

Cancers in Australia in 2010 attributable to total breastfeeding durations of 12 months or less by parous women

Susan J. Jordan,^{1,2} Louise F. Wilson,¹ Christina M. Nagle,^{1,2} Adele C. Green,^{1,2,3} Catherine M. Olsen,^{1,2} Christopher J. Bain,^{1,4} Nirmala Pandeya,^{1,2} David C. Whiteman,^{1,2} Penelope M. Webb^{1,2}

There are strong associations between a number of reproductive factors and hormone-related cancers such as breast, ovarian and endometrial cancer, but most of these factors (e.g. numbers of pregnancies, age at first birth) cannot pragmatically be modified for the purposes of cancer prevention. Breastfeeding has marked effects on maternal reproductive hormones, has been inversely linked to breast and ovarian cancer and, unlike many other reproductive exposures, can be promoted to women for its public health and individual benefits.

In the Second Expert Report on Food, Nutrition, Physical Activity and the Prevention of Cancer¹ and subsequent Continuous Update Project (CUP),² the World Cancer Research Fund/American Institute for Cancer Research (WCRF/AICR) concluded that there was convincing evidence that breastfeeding decreases risk of maternal pre- and post-menopausal breast cancer, but also concluded that the evidence for a causal association between breastfeeding and ovarian cancer^{1,3} was only "limited-suggestive". This latter conclusion was based on their meta-analysis of three cohort studies⁴⁻⁶ which showed a non-significant 10% reduction in risk for ever versus never breastfeeding (relative risk [RR] 0.90; 95% confidence interval [CI] 0.75-1.08).³ However, results of another recently published meta-analysis of three cohort studies^{5,7,8} (only one of which⁵ was included in the WCRF review) suggested that each additional month

Abstract

Objectives: To estimate the proportion and number of cancers occurring in Australia in 2010 attributable to parous women having breastfed for total durations of ≤ 12 months.

Methods: We estimated the population attributable fraction (PAF) of breast cancers (the only cancer site with convincing evidence of causal association) associated with women breastfeeding for ≤ 12 months in total, using standard formulae incorporating breastfeeding prevalence data, relative risks associated with breastfeeding and cancer incidence. We also estimated the proportion change in disease incidence (potential impact fraction [PIF]) that might have occurred under two hypothetical scenarios of women breastfeeding for longer durations.

Results: An estimated 235 (1.7%) breast cancer cases that occurred in Australian in 2010 could be attributed to women breastfeeding for total durations of ≤ 12 months. Assuming a hypothetical increase in breastfeeding, we estimated that the number of breast cancers prevented would range from 36 to 51 (prevented fraction = 0.3% to 0.4%).

Conclusions: More than 200 breast cancers were attributable to women breastfeeding for total durations of ≤ 12 months.

Implications: Policies to increase breastfeeding duration may help prevent breast cancers in the future.

Key words: population attributable fraction, cancer, risk factor, breast feeding, potential impact fraction

of breastfeeding was associated with a significant 1.02% reduction in risk of ovarian cancer.⁹

There are several biologically plausible mechanisms by which breastfeeding might reduce risk of breast and ovarian cancers. Lactation causes differentiation of breast epithelial cells so they may be less susceptible to neoplastic transformation;² ductal epithelial cells also exfoliate during lactation potentially eliminating those with DNA-damage.² Furthermore, breastfeeding suppresses gonadotrophins, thereby lowering endogenous oestrogen and progesterone,

and these hormones are thought to play an important role in the development of breast neoplasia.² For ovarian cancer, most data suggest that repeated exposure of the ovarian/fallopian tube epithelium (many ovarian cancers may actually arise from the fallopian tube) to the effects of recurrent ovulation and/or reproductive hormones have an important role in carcinogenesis. In suppressing gonadotrophins and ovulation, lactation should decrease exposure of the ovary/fallopian tube to most factors postulated to have a strong causative role in cancer development.¹⁰

1. QIMR Berghofer Medical Research Institute, Queensland

2. School of Public Health, The University of Queensland

3. Cancer Research UK, Manchester Institute and Institute of Inflammation and Repair, University of Manchester, United Kingdom

4. National Centre for Epidemiology and Population Health, Research School of Population Health, Australian National University, Australian Capital Territory

Correspondence to: Professor David C. Whiteman, Cancer Control Group, QIMR Berghofer Medical Research Institute, Locked Bag 2000, Royal Brisbane and Women's Hospital, Queensland 4029; e-mail: david.whiteman@qimrberghofer.edu.au

Submitted: March 2015; Revision requested: May 2015; Accepted: June 2015

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The authors have stated they have no conflict of interest.

Our aim was to estimate the proportion of cancers attributable to little or no breastfeeding by parous women. Based on our *a priori* decision to limit our primary analyses to exposure–cancer relationships that either the WCRF or International Agency for Research on Cancer (IARC) had concluded were causal, in our primary analysis we estimated only the proportion of breast cancers diagnosed in 2010 that were attributable to little or no breastfeeding by women who had children. On the assumption that further studies will likely strengthen the evidence for a protective causal association between breastfeeding and ovarian cancer, we have undertaken a supplementary analysis to calculate PAF estimates for ovarian cancer.

Methods

The National Health and Medical Research Council Australian Dietary Guidelines recommend that individual babies be breastfed for at least the first year.¹¹ However, epidemiological studies of breastfeeding and cancer risk have mostly considered the effects of total duration of breastfeeding (i.e. the sum of the duration of all episodes of breastfeeding rather than the duration of individual episodes). The best prevalence data for Australian women that we could access were also expressed in terms of total duration and, in addition, grouped all women with total breastfeeding durations of greater than 12 months together. Therefore, for pragmatic reasons we have defined a theoretically optimal level of breastfeeding (in terms of cancer prevention) by a parous woman as a cumulative total duration of more than 12 months, irrespective of the number of children women had.

Relative risk estimates

For breast cancer, the WCRF/AICR (2007),¹ estimated a summary dose-response relative

risk of 0.98 (95%CI 0.97-1.00) per five months of breastfeeding among parous women. This estimate was not updated in the 2010 report,² so we used this RR in our calculations. To obtain an estimate of risk per month of deficit in breastfeeding we assumed a log-linear relationship between exposure and risk:

$$\text{Increase in log risk per 1 month deficit of breastfeeding } (R_{bf}) = (\ln(1/RR_5))/5$$

where RR_5 is the relative risk per 5 months of breastfeeding, giving an increase in log risk of $4.041e^{-3}$ per month deficit in breastfeeding.

Exposure prevalence estimates

The relative risks we used were for total duration of breastfeeding over a woman's lifetime, regardless of when in a woman's life breastfeeding may have occurred. We have only considered parous women in our estimates of the numbers of cases attributable to a lack of breastfeeding, because relative risks reported in the literature use parous women who have never breastfed as the reference group.

Data on the proportion of Australian women who have had children and breastfed, by the total duration of breastfeeding, were sourced from the 2001 National Health Survey (NHS) Confidentialised Unit Record Files (CURF).¹² These data were available only for women aged 19 to 64 years, so we have applied the prevalence of breastfeeding among the 60–64 year age group to the 65+ year age group. Breastfeeding prevalence was obtained for each 5-year age group across 14 categories of duration, ranging from the lowest category (never) to the highest category (more than 12 months), spanned by 12 ordinal categories rising in monthly increments (see Table 1).

Statistical analysis

The population attributable fraction (PAF) was calculated by age category using the following formula:¹³

$$PAF = \frac{\sum(p_x * ERR_x)}{1 + \sum(p_x * ERR_x)}$$

where p_x is the proportion of the population and ERR_x the excess RR in breastfeeding category x .

The excess relative risk (ERR) was calculated as:

$$ERR_x = \exp(R_{bf} \times BF_x) - 1$$

where R_{bf} is the increase in log risk for a deficit of 1 month of breastfeeding (using the formula described in Relative Risk estimates) and BF_x is the deficit in months of breastfeeding below 13 months in duration category x .

To estimate the number of cancers attributable to breastfeeding for durations of 12 months or less in a population of parous women, the incidence of breast cancer in 2010¹⁴ was split into the estimated proportions occurring in parous and nulliparous women based on the average proportions of breast cancers in parous and nulliparous women across two prospective studies (1 Australia, 1 UK) and one pooled analysis of four prospective studies (US).¹⁵⁻¹⁷ The proportional split (nulliparous/parous) was 14%/86%.

Supplementary analysis

We modelled the impact of breastfeeding for total durations of 12 months or less on ovarian cancer using the relative risk estimate of 0.95 (95%CI 0.90-0.99) per five months of breastfeeding (among parous women) from the meta-analysis by Luan and colleagues.⁹ This equates to an increase in log risk for each one-month deficit of breastfeeding of $10.259e^{-3}$. The estimated proportional split of ovarian cancers occurring in nulliparous and parous women, based on two cohort studies and one pooled analysis, was 21%/79%.^{5,18,19}

Potential impact of changing the prevalence of breastfeeding

While the NHMRC Australian Dietary Guidelines recommend breastfeeding infants

Table 1: Proportions (%) of parous women breast feeding for different total durations (months), Australia 2001.

Age Group	Duration of breastfeeding (months)													
	Never	≤1	>1 to 2	>2 to 3	>3 to 4	>4 to 5	>5 to 6	>6 to 7	>7 to 8	>8 to 9	>9 to 10	>10 to 11	>11 to 12	>12
19-24 yrs	20.3	14.8	10.7	0.6	9.3	9.7	4.2	5.5	1.1	5.5	0.8	2.1	3.4	12.2
25-29 yrs	13.1	17.2	8.2	0.7	4.0	5.9	4.4	3.5	3.3	3.5	3.1	1.1	1.9	30.1
30-34 yrs	8.2	6.1	6.4	0.7	5.1	3.5	3.8	4.5	4.2	3.3	4.4	2.2	1.9	45.7
35-39 yrs	8.9	4.3	4.2	0.5	3.4	4.3	2.4	5.8	2.6	3.6	2.5	3.6	1.8	52.1
40-44 yrs	11.0	4.5	5.9	0.4	3.1	3.2	1.6	5.5	1.7	1.6	3.3	3.1	1.6	53.5
45-49 yrs	14.0	4.5	3.5	0.0	4.8	4.2	2.5	5.2	2.7	2.1	2.2	1.5	1.7	51.2
50-54 yrs	21.7	3.4	5.7	1.0	6.1	3.5	4.5	6.6	2.3	3.8	4.4	2.3	2.8	32.1
55-59 yrs	22.2	4.2	5.6	0.3	5.4	4.4	2.1	3.5	2.3	4.9	6.7	2.7	3.0	32.7
60-64 yrs	20.7	4.0	3.5	0.1	4.5	4.3	2.3	4.7	3.3	3.8	2.9	2.9	3.2	39.9

Source: 2001 National Health Survey, Expanded CURF, RADL. Findings based on use of Australian Bureau of Statistics CURF data 12

for at least the first 12 months,¹¹ it may not be realistic to expect all mothers will be able to reach even a minimum total duration of 12 months across all pregnancies. We modelled the impact of more achievable prevalence changes among parous women:

1. If those who never breastfed instead fed for 1–3 months total duration; and those who reported ≤6 months of breastfeeding breastfed for a total of >6 months.
2. No new women initiated breastfeeding, however, those who reported ≤6 months increased their breastfeeding to a total of >6 months.

To model the first scenario, we re-distributed women who never breastfed across to the '>1 to 2 months' and '>2 to 3 months' categories according to the actual distribution of women in these categories, and shifted the rest of the women who breastfed for up to six months to the '>6 to 7 months' category. In the second scenario, the proportion of women who never breastfed was not changed, while all the women who did breastfeed their children but did so for six months or less were shifted into the '>6 to 7 month' category. We then calculated the potential impact fraction (PIF) using the formula from Morgenstern and Bursic.²⁰

$$PIF = \frac{\sum_{x=1}^n p_x RR_x - \sum_{x=1}^n p_x^* RR_x}{\sum_{x=1}^n p_x RR_x}$$

where p_x is the proportion of the population in category x , RR_x is the RR for that category and p_x^* is the population in category x after re-distribution of women who breastfed for less than six months according to the alternative scenarios described above.

We then calculated the number of breast cancer cases that would have occurred in Australia in 2010 assuming that the alternative scenarios of breastfeeding duration had prevailed. The PIF is then the proportional difference between the observed number of breast cancers and the number expected under the alternative prevalence scenarios.

Results

The proportion of parous women who breastfed for a total duration of more than 12 months was lowest for the youngest age category (19–24 years) at 12%, increased to around 50% for the age groups 25–49 years, but then declined sharply in the older age categories (50–64 years). More than 20% of parous women in these older age categories never breastfed their children (Table 1).

An estimated 235 breast cancer cases diagnosed in parous Australian women aged 19 years and over in 2010 (1.7% of all breast cancers) could be attributed to breastfeeding for a total of 12 months or less (Table 2). This corresponds to 0.5% of all cancer cases in women (aged 19+ years), excluding basal cell carcinoma and squamous cell carcinoma of the skin.

Supplementary analysis

If the association between a deficit in breastfeeding duration and ovarian cancer is causal, then we estimated that 51 ovarian cancers (3.9% of all ovarian cancers) would be attributable to breastfeeding for 12 months or less among parous women aged 19+ years.

Potential impact of changing the prevalence of breastfeeding

Altering the distribution of breastfeeding durations in Australian parous women had minimal impact on estimated breast cancer incidence. Under alternative scenario one (all parous women who had never breastfed instead breastfed for 1–3 months, and all

women who breastfed for six months or less, breastfed for >6 to 7 months), we estimated there would have been 51 fewer breast cancers diagnosed in 2010 (PIF 0.4%); 22% of the breast cancers attributable to lack of breastfeeding would not have occurred.

Under scenario two (women who never breastfed did not change, but those who breastfed for six months or less instead breastfed for >6 to 7 months) we estimated there would have been 36 fewer breast cancers (PIF 0.3%); i.e. 15% of the breast cancers attributable to lack of breastfeeding would not have occurred.

Discussion

We estimated that 235 of the breast cancer cases occurring in parous Australian women (aged ≥19 years) in 2010 (1.7% of all breast cancers) could be attributed to breastfeeding for a total of 12 months or less. We also estimated that 51 (3.9%) ovarian cancers could be attributed to no or limited breastfeeding, although it is less clear whether the breastfeeding–ovarian cancer association is causal and these results should be interpreted in that light.

UK study estimates of 3.1% and 18% of breast and ovarian cancer respectively being attributable to less than six months of breastfeeding per child are both higher than the PAFs we have estimated.²¹ For breast cancer, the difference has arisen because the proportion of women who breastfed in the UK was somewhat lower than in Australia. In the UK in 2000 only 69% of women had initiated breastfeeding at the birth of a child,²¹ whereas, the equivalent figure was 83% in Australia in 2001.²² The larger difference for ovarian cancer is mostly due to the use of different relative risk estimates. The higher estimate used in the UK study was from one cohort study (RR reduction per month of breastfeeding = 2%)⁷ whereas we used a substantially lower relative risk estimate from a more recent meta-analysis (RR reduction per month of breastfeeding = 1.02%).⁹ While there have been several other studies (from France,²³ China²⁴ and California²⁵) that have calculated PAFs for breast cancer in relation to limited or no breastfeeding, the methodological approach taken in those papers was very different to ours, making direct comparisons inappropriate.

Our analysis had a number of limitations. The longest duration category of breastfeeding in the available prevalence data was 'greater than 12 months'. We therefore had to assume

Table 2: Population attributable fraction (PAF) and estimated number of cancers diagnosed in Australia in 2010 attributable to breast feeding for a total duration of 12 months or less.

Age Group	Breast Cancer (C50) ^a		
	PAF	Est. cases in parous women	Excess
Females			
19-24 yrs	3.1	6	0
25-29 yrs	2.5	58	1
30-34 yrs	1.6	164	3
35-39 yrs	1.4	431	6
40-44 yrs	1.5	789	12
45-49 yrs	1.6	1,343	22
50-54 yrs	2.2	1,566	35
55-59 yrs	2.2	1,578	34
65+ yrs	2.0	6,250	122
Total		12,185	235
PAF _{aw}	1.9 ^b		
	1.7 ^c		

Abbreviations: Est. cases in parous women = estimated number of observed breast cancers in parous women in 2010; Excess = excess cancers in 2010 attributable to breast feeding for a total duration of 12 months or less; PAF = population attributable fraction (expressed as a percentage); PAF_{aw} = age-weighted population attributable fraction (expressed as a percentage).

a: International Classification of Diseases Code (ICD-10).

b: % of breast cancers estimated in parous Australian women 19+ years in 2010.

c: % of all breast cancers diagnosed in Australian women 19+ years in 2010.

that only total durations of breastfeeding of 12 months or less over a woman's lifetime were associated with cancer development. Given that this equates to only six months of breastfeeding per child (if women have, on average, two children) and the evidence suggests that risk continues to decrease with increasing durations of breastfeeding, the proportion of cases potentially prevented by increasing breastfeeding beyond a total of 12 months is likely to be even greater. Furthermore, the effects of lactation on maternal physiology vary considerably with the duration and intensity of individual episodes of breastfeeding as well as a woman's age at the time of breastfeeding, and so it is likely that effects on breast cancer risk also vary according to these factors; our PAF calculations cannot account for this. However, we have used the most reliable information available and further refinement of our estimates will require future new studies to adequately investigate these issues.

Notwithstanding the limitations, our results suggest that increasing the proportion of women who breastfeed their babies for longer durations might have a small but measurable impact on the number of women who develop cancer. Available data indicate that breastfeeding initiation rates are relatively high in Australia and may be increasing over time. Between 2005 and 2011, the proportion of children aged 0–3 years having ever received breast milk increased from 88% to 92%.^{26,27} However, the results of the 2010 Australian National Infant Feeding Survey show that only 47% of infants were still predominantly breastfed at three months of age, reducing to 21% being predominantly breastfed at five months of age.²⁸ The relatively low prevalence of longer durations of breastfeeding indicates there is still potential to further lower rates of breast cancer, and possibly ovarian cancer. Public health policies and campaigns aimed at boosting breastfeeding duration should emphasise the cancer-preventing benefits of breastfeeding along with the other maternal and infant benefits, and these may help prevent breast and perhaps ovarian cancers in Australian women in the future.

Acknowledgements

This work was supported by a grant from the Cancer Council Australia. SJJ, NP, DCW, and PMW were supported by Research Fellowships from the National Health and Medical Research Council of Australia (NHMRC). CMO and CMN were supported

by a NHMRC Program Grant (552429). The funding bodies had no role in the design and conduct of the study, the collection, management, analysis, and interpretation of the data, or the preparation, review, or approval of the manuscript.

SJJ and LFW contributed equally to this manuscript and share first authorship.

PAF Project

Chief Investigators: David C. Whiteman, Penelope M. Webb, Adele C. Green, Rachel E. Neale, Lin Fritschi

Associate Investigators: Louise F. Wilson, Catherine M. Olsen, Christina M. Nagle, Nirmala Pandeya, Susan J. Jordan, Annika Antonsson, Bradley J. Kendall, Torukiri I. Ibiebele, Maria Celia B. Hughes, Kyoko Miura, Susan Peters, Renee N. Carey

Advisers: Christopher J. Bain, D. Max Parkin

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