Breast cancer risk among female employees of the Australian Broadcasting Corporation in Australia

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ABSTRACT

Objective: To determine whether there is an excess risk of breast cancer among female employees of the Australian Broadcasting Corporation (ABC), especially outside Queensland, compared with women in the general populations of the states and territories.

Design, setting and participants: We used an occupational cohort design. Information from ABC staff records was linked with data from state and territory cancer registries to identify female employees of the ABC with an incident, histologically confirmed breast cancer. Data linkage was complemented by a self-report method. We included a cohort of ABC female employees who had developed breast cancer at any time between 1994 and 2005, during their employment or after cessation of employment with the ABC. The standardised incidence ratio (SIR) was calculated as the number of women at the ABC observed with breast cancer divided by the expected number based on population rates in each state and territory. Tests for heterogeneity were performed to examine the variation of breast cancer risk between states and territories.

Results: Out of 5969 women who were permanently employed either part-time or full-time at the ABC between 1994 and 2005, 48 eligible women with breast cancer were identified. An excess risk of breast cancer among ABC female employees in Queensland (identified in an earlier study) was reconfirmed. No excess risk of breast cancer was observed among ABC staff diagnosed in states outside Queensland (SIR, 1.01 [95% CI, 0.72–1.38]), or in Australia as a whole (including Queensland) (SIR, 1.12 [95% CI, 0.83–1.49]). There was no significant heterogeneity in breast cancer risk among states and territories once Queensland was excluded from the analysis ($P = 0.39$).

Conclusion: No statistically significant excess risk of breast cancer in ABC female employees was found across the Australian states and territories as a whole compared with their respective population incidences. A statistically significant increased risk of breast cancer was found among ABC female employees in Queensland, consistent with the findings in an earlier report.

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In May 2005, an apparent breast cancer cluster was identified among female employees at the Toowong site of the Australian Broadcasting Corporation (ABC) in Brisbane, Queensland. In July 2006, an Independent Review and Scientific Investigation Panel found a sixfold increase in breast cancer incidence among ABC female employees at Toowong compared with the Queensland general population, but no evidence of exposure to any known or suspected environmental risk factors.[1]

The Panel reasoned that, if there was an unknown or undetected aspect of work or the working environment at ABC Toowong that could have contributed to the observed increased risk of breast cancer, it might also be present in ABC studios elsewhere in Australia.[1] Absence of an increased risk elsewhere would provide reassurance that this is not a systemic problem. Presence of an increased risk would justify more extensive investigation into possible causes.

We conducted a nationwide study to determine whether there is an excess risk of breast cancer among female employees of the ABC, especially outside Queensland, compared with rates in state and territory general populations.

METHODS

We used methods for an occupational cohort analysis.[2] ABC employee records were linked to data from the National Cancer Statistics Clearing House (NCSCH), operated by the Australian Institute of Health and Welfare (AIHW). The number of cases observed among female employees was compared with the expected number of cases based on the background incidence of breast cancer in Australian women.

As state cancer incidence statistics and NCSCH case reports were available only up to 31 December 2005, the study period was limited to the 12 years from 1 January 1994 (the start of the Toowong investigation) to 31 December 2005.

Employee records

ABC human resources (HR) records identified all female employees aged 15 years or over. Due to the uncertainty of start and cessation dates for casual staff, analyses were restricted to permanent employees (part-time and full-time).

Case definition

Because of uncertainty about exposure to risk factors in other occupations after leaving the ABC, we used two definitions of breast cancer cases, one involving all female employees (past or current) who developed breast cancer during the study period, and one excluding those who had ceased employment with the ABC during the study period.

For the method that involved following up all employees, a case was defined as any current or former permanent ABC female employee diagnosed with a primary invasive breast cancer within the study period.

For the method that involved counting cases diagnosed only during employment at the ABC, a case was defined as any permanent ABC female employee diagnosed with a primary invasive breast cancer within the study period while employed at the ABC.

Selection criteria for primary breast cancer cases were as follows:

- Date of diagnosis of primary breast cancer after the commencement of permanent employment at the ABC;
- International classification of diseases, 10th revision (ICD-10) diagnosis code C50 (or any subdivision of C50);
- Morphology behaviour code /3 (malignant, primary site); and
- Diagnosis based on histological evidence.

Cases of ductal carcinoma-in-situ were excluded.

Case identification

We employed two methods for identifying cases of breast cancer among ABC female employees: record linkage and self-report.

Record linkage

Reporting of cancers is mandatory in Australia. Each state and territory registers all reports of cancer diagnosed among its residents, and these data are collated by the NCSCH.

The ABC provided the AIHW with HR records of all female permanent employees who worked at the ABC during the study period. The records included employment number, surname, given names, maiden name, date of birth, date of last contact with the ABC, residential addresses, state and postcode of residence at last contact, dates of employment and date of death (if known).

The AIHW linked the ABC employee records with both the NCSCH and the National Death Index to produce a list of possible cancer cases and a list of deaths. The AIHW used REMA (Record Matcher), an in-house record linkage program that has been proven to be reliable in a number of diverse settings.[3,4]

Self-report recruitment

Aware of the possibility that linkage with state and territory cancer registries may have missed some matches because of changes in employees' details (eg, surname or address), we also sought self-reported diagnoses. This was the method used to investigate the Toowong cancer cluster.[1] Our study was widely publicised among ABC employees. Any current or former ABC employee who had been diagnosed with breast cancer, or any friend or relative of such an employee, was encouraged to contact the ABC's liaison staff in each capital city. The investigators then contacted these employees to collect data about their diagnoses. Fourteen cases of breast cancer during the study period were identified by this method, all of whom were included in the 48 cases identified by record linkage.

Breast cancer incidence

For the years 1994–2005, each state and territory cancer registry provided the annual number of women with histologically confirmed invasive breast cancer in 5-year age groups from 15 to >85 years of age. The Australian Bureau of Statistics supplied data on the number of women in the population stratified by state or territory, calendar year and 5-year age group.[5] For each stratum, the age-specific breast cancer incidence was calculated as the total number of breast cancer cases divided by the total population.

Person-years contribution among ABC female employees

From the HR employment records, we derived the number of person-years of observation in each state, calendar year, and age-specific group, from the commencement of each woman's first permanent employment or 1 January 1994 (whichever came last) to a specified date, using the following definitions:

- For all employees: until an eligible diagnosis of breast cancer, death or 31 December 2005 (whichever came first);
- For employees with breast cancer diagnosed while employed with the ABC: until termination of permanent employment, an eligible diagnosis of breast cancer, death or 31 December 2005 (whichever came first).

For each year, each employee contributed observation time from 1 January or the start of employment (whichever came last) until an eligible diagnosis of breast cancer, death or 31 December (whichever came first).

For each age group, each employee contributed the corresponding proportion of a year to observation time according to her age before and after her birthday.

Expected cases among ABC female employees

For each stratum, the breast cancer incidence rate was multiplied by the number of person-years of observation. The totals across all strata represented the number of expected breast cancer cases among ABC female employees. The standardised incidence ratio (SIR) was calculated as the number of observed cases divided by the number of expected cases.

Statistical analysis

We calculated SIRs for women who developed breast cancer at any time during the study period, during or after cessation of employment at the ABC. Because of uncertainty about exposure to other occupations after leaving the ABC, we then restricted the analysis to women who developed breast cancer during their employment at the ABC. A 95% confidence interval was calculated based on a Poisson distribution.[2,6] Statistical tests of heterogeneity[2,6] were used to determine whether there were significant differences in breast cancer risk between states and territories (with state of residence based on the employee's last known address), or between age groups.

Ethics approval

Ethics approval was obtained from the Cancer Council New South Wales, the AIHW, and relevant ethics committees in each state and territory. Approval took 8 months to complete.

RESULTS

A total of 5969 women were permanently employed at the ABC sometime between 1994 and 2005. Of these, 4637 (78%) were aged 15–39 years when they entered the study, 952 (16%) were aged 40–49 years and 380 (6%) were 50 years or older.

The 5969 employees contributed a total follow-up time of 43 647 person-years of observation, 23 737 person-years while in employment with the ABC (Box 1). The average contribution was 9 years of observation; half the participants contributed 10 years; and nearly a third (1902) were followed for the entire study period.

1 Person-years (PY) of follow-up among ABC employees, by state/territory and age group

	PY of follow-up	
	To end of study period	While employed at the ABC
State/territory		
Australia	43 647	23 737
Australia, excluding QLD	40 107	21 733
ACT	1 012	674
NSW	22 920	12 002
NT	985	613
QLD	3 540	2 004
SA	2 993	1 608
TAS	1 554	957
VIC	7 936	4 409
WA	2 707	1 470
Age group (years)		
15–39	25 938	14 684
40–49	10 644	5 629
⩾ 50	7 065	3 423

ABC = Australian Broadcasting Corporation. ACT = Australian Capital Territory. BC = breast cancer. NSW = New South Wales. NT = Northern Territory. QLD = Queensland. SA = South Australia. TAS = Tasmania. VIC = Victoria. WA = Western Australia. ◆

Record linkage with NCSCH data identified 48 eligible cases of histologically confirmed primary invasive breast cancer diagnosed among current or former female employees during the study period (Box 2). Of these, 25 were diagnosed among women while employed at the ABC and 23 were diagnosed among women who had formerly been employed at the ABC. A comparison of observed and expected numbers of cases among ABC female employees, nationally (including or excluding Queensland) and by state and territory, is shown in Box 2. SIRs among states and territories ranged from 0.00 to 2.37. For Queensland only, there was a statistically significant excess of observed cases over expected cases (SIR, 2.37).

There was some heterogeneity in SIRs for all the states and territories ($P = 0.08$). However, when data for Queensland were excluded, there was no significant heterogeneity between the states ($P = 0.39$) (Box 2).

Similar results were observed for employees who were diagnosed with breast cancer while employed at the ABC. Queensland was the only state in which there was a significant excess of breast cancer (SIR, 4.28) (Box 2). Again, there was significant heterogeneity when all states and territories were compared ($P < 0.001$), but when the data for Queensland were excluded, the results were similar across states ($P = 0.26$).

There was no significant heterogeneity in SIRs across age groups ($P = 0.23$) (Box 3).

DISCUSSION

This was a follow-up study of a hypothesis generated by a cluster investigation. We found no statistically significant excess risk of breast cancer in ABC female employees across the states and territories as a whole compared with state incidence rates in the general population. However, a statistically significant increased risk of breast cancer was found among ABC female employees in Queensland. Our results are in broad agreement with those of the 2007 study of the Toowong breast cancer cluster.[1] The differences can be attributed to variations in methodology and definitions: (i) the cut-off point for our study was 2005 (compared with 2006 in the Toowong study); (ii) we used central ABC HR employment records and last known address (instead of self-report) to determine the place where the cancer was diagnosed; and (iii) we excluded casual and contract employees.

The nature of HR administrative data placed some limitations on our study. Both the payroll and HR computer systems had been replaced a number of times, and the earliest records were on microfiche. Records of permanent workers were usually converted to newer systems. These data included women who were directly employed by the ABC, either on staff or as direct contractors. Subcontractors could not be identified in ABC HR records. Within the ABC, employees may have changed positions or job locations while remaining in the same administrative cost centre attached to a particular state office. Such changes may have reduced the accuracy of state-level analyses, but would not have affected overall national rates.

As the HR records did not identify specific work sites (in or out of the office) for many staff, it was not possible to accurately assess exposure to potential workplace hazards. For part-time workers, there were no measures of the proportion of time spent working

2 Risk of invasive breast cancer (BC) among ABC female employees, by state/territory

State/territory	Cases observed	Cases expected	SIR (95% CI)*
All employees			
Australia	48	42.82	1.12 (0.83–1.49)
Australia, excluding QLD	40	39.45	1.01 (0.72–1.38)
ACT	1	0.78	1.28 (0.03–7.15)
NSW	26	22.39	1.16 (0.76–1.70)
NT	0	0.58	0.00 (0.00–6.38)
QLD	8	3.37	2.37 (1.03–4.68)
SA	0	2.87	0.00 (0.00–1.29)
TAS	0	1.65	0.00 (0.00–2.23)
VIC	9	8.37	1.07 (0.49–2.04)
WA	4	2.80	1.43 (0.39–3.65)
Employees with BC while employed†			
Australia	25	21.52	1.16 (0.75–1.71)
Australia, excluding QLD	18	19.88	0.91 (0.54–1.43)
ACT	0	0.43	0.00 (0.00–8.52)
NSW	8	10.89	0.73 (0.32–1.45)
NT	0	0.34	0.00 (0.00–10.71)
QLD	7	1.64	4.28 (1.72–8.81)
SA	0	1.54	0.00 (0.00–2.40)
TAS	0	1.02	0.00 (0.00–3.63)
VIC	7	4.26	1.64 (0.66–3.39)
WA	3	1.40	2.14 (0.44–6.26)

ABC = Australian Broadcasting Corporation. ACT = Australian Capital Territory. NSW = New South Wales. NT = Northern Territory. QLD = Queensland. SA = South Australia. SIR = standardised incidence ratio. TAS = Tasmania. VIC = Victoria. WA = Western Australia.

* Test for heterogeneity (all employees): $P = 0.08$ (including QLD), $P = 0.39$ (excluding QLD). Test for heterogeneity (employees with BC): $P < 0.001$ (including QLD), $P = 0.26$ (excluding QLD). † Diagnosed while employed with the ABC. ◆

3 Risk of invasive breast cancer (BC) among ABC female employees, by age group

Age group (years)	Cases observed	Cases expected	SIR (95% CI)*
All employees			
15–39	6	7.7	0.78 (0.29–1.71)
40–49	22	15.6	1.41 (0.89–2.14)
⩾ 50	20	19.6	1.02 (0.62–1.58)
Employees with BC while employed†			
15–39	3	4.0	0.75 (0.15–2.19)
40–49	13	8.3	1.57 (0.83–2.68)
⩾ 50	9	9.2	0.98 (0.45–1.85)

SIR = standardised incidence ratio. * Test for heterogeneity (all employees): $P = 0.22$. Test for heterogeneity (employees with BC): $P = 0.23$. † Diagnosed while employed with the ABC. ◆

during the study period. Follow-up time was estimated from the worker's commencement date to the end of employment.

The AIHW provided records of all breast cancer diagnoses that were reported between 1 January 1982 and 31 December 2005 among ABC female employees (although some cases may have been missed by probabilistic record linkage). Identification of women who had a breast cancer diagnosis before they joined the ABC may have been incomplete if the diagnosis occurred before 1982, when cancer registration became nearly universal in Australia (except for the Northern Territory and the Australian Capital Territory).

While all Australian cancer registries have high standards of case ascertainment and completeness of cancer reporting,[7] they do not include cases of cancer diagnosed outside Australia. However, no cases of breast cancer diagnosed outside Australia were identified by self-report. In our hands, record linkage yielded more breast cancer cases than self-report, and thus provided a more complete national picture.

CONCLUSION

Except in Queensland, we found no evidence of an excess risk of breast cancer among ABC female employees compared with the risk in the Australian general population. This suggests that any factors that could have contributed to the observed increased risk of breast cancer at ABC Toowong are unlikely to be present in ABC studios elsewhere in Australia.

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COMPETING INTERESTS

The ABC funded our project but had no influence over the study protocol, analysis and interpretation of results. The ABC had no influence over the expert panel that was appointed to review the study protocol and the first draft report. The protocol was also reviewed by the Cancer Council's independent research review committee.

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REFERENCES

1 Armstrong B, Aitken J, Sim M, Swan N. Breast cancer at the ABC Toowong Queensland. Final report of the Independent Review and Scientific Investigation Panel, 2007. http://www.abc.net.au/corp/pubs/documents/Breast_Cancer_Toowong_Final_Report.pdf (accessed Feb 2010).
2 Breslow NE, Day NE, editors. Statistical methods in cancer research. Vol II. The design and analysis of cohort studies. Lyon: International Agency for Research on Cancer, 1987. (IARC Scientific Publications No. 82.)
3 Reid A, Heyworth J, de Klerk NH, Musk B. Cancer incidence among women and girls environmentally and occupationally exposed to blue asbestos at Wittenoom, Western Australia. *Int J Cancer* 2008; 122: 2337-2344.
4 Welborn TA, Dhaliwal SS. Preferred clinical measures of central obesity for predicting mortality. *Eur J Clin Nutr* 2007; 61: 1373-1379.
5 Australian Bureau of Statistics. Australian historical population statistics. Canberra: ABS, 2009. (ABS Cat. No. 3105.0.65.001.)
6 Olsen SF, Martuzzi M, Elliott P. Cluster analysis and disease mapping — why, when and how? A step by step guide. *BMJ* 1996; 313: 863-866.
7 Curado MP, Edwards B, Shin HR, et al, editors. Cancer incidence in five continents. Vol IX. Lyon: International Agency for Research on Cancer, 2007. (IARC Scientific Publications No. 160.)

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