Cancer Causes and Control **14**: 109–121, 2003.

Cancer in Indigenous Australians: a review

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Received 21 February 2002; accepted in revised form 20 September 2002

Key words: aborigine, indigenous, neoplasm.

Abstract

Objectives: To summarize for the first time evidence of the impact of cancer on Indigenous Australians.
Methods: Medline search of peer-reviewed scientific journals, and extensive search of reports of government agencies, publications of cancer registries and non-government organizations, and other non-peer-reviewed sources.
Results: Indigenous Australians have much higher incidence rates than other Australians of cancers of the lung, liver, and cervix; but much lower rates of cancers of the breast, colon and rectum, prostate, melanoma of skin, and lymphoma. Some of these differences can be explained, in part at least, by differences in risk factor prevalence. Indigenous Australians also have higher mortality and lower survival from cancer as a whole than other Australians. More advanced disease at diagnosis, and possibly poorer treatment, are partly responsible for these differences, but other factors may also be involved.
Conclusions: Less accessible and less effective health programs are as great a problem for cancer control as for other aspects of Indigenous health in Australia. Major improvements in preventive services, screening, primary care, and specialist treatment services are required to reduce cancer incidence and improve cancer outcomes for Australia's Indigenous people.

Introduction

Cancer is a designated National Health Priority Area in Australia, where it is one of the major causes of death and accounts for a considerable proportion of hospital activity and health services expenditure [1, 2]. For Indigenous Australians (Aborigines and Torres Strait Islanders), cancer is only now becoming a priority health issue. In his 1973 book *Aboriginal Health*, Moodie did not mention cancer [3]. In 1989 the only specific references to cancer in the National Aboriginal Health Strategy were recommendations for educational and clinical programs in Indigenous communities to improve knowledge of, and promote, regular Pap smears and breast self-examination [4]. Much greater attention was given to other diseases, and to underlying social, economic, and environmental issues. Now, however, the aims of the new National Aboriginal and Torres Strait Islander Health Strategy (draft for discussion, February 2001) include cancer as one of three priority chronic diseases to be addressed [5].

Information regarding cancer in Indigenous Australians is limited. It is not clear what priority Indigenous Australians should give to cancer relative to other health issues, nor which particular aspects of cancer prevention and treatment are of greater significance for Indigenous than for other Australians. It is also not clear whether the incidence of and mortality from particular types of cancer are changing for Indigenous Australians, as is occurring in other indigenous peoples.

This is the first comprehensive review of available information concerning cancer in Indigenous Australians. We have examined whether there are differences in incidence and mortality for all cancers and for specific cancer sites (*i.e.* sites of origin in the body) between Indigenous and non-Indigenous Australians. Where

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there is evidence of higher mortality for specific cancer sites, we have examined whether this is due to higher cancer incidence or lower survival. For cancers with differences in incidence, we have examined whether these can be explained by differences in the occurrence of cancer risk factors or access to or uptake of prevention programs. Where there are differences in cancer survival, we have examined whether these can be explained by differences in access to health services, both diagnostic and therapeutic.

Materials and methods

Data sources

This review summarizes published information concerning cancer incidence, mortality, survival, risk factors, screening programs, and health services for Indigenous Australians. Relevant information was identified by Medline search of peer-reviewed scientific publications and extensive search for relevant material in other sources. Only a small proportion of relevant material was found in peer-reviewed scientific publications – almost all Indigenous cancer incidence and mortality statistics were published in monographs or serial reports. Sources included publications of the eight Australian cancer registries, reports of commonwealth and state government agencies, publications of non-government organizations such as national and state Cancer Councils and Indigenous health organisations, annotated bibliographies of Indigenous health publications, and non-peer-reviewed journals and books. With the exception of cancer risk factors, for which only the most relevant material has been included, we are confident that little, if any, relevant statistical material has been omitted.

Age-standardized rate ratios were used to compare cancer incidence and mortality rates of Indigenous and non-Indigenous Australians, either directly as published or calculated from published rates. Confidence intervals for rate ratios are not presented here because they were not published in source publications and generally could not be calculated from published data.

Data quality

Inaccurate identification of indigenous status in disease registers, administrative information systems, population censuses, and surveys is a major impediment to obtaining accurate statistics on cancer and related issues for Indigenous Australians [6]. Data sources that are available for the general population are not available, or are unreliable, because Indigenous people cannot be separately identified.

Indigenous Australians are a relatively small population – about 460,000 in 2001 or 2.4% of the country's population [7]. They are widely dispersed in the much larger non-Indigenous population or live in rural or remote areas. They are often difficult to identify or reluctant to be identified as Indigenous. Each of these aspects alone presents problems when collecting data on health issues – together they magnify the problems for indigenous populations, both in Australia and elsewhere.

These problems are illustrated by the experience of Australian cancer registries in producing cancer statistics for Indigenous Australians. No national cancer incidence statistics are published for Indigenous Australians because cancer registries in several states do not accurately record indigenous status. Their data sources, principally pathology reports and notifications from hospitals, either do not include or have inaccurate information on indigenous status [6, 8].

Three of the eight Australian registries have published cancer incidence statistics for Indigenous Australians. In data from the Western Australian (WA) Cancer Registry for 1996 and 1997 indigenous status was not recorded for 17–18% of notifications and the accuracy of indigenous status, where it was recorded, was not reported [9, 10]. The South Australian (SA) Cancer Registry published Indigenous incidence statistics in 1993 [11], but later found that indigenous identification was seriously inaccurate. The Registry then undertook a retrospective check of hospital records to determine indigenous status of all registered cases from 1977 to 1994 [12]. This increased the number of cases identified as Indigenous by 65%, but a formal audit of the accuracy of indigenous identification in SA hospital records was not reported and it is likely that some Indigenous cancer cases remained unidentified.

Initial cancer incidence statistics from the Northern Territory (NT) Cancer Registry [13–16] were later found to be inaccurate, but more because of incomplete case ascertainment than inaccurate indigenous identification (personal communication, NT Cancer Registry). The NT Registry relies on the NT Hospitals Information System to determine indigenous status. A 1997 formal audit of data quality based on personal interview of inpatients found that indigenous status was correctly recorded for 94% of all inpatients – most errors were Indigenous people incorrectly recorded as non-Indigenous [17]. Since 1987 the NT Registry has improved case ascertainment (including legislated mandatory reporting from pathology laboratories and active case-finding from hospital inpatient morbidity data), but NT incidence statistics will still slightly underestimate Indigenous cancer incidence because of inaccurate recording of indigenous status.

Mortality statistics for Indigenous Australians were first reported in the 1960s for regional areas covering small populations. Reliable national statistics are not available because of inaccurate identification of indigenous status in death registrations in several states [8]. Indigenous cancer mortality statistics are available for SA, WA, and the NT [6]. Coding of cause of death appears to be consistent for Indigenous and non-Indigenous cancer deaths – for NT deaths a similar proportion of Indigenous and non-Indigenous cancer deaths were coded as due to cancer of unspecified site [18].

Despite these difficulties, high-quality information is available for Indigenous Australians from population-based registers and mortality statistics in some Australian states and from specific surveys and research projects. While these do not present a complete picture, there is a consistent pattern of large differences between Indigenous and non-Indigenous Australians in incidence of cancer at several specific sites, cancer mortality at most sites, and cancer survival. Although the size of these differences could be more precisely measured, the overall pattern cannot be plausibly attributed to incomplete case ascertainment in cancer registers or inaccurate indigenous identification in data collections.

Cancer incidence

The first reports of cancer in Indigenous Australians were individual case reports and occasional mentions of cancer cases or deaths in local health surveys and reports of Indigenous mortality [19–32]. These do not provide an overall picture of cancer in Indigenous people. The cancer registries in the NT, SA, and WA (hereafter referred to as the three western states) have individually published Indigenous cancer statistics.

In the NT in 1987–1997 Indigenous cancer incidence was reported to be 16% lower than that in all Australians (Table 1). For NT non-Indigenous people cancer incidence was similar to the all-Australian rate (age-standardized incidence rate ratio 1.01 in males and 0.97 in females) [18]. The Indigenous cancer incidence is probably underestimated to a small extent and the non-Indigenous incidence slightly overestimated because of incomplete identification of Indigenous people.

Indigenous cancer incidence in SA in 1988–1994 was reported to be lower than the corresponding non-Indigenous rate for males and similar for females (Table 1); the same was reported from WA in 1993–1997 (Indigenous:non-Indigenous rate ratio: males 0.67, females 0.94; 325 Indigenous cases) [9]. However, Indigenous incidence was almost certainly underestimated, particularly in WA, because of incomplete indigenous identification.

Only the NT and SA Cancer Registries have published Indigenous cancer incidence for specific cancer sites after thorough case detection and identification of indigenous status. Compared with non-Indigenous Australians, Indigenous incidence rates were higher for cancers of the liver, lung, and cervix, and lower for cancers of the colon and rectum, prostate, breast, melanoma of skin, and lymphoma (Table 1). The differences in incidence were large, ranging from over

Table 1. Age-standardized[a] cancer incidence rate ratios (Indigenous:non-Indigenous) [12, 18]

Type	Northern Territory[b]			South Australia[c]		
	Male	Female	Indigenous cases[d]	Male	Female	Indigenous cases[d]
Breast	–	0.3	34	–	0.5	25
Cervix	–	3.1	53	–	4.5	27
Colon and rectum	0.4	0.3	32	0.6	0.5	18
Liver	9.8	7.4	35	5.7	10.0	8
Lung	1.7	2.6	136	1.0	2.3	32
Lymphoma	0.2	0.5	17	0.5	0.5	6
Melanoma of skin	0.2	0.1	9	0.1	0.0	1
Prostate	0.3	–	15	0.7	–	13
All cancers	0.84	0.84	644	0.88[e]	1.03[e]	139[e]

[a] Age-standardized to World Standard Population.

[b] Northern Territory Indigenous (1987–1997) compared with total Australian population (1987–1994).

[c] South Australian Indigenous (1977–1995) compared to SA non-Indigenous population (1977–1995).

[d] Number of Indigenous cases.

[e] SA all cancers: 1988–1994 only.

six times greater for primary liver cancer to 80% or more lower for melanoma [12, 18, 33]. A study of 280 cases diagnosed in residents of 13 remote, predominantly Indigenous, communities in Queensland in 1982–1996 reported a similar pattern of cancer site-specific incidence [34].

No information is available on trends in cancer incidence in Indigenous Australians because of the incomplete identification of Indigenous people in most cancer registries, the relatively short period for which data are available, and the small number of cancer cases in a relatively small population.

Cancer mortality

In contrast to incidence, several studies since the late 1970s, mostly in WA and the NT, have found that cancer mortality in Indigenous Australians was similar to or higher than that in non-Indigenous Australians for males and up to twice as high for females (Table 2). However, Indigenous cancer mortality relative to that in non-Indigenous Australians was not as high as relative mortality from other conditions – in most of these studies Indigenous all-cause mortality was reported to be three to four times higher than that in non-Indigenous people.

Anderson *et al.* reported on Indigenous mortality in the three western states of Australia for the years 1992–1994 [44]. Consistent with the incidence patterns, Indigenous people had higher mortality from cancer of the liver, cervix, and lung, but lower mortality from cancer of the breast and prostate (Table 3). The mortality rate ratios were higher than incidence rate ratios for most sites. A similar pattern of site-specific mortality rates has been reported for the NT for 1987–1995 (Table 3).

There was an estimated 1% annual increase in the age-standardized cancer mortality rate in Indigenous

Table 2. Age-standardized cancer mortality rate ratios (Indigenous:non-Indigenous) [12, 18, 35–45]

Area	Period	Comparison population	Indigenous deaths (no.)	Mortality rate ratio	
				Male	Female
Southern NT	1984–1986	Total NT	ns[a]	0.9	1.3
Rural NSW	1980–1981	Total NSW	ns	1.4	1.7
WA	1983	Total WA	30	1.0	1.6
WA	1983–1989	WA non-Indigenous	ns	0.8	1.4
WA	1990–1994	WA non-Indigenous	177	1.1	1.3
NT	1979–1983	Total Australia	127	1.1	1.3
NT	1989–1991	Total Australia	121	1.2	2.0
NT	1987–1995	Total Australia	382	1.5	1.6
SA	1988–1994	Total SA	ns	1.5	1.6
SA, WA, and NT	1992–1994	Australia non-Indigenous	ns	1.4	1.8
SA, WA, and NT	1995–1997	Total Australia	323	1.4	1.4

[a] ns = Not stated.

Table 3. Age-standardized mortality rate ratios for specific cancer types (Indigenous:non-Indigenous) [18, 44]

Site	Northern Territory[a]			Three states[b]	
	Male	Female	Indigenous deaths[c]	Male	Female
Breast	–	0.6	11	–	0.5
Cervix	–	9.5	32	–	8.3
Colon and rectum	0.5	0.7	20	ns[d]	ns
Liver	10.4	7.2	29	4.2	8.5
Lung	2.0	2.6	105	1.7	ns
Lymphoma	0.4	0.9	8	ns	ns
Melanoma of skin	0.6	1.1	4	ns	ns
Prostate	0.6	–	8	0.2	–

[a] NT Indigenous (1987–1995) compared with Australia (1987–1994).
[b] NT, SA, and WA Indigenous combined (1992–1994) compared with Australia (1992–1994); number of deaths not stated.
[c] Number of Indigenous deaths.
[d] ns = Not stated.

males and 2% in Indigenous females in the three western states of Australia between 1985 and 1994 [44]. Neither trend was statistically significant and each could have been due to increasing identification of Indigenous people in death registrations rather than increasing mortality.

Differences in cancer mortality between Indigenous and non-Indigenous people may be due to differences in cancer incidence. The only directly comparable incidence and mortality data available are for Indigenous Australians in the NT compared to total Australian rates in 1987–1995 (Tables 1 and 3). Higher Indigenous mortality rates for liver and lung cancer appear to be entirely due to higher incidence rates. For liver cancer, the incidence rate ratios (Indigenous to total Australian) were 10 for males and 7 for females, the same as the mortality rate ratios. Similarly for lung cancer, incidence rate ratios were 1.7 for males and 2.6 for females, approximately the same as mortality rate ratios. However, for other cancers – including cancers of the colon and rectum, cervix, breast, prostate, melanoma of skin, and lymphoma – mortality rate ratios are considerably higher than incidence rate ratios, indicating that higher Indigenous mortality is only partly due to higher incidence.

Cancer survival

Only one analysis of survival of Indigenous Australians with cancer has been reported. After improving the accuracy of indigenous status (see above), the SA Cancer Registry reported on survival of 139 Indigenous people with cancer diagnosed in 1988–1994 compared with that in a sample of non-Indigenous people with cancer, matched for year of diagnosis, age at diagnosis, sex, and primary site [12]. Five-year cause-specific survival from cancer was lower in Indigenous people (37%) than non-Indigenous people (49%). Fifty percent of Indigenous Australians had cancer that had spread, at diagnosis, beyond the tissue of origin compared to 40% of non-Indigenous Australians, but this more advanced disease in Indigenous people did not fully explain the difference in survival. After adjustment for cancer spread at diagnosis, 5-year cause-specific survival was 40% for Indigenous people compared with 48% for non-Indigenous people ($p = 0.058$). Survival for specific sites was not reported.

A crude indicator of Indigenous cancer survival for specific sites can be obtained by comparing ratios of mortality to incidence rates for NT Indigenous people and for Australians as a whole (Table 4). The ratios of

Table 4. Ratio of age-standardized mortality:incidence rates, selected cancers, NT Indigenous and total Australian [18]

Site	NT Indigenous[a]			Australian[b]		
	Mortality[c]	Incidence[d]	M:I ratio[e]	Mortality[c]	Incidence[d]	M:I ratio[e]
Male						
Colorectal	9.5	16.6	0.57	20.4	45.5	0.45
Liver	29.2	26.4	1.11	2.8	2.7	1.04
Lymphoma	2.7	2.8	0.96	6.5	14.9	0.44
Melanoma	3.0	5.6	0.54	5.0	31.9	0.16
Prostate	10.8	17.0	0.64	17.6	62.0	0.28
Trachea, bronchus, and lung	83.6	76.1	1.10	41.6	46.1	0.90
All cancers	231.5	275.7	0.84	156.4	328.0	0.48
Female						
Breast (female)	12.5	22.9	0.55	20.3	70.0	0.29
Cervix	27.6	31.4	0.88	2.9	10.0	0.29
Colorectal	10.2	8.0	1.28	14.0	32.0	0.44
Liver	7.9	5.9	1.34	1.1	0.8	1.38
Lymphoma	3.8	5.0	0.76	4.3	10.2	0.42
Melanoma	2.6	1.4	1.86	2.4	26.2	0.09
Trachea, bronchus, and lung	33.7	38.8	0.87	12.9	15.0	0.86
All cancers	163.7	215.2	0.76	100.0	263.6	0.38

[a] Northern Territory Indigenous incidence 1987–1997, mortality 1987–1995.
[b] Total Australian incidence 1987–1994, mortality 1987–1994.
[c] Age-standardized mortality rate, standardized to World Standard Population.
[d] Age-standardized incidence rate, standardized to World Standard Population.
[e] Ratio of mortality rate to incidence rate.

mortality to incidence rates (M:I ratio) for liver and lung cancers are close to or above 1.0 for both NT Indigenous and all Australians, indicating low survival for NT Indigenous people as for other Australians with these cancers [46].

For cancers of the colon and rectum, cervix, breast, prostate, melanoma of skin, and lymphoma, the M:I ratio in the total Australian population varies from 0.09–0.16 (melanoma of skin) to 0.44–0.45 (colon and rectum), reflecting the better 5-year survival for these cancer sites. However, for NT Indigenous people the M:I ratios are higher for each of these cancer sites, indicating lower survival than for Australians generally (Table 4). The M:I ratios for NT non-Indigenous people were similar to or lower than those of the total Australian population (data not presented) [18].

Cancer risk factors

Indigenous Australians have a very high prevalence of tobacco smoking and hepatitis B carriage, low Pap test rates, early onset of childbearing, high numbers of pregnancies and births, and a different diet from other Australians. These factors may at least partly explain differences in incidence of cancers of the lung, liver, cervix, breast, colon, and rectum.

Lung cancer risk factors: tobacco consumption

In the 1994 National Aboriginal and Torres Strait Islander Survey, 54% of males and 46% of females aged 13 years or more reported that they smoked. This was about twice the proportion of Australians overall – males 28%, females 22% [47, 48].

There are regional differences in the proportions of Indigenous people who smoke. A 1986–1987 survey of Indigenous people in rural and remote communities in the NT found that more people reported smoking cigarettes in the northern region (male 81%, female 72%) than in the southern region (male 59%, female 9%) [49]. However, in the southern region 20% of males and 61% of females said they chewed tobacco. Regional differences in smoking prevalence were also found across Australia in the 1994 National Aboriginal and Torres Strait Islander Survey [47]. No data have been reported on regional differences in lung cancer incidence.

Indigenous people appear to have different perceptions of smoking risks than other Australians. In response to a survey question on which of several listed substances caused the most deaths, less than 5% of Indigenous Australians in urban areas chose tobacco compared with over 30% of other Australians. Over 60% of Indigenous Australians named alcohol as causing the most deaths, and more named petrol sniffing, cocaine, and heroin than tobacco [50].

Liver cancer risk factors: alcohol consumption and hepatitis B carriage

A smaller proportion of Indigenous Australians report being consumers of alcohol than do other Australians. In the 1993 and 1994 National Drug Strategy surveys only 33% of urban Indigenous adults reported being current drinkers compared with 45% in the general population [50]. A large proportion of the Indigenous population are total abstainers from alcohol. In the 1994 National Aboriginal and Torres Strait Islander Survey, 19% of males and 34% of females aged 13 and over reported that they had never drunk alcohol. The proportion of abstainers varied considerably by region, with the highest abstention rates in the NT (30% in males and 60% in females respectively) [47]. Indigenous Australians who do drink alcohol, however, are much more likely to do so to a harmful degree than other Australian drinkers. Of Indigenous people who reported drinking at least weekly in the National Drug Strategy Survey, 79% consumed alcohol at harmful levels, compared with only 12% in the general population [50].

Hepatitis B infection is very common in Indigenous Australians, usually in childhood when it causes only a mild illness that is often not recognized. However, a high proportion of Indigenous people infected remain as chronic carriers. In the late 1980s a serology survey in a small New South Wales town found evidence of present or past hepatitis B infection in 69% of 297 Indigenous children aged less than 17 years; 14% were HBsAg-positive, indicating chronic carriage. Of 111 non-Indigenous children, 10% had evidence of previous infection and none was HBsAg-positive [51]. Wan and Mathews summarized several surveys performed in remote Indigenous communities between 1971 and 1990 and estimated that 13% of adults aged over 40 years were HBsAg-positive [52].

Cervical cancer risk factors: human papillomavirus (HPV) infection and cervical cancer screening

There have been several reports from primary healthcare services of the prevalence of HPV infection found in Pap tests from Indigenous women, ranging from 1.7% to 10.9% [53–57]. However, these results are difficult to interpret because study populations were poorly described, the reasons women attended for Pap tests were not included, age-specific HPV prevalence was generally not reported, and none directly compared Indigenous and non-Indigenous women using similar detection methods. None of these studies used the more sensitive techniques developed in recent years to detect HPV infection.

There are no reports of Pap test coverage for Indigenous Australian women at a state or national level. The National Aboriginal and Torres Strait Islander Survey did not collect information on Pap tests, and the State and Territory Pap test registers are unable to record indigenous identification because identifying details are supplied to the Registers by pathology laboratories, which do not collect indigenous identification. Estimates from individual Indigenous health services or communities of the proportion of women who have ever had a Pap test range from 27% to 63%, with one report that 37% of women were adequately screened (*i.e.* had a Pap test within the previous 3 years) [54, 57, 58]. Two local programs achieved coverage (2-year cumulative incidence) of 82% and 60% of eligible women aged 20–69 years (age-standardized to the 1997 Australian female population) during the first 2 years of the programs, but long-term results have not been reported [58, 59]. Data for Australian women as a whole from Pap test registers (excluding Queensland) indicate that 62% of those aged 20–69 years in 1996–1997 had a Pap test in the preceding 2 years [60].

A study of regional variations in Pap test screening rates in the state of New South Wales in 1998–1999 found that regions where Indigenous people comprised more than 10% of the population had lower Pap test rates than regions with less than 5% of the population Indigenous. The proportion of the population who are Indigenous was not associated with low Pap test rates when adjusted for remoteness, which suggests that Indigenous women may have low Pap test rates because of their more frequent residence in remote areas [61].

Several small studies of Pap test results in Indigenous women have been reported. In a Pap test program in remote Central Australian communities in 1973–1974 the prevalence of "cervical dysplasia" was found to be 0.2% of 430 women [62]. Several primary-care services reported between 1986 and 1996 prevalences of cervical intra-epithelial neoplasia (CIN) I–III in Indigenous women varying between 0.9% and 2.0% from study populations of 113–545 women [54–58, 63]. The National Cervical Screening Program reported that 0.7% of women aged 20–69 years having Pap tests in Australia in 1996–1997 had high-grade abnormalities (borderline CIN I/II, CIN II, CIN III or adenocarcinoma *in-situ*) [60]. The prevalence data for Indigenous women are not directly comparable to these overall Australian figures as they included CIN I (which is not separately identifiable in broad national statistics) and age-specific or age-standardized comparisons cannot be made because age-specific data were not reported for the Indigenous women.

Breast cancer risk factors: reproductive and hormonal factors and breast cancer screening

Indigenous women commence childbearing younger than do other Australian women, and have more children. Of women who gave birth in 1997, 23% of Indigenous women were aged less than 20, compared with 5% of non-Indigenous women. Thirteen percent of Indigenous women had three previous births and 15% had four or more previous births compared with 6% and 4% respectively of all Australian women [64].

Earlier age at first pregnancy and a high number of births would tend to reduce the risk of breast cancer in Indigenous women, which is consistent with their lower breast cancer incidence. No information is available on age at menarche or menopause in Indigenous women, or on estrogen use, either for contraception or as post-menopausal hormone replacement therapy.

A 1996 review of breast cancer in Indigenous women, done by the Australian National Breast Cancer Centre, found no published results of research on breast cancer screening. It reported unpublished data on 151 Indigenous women in the 1989–1990 National Health Survey (which did not include women from remote areas) that indicated that a smaller proportion of Indigenous women (52%) than non-Indigenous women (63%) regularly examined their own breasts. The review also reported unpublished data from BreastScreen Australia on the proportion of Indigenous women who received a mammogram between July 1993 and June 1995. In the target age group 50–69 years 26% of eligible Indigenous women were screened, compared with 37% of eligible non-Indigenous women [65].

An evaluation of the first 18 months' operation (to May 1996) of the mammographic screening program in the NT found that Indigenous women comprised 10% of the target population in the Darwin urban and rural areas, but only 5% of women screened. In a questionnaire survey (65% response), general practitioners were asked if they recommended mammography screening to women aged 50–69 years. For general practitioners with a predominantly non-Indigenous clientele, 46 of 47 reported that they did so. For those with a predominantly Indigenous clientele, only eight of 14 reported that they did so – of the other six, three said that the service was difficult or impossible for their clients to access and three that mammography screening was not a priority for Indigenous women [66].

Other cancer risk factors: obesity, diet, and physical activity

Obesity is more prevalent in Indigenous than other Australians. In a 1994–1995 national, direct measurement survey of height and weight of people aged more than 18 years, 25% of Indigenous males and 27% of Indigenous females were obese (BMI > 30) compared with 19% of Australian males and females generally [67]. Obesity was much more common in Torres Strait Islanders, 43% of males and 50% of females.

There are major differences between the contemporary diet of Indigenous Australians and their diet before European colonization of Australia. Compared with other Australians, the contemporary diet of Indigenous Australians in remote communities is very low in fruit and vegetable content, high in energy and sugars, and moderately high in fats. This is at least partly due to problems with the supply, cost and availability of fresh food [68]. There is little information available on the contemporary diet of Indigenous Australians living in urban communities.

O'Dea has summarized differences between the contemporary and traditional lifestyle of Indigenous Australians, with the contemporary lifestyle being lower in physical activity, with a diet of higher energy density and excessive energy intake but lower nutrient density, lower in protein but higher in saturated animal fat and carbohydrate (especially simple carbohydrate) content [69].

Cancer treatment

A report of Australian hospitalization rates for the year 1997–1998 found that hospitalization for all causes, excluding renal dialysis, was higher in Indigenous than non-Indigenous people (indirectly age-standardized rate ratio in males 1.4, females 1.4) but hospitalization for cancer was considerably lower (males 0.6, females 0.7) in Indigenous people. Indigenous rates, however, were underestimated to some degree because indigenous identification is known to be incomplete in several states [70].

In the NT in 1977–1982 the annual age-standardized rate ratio of hospitalization for cancer for Indigenous people, relative to non-Indigenous, ranged between 0.3 and 0.4 for males and between 0.5 and 0.7 for females [42]. By 1988 this ratio had risen, particularly in females (males 0.5, females 1.0) [43], and the numbers of hospital admissions for cancer in Indigenous people increased by a further 40% between 1993 and 1997 while those in non-Indigenous people increased by 19% [71]. The accuracy of indigenous identification in NT hospital separations data is known to be high, although a formal assessment was not made until 1997 [17].

Two early WA studies reported that the hospital admission rate for cancer in Indigenous people was lower than that in non-Indigenous people (1983 age-standardized rate ratio males 0.51, females 0.84: 1977–1988 crude rate ratio male 0.3, female 0.5) [39, 72]. The accuracy of indigenous identification in WA hospital separations data was not assessed until 2000, when indigenous status was found to be correctly recorded in hospital separations data for 85.5% of Indigenous people and 99.5% of non-Indigenous people [73].

None of these studies adjusted for differences between Indigenous and non-Indigenous people in the underlying incidence rates of cancer, or the distributions of stage at diagnosis and type of cancer, which are probably correlated with the frequency and number of hospital admissions required for a particular cancer.

We found no published reports concerning palliative care services for Indigenous Australians with cancer.

Discussion

Risk of cancer as a whole in Indigenous Australians is, on present evidence, less than or about the same as it is in the non-Indigenous population. While the rates for Indigenous Australians are affected by under-identification of indigenous origin and probably under-notification of cancer from more remote communities, it appears that Indigenous Australians do not suffer appreciable disadvantage with respect to incidence of cancer as a whole.

In contrast, cancer mortality as a whole is higher in Indigenous than in other Australians. Although Indigenous Australians have high incidence rates of liver and lung cancers, both of which have very low survival, this does not explain their higher overall cancer mortality. The ratio of mortality to incidence rates of other cancers is higher in Indigenous than in other Australians, suggesting that Indigenous Australians have poorer survival from cancer, which is confirmed by the one small study of cancer survival in Indigenous Australians.

Limitations of the data

There are considerable limitations to our understanding of cancer in Indigenous Australians. Reliable cancer mortality statistics are available for only the three western states and reliable incidence statistics for two of these states (34% and 19% respectively of the Indigenous population) [74] because of incomplete identification of Indigenous people by death and cancer registries. Even in these states cancer incidence and mortality are probably underestimated a little, and the small numbers of cancer cases in Indigenous people limits the reliability of the rates.

Cancer incidence, mortality, and survival may not be the same for Indigenous people in the eastern states as in the three western states. Many Indigenous people in the western states live in isolated communities and have had contact with non-Indigenous Australians for a shorter time than have Indigenous people in the eastern states. There are no published comparisons of cancer incidence or mortality differences between Indigenous people living in urban and remote communities.

Problems in the quality of cancer data for Indigenous populations are not unique to Australia. There are no national cancer incidence statistics for Native Americans in the USA or Canada. The two most comprehensive data sources in the USA are from the Indian Health Service (which covers 38% of the US Native American population) based on hospital separations data [75], and from population-based cancer registers in Alaska and New Mexico which are part of the Surveillance, Epidemiology, and End Results (SEER) Program of the US National Cancer Institute [76]. Other cancer registries have reported difficulties identifying indigenous cases and special efforts to improve indigenous identification [77, 78].

Cancer registries need to place greater emphasis on accurate identification of Indigenous people, reporting on data quality and incorporation of measures of precision in statistical reports. In addition, collaboration between cancer registries that have reasonably accurate data on indigenous status would increase the number of cases being analyzed and the precision of incidence, mortality, and survival statistics.

Despite the limitations, the large differences between Indigenous and non-Indigenous Australians in incidence of and mortality from several cancers are at most only partially due to incomplete identification of Indigenous people by cancer and death registries. Certainly the higher incidence of and mortality from liver, lung, and cervical cancer cannot be thus explained.

Specific cancers

Indigenous Australians have higher incidence rates of cancers of the liver and lung than do other Australians. New Zealand Maori have similarly higher incidence of and mortality from these cancers in comparison with non-indigenous New Zealanders [79]. Native Americans, though, have only a slightly higher incidence of liver cancer than other Americans, and only in females, and a lower incidence of lung cancer, although there is considerable variation between different parts of the United States in Native Americans lung cancer rates [75].

There is little evidence of any difference between Indigenous and non-Indigenous Australians in survival from lung and liver cancers and probably, therefore, little scope to reduce mortality from these cancers by improving survival. There is, however, considerable scope to reduce this high mortality through cancer-prevention strategies. As reviewed here, Indigenous Australians smoke more than non-Indigenous Australians, and have higher prevalences of persistent infection with hepatitis B virus and drinking alcohol at harmful levels, both of which are risk factors for hepatocellular carcinoma. Both smoking reduction and alcohol misuse programs in Indigenous Australian communities are relatively underdeveloped and should be better resourced, implemented, and evaluated to increase their coverage and improve their effectiveness [80, 81]. Hepatitis B vaccination of Indigenous children was recommended as national policy in Australia in 1987 and was implemented over the next several years in different States and Territories [82]. A fall in primary liver cancer rates will follow, but not for some time yet.

While the incidence of cervical cancer in Indigenous Australian women is three to four times higher than in other Australian women, the mortality rate is eight to nine times higher, indicating that survival is probably poor. A similar pattern of higher incidence and morality, and probably lower survival, is seen in Maori and Native Americans compared to local non-indigenous populations, although the differentials are not as great as in Australia [75, 77, 83–86].

Indigenous Australian women may have higher rates of infection with HPV, and probably do have lower rates of Pap test screening, both of which would contribute to a higher incidence of cervical cancer. It is not clear what the current coverage of cervical cytology programs is in Indigenous communities, nor how Indigenous women perceive Pap test screening; as a first step, better information on screening coverage and quality is urgently required. Assuming that attainment of non-Indigenous rates is possible, cervical cancer mortality in Indigenous women could be reduced to less than 20% of current levels through better screening coverage and possibly more effective treatment.

Breast cancer incidence in Indigenous Australian women appears to be considerably lower than in other Australian women. The same appears to be true for Native American women, although not for Maori women [75, 76, 87, 88].

Breast cancer in Indigenous women presents an unusual cancer control challenge: how to prevent very low incidence levels from rising in a minority population that has undergone or is still undergoing rapid and dramatic changes in lifestyles. High fertility levels and early age at first birth are protective factors that are likely to change and become more adverse over time. Promotion of high fertility and high levels of teenage childbearing, however, are hardly viable breast cancer-prevention measures. The high levels of obesity in Indigenous women will also contribute to higher breast cancer rates. Research has shown that dietary interventions in remote Indigenous communities can reduce risk factors for diabetes and cardiovascular disease [89]. This work should be extended to other and more urbanized Australian Indigenous populations.

In the areas of early diagnosis and treatment breast cancer presents similar challenges to cervical cancer, with very high mortality relative to incidence and apparently low survival. Free mammographic screening is available in Australia, and is made available to rural and remote communities through mobile units [90]. Present indications are, though, that Indigenous women underuse it. This issue will need to be addressed as breast cancer incidence rises.

There is an apparent inconsistency between the low incidence rate of breast cancer in Indigenous Australian women and the high rate in Maori women. Both populations have high birth rates and relatively young age at first birth, which protect against breast cancer, and high rates of obesity, which increase risk of postmenopausal breast cancer [91]. A partial explanation for this inconsistency may lie in the shorter life expectancy of Indigenous Australian women: 62 years compared with 72 years in Maori women [92, 93], which would reduce the impact of obesity on their overall breast cancer risk.

The low incidence rates of colorectal cancer in Indigenous Australians and New Zealanders are also puzzling. The contemporary Indigenous Australian pattern of low physical activity and a diet low in fruit and vegetables and high in refined carbohydrate [68] might be expected to increase their risk of colorectal cancer above that of other Australians, which is contrary to the observed pattern. Similarly, a New Zealand review of available information on intake of total fat, cholesterol, meat, fiber, and alcohol suggested that Maori should have higher rather than lower colorectal cancer incidence compared with non-Maori [94]. Research into these inconsistencies could help prevent Indigenous Australians from ultimately sharing the high rates of colorectal and breast cancer in the non-Indigenous population.

Survival

It appears that for cancer sites where all Australians have poor survival Indigenous Australians suffer little or no survival disadvantage. However, for cancer sites where most Australians can expect a medium to high probability of surviving 5 years or more, Indigenous Australians appear to be at a considerable disadvantage. The only study directly examining cancer survival for Indigenous Australians confirms lower survival for all cancers combined, but did not report survival proportions for specific sites. The same study also reported evidence that Indigenous Australians have more advanced disease at diagnosis, which partly but not completely explained their overall survival disadvantage.

More advanced disease at diagnosis has also been reported for both Native Americans [84, 95] and Maori [96–98], and lower survival for Native Americans in most studies [84–86, 95, 99–101]. One study of cancer survival in Maori found that breast cancer survival in 133 Maori women was not lower than that of non-Maori [102].

More advanced disease at diagnosis does not explain the entire cancer survival disadvantage of Indigenous Australians. Low hospital admission rates for cancer in Indigenous Australians suggest that they have less access to effective cancer care than other Australians, and there is evidence from North American studies that Native Americans receive less effective cancer treatment than is the norm for their country [84, 100].

It is possible that remote residence, for some, and their high prevalence of chronic diseases such as diabetes, heart, and kidney disease [92] may influence decisions regarding cancer treatment for Indigenous Australians or reduce prospects of recovery when optimal treatment is given. There have been no reports of research into such possibilities. The indirect and limited indications of lower survival from some cancers in Indigenous Australians need to be verified, and the reasons for this apparent survival disadvantage investigated.

Conclusions

While cancer has a greater impact on Indigenous than other Australians, it should not be considered apart from their many other health problems. Many of the improvements required in disease-prevention programs and diagnosis and treatment services to reduce cancer incidence and mortality are the same improvements needed to reduce the impact of other health and social problems [103]. Reduction of tobacco usage would reduce levels of several other chronic diseases. Reduction in alcohol consumption would have direct individual benefits and even greater indirect benefits to families and communities through reduced levels of violence and family disruption and increased expenditure on food, clothing, housing, and other necessities. Improved Pap test screening, if implemented through a holistic women's health program, would have other sexual and reproductive health benefits. Adequately resourced primary health-care services and improved access to secondary services would improve diagnosis and treatment of all chronic conditions, not just cancer.

While there are considerable deficiencies in routine statistics and research on cancer in Indigenous Australians that need to be remedied, there are reasonable grounds for believing that the differences between Indigenous and non-Indigenous Australians described here are real, particularly given the similar patterns observed in other indigenous minorities of the Pacific basin. Indigenous Australians are at greater risk of several specific cancers that are largely preventable, and they are probably less likely to survive after diagnosis of cancer than are other Australians. Problems of inadequate access to, and effectiveness of, public health, primary care, and specialist services appear to be as evident in cancer control as they are in any other aspect of Indigenous health in Australia [92], and in just as much need of urgent attention.

Acknowledgements

Dr Condon was supported by a National Health and Medical Research Council postgraduate scholarship; Dr Cunningham was supported by a Menzies Foundation fellowship.

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