Cancer Incidence in New South Wales Migrants 1991 to 2001

Rajah Supramaniam[1]

Dianne O'Connell[1]

Elizabeth Tracey[2]

Freddy Sitas[1]

[1] **Cancer Epidemiology Research Unit, The Cancer Council NSW**

[2] **NSW Central Cancer Registry, Cancer Institute NSW**

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Correspondence to:
Cancer Research and Registers Division
The Cancer Council NSW
Locked Mail Bag 8000
Potts Point 1335
NSW Australia

Telephone: 61 2 9334 1900
Fax: 61 2 9334 1778
Email: crd@nswcc.org.au
Internet: www.cancercouncil.com.au

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Forewords

From the School of Public Health and Community Medicine, The University of New South Wales

Cancer is a life-threatening disease that affects all Australians, but differentially. The risk of getting cancer varies according to family history, where we were born, our age and gender, among many exposure factors. Yet, each person probably has a friend, family member or work colleague with cancer. At least a quarter of us will be diagnosed with cancer before we turn 75. Cancer is on the rise in Australia, and concerns us all.

To effectively fight cancer, we need timely and high quality data. Health services planning depends on accurate knowledge of who is most at risk of cancer, what types of tumours are most prevalent, and the trajectory of the disease. This report from The Cancer Council NSW describes the incidence of cancer in the state from 1991 to 2001. A series of analyses done by place of birth, tumour type and sex strongly confirm that cancer affects people differently. The report also highlights the complexities involved in migration cancer studies. NSW is the most culturally diverse state in Australia. This rich ethnic mix poses considerable challenges for cancer control.

Overall, Australia has an excellent record in cancer management. We still have a long way to go however in ensuring equitable outcomes, such as timely detection and optimal treatment for everyone. We are still learning about different cultural responses to cancer. Often, we do not provide appropriate care for people who have grown up with different values about the early detection of life-threatening diseases and subsequent intensive hospital treatment. The wide diversity in health beliefs and knowledge about cancer is a barrier to optimal care, compounded by language barriers and a lack of familiarity with the Australian health care system.

Regular, useful statistical analyses on cancer trends by place of birth are essential planning tools to facilitate monitoring of equitable outcomes. At a national level, the Australian National Cancer Strategies Group Data Monitoring Committee has noted the need for the kind of statistical analyses contained in this report. The Cancer Council NSW is to be congratulated for its excellent report that will support public health research and improve our knowledge of cancer incidence in NSW. The Cancer Epidemiology Research Unit consistently produces work of top quality, with detailed and careful analyses of practical use, and this is no exception.

Associate Professor Rosemary Knight
School of Public Health and Community Medicine
University of New South Wales, Sydney

From CanRevive

This report provides an overview and some very comprehensive data for shaping the future provision of treatment, information and prevention services for different migrant groups living with cancer. The higher incidence rate of liver cancer, as revealed in this report, in Chinese male migrants from China and Hong Kong and Macau, who were resident in NSW, coincides with the number of cancer cases serviced by CanRevive.

Despite female migrants from China having had a 45% lower incidence rate of breast cancer compared to the Australian-born population of NSW, CanRevive notes that the incidence rate in female migrants from China has been on the rise in recent years. This rising trend matches with the findings on Chinese migrants in NSW when compared with females still living in China.

CanRevive finds these migrant studies invaluable especially as NSW is where the majority of Australian-Chinese migrants call home. This report contributes data and evidence leading to the identification of specific health needs, such as diet and smoking among others, and to promote awareness of protective behaviour in the migrant communities.

Dennis Yeung
President, CanRevive

From Cancer Voices

Cancer Voices NSW is the state level voice for people affected by cancer. We welcome the Cancer Council NSW publication of *Cancer incidence in NSW migrants 1991 to 2001*.

By providing an updated overview of the types of cancer experienced by people of many national origins, this work will help planners and service providers. It offers a basis for helping the cancer world understand what sort of diet, environment and lifestyle relates to which cancers. Clearer information of this type will help all people affected by cancer.

We believe its findings will also be useful for the Cancer Councils' Multicultural Information Service, an important component of The Cancer Council NSW's assistance to people of different national origins.

We see this report as a building block for policies about prevention, protection, information and care, with potential to positively influence the eventual journey of people affected by cancer.

Sally Crossing AM
Chair, Cancer Voices NSW

From the Cancer Council Multicultural Information Service

Cancer incidence in NSW migrants 1991 to 2001 is a long awaited report with valuable information on cancer incidence among the migrant groups in NSW. The information contained in this report is immensely useful for targeting program strategies towards combating certain types of cancers among specific language groups and therefore enhancing the efficiency in delivering both prevention and information and support programs in the migrant community.

The comparative rates of cancer among the different migrant communities as well as the comparisons between the post- and pre-migration experience of cancer, is a unique contribution of this report and perhaps very significant. The report captures this information in a fascinating way to form the basis for future research. The impact of changes in lifestyles, food choices and general wellbeing after migrating to a new country may need further investigations to answer questions regarding these differential rates.

The Cancer Council Multicultural Information Service will be delighted to use this report as a resource. This document will fill in gaps in information available on migrant communities and cancer and has the potential to be used as a credible reference by health professionals, cancer services and the community.

Ms Gunjan Tripathi
Manager, Cancer Council Multicultural Information Service
The Cancer Council NSW

Summary

In 1993, The Cancer Council NSW published a report called *Common cancers in migrants to NSW in 1972 to 1990* [1]. This new report follows that theme by describing the incidence of cancer in NSW for the subsequent period 1991 to 2001 by place of birth. It describes the incidence of the 20 most common cancers for the 25 most common places of birth in NSW.

The report uses data abstracted from the NSW Central Cancer Registry along with incidence data from the International Agency for Research on Cancer's GLOBOCAN databases to compare incidence in migrants to Australia to both Australian-born people and to people still resident in their respective places of birth.

Summary tables

Tables S1 and S2 summarise the results. Table S1 shows the results of comparing the incidence of cancer in NSW in 1991 to 2001 by place of birth and sex with the Australian-born population. Table S2 shows the results of comparing the incidence of cancer in NSW in 1991 to 2001 by place of birth and sex with people still resident in their respective places of birth.

Incidence compared to Australian-born in NSW (Table S1)

Males

The observed incidence of liver and stomach cancers by place of birth were all higher than, or similar to, that of the Australian-born male population.

The observed incidence of colorectal, brain and central nervous system and prostate cancers, cancers with an indefinite or unspecified site, melanoma of the skin and non-Hodgkin lymphoma by place of birth were all lower than, or similar to, that of the Australian-born male population.

The incidence by place of birth was mixed with some rates higher, some lower and some similar to the Australian-born male population for leukaemia, cancers of the bladder, head and neck, kidney, lung, testis and thyroid.

There were no significant differences in the incidence of pancreatic cancer by place of birth compared to that of the Australian-born male population.

Females

The observed incidence by place of birth of liver, ovarian, stomach and thyroid cancers were all higher than, or similar to, that of the Australian-born female population.

The observed incidence by place of birth of brain and central nervous system, breast, colorectal and kidney cancers, cancers with an indefinite or unspecified site and melanoma of the skin were all lower than, or similar to, that of the Australian-born female population.

The incidence by place of birth was mixed with some rates higher, some lower and some similar to the Australian-born female population for non-Hodgkin lymphoma and cancers of the cervix, head and neck, lung and uterus.

There were no significant differences in the incidence by place of birth of leukaemia and bladder and pancreatic cancer compared to that of the Australian-born female population.

Incidence compared to place of birth (Table S2)

Males

The observed incidence in male migrants of kidney, pancreatic, prostate, testicular and thyroid cancers as well as leukaemia, melanoma of the skin and non-Hodgkin lymphoma by place of birth were all higher than, or similar to, that of males resident in their place of birth.

The observed incidence in male migrants of cancers of the stomach by place of birth was lower than, or similar to, that of males resident in their place of birth.

The incidence in male migrants by place of birth was mixed with some rates higher, some lower and some similar to that of males resident in their place of birth for cancers of the bladder, brain and central nervous system, colon and rectum, head and neck, liver and lung.

Females

The observed incidence in female migrants of breast, colorectal, kidney, pancreatic and thyroid cancers, leukaemia and non-Hodgkin lymphoma by place of birth were all higher than, or similar to, that of females resident in their place of birth.

The observed incidence in female migrants of liver and stomach cancers by place of birth was lower than, or similar to, that of females resident in their place of birth.

The incidence in female migrants by place of birth was mixed with some rates higher, some lower and some similar to that of females resident in their place of birth for cancers of the bladder, brain and central nervous system, cervix, head and neck, lung, ovary and uterus and melanoma of the skin

Table S1: Summary of relative incidence compared to Australian-born by place of birth, cancer type and sex in NSW 1991-2001

	China		Egypt		Fiji		Germany		Greece	
Cancer type	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Bladder	Lower				*	*	Higher			
Breast	*	Lower	*		*		*		*	Lower
Cancers of the brain and CNS	Lower	Lower			*	*				
Cancer with an indefinite site	Lower	Lower	Lower							
Cervix	*	Higher	*		*	Higher	*		*	
Colon and rectum	Lower	Lower	Lower	Lower	Lower				Lower	Lower
Head and neck			Lower			*	Lower		Lower	Lower
Kidney	Lower	Lower			*	*				
Leukaemia	Lower				*					
Liver	Higher	Higher	Higher	*	*	*		*		*
Lung	Lower		Lower	Lower	Lower					Lower
Melanoma of the skin	Lower	Lower	Lower	Lower	Lower	Lower	Lower	Lower	Lower	Lower
Non-Hodgkin lymphoma	Lower	Lower				Lower				
Ovary	*		*		*		*		*	
Pancreas					*	*				
Prostate	Lower	*	Lower	*		*		*	Lower	*
Stomach	Higher	Higher		*	*	*	Higher		Higher	Higher
Testis	Lower	*	*	*	*	*		*		*
Thyroid			*	*	*		*		Higher	Higher
Uterus	*	Lower	*		*		*		*	

	Hong Kong and Macau		India		Indonesia		Italy		Korea	
Cancer type	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Bladder	*	*		*	*	*			*	*
Breast	*		*		*		*	Lower	*	Lower
Cancers of the brain and CNS	*	*		*	*	*			*	*
Cancer with an indefinite site							Lower			
Cervix	*		*		*	Higher	*	Lower	*	
Colon and rectum			Lower	Lower	Lower		Lower	Lower	Lower	
Head and neck	Higher		Lower	Lower		*	Lower		Lower	*
Kidney	*	*			*	*		Lower		*
Leukaemia		*				*				*
Liver	Higher	*	*	*	Higher	*	Higher	Higher	Higher	*
Lung			Lower					Lower	Lower	
Melanoma of the skin	Lower	Lower	Lower	Lower	Lower	Lower	Lower	Lower	Lower	*
Non-Hodgkin lymphoma			Lower						Lower	Lower
Ovary	*		*		*		*		*	*
Pancreas	*	*			*	*			*	*
Prostate		*	Lower	*	Lower	*	Lower	*	Lower	*
Stomach		*		*	*	*	Higher	Higher	Higher	Higher
Testis	Lower	*	Lower	*	*	*	Lower	*	*	*
Thyroid	*	Higher	*		*			Higher	*	
Uterus	*		*		*	*	*		*	*

Key

Higher Incidence rate in migrants from the place of birth was statistically significantly higher than that of the Australian born population of NSW.

Lower Incidence rate in migrants from the place of birth was statistically significantly lower than that of the Australian born population of NSW.

Incidence rate in migrants from the place of birth was not statistically significantly different to that of the Australian born population of NSW.

* Incidence rate in migrants from the place of birth was no calculated due to insufficient number of cases or the cancer type was not applicable to this sex.

Table S1: Summary of relative incidence compared to Australian-born by place of birth, cancer type and sex in NSW 1991-2001 (continued)

	Lebanon		Malaysia and Brunei		Malta		Netherlands		New Zealand	
Cancer type	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Bladder			*	*			Higher			
Breast	*	Lower	*		*	Lower	*		*	
Cancers of the brain and CNS			*	*		*				
Cancer with an indefinite site	Lower			*						
Cervix	*		*		*		*		*	Higher
Colon and rectum	Lower	Lower	Lower		Lower	Lower	Lower	Lower		
Head and neck	Lower			Higher	Lower		Lower		Lower	
Kidney			*	*						Lower
Leukaemia			Higher	*						
Liver		*	*	*	*	*		*		*
Lung	Lower	Lower			Higher		Higher			Higher
Melanoma of the skin	Lower	Lower	Lower	Lower	Lower	Lower	Lower	Lower	Lower	
Non-Hodgkin lymphoma						Higher				
Ovary	*		*		*		*		*	
Pancreas			*	*						
Prostate	Lower	*		*	Lower	*	Lower	*	Lower	*
Stomach			*	Higher						
Testis		*	*	*	*	*	*	*	Higher	*
Thyroid	Higher	Higher	*		*	*	*	*		
Uterus	*		*		*		*		*	

	Philippines		Poland		Portugal		South Africa		Spain	
Cancer type	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Bladder	Lower	*			*	*		*		*
Breast	*		*	Lower	*		*		*	
Cancers of the brain and CNS		Lower			*	*	*	*	*	*
Cancer with an indefinite site						*				*
Cervix	*	Higher	*		*	*	*		*	*
Colon and rectum	Lower	Lower					Lower	Lower		
Head and neck						*		*		*
Kidney			Higher			*		*		*
Leukaemia					*	*		*	*	*
Liver	Higher	*		*	*	*	*	*	*	*
Lung							Lower			Lower
Melanoma of the skin	Lower	Lower	Lower	Lower	Lower	*		Lower	Lower	Lower
Non-Hodgkin lymphoma					*	*				*
Ovary	*		*	Higher	*	*	*		*	*
Pancreas	*				*	*	*	*	*	*
Prostate	Lower	*	Lower	*		*		*		*
Stomach			Higher	Higher	*	*				*
Testis	Lower	*	*	*	*	*	*	*	*	*
Thyroid	Higher	Higher	*		*	Higher	*	*	*	*
Uterus	*		*	Higher	*	*	*		*	*

Key

Higher Incidence rate in migrants from the place of birth was statistically significantly higher than that of the Australian born population of NSW.

Lower Incidence rate in migrants from the place of birth was statistically significantly lower than that of the Australian born population of NSW.

Incidence rate in migrants from the place of birth was not statistically significantly different to that of the Australian born population of NSW.

* Incidence rate in migrants from the place of birth was no calculated due to insufficient number of cases or the cancer type was not applicable to this sex.

Table S1: Summary of relative incidence compared to Australian-born by place of birth, cancer type and sex in NSW 1991-2001 (continued)

	Sri Lanka		United Kingdom and Ireland		United States of America		Vietnam		Yugoslavia	
Cancer type	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Bladder	*	*	Higher			*	Lower	*		
Breast	*	Lower	*		*		*	Lower	*	Lower
Cancers of the brain and CNS	*	*			*	*	Lower			
Cancer with an indefinite site	Lower		Lower			*				
Cervix	*	*	*		*		*	Higher	*	
Colon and rectum	Lower	Lower	Lower	Lower			Lower	Lower	Lower	Lower
Head and neck		*	Lower			*			Lower	Lower
Kidney	*	*	Lower			*	Lower		Lower	Lower
Leukaemia	*	*	Lower			*				
Liver	*	*			*	*	Higher	Higher		*
Lung	Lower	Lower	Higher	Higher						Lower
Melanoma of the skin	Lower	Lower	Lower	Lower	Lower		Lower	Lower	Lower	Lower
Non-Hodgkin lymphoma		*	Lower	Lower		*		Lower	Lower	Lower
Ovary	*	*	*	Higher	*	Higher	*		*	
Pancreas	*	*			*	*				
Prostate	Lower	*	Lower	*		*	Lower	*	Lower	*
Stomach	*	*	Higher	Higher	*	*	Higher	Higher	Higher	Higher
Testis	*	*		*	*	*	Lower	*	Lower	*
Thyroid	*		Lower		*	*	*	Higher		
Uterus	*	*	*		*	*	*		*	

Key

Higher Incidence rate in migrants from the place of birth was statistically significantly higher than that of the Australian born population of NSW.

Lower Incidence rate in migrants from the place of birth was statistically significantly lower than that of the Australian born population of NSW.

Incidence rate in migrants from the place of birth was not statistically significantly different to that of the Australian born population of NSW.

* Incidence rate in migrants from the place of birth was no calculated due to insufficient number of cases or the cancer type was not applicable to this sex.

Table S2: Summary of relative incidence compared to people still resident in their respective place of birth by cancer type and sex in NSW 1991-2001

	China		Egypt		Fiji		Germany		Greece	
Cancer type	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Bladder	Higher	Higher	Lower		*	*			Lower	
Breast	*	Higher	*	Higher	*	Higher	*	Higher	*	Higher
Cancers of the brain and CNS				Higher	*	*				
Cervix	*	Higher	*		*	Lower	*		*	
Colon and rectum	Higher	Higher	Higher	Higher	Higher	Higher			Higher	Higher
Head and neck	Higher	Higher		*	Higher	*	Lower		Lower	
Kidney	Higher	Higher	Higher	*	*	*			Higher	Higher
Leukaemia	Higher	Higher			*	Higher				
Liver	Lower	Lower		*		*		*	Lower	Lower
Lung			Higher	Higher				Higher	Lower	Lower
Melanoma of the skin	Higher	*	Higher	*	*	*	Higher		Higher	
Non-Hodgkin lymphoma	Higher	Higher	Higher	Higher	*	*			Higher	Higher
Ovary	*	Higher	*	Higher	*		*		*	
Pancreas	Higher	Higher	Higher	Higher	*	*				
Prostate	Higher	*	Higher	*	Higher	*	Higher	*	Higher	*
Stomach	Lower	Lower		*	*	*		Lower		
Testis	*	*	*	*	*	*		*	*	*
Thyroid	Higher	Higher	*	*	*		*		Higher	Higher
Uterus	*	Higher	*	Higher	*	Higher	*		*	Higher

	Hong Kong and Macau		India		Indonesia		Italy		Korea	
Cancer type	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Bladder		*	Higher	*	*	*	Lower		*	*
Breast	*	Higher	*	Higher	*	Higher	*	Higher	*	Higher
Cancers of the brain and CNS	*	*		*	*	*			*	*
Cervix	*	Lower	*	Lower	*		*	Lower	*	
Colon and rectum			Higher	Higher	Higher	Higher	Higher			
Head and neck	Lower	Lower	Lower	Lower	*	*	Lower		Lower	*
Kidney	*	*	Higher	*	*	*			*	*
Leukaemia	*	*	Higher	*	Higher	*	Higher		*	*
Liver	Lower	Lower	*	*		*	Lower	Lower	Lower	
Lung	Lower		Higher	Higher		Higher	Lower		Lower	
Melanoma of the skin	*	*	*	*	*	*	Higher		*	*
Non-Hodgkin lymphoma		*		Higher	Higher	Higher			*	*
Ovary	*		*		*		*		*	*
Pancreas	*	*	Higher	Higher	*	*			*	*
Prostate	Higher	*	Higher	*	Higher	*	Higher	*	Higher	*
Stomach				*	*	*	Lower	Lower	Lower	
Testis	*	*	*	*	*	*		*	*	*
Thyroid	*		*	Higher	*	Higher	Higher		*	Higher
Uterus	*		*	Higher	*	*	*	Lower	*	*

Key

Higher Incidence rate in migrants from the place of birth was statistically significantly higher than that of people resident in their place of birth.

Lower Incidence rate in migrants from the place of birth was statistically significantly lower than that of people resident in their place of birth.

Incidence rate in migrants from the place of birth was not statistically significantly different to that of people resident in their place of birth.

* Incidence rate in migrants from the place of birth was not calculated due to insufficient number of cases or the cancer type was not applicable to this sex.

Table S2: Summary of relative incidence compared to people still resident in their respective place of birth by cancer type and sex in NSW 1991-2001 (continued)

	Lebanon		Malaysia and Brunei		Malta		Netherlands		New Zealand	
Cancer type	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Bladder		Higher	*	*	Lower					
Breast	*	Higher	*	Higher	*		*		*	
Cancers of the brain and CNS		*	*	*		*		Higher		Lower
Cervix	*		*		*		*		*	
Colon and rectum	Higher	Higher					Lower		Higher	
Head and neck	Lower	Higher			Lower		Lower		Lower	
Kidney	Higher	Higher	*	*						
Leukaemia		Higher	Higher	*						
Liver		*		*	*	*	*	*	Lower	*
Lung		Higher			Higher	Higher		Higher	Lower	
Melanoma of the skin	*	*	*	*	*	*				Lower
Non-Hodgkin lymphoma		Higher		Higher		Higher				
Ovary	*		*		*		*		*	Lower
Pancreas			*	*						
Prostate	Higher	*	Higher	*	Higher	*		*		*
Stomach							Lower			
Testis	Higher	*	*	*	*	*	*	*	Higher	*
Thyroid	Higher	Higher	*		*	*	*	*		
Uterus	*		*		*	Lower	*		*	

	Philippines		Poland		Portugal		South Africa		Spain	
Cancer type	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Bladder	*	*				*	Higher	*		*
Breast	*	Higher	*	Higher	*	Higher	*	Higher	*	Higher
Cancers of the brain and CNS	*	*	Higher	*	*	*	*	*	*	*
Cervix	*	Lower	*	Lower	*	*	*	Lower	*	*
Colon and rectum			Higher	Higher			Higher	Higher		
Head and neck	Lower		Lower	*	Lower	*	Lower	*		*
Kidney			Higher		Higher	*	Higher	*		*
Leukaemia			Higher		*	*	Higher	*	*	*
Liver	Higher	Lower	Lower		*	*	*	*	*	*
Lung	Higher			Higher		*				*
Melanoma of the skin	*	*	Higher		*	*	Higher	Higher	*	*
Non-Hodgkin lymphoma		Higher	Higher	Higher	*	*	Higher	Higher	Higher	*
Ovary	*		*		*	*	*	Higher	*	*
Pancreas	*		Higher		*	*	*	*	*	*
Prostate	Higher	*	Higher	*	Higher	*	Higher	*	Higher	*
Stomach	Lower					*				*
Testis	*	*	*	*	*	*	*	*	*	*
Thyroid	Higher	Higher	*	Higher	*	Higher	*	*	*	*
Uterus	*	Higher	*		*	*	*		*	*

Key

Higher Incidence rate in migrants from the place of birth was statistically significantly higher than that of people resident in their place of birth.

Lower Incidence rate in migrants from the place of birth was statistically significantly lower than that of people resident in their place of birth.

Incidence rate in migrants from the place of birth was not statistically significantly different to that of people resident in their place of birth.

* Incidence rate in migrants from the place of birth was not calculated due to insufficient number of cases or the cancer type was not applicable to this sex.

Table S2: Summary of relative incidence compared to people still resident in their respective place of birth by cancer type and sex in NSW 1991-2001 (continued)

	Sri Lanka		United Kingdom and Ireland		United States of America		Vietnam		Yugoslavia	
Cancer type	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Bladder	*	*	Higher	Lower		*	Lower	*		
Breast	*	Higher	*	Higher	*		*	Higher	*	
Cancers of the brain and CNS	*	*	Higher		*	*	Lower	*	Lower	
Cervix	*	Lower	*	Lower	*		*		*	Lower
Colon and rectum		Higher	Higher	Higher			Higher	Higher	Higher	
Head and neck	Lower	Lower		Higher		*			Lower	Lower
Kidney	*	*	Higher	Higher		*		Higher		
Leukaemia	*	*	Higher	Higher		*			Higher	
Liver	*	*	Lower		*	*	Higher			Lower
Lung	Lower	*	Higher		Lower				Lower	Lower
Melanoma of the skin	*	*	Higher	Higher			*	*		
Non-Hodgkin lymphoma	*	*	Higher	Higher		*	Higher		Higher	Higher
Ovary	*	*	*	Lower	*		*		*	
Pancreas	*	*	Higher		*	*		Higher		
Prostate		*	Higher	*		*	Higher	*	Higher	*
Stomach	*	*	Lower	Lower	Lower	*	Lower			
Testis	*	*	Higher	*	*	*	*	*		*
Thyroid	*	Higher		Higher	*	*	*	Higher		Higher
Uterus	*	*	*		*		*	Higher	*	Lower

Key

Higher Incidence rate in migrants from the place of birth was statistically significantly higher than that of people resident in their place of birth.

Lower Incidence rate in migrants from the place of birth was statistically significantly lower than that of people resident in their place of birth.

Incidence rate in migrants from the place of birth was not statistically significantly different to that of people resident in their place of birth.

* Incidence rate in migrants from the place of birth was not calculated due to insufficient number of cases or the cancer type was not applicable to this sex.

Introduction

Geographical studies of disease such as this one have provided invaluable clues in discerning the importance of environmental over genetic factors in their causation.

While it has been known since the turn of the twentieth century that the incidence and mortality of some of the leading cancer types vary greatly across the world, contemporary population-based cancer registries have allowed important differences in cancer patterns to be discovered. For example, as Table I1 shows incidence rates for melanoma were highest for males in Australia and for females in New Zealand, and were lowest in males in Egypt and females in Vietnam. Approximately ninety-five-fold differences are seen in the incidence of prostate cancer between the highest rate in the United States of America and lowest in Sri Lanka. Whereas rates of head and neck cancer observed in Sri Lanka are more than twenty-fold that in Egypt. Table I1 shows some of the international differences observed for selected cancers.

Table I1: International variation in projected age-standardised cancer incidence rates^ per 100,000 for 2000

Cancer type	Country with highest incidence (Rate)	Country with lowest incidence (Rate)	Ratio*
	Male		
Melanoma of the skin	Australia (40.5)	Egypt (0)	-
Prostate	USA (104.3)	Sri Lanka (1.1)	94.8
Colon and rectum	New Zealand (55.3)	Sri Lanka (1.8)	30.7
Lung	Yugoslavia (80.9)	Sri Lanka (1.9)	42.6
Stomach	Korea (70)	Sri Lanka (1.2)	58.3
Head and neck	Sri Lanka (42.6)	Egypt (1.7)	25.1
Thyroid	USA (3)	Spain (0.5)	6.0
Leukaemia	New Zealand (11.8)	India (3.1)	3.8
	Female		
Melanoma of the skin	New Zealand (34.9)	Vietnam (0.1)	349.0
Breast	Netherlands (91.6)	Korea (12.5)	7.3
Colon and rectum	New Zealand (43.4)	Sri Lanka (1.9)	22.8
Lung	USA (34)	Sri Lanka (1.1)	30.9
Stomach	Korea (25.7)	Sri Lanka (0.6)	42.8
Head and neck	Sri Lanka (14.2)	Egypt (0.6)	23.7
Cervix	Fiji (38.7)	China (5.2)	7.4
Thyroid	Italy (8.5)	China (1.6)	5.3
Leukaemia	New Zealand (8.7)	India (2.1)	4.1

^ Standardised to the World Population
*** Ratio of highest to lowest incidence rate**
Source: GLOBOCAN 2000 [(2)]

It has been shown that populations that migrate continue some lifestyle behaviours typical of their former homeland. However, these lifestyle behaviours and resulting cancer incidence patterns among migrants begin to resemble those of their host country the longer they live in that country.

Migrant studies are valuable in discerning time periods of aetiological importance; in identifying protective behaviours; and in providing evidence for similar or dissimilar causes of different cancers. In addition, studies among migrants may identify specific health needs that may differ from those of the host population. Thomas and Karagas[(3)] reviewed these issues and pointed out how migrant studies may identify cancer profiles for populations where disease registration is unreliable and also help identify possible factors of importance for further study.

New South Wales is the most culturally diverse state in Australia with 25% of the population being born overseas. About 200 nationalities are represented in the NSW population. This rich diversity of people offers many opportunities for the study of different risk factors for cancer such as diet, smoking, infections, reproductive history and genetic heterogeneity that is not available in most places with more homogeneous populations.

Table I2 shows the median ages for migrants by sex in NSW for the top 25 places of birth and for Australian-born. It has been predicted that between 1996 and 2011 the proportion of migrants over the age of 65 will increase by 74% [(4)]. By 2026, the three leading non-Australian birthplaces will be China, Italy and Vietnam.

As shown in Table I3, the United Kingdom (including Northern Ireland) was the largest source of migrants to Australia since federation in 1901. After World War II, the numbers of migrants from Yugoslavia, the Netherlands, Poland, Italy, Greece and other European countries increased considerably. Since the 1970s the numbers of immigrants from Asia, North Africa and the Middle East also increased. Significant increases occurred in the number of Chinese migrants at the turn of the 20th Century and then again after 1990 following a steady increase since the 1950s.

While life expectancy for the general population of NSW is improving[(4)], it is possible that this is not shared equally among immigrant populations.

Earlier reports from Australia have shown that cancer rates differ substantially between migrants and Australian-born residents.[(1)(5)(6)].

In 1993, The Cancer Council NSW published a report called *Common cancers in migrants to NSW in 1972 to 1990* [(1)]. This report follows the same theme by describing the incidence of cancer in NSW by place of birth for the subsequent period of 1991 to 2001.

The objective of this report is to compare the relative incidence of cancer in populations according to their places of birth with their expected incidence if they had been born in Australia or if they had remained resident in their place of birth. This will help identify priority areas for the future provision of cancer treatment, information and prevention services to specific migrant groups identified by their place of birth.

Table I2: Median age of migrants and Australian-born people resident in NSW by place of birth and sex in 1991 to 2001

	Median age (years)	
Place of birth	**Male**	**Female**
Egypt	48.8	49.3
China	42.5	43.4
Fiji	34.1	34.5
Germany	50.9	52.7
Greece	54.3	53.7
Hong Kong and Macau	29.7	30.9
India	38.1	39.9
Indonesia	34.6	34.7
Italy	56.3	56.5
Korea	33.9	33.3
Lebanon	40.4	39.1
Malaysia and Brunei	34.4	35.8
Malta	52.5	52.8
Netherlands	54.7	54.8
New Zealand	36.3	36.9
Philippines	32.6	36.3
Poland	54.1	53.0
Portugal	40.9	40.6
South Africa	36.8	37.7
Spain	47.3	47.1
Sri Lanka	37.9	38.3
United Kingdom and Ireland	48.9	50.5
United States of America	36.7	35.1
Vietnam	35.0	36.0
Yugoslavia	46.9	46.1
Australian-born	**32.4**	**34.8**

Source: Australian Bureau of Statistics estimated resident populations 1991 to 2001

Table I3: Australian population (in 100s) by place of birth 1901-2001

	Year of census							
Place of Birth	**1901**	**1911**	**1921**	**1933**	**1947**	**1954**	**1961**	**1966**
Oceania								
New Zealand	258	319	386	460	436	434	470	525
Fiji	6	9	11	13	15	18	27	31
Other Oceania	98	24	23	22	28	33	53	83
Europe and the former USSR								
Germany	384	330	224	168	146	654	1093	1087
Netherlands	6	7	14	13	22	520	1021	995
Greece	9	18	37	83	123	259	773	1401
Italy	57	67	81	268	336	1199	2283	2673
Malta	0	2	13	28	32	200	393	551
Spain	5	7	9	11	10	14	38	109
Yugoslavia	0	0	8	40	59	229	498	713
Poland	0	0	18	32	66	566	600	616
UK (excluding Ireland but including Nth Ireland)	4955	4543	5715	6363	4982	6260	7183	8705
Other Europe	2118	1669	1318	1066	739	1614	2013	2025
Middle East and North Africa								
Lebanon	0	0	0	0	0	39	73	107
Arab Republic of Egypt	1	1	4	6	8	82	163	220
Other Middle East and North Africa	16	21	21	28	45	98	138	174
South East Asia								
Indonesia	3	7	4	2	9	36	60	66
Malaysia	7	10	6	9	18	23	58	92
Philippines	7	4	3	2	1	2	4	10
Other South East Asia	0	3	0	0	1	11	46	67
North East Asia								
China	0	208	152	86	64	103	145	174
Hong Kong and Macau	2	4	3	2	8	16	35	42
Korea	0	35	28	23	3	10	23	31
Other North East Asia	36	35	28	23	3	10	23	31
Southern Asia								
India	76	69	69	68	82	120	142	158
Sri Lanka	6	6	6	6	0	20	34	56
Other Southern Asia	19	2	11	22	10	40	32	38
Other Asia	55	40	39	45	14	61	101	136
Northern America								
USA	0	98	103	101	104	128	168	259
Other Northern America	32	31	37	40	41	47	64	92
Africa (excluding North Africa)								
South Africa	15	39	54	62	59	60	79	97
Other Africa	13	9	9	10	8	17	44	99
Total overseas born	**8654**	**7873**	**8540**	**9032**	**7441**	**12864**	**17787**	**21309**
Total population (overseas and Australian-born)	**37738**	**44550**	**54357**	**32627**	**75794**	**89865**	**105082**	**115505**

Table I3: Australian population (in 100s) by place of birth 1901-2001 (continued)

	Year of census						
Place of Birth	**1971**	**1976**	**1981**	**1986**	**1991**	**1996**	**2001**
Oceania							
New Zealand	741	839	1607	1999	2641	2914	3558
Fiji	39	57	90	143	302	371	443
Other Oceania	115	185	252	345	422	494	550
Europe and the former USSR							
Germany	1100	1069	1093	1135	1120	1103	1082
Netherlands	986	915	951	944	947	879	833
Greece	1590	1524	1458	1369	1359	1265	1164
Italy	2883	2795	2750	2610	2534	2382	2187
Malta	535	558	568	561	538	509	470
Spain	145	153	150	161	145	136	127
Yugoslavia	1282	1431	1486	1493	1606	1754	1813
Poland	595	559	590	669	686	651	581
UK (excluding Ireland but including Nth Ireland)	10398	10444	10758	10720	11074	10726	10362
Other Europe	2261	2457	2327	2337	2497	2552	2428
Middle East and North Africa							
Lebanon	239	333	494	561	688	702	713
Arab Republic of Egypt	281	301	305	305	331	342	334
Other Middle East and North Africa	348	548	655	735	918	1089	1284
South East Asia							
Indonesia	77	89	118	170	326	442	472
Malaysia	144	187	305	465	717	763	789
Philippines	23	55	148	328	730	929	1039
Other South East Asia	117	214	750	1399	1969	2431	2575
North East Asia							
China	171	190	252	366	779	1110	1428
Hong Kong and Macau	54	84	153	278	592	703	691
Korea	44	66	109	187	390	531	644
Other North East Asia	40	57	76	117	311	427	480
Southern Asia							
India	287	370	410	471	610	776	955
Sri Lanka	90	148	168	223	371	470	535
Other Southern Asia	26	50	47	61	114	210	352
Other Asia	183	321	872	1576	2394	3068	3408
Northern America							
USA	388	424	453	566	662	747	810
Other Northern America	135	138	164	192	229	255	277
Africa (excluding North Africa)							
South Africa	122	153	265	364	490	558	794
Other Africa	208	246	322	404	442	516	611
Total overseas born	**25463**	**26894**	**31281**	**34373**	**40538**	**45250**	**51397**
Total population (overseas and Australian-born)	**127195**	**135149**	**145169**	**155426**	**167718**	**177528**	**187692**

Methods

Data sources

Population data and place of birth definitions
The populations used in this report were the annual mid-year estimated resident populations of NSW for each place of birth for each year from 1991 to 2001 by sex and five-year age groups (see Appendix 1). Populations were provided by the Australian Bureau of Statistics and abstracted from HOIST, a SAS-based data warehouse operated by the Centre for Epidemiology and Research, NSW Department of Health.

The places of birth groupings chosen for this report correspond to the population groupings available from HOIST (see Appendix 2). Further, some of the populations have been amalgamated to allow comparison with geographical boundaries and classifications available in GLOBOCAN 90 [7].

The places combined were: Malaysia and Brunei, the United Kingdom and Ireland, North and South Korea, countries of the former republic of Yugoslavia, and Hong Kong and Macau. The United Kingdom, in this report, includes England, Scotland, Northern Ireland and Wales. Yugoslavia includes the current countries of Croatia, Bosnia and Herzegovina, Serbia and Montenegro, Slovenia and the former Yugoslavian Republic of Macedonia. The country of China refers to mainland China excluding both Taiwan and the Special Administrative Regions of Hong Kong and Macau.

International incidence rates
Incidence rates for relevant places of birth were abstracted from the GLOBOCAN 90 and GLOBOCAN 2000 databases created by the International Agency for Research on Cancer (IARC) for the years 1990 and 2000 respectively [2][7]. Incidence rates for years 1991 to 1999 were linearly interpolated and extrapolated for 2001.

Cases of cancer
The incident cancer cases for the years 1991 to 2001 for people resident in NSW were abstracted from the NSW Central Cancer Registry (CCR). The CCR was established in 1971 as a population-based register of all cancers in NSW. Since 1972 notification of all malignant neoplasms, except for non-melanocytic skin cancers, has been a statutory requirement for all NSW public and private hospitals, radiotherapy departments and nursing homes. Notification became mandatory for pathology laboratories and outpatients departments in 1985, and for day procedure centres in 1991.

The cancer types included in this report are those used in the detailed description section of the CCR's annual reports on cancer incidence and mortality in NSW.

However, for individual places of birth only cancer types where either the observed or expected number of cases was greater than 11 cases in 11 years were included. Finally, some types were amalgamated (see Appendix 3) to ensure comparability with the projected international incidence rates available on GLOBOCAN 90 [7].

The cancer types described in this report are: cancers of the bladder, brain and central nervous system, female breast, cervix, lung, colon and rectum, head and neck, indefinite sites (for comparison to Australian-born only), kidney, liver, ovary, pancreas, prostate, stomach, testis, thyroid, and uterus and melanoma of the skin, all leukaemias and non-Hodgkin lymphoma. See Appendix 3 for a list of all cancer types included in the report and notes on any types that were amalgamated.

Standardised incidence ratios and confidence intervals

A standardised incidence ratio (SIR) allows for the comparison of incidence in a study population of interest relative to the incidence in another standard population where the age distributions differ. In this report, when the number of cases is relatively small in the study population, such as is observed in some of the places of birth, then indirect standardisation provides a more robust method of comparing incidence than does direct standardisation [8]. However, SIRs do not allow for an easy comparison of incidence rates between different study populations.

The SIR was calculated by dividing the number of cases observed in the time period 1991 to 2001 in the study population of interest, as defined by the place of birth, by the number of cases that would be expected if the incidence was the same as that in the standard population. See Appendix 6 for a more detailed explanation. The expected number of cases was obtained by multiplying the observed age-specific rates for the standard population by the populations in each respective age group of the study population.

In this report the study population of interest was defined by the place of birth and the standard population was either the Australian-born NSW population or the population resident in the respective place of birth.

An SIR greater than 1 indicates that the number of cases in the study population was greater than that expected if the incidence was similar to the standard population. Conversely, an SIR less than 1 indicates that the observed number of cases was less than that expected if the study population had the same age-specific incidence rates as the standard population.

Further, in this report we have calculated 99% Poisson confidence intervals [(9)] to indicate the level of precision of the SIRs (see Appendix 4 for a more detailed explanation). An SIR for a place of birth was deemed to be significantly different from the Australian-born population of NSW or from residents of that place of birth if the confidence interval did not include 1. Note that 99% confidence intervals are used throughout this report. The use of 99% confidence intervals reduces the possibility that any differences identified in this report are purely due to chance given the large number of comparisons that were made.

Structure of the report

This report has been divided into two sections illustrating the same data in two different ways:

Section 1: Analysis by place of birth
This section describes the incidence of common cancers in NSW in 1991 to 2001 by the place of birth. The first page shows the SIRs and 99% confidence intervals for selected cancers for migrants by place of birth compared to the Australian-born population of NSW for the same time period. The second page shows the SIRs and confidence intervals for migrants by place of birth compared to people of the same sex resident in that place.

Section 2: Analysis by cancer type
This section presents the incidence data by cancer type. The first page shows the SIRs and 99% confidence intervals comparing the cancer incidence in people with different places of birth to that of the Australian-born population. The second page compares their cancer incidence to people of the same sex resident in their respective places of birth.

Guide to interpretation of results

As with all ecological studies of disease patterns there are a number of limitations to the interpretation of the data presented here. Readers should be aware of these limitations before drawing their own conclusions [10].

As no data were available on the CCR for the length of time people resided in Australia before they were diagnosed with cancer, it is therefore not possible to quantify the respective risks of cancer attributable to risk factors associated with their place of birth and those associated with migration to Australia.

No information was available on the CCR on whether people emigrated directly to NSW from their place of birth so any exposure to risk factors during any transitional or temporary residence cannot be determined.

There are also limitations to using place of birth as a proxy for ethnic group. Immigrants to NSW may not be representative of the dominant ethnic group in their place of birth. Refugees, for example, may be predominantly from an ethnic minority in their place of birth. Immigrants to Australia may also be from a specific socio-economic group or be generally healthier than those who do not migrate.

Place of birth reporting is not complete for all cancers in the CCR. Table I4 indicates the completeness of place of birth by cancer site. The CCR uses place of birth information on death certificates as part of their efforts in determining place of birth, as a result cancer types with a poor survival have slightly higher rates of known countries of birth compared to those cancer types with better prognoses.

Table I4: Percentage of unknown place of birth by cancer type 1991 to 2001

Cancer type	Place of birth unknown %
Bladder	3%
Breast	8%
Cancers of the brain and CNS	2%
Cancers with an indefinite site	5%
Cervix	14%
Colon and rectum	5%
Head and neck	4%
Kidney	7%
Leukaemia	9%
Liver	2%
Lung	2%
Melanoma of the skin	40%
Non-Hodgkin lymphoma	8%
Ovary	4%
Pancreas	1%
Prostate	18%
Stomach	3%
Testis	6%
Thyroid	11%
Uterus	6%
Overall	11%

Differences in international cancer registration practices, particularly under-registration of incident cases in some places due to inadequate resources or incomplete population coverage, may lead to differences in relative cancer incidence ratios that are not necessarily related to cancer risk.

Some countries of birth may be represented as cases in the registry but not included as part of the NSW population denominator. For example people from New Caledonia are generally referred to and treated in Sydney and thus may give a NSW address of residence during treatment, but will not have been

counted in the Australian census populations upon which the resident populations are estimated. This may occur to a lesser extent for people born in Fiji.

Finally the existence of free, de-facto and/or subsidised cancer screening services in Australia for breast, prostate and cervical cancers in particular may lead to a detection bias resulting in breast or prostate cancer rates being higher than in places without screening programs. However, detection and treatment of pre-cancerous cervical lesions prevents cervical cancer so rates may be lower than in places without a screening program.

Discussion

The report is descriptive, showing the relationship between the incidence of 20 major cancer types in migrants in NSW from 25 places of birth. The report illustrates the wide heterogeneity in the origin of people in NSW, and by inference, their lifestyle characteristics, as well as how all these diverse lifestyles in some way contribute to the cancer patterns shown in this report. Aside from this short commentary, we hope the tabulations and graphs will generate discussion to develop hypotheses about possible causality and progress for cancer prevention as well as the delivery of cancer services.

The results are in broad agreement with the previous report by McCredie et al[1]. A new addition to this report was the comparison of rates from places of birth using cancer incidence estimates from the GLOBOCAN databases. However an important limitation is that for some of the countries, where no reliable cancer incidence data exist, rates are derived from adjoining regions or from locally available mortality data. They are therefore less reliable than population based cancer registration such as we have in NSW.

It is clear that the current cancer incidence of NSW was governed by past immigration trends and policies, and these trends are likely to have a profound effect on future cancer incidence. For example, from 1991 to 2001 the estimated resident population born in United Kingdom and Ireland, the leading migrant group in NSW, declined by 7% (from 344,410 to 322,364 persons), but for migrants born in China the proportion increased by about 225% (from 48,337 to 108,807), and 227% for migrants born in India (from 22,121 to 50,202). Increases in numbers have also been observed for people born in Vietnam, South Africa, Indonesia, New Zealand and Sri Lanka (Appendix 1). Given that 72,883/297,457 (24.5%) cancers in 1991 to 2001 occurred in migrants, it is likely that the profile of cancer patients will continue to change such that in the near future it may diverge quite significantly from the ‘typical western’ profile.

The attribution of characteristics of a group to an individual or sub-group of individuals based on group measures, often leads to incorrect conclusions being formulated. This widely accepted source of error in interpretation is known as ecological confounding, or the ecological fallacy. For example, migrants to a country such as Australia may not be representative of people from their place of birth. This may occur due to several factors such as an influx of ethnic minorities fleeing unrest, or Australian migration policies favouring people with particular skills, or people of higher or lower socio-economic status, or lastly, that only people of good health have the ability to migrate long distances. This final reason is often called the ‘healthy migrant effect’ and may play a part in explaining perceived anomalies in cancer incidence found in this report.

Liver, stomach, head and neck, cervical, and thyroid cancers are some of the cancer types that show significant heterogeneity in incidence by place of birth and are likely to continue to increase in these groups, unless targeted interventions are initiated. These are leading cancer types in several South East Asian migrants and some Southern European migrants as well.

Lung cancer deserves special mention because of the large heterogeneity observed for this common cancer type by place of birth. Chinese-born males, for example, have approximately a 20% lower incidence of lung cancer, whilst those born in the United Kingdom and Ireland have a 19% increased incidence compared to those born in Australia. Although some of the differences in rates may be due to ecological confounding there also appears to be a doubling of lung cancer incidence in males from India, the Philippines and Egypt, when compared to rates observed in their respective places of birth. With such wide heterogeneity in lung cancer incidence, the calculation of tobacco-attributed cancer risks based on estimates from largely ‘Caucasian’ populations may well turn out to be misleading.

Cervical cancer also deserves special mention not only because it is preventable by screening, but because there appears to be a higher incidence among migrants from a number of South East Asian and Pacific Island communities. By contrast, compared to the Australian-born males, we found a low incidence of testicular cancer among migrants from South East Asia and the Philippines (SIR < 0.2) but higher incidences in migrants from the United Kingdom and Ireland, New Zealand and Germany (SIR > 1.2). This may point to opportunities for examining the causality of this disease.

Melanoma of the skin in all migrant groups, except for those from South Africa and New Zealand, had lower rates compared to people born in Australia. South African migrants are perhaps an obvious example of ecological confounding. Most migrants from South Africa are of 'European' origin, however they comprise only 20% of the total South African population. Likewise there may be other migrant groups that differ substantially in health status, lifestyle and socioeconomic condition from the population of their places of birth.

The Central Cancer Registry does not collect the date of arrival to Australia, but clearly, such a variable would be key to our understanding of the causal significance of genetic versus environmental factors and the effect of migration at different time periods. It is often thought that one's place of birth 'locks' one into a particular cancer risk trajectory, date of arrival information would allow us to discern the degree to which recent exposure might be modifiable as determined by length of stay in Australia.

However some indication of a shift in risk profile is gleaned from the changes observed compared to rates reported in their place of birth. Bearing in mind the possibility of ecological confounding, and diagnostic bias, the magnitude of the difference in SIRs between migrants and those living in their place of birth is quite remarkable, and would not support the hypothesis of lifestyle patterns being 'locked' at an early age. The high SIR for breast, colorectal, lung, thyroid, pancreatic and prostate cancers, and melanoma of the skin and non-Hodgkin lymphoma in migrants compared with rates in their place of birth is noteworthy. By contrast, very little heterogeneity was observed for ovarian cancer, in keeping with international observations of small variations in this cancer type. Clearly studies among migrants would produce a rich source of information regarding lifestyle and cancer.