[25] Similarly, a systematic review of 32 studies concluded rates of BR were significantly lower in women aged 60 years or over.[26] The reasons why older women are less likely to have BR are largely unknown. While it could be suggested the risks of post-BR complications for older women are greater, older age is not necessarily associated with higher rates of post-operative complications.[27,28]

Women living outside major cities were significantly less likely to have BR. These findings are in line with other Australian[13,29] and international studies.[10,11] Reduced access to BR in hospitals away from major cities may represent one reason why this disparity continues to exist along with plastic and reconstructive surgeon availability. A Canadian study found 46% of the geographical variation in IBR was explained by plastic surgeon access.[10] We do not know whether clinicians are less likely to discuss the options of BR with regional and rural women, compared to those living in urban locations or whether women themselves feel the geographical barriers are too great.

In this study, the likelihood of having either IBR or DBR was significantly lower for women who had their mastectomy in a public versus private hospital. These findings are similar to those observed elsewhere.[8,11,13] This disparity was more marked for IBR, with women who had mastectomy in a public hospital being nearly 70% less likely to have IBR (the corresponding figure for DBR was about 20%) compared to those using a private hospital. It is difficult to identify the exact reasons for this finding. Our models were fully adjusted for patient sociodemographics, clinical factors, hospital volume and comorbidities. We did not however, have individual-level information on health insurance status, and it is likely that some of the differential in BR rates can be explained by access to private insurance. While this study was not designed to identify the reasons for the lower BR rates in public hospitals, others have identified surgical timetables and limited theatre availability as barriers to BR.[30] The time from mastectomy to DBR was nearly double for women in public compared to private hospitals (29.1 and 18.6 months, respectively).

We observed a nearly 20% increase in the use of implant BR and a subsequent decrease in autologous BR over time. This is despite recent evidence of superior patient-reported outcomes for autologous BR.[31] The need for reduced operative and recovery time may have contributed to the shift away from autologous BR.

Strengths and limitations

The strength of this study is that it is population-based and included the linkage of an extensive set of sociodemographic and clinical variables. A further strength is the inclusion of both IBR and DBR, providing a more comprehensive examination of BR in Queensland. Some limitations do however need to be considered. We did not have data on individual surgeon volume, nor clinician specialty. Nor did we have data on patient preference or whether (and to what extent) BR was discussed prior to mastectomy. Both factors are likely to influence whether a woman would or would not have BR. Additionally, a potential limitation was that we elected to classify 15 or more breast operations per year as high volume.

Conclusions

Rates of BR are low in public compared to private hospitals. Additionally, low rates of BR continue to be observed for women living in regional and rural areas as well as in those over 60 years. Addressing factors such as adequate and timely access to theatre time, inclusion of plastic surgeons in multidisciplinary team meetings and wide-spread acknowledgement of the benefits of BR are required to improve rates of BR in the public sector. Further, supportive care pathways need to be established to help regional and rural women access BR.

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Author Contributions

Philippa Youl: Conceptualization; formal analysis; methodology; writing-original draft; writing-review and editing. **Shoni Philpot:** Conceptualization; methodology; writing-review and editing. **Julie Moore:** Data curation; project administration; writing-review and editing. **David Theile:** Conceptualization; methodology; writing-review and editing.

Conflicts of interest

None declared.

References

1. Australian Institute of Health and Welfare. *Cancer in Australia 2019*. Cancer series no.119. Cat. no. CAN 123. Canberra: AIHW. 2019.
2. Queensland Government. *Queensland Breast Cancer Quality Index: Practice indicators of safe, Quality Cancer Care. Public and Private Hospitals 2007-2016*. Brisbane: Queensland Health, **2019**
3. Cancer Australia. *Influencing Best Practice in Breast Cancer*. [Cited 18 Aug 2020.] Available from URL: https://thestatement.canceraustralia.gov.au/about
4. Howes BH, Watson DI, Xu C, Fosh B, Canepa M, Dean NR. Quality of life following total mastectomy with and without reconstruction versus breast-conserving surgery for breast cancer: a case-controlled cohort study. *J. Plast. Reconstr. Aesthet. Surg.* 2016; **69**: 1184–91.
5. Yang X, Zhu C, Gu Y. The prognosis of breast cancer patients after mastectomy and immediate breast reconstruction: a meta-analysis. *PLoS One* 2015; **10**: e0125655.
6. Bezuhly M, Wang Y, Williams JG, Sigurdson LJ. Timing of Postmastectomy reconstruction does not impair breast cancer-specific survival: a population-based study. *Clin. Breast Cancer* 2015; **15**: 519–26.

7. Cancer Australia. *Influencing Best Practice in Breast Cancer*. [Cited 1 Oct 2019]. Available from URL: https://www.canceraustralia.gov.au/publications-and-resources/cancer-australia-publications/influencing-best-practice-breast-cancer
8. Flitcroft K, Brennan M, Costa D, Spillane A. Documenting patterns of breast reconstruction in Australia: the national picture. *Breast* 2016; **30**: 47–53.
9. Jeevan R, Mennie JC, Mohanna PN, O'Donoghue JM, Rainsbury RM, Cromwell DA. National trends and regional variation in immediate breast reconstruction rates. *Br. J. Surg.* 2016; **103**: 1147–56.
10. Platt J, Zhong T, Moineddin R *et al*. Geographic variation immediate and delayed breast reconstruction utilization in Ontario, Canada and plastic surgeon availability: a population-based observational study. *World J. Surg.* 2015; **39**: 1909–21.
11. Regis C, Le J, Chauvet MP, Le Deley MC, Le Teuff G. Variations in the breast reconstruction rate in France: a nationwide study of 19,466 patients based on the French medico-administrative database. *Breast* 2018; **42**: 74–80.
12. Sisco M, Du H, Warner JP, Howard MA, Winchester DP, Yao K. Have we expanded the equitable delivery of postmastectomy breast reconstruction in the new millennium? Evidence from the national cancer data base. *J. Am. Coll. Surg.* 2012; **215**: 658–66 discussion 66.
13. Feng Y, Flitcroft K, van Leeuwen MT, Elshaug AG, Spillane A, Pearson SA. Patterns of immediate breast reconstruction in New South Wales, Australia: a population-based study. *ANZ J. Surg.* 2019; **89**: 1230–5.
14. Dasgupta P, Youl PH, Pyke C, Aitken JF, Baade PD. Geographical disparity in breast reconstruction following mastectomy has reduced over time. *ANZ J. Surg.* 2017; **87**: E183–E7.
15. Jeevan R. Reconstructive utilisation and outcomes following mastectomy surgery in women with breast cancer treated in England. *Ann. R. Coll. Surg. Engl.* 2020; **102**: 110–4.
16. Bell RJ, Robinson PJ, Fradkin P, Schwarz M, Davis SR. Breast reconstruction following mastectomy for invasive breast cancer is strongly influenced by demographic factors in women in Victoria, Australia. *Breast* 2012; **21**: 394–400.
17. Karunanayake M, Bortoluzzi P, Chollet A, Lin JC. Factors influencing the rate of post-mastectomy breast reconstruction in a Canadian teaching hospital. *Plast. Surg.* 2017; **25**: 242–8.
18. Yoon AP, Qi J, Brown DL *et al*. Outcomes of immediate versus delayed breast reconstruction: results of a multicenter prospective study. *Breast* 2018; **37**: 72–9.
19. Australian Institute of Health & Welfare. *Australian Classification of Health Interventions 11th Edition*. [Cited 20 Sept 2019]. Available from URL: https://meteor.aihw.gov.au/content/index.phtml/itemId/699613
20. Australian Bureau of Statistics. *Australian Statistical Geography Standard (ASGS): Volume 5 – Remoteness Structure 2011*. Canberra: ABS, 2013.
21. Australian Bureau of Statistics. *Census of Population and Housing: Socio-Economic Indexes for Areas (SEIFA), Australia, 2011*. Canberra: ABS. [Cited 5 Feb 2020.] Available from URL: http://www.abs.gov.au/ausstats/abs@.nsf/Lookup/by%20Subject/2033.0.55.001~2011~Main%20Features~Main%20Page~1
22. DeCoster RC, Bautista RF Jr, Burns JC *et al*. Rural-urban differences in breast reconstruction utilization following oncologic resection. *J. Rural Health* 2019; **36**: 347–54.
23. Negre G, Balcaen T, Dast S, Sinna R, Chazard E. Breast reconstruction in France, observational study of 140,904 cases of mastectomy for breast cancer. *Ann. Chir. Plast. Esthet.* 2020; **65**: 36–43.
24. Nayyar A, Strassle PD, Reddy KG *et al*. Variations in the utilization of immediate post-mastectomy breast reconstruction. *Am. J. Surg.* 2019; **218**: 712–5.
25. Platt J, Baxter N, Zhong T. Breast reconstruction after mastectomy for breast cancer. *CMAJ* 2011; **183**: 2109–16.
26. Oh DD, Flitcroft K, Brennan ME, Spillane AJ. Patterns and outcomes of breast reconstruction in older women – a systematic review of the literature. *Eur. J. Surg. Oncol.* 2016; **42**: 604–15.
27. Bowman CC, Lennox PA, Clugston PA, Courtemanche DJ. Breast reconstruction in older women: should age be an exclusion criterion? *Plast. Reconstr. Surg.* 2006; **118**: 16–22.
28. Fischer JP, Wes AM, Tuggle CT *et al*. Mastectomy with or without immediate implant reconstruction has similar 30-day perioperative outcomes. *J. Plast. Reconstr. Aesthet. Surg.* 2014; **67**: 1515–22.
29. Flitcroft KL, Brennan ME, Costa DSJ, Spillane AJ. Regional variation in immediate breast reconstruction in Australia. *BJS Open* 2017; **1**: 114–21.
30. Sandelin K, King E, Redman S. Breast reconstruction following mastectomy: current status in Australia. *ANZ J. Surg.* 2003; **73**: 701–6.
31. Toyserkani NM, Jorgensen MG, Tabatabaeifar S, Damsgaard T, Sorensen JA. Autologous versus implant-based breast reconstruction: a systematic review and meta-analysis of breast-Q patient-reported outcomes. *J. Plast. Reconstr. Aesthet. Surg.* 2020; **73**: 278–85.