Are immigrants at risk of heart disease in Australia? A systematic review

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Abstract

We systematically reviewed the peer-reviewed literature to establish the prevalence of cardiovascular disease (CVD) among immigrants in Australia and whether being an immigrant is a CVD risk factor. Of 23 studies identified, 12 were included. Higher prevalence of CVD was found among Middle Eastern, South Asian and some European immigrants. Higher prevalence of CVD risk factors was found among Middle Eastern and Southern European immigrants. Higher alcohol consumption was found among immigrants from New Zealand, the United Kingdom and Ireland. Smoking and physical inactivity were highly prevalent among most immigrants.

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What is known about the topic?

Although there is a large and ethnically diverse population living in Australia, specific information on the overall prevalence, morbidity, mortality and risk factors for cardiovascular disease (CVD) in the relevant migrant subgroups is limited.

What does this paper add?

This study identified immigrant groups in Australia with a high CVD and CVD risk factor prevalence. These groups also exhibited potentially modifiable behaviours that might further increase CVD risk.

What are the implications for practitioners?

Targeted interventions may reduce CVD among these immigrant groups.

THE OVERALL PREVALENCE, morbidity, mortality and risk factors of cardiovascular disease (CVD)[1] vary among ethnic groups due to a range of factors.[2,3] These factors include subgroup of origin, birthplace, age, socioeconomic status, education, culture, and genetic composition.[4] In addition, fluency in English and job and life satisfaction in Australia have also been associated with CVD risk.[5] Previous international literature on the relationship between patterns of CVD and immigrant subgroup has explored the prevalence of CVD morbidity, mortality and risk factors among migrants from a range of countries and regions/continents such as Japan,[6] China,[7] Africa,[8] South Asia[9,10] and Mexico, compared with the host population. Although there is a large and ethnically diverse population living in Australia, specific information on the overall prevalence, morbidity, mortality and risk factors of CVD in the relevant migrant subgroups is limited.

Australia is one of the most multicultural societies in the world with more than 200 ethnic groups living in the country. Its overseas-born residents comprise 4.6 million people — 23% of the estimated total population of 19.6 million. Moreover, 27% of the population have one or both parents born overseas.[10] Therefore, one out of four Australians was born overseas and more than half of these people came from non-English-speaking countries.[10]

Recent Canadian, Swedish, Israeli, and American studies have examined the prevalence of CVD

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among immigrants as compared with the respective host populations. These studies found that the standardised mortality rates (SMR) were higher among Canadians, and South Asians[7] and that, in Sweden, the incidence rates for coronary heart disease (CHD) and CVD were highest among immigrants from Finland, Iran and Poland.[11] In addition, the rates of ischaemic heart disease in Israel were found to be higher for Russian immigrants.[12] In contrast, immigrants in the United States from South Asia[13] had a similar risk of hospitalisation for CHD compared with the host population.

The risk factors for CVD and CHD vary from ethnic group to ethnic group.[14] For example, immigrants originating from South Asia are at higher risk of CHD even at "normal" total cholesterol (TC) concentrations, due to lower concentrations of high-density lipoprotein cholesterol (HDL-C). In contrast, high levels of triglycerides (TG) and high blood pressure appear to be the major risk factors associated with CVD among people of Chinese origin.[15]

Although CVD is a leading cause of morbidity and mortality in Australia,[16] and despite the international data indicating an increased incidence of CVD in migrant groups, it is unclear whether morbidity, mortality and risk factors of CVD are different in the various Australian migrant groups when compared with the host population of native-born Australians. Therefore, in order to obtain an in-depth understanding of this issue, we performed a systematic review of the published peer-reviewed literature to establish the prevalence of CVD morbidity and mortality among immigrants living in Australia to determine whether being an immigrant to Australia is a risk factor for CVD.

Methods

Literature search

A search of the published literature between 1986 and 2006 was performed using PubMed, MEDLINE, EMBASE, ProQuest, CINAHL and Australian government reports produced by the responsible authorities. The following search terms were used: migration, immigration, emigration, immigrant and emigrant, alone and in combination with CVD and stroke. The articles selected for analysis included those that presented primary data on the morbidity, mortality, ethnicity and risk factors for CVD and stroke in any immigrant populations living in Australia. From the reference lists of these studies other similar literature was located.

Inclusion criteria were used for English language peer-reviewed journal articles, opinion pieces and reviews, and reports by the Australian Institute of Health and Welfare (AIHW) and the Australian Bureau of Statistics (ABS), including:

- first generation migrants and their siblings, and
- those with an Australian-born control group.

Studies focusing upon refugees or asylum seekers, and farming or agricultural workers were excluded.

Study selection and data extraction

Studies were selected according to the guidelines of the National Health and Medical Research Council of Australia (NHMRC)[17] for classifying scientific studies. The guidelines recommend including reviews and meta-analyses, randomised controlled trials, non-randomised trials, case studies, factual reports and interpretations in systematic reviews. The following methodological features were evaluated: study population, extent of randomisation used, sample size by ethnic group, age distribution of the study group, response rate, methods used to identify patients, methods used to measure CVD risk factors, and methods used to measure mortality.

Results

The search of the databases yielded 23 apparently eligible papers. From those papers, six were selected based on title or abstract. From the reference lists of these studies an additional six reports were located that met the inclusion criteria. Twelve studies were excluded that did not meet the inclusion criteria. Altogether 12 studies were reviewed. From these 12, four of the studies explored individual immigrant

groups (only one country) and eight studies reported data on multiple immigrant groups (more than one country) in Australia.

Out of the 12 selected studies, four were cross-sectional surveys with data reporting on the prevalence of CVD risk factors; seven retrospective studies presented standardised morbidity and mortality for CVD; and one study used a prospective cohort design on biomedical risk factors. All of the selected studies used an Australian-born population as a reference group. The majority of studies focused on the prevalence of morbidity, mortality and risk factors for CVD among the immigrant population. Five studies were designed to estimate the incidence of morbidity in a hospital setting; two studies examined the prevalence of mortality; and five studies examined the prevalence of CVD risk factors for all the immigrant groups living in Australia.

Seven studies had original published data on the prevalence of morbidity, mortality and risk factors for CVD among specific immigrant populations in Australia, and the rest consisted of Australian government reports.

General methodological characteristics

In the papers that were selected for analysis, a range of methods was used to sample the populations (Box 1). These methods included selecting participants from databases such as the electoral roll[18] and telephone directory[19] on the basis of the likely ethnic origin of their surname; recruiting participants from particular ethnic backgrounds via a public campaign;[20] and using databases in which individuals were identified using their known country of birth.[1,5,21,22] Random selection techniques were used in four[1,18,19,22] studies, and non-random selection techniques were used in a further eight studies. The age range varied from study to study but individuals aged from 14 to 75 years were included in the analyses.[1,18-27]

The reported response rates ranged from 72.6% to 81%,[18,19,22,23] although seven studies did not indicate their response rates. However, this was probably due to the fact that their data were extracted from existing databases.

CVD morbidity data were derived from hospital medical records,[24,25,27] and self-report.[1,28] Mortality data were gathered from Australian population census data indicating death by birthplace[1,21] and from Australian death registries.[25] Biomedical risk factors such as blood pressure, blood lipid profile and body weight/obesity were measured using either direct measurement of the variable,[20,23] or by self-report.[1,18,19,25] Behavioural risk factors such as smoking,[1,18,19,23,25] alcohol consumption, and physical activity and exercise were measured using self-report methods.[1,18,23,25]

Morbidity and mortality

The prevalence of circulatory system disease (ischaemic heart disease, cerebrovascular and hypertensive disease) reported in the selected studies is outlined in Box 2. Five studies examined hospital morbidity (discharge) data for the migrant groups identified from the general population. The first of the three studies examined data collected from 1985–1996 and reported that females from the Middle East and South Asian regions had significantly higher rates of hospitalisation for ischaemic heart disease than the reference Australian-born population. These data were generally supported by data for age-adjusted separation rates for ischaemic heart disease from New South Wales hospitals. In particular, these data revealed that men who migrated to Australia from Egypt, Other Asia, Other Europe and the Middle East had significantly higher age-adjusted separation rates for ischaemic heart disease than the reference population. In contrast, the third of these studies, conducted from 1989–1990, consistently found that male and female migrants from all regional subgroups had significantly lower rate ratios of circulatory system disease than the Australian-born population. Interestingly, the lower levels of circulatory system disease reported in the study by Young were supported by self-reported data collected from 1999–2000, which showed significantly lower standardised rates of coronary heart disease for both men and women from all immigrant regional subgroups compared with the Australian-born population.[21] Unfortunately, the

1 Characteristic of 12 studies on cardiovascular disease (CVD) risk factors among immigrants and the Australian-born population

Study	Study population	Sampling method	Age range (years)	Sample size by ethnic group & response rate (RR, %)	Available data	Method of data collection
Bennet (1993)[22]	England & Wales; Scotland, Ireland; Greece, Italy, Other Southern Europe; Western Europe; Eastern Europe; Middle East, Southeast Asia; Other Asia, New Zealand, Other countries; Australian-born	Random sampling*	14–29	Immigrants 6116; Australian-born 14941; RR, 75%	Systolic & diastolic BP, TC, TG, LDL-C, HDL-C/ TC ratio, BMI, smoking , alcohol consumption, exercise during leisure	Actively measured
Wilson et al (1993)[18]	Greek	Random sampling	18–65	Greek 834; RR, 81%	Cholesterol, BP, weight, height, health status, diet, smoking, physical activity & exercise	Participant interview
Hsu-Hage & Wahlqvist (1993)[23]	Chinese	NR	25+	Chinese 547; RR, 72.6%	Systolic & diastolic BP, cholesterol, overweight & obesity, smoking, multiple	Self-administer & participant interview
Rissel & Russel (1993)[19]	Vietnamese	Random sampling	18+	Vietnamese 389; RR, 79.2%	Diastolic BP, TC, smoking status, BMI	Telephone interview; actively measured
Ireland & Giles (1996)[20]	Australian; Italian	Non-sampling	40–69	Australian-born 673; Italian 335; NR	BP, BMI	Actively measure, medical records
Young (1987)[21]	All immigrants	Non-sampling	15–75		Mortality	Death records
Kliewer & Butler (1995)[24]	All immigrants	Non-sampling†	0–75+	Immigrants 88929; Australian-born 241984; NR	Hospital separations (all CVD)	Medical records
Singh and de Looper (2002)[25]	UK & Ireland; Other European; Asia, Others	Non-sampling	15+	NR	Hospital morbidity‡; mortality§	Medical records; in-person interview
Young & Coles (1992)[1]	All immigrants	Random sampling	15–75	Immigrants 6268; Australian-born 6308; NR	Morbidity¶; health risk factor	Self-administer
Young (1992)[28]	All immigrants	Non-sampling	15–69	NR	Mortality	Medical records
d'Espaignet & Stevenson (1992)[26]	All immigrants	Non-sampling	15–69	Not clear; NR	Hospital separations/ admission	Medical records
Taylor et al (1999)[27]	Australian; New Zealand; UK & Ireland; Southern European; North Western Europe; Eastern Europe; Middle East; Asian	Non-sampling	35–74	Male, Female: Australian 1597, 7799; New Zealand 217, 68; UK & Ireland 2003, 761; Southern European 1912, 465; North Western Europe 663, 195; Eastern Europe 609, 271; Middle East 774, 208; Asian 638, 234; NR	Hospital admission of/ AMI	Medical records

BP = blood pressure. TC = total cholesterol. TG = triglycerides. LDL-C = low-density lipoprotein cholesterol. HDL-C = high-density lipoprotein cholesterol. BMI = body mass index. NR = not reported. AMI = acute myocardial infarction. * Data derived from National Heart Foundation Risk Factors Prevalence study, 1980, 1983 and 1989. † Hospital separations. ‡ AIHW, National Hospital Morbidity database. § AIHW, National Mortality database. ¶ National Health Survey 1989–1900, ABS.

2 Data from seven studies of cardiovascular disease (CVD) morbidity and mortality among immigrants and Australian-born population

Study	Study type & period	Immigrants and reference group	Rates and percentages
Kliewer & Butler (1995)[24]	CVD hospital discharge (age-standardised hospital discharge rate ratios) (1985–1987)	*Ischaemic disease:*	
		Middle East (m,f);* Southern Asia (m,f);* Australian-born	Not reported
d'Espaignet & Stevenson (1992)[26]	CVD hospital separations/admission NSW (age-adjusted hospital separations) (1986)	*Ischaemic heart disease:*	
		Australia (m,f)	103; 107
		Egypt (m)	149
		Other Asia (m)	123
		Other Europe (m)	106
		Middle East (m)	118
Taylor et al (1999)[27]	Age-adjusted hospital admission of acute myocardial infarction (relative risk with 95% CI) (1991–92 to 1995–96)	Eastern Europe (m,f)	0.85 (0.73,1.00), 1.03 (0.86,1.22)†
		Middle East (m,f)	1.42 (1.23,1.64),† 1.38 (1.14,1.68)†
		Australia (reference)	1.00, 1.00
Young & Coles (1992)[1]	Self-reported National Health Survey (age-standardised incidence ratios) (1989–90)	*Disease of circulatory system (m,f):*	
		Australia	105, 102
		UK & Ireland; Overseas minus UK & Ireland; Italy; Greece; Total overseas; Australian-born	All immigrants were significantly lower
Singh and de Looper (2002)[25]	CVD hospital admission (aged standardised hospital admission ratio) (1999–2000)	*Coronary heart disease (m,f):*	
		Australia	1.00
		Other Europe; Asia; Other	All immigrants were significantly lower
		Stroke (m,f):	
		UK & Ireland; Other Europe; Asia; Other	All immigrants were significantly lower
Young (1987)[21]	Heart disease mortality (standardised mortality ratios) (1980–1982)	Australia (m,f)	1.00
		Ireland (all parts) (m);† Scotland (m);† Poland (m,f);† South Asia (m,f);† North America (f); Other Oceania excluding New Zealand (m,f);† Middle East (f);† Malta	All immigrants were higher
Singh and de Looper (2002) [25]	CVD standardised mortality ratios (1997–1999)	*Coronary heart disease (m,f):*	
		Australia	1.00
		UK & Ireland; Other Europe; Asia; Other	All immigrants were significantly lower
		Stroke (m,f):	
		UK & Ireland; Other Europe; Asia; Other	All immigrants were significantly lower

m,f = male, female. * Significantly differs from 1.00 (Australian-born). † Significantly higher.

different classification systems used to group the immigrant subgroups makes it difficult to identify the reasons for the substantially different results reported in these studies.

Two studies reported the standardised mortality rates (SMRs) for heart disease for Australian migrants. The first of these studies was conducted over the period 1980–1982, and it reports that

males who migrated to Australia from Other Oceania, South Asia, Poland, Scotland, and Ireland displayed significantly higher SMRs for heart disease compared with Australian-born individuals, ranging from 106 to 131 per 1000.[21] The same study reported that females who migrated from Poland, Malta, the Middle East, Other Oceania, North America and South Asia had significantly higher SMRs for heart disease compared with the Australian-born population, with rates ranging from 107 to 128 per 1000. In contrast to these findings, an investigation conducted over the period of 1997–1999 by the Australian Institute of Health and Welfare[25] reported that the SMR for coronary heart disease and stroke was significantly lower for all the regional immigrant subgroups compared with the Australian-born population. This difference may be due to the fact that the two studies used different aggregation systems of regional immigrant groups. As a result, the true effect may be hidden or masked.

Prevalence of cardiovascular risk factors

Hypertension and blood pressure

Five studies presented data on the prevalence of hypertension among immigrants in Australia (Box 3). One of these studies provided data on all immigrant subgroups and indicated that systolic blood pressure was significantly higher among men who emigrated to Australia from Eastern Europe compared with Australian-born males.[22] In addition, three individual studies examined the effect of blood pressure independently. One study[18] reported that the prevalence of high blood pressure in Greek-Australians (5.2% for men and 8.1% for women) was significantly lower compared with their Australian-born counterparts.[29] The overall prevalence of high blood pressure was lower among Chinese immigrants in Australia (8.6% for men and 11.2% for women) compared with the Australian-born population.[23] The prevalence of elevated diastolic blood pressure for Vietnamese migrants to Australia was 8% for men and 3% for women, but these data were not directly compared with an Australian-born population.[19] In another follow-up study,[20] Italian-born men and women in some age groups were reported to have significantly higher blood pressure compared with the Australian-born population.

Plasma lipids

Three studies examined lipid levels in Australian migrants[18,19,22] (Box 3). Objectively measured TC levels were reported to be significantly higher (+ 0.17 mmol/L) among Western European men compared with the Australian-born population.[22] The HDL-C level of all migrants from Greece and the Middle East, and women migrants from Italy, Southern Europe and other Asian countries were significantly lower,[22] while the LDL-C (low-density lipoprotein cholesterol) levels were higher only in men from Western Europe.[22] The ratios of HDL-C/TC were significantly higher among men from New Zealand.[22] Plasma cholesterol and TG were found to be similar in Chinese immigrants (men 7.7 mmol/L and women 5.2 mmol/L) compared with their Australian-born counterparts. The other two studies[18,19] did not present any data on detailed estimates of cholesterol.

Smoking

The prevalence of smoking was reported in five studies[1,18,19,22,23] (Box 4) and was found to differ across ethnic groups and genders. Three different studies found that smoking was higher among all migrants from Scotland and Ireland[22] and women from the UK and Ireland[1] compared with the Australian-born population. Two studies found that smoking was higher among male migrants from Greece,[18,2] while another found that it was higher only among Greek men.[1] Some studies also found that smoking was higher among men from the Middle East,[1] Italy,[1,22] Western Europe,[22] China,[19,22] Vietnam,[19] and Poland,[1] and also among women from New Zealand compared with the Australian-born population (rates: men, 120 to 158, women, 140).

Alcohol consumption

The prevalence of alcohol consumption was observed in three studies.[1,22] Alcohol consumption ranging from 1 to 27 standard drinks per

3 Data on five studies of prevalence of biomedical risk factors among immigrants and Australian-born population

Study, data collection type, immigrant group	Systolic BP	Diastolic BP	TC	HDL-C	LDL-C	HDL-C/TC (%)	High cholesterol
*Bennet et al (1993),[22] actively screened**							
Greece				1.15 mmol/L†, m			
Italy				1.43 mmol/L†, f			
Other Southern Europe				1.43 mmol/L†, f			
Western Europe			5.91 mmol/L‡, m		4.40 mmol/L†, m		
Eastern Europe	140.7 mmHg‡, m						
Middle East				1.09 mmol/L†, m, 1.33 mmol/L†, f			
Other Asia				1.43 mmol/L‡, f			
New Zealand						23.9 mmol/L‡, m*	
Australia	131.7 mmHg, m; 124.6 mmHg, f		5.66 mmol/L, m; 5.58 mmol/L, f	1.23 mmol/L, m; 1.52 mmol/L, f	4.13 mmol/L, m; 3.85 mmol/L, f	22.5 mmol/L, m; 28.2 mmol/L, f	
Wilson et al (1993),[18] self-reported high§							
Greek	5.2% (2.2–8.2; m); 8.1% (5.1–11.1; f)						13.7% (9.1–18.3; m); 14.6% (10.8–18.4; f)
Australian	15.9% (14.8–17.0; m); 20.0% (18.8–21.2; f)						15.3%(14.3–16.3; m); 11.9% (11.0–12.8; f)
Hsu-Hage & Wahlqvist (1993),[23] self-reported high§							
Chinese	8.6%, m; 11.2%, f						7.7 mmol/L‡, m; 5.2 mmol/L, f
Australian	19.8%, m; 15.6%, f						6.8 mmol/L, m; 4.4 mmol/L, f
Rissel & Russel 1993,[19] self-reported high§							
Vietnamese		8% (4 –11; m) 3% (1–5; f)	29% (23–43; m); 15% (11–20; f)				
Ireland (1996),[20] physician repor§							
Italian, 1990–1994							
40–49 years, m		3.4% (0.0–10.0)¶					
50–59 years, m		33.3% (19.5–47.1)					
60–69 years, m		26.9% (16.3-37.5)					
40–49 years, f		8.3% (0.0–17.3)					
50–59 years, f		29.0% (18.8–39.2)					
60–69 years, f		36.2% (28.5–43.9)					
Australian, 1990–1994							
40–49 years, m		8.9% (4.3–13.5)					
50–59 years, m		25.4% (14.3–36.5)					
60–69 years, m		36% (25.9–46.1)					
40–49 years, f		8.2% (4.2–12.2)					
50–59 years, f		20.0% (10.6–29.4)					
60–69 years, f		40.0% (33.5–46.5)					

* Reported values are unadjusted mean. † $P < 0.01$. ‡ $P < 0.05$. § Reported values are percentage of patients (95% confidence intervals). ¶ Mean % blood pressure told by doctor. BP = blood pressure. HDL-C = High-density lipoprotein cholesterol. LDL-C = Low-density lipoprotein cholesterol. TC = total cholesterol.

4 Self-reported data in five studies of prevalence of behavioural risk factors among immigrants and Australian-born population

Study and immigrant group	Data collection type			
	Smoking	Physical inactivity	BMI or overweight or obesity	Alcohol intake
Bennet et al (1993),[22] self-reported				
England & Wales				1.58 (1.32–1.90; m)†; 1.34 (1.13–1.59; f)
Scotland & Ireland	1.65 (1.28–2.22; m)†	1.51 (1.12–2.04; m)†		
Greece	1.65 (1.23–2.22; m)†	3.53 (2.39–4.68; m)†	27.1, m†; 26.9, f† (a)	
Italy	1.60 (1.27–2.02; m)†	3.92 (2.95–5.20; m)†	26.8, m†; 26.6, f†	1.60 (1.19–2.16; m)†
Other Southern Europe	1.80 (1.35–2.40; m)†	3.67 (2.62–5.13; m)†	26.3, m†; 26.6, f†	
Western Europe	1.39 (1.06–1.83; f)*			1.96 (1.38–2.76; m)†
Eastern Europe		1.56 (1.10–2.22; f)*		1.63 (1.18–2.25; m)†
Middle East		1.55 (1.13–2.14; m)†	26.2, m†; 26.2, f†	
South East Asia		2.76 (1.78–4.01; m)†		
Other Asia		2.77 (1.92–3.99; m)†		
Australia	1.00	1.00	25.4, m; 24.1, f	1.00
Wilson (1993),[18] self-reported				
Greek	44% (37.4–50.8; m); 18.6% (14.4–22.8; f)	49.5%, m; 48.5%, f. Data not compared with Australian-born population	58.0% (51.4–64.6; m);(b) 40.3% (35.0–45.6; f)	
Australian	25.4% (24.1–26.7; m); 21.2% (20.0–22.4; f)		47.8% (46.3–49.3; m); 32.0 % (30.7–33.3; f)	
Hsu-Hage & Wahlqvist (1993),[23] self-reported				
Chinese	26.9%, m; 3.4%, f	No data	18.5%, m; 16.1%, f(b)	
Australian	24.1%, m; 20.3%, f	No data	50%, m; 14.8%, f	
Rissel & Russel (1993),[19] self-reported				
Vietnamese men	53% (48–57; m); 2% (0.6–3.4; f)	Available data not clear	15% (11–20; m);(c) 13% (9–17; f)	Available data not clear
Singh and de Looper (2002),[25] self-reported				
Other European		1.38*, m; 1.37*, f		
Young & Coles (1992)[1] self-reported				
UK & Ireland	122*, f(d)			118*, f
Italy			128*, m; 130*, f(d)	
Greece	138*, m		128*, m; 140*, f	
Malta			140*, f	
Yugoslavia			120*, m; 152*, f	
Other Southern European			160*, f	
Poland	158*, m			
Middle East & North Africa	130*, m		122*, m; 146*, f	
New Zealand	140*, f			143*, m; 123*, f
Australian	98, m; 103, f		101, m; 99, f	111*, m; 104*, f

(a) Body mass index (BMI). (b) Prevalence overweight and obesity. (c) BMI prevalence. (d) Age standardised rates. Significantly differs from Australian-born population: *$P < 0.05$, †$P < 0.01$.

week for men and 1 to 13 standard drinks per week for women was reported as a potential beneficial risk factor. Alcohol consumption over 28 standard drinks per week for men and 14 standard drinks per week for women was a negative risk factor. Alcohol consumption was found to be higher among men and women from England and Wales,[22] and New Zealand.[1] Another study found that only women from the UK and Ireland and men and women from New Zealand[1] were likely to have a higher level of alcohol consumption compared with their Australian counterparts. In addition, men from Italy, Western Europe, and Eastern Europe were found to have a higher level of alcohol consumption compared with the Australian-born population[22] (OR ranging from 1.58 to 1.96 for men).

BMI or overweight or obesity

The issue of overweight and obesity was explored in five studies[1,18,19,22,23] (Box 4). A body mass index of 20–25 kg/m^2 is considered as ideal body weight and values over 25 are considered to be overweight or obese. Being overweight or obese was more common among all migrants from Middle Eastern countries (Middle East and North Africa),[1,22] Southern European females, Greek male and females,[22] and Yugoslavian males and females[1] compared with the Australian–born population. Significantly higher levels of overweight and obesity were also found among Maltese men.[1] The highest incidences of overweight and obesity were found in Southern European and Middle Eastern immigrants.[22]

Physical inactivity or exercise during leisure time

The level of physical inactivity or exercise during leisure time was reported in three studies[18,22,25](Box 4). The absence of leisure time physical activity or exercise during the previous 2 weeks was considered to be a risk for CVD.[22] Physical inactivity was found to be more pronounced among male migrants from Scotland and Ireland, Southern Europe, the Middle East, South East Asia, and Other Asia, and in Eastern European females[25] compared with the Australian-born population

Discussion

This is the first systematic review conducted on the risk factors associated with CVD in migrants to Australia. This review provides evidence of actual morbidity and mortality as a result of CVD in Australian migrants. The prevalence of CVD morbidity and mortality was found to be higher among male and female immigrants to Australia from Middle Eastern, other European and South Asian countries. Similarly, risk factors for CVD were higher among male and female immigrants from Middle Eastern and Southern European countries.

These immigrant subgroups were reported to have multiple risk factors for CVD that varied according to region and gender. For example, HDL-C levels appear to be lower among Middle Eastern and Southern European women compared with Australian-born women. Conversely, obesity is more prevalent among women in these regions. The major preventable risk factor for CVD is smoking, which was found to be higher among male immigrants from the Middle East, the UK and Ireland, Western Europe, Southern Europe, China and Vietnam compared with their Australian male counterparts. Physical inactivity was higher among both male and female immigrants from all regional groups (except for the Chinese subgroup) compared with the Australian-born population. A higher prevalence of alcohol consumption was reported consistently among men and women from the UK and Ireland, and New Zealand.

Study quality

In order to estimate the quality of studies, it is necessary to examine the sample size, response rate and the method of data collection. In particular, the aggregation of statewide administrative data (morbidity) can be problematic because data collection and recording techniques may not have been consistent, and data entry personnel and methods of disease classification may have

changed over time.[30] The response rate of the majority of studies that estimated the prevalence of risk factors associated with CVD was more than 70%, which is a satisfactory response rate. Some studies used objective[20,22] methods to measure biomedical risk factors for CVD while others used subjective methods.[1,18,19,25] We recognise that there are limits to conducting objective measures of biomedical CVD risk factors because of high laboratory charges. In addition, obtaining ethics approval can be another limiting factor. However, it is necessary to note that it is preferable that biomedical risk factors for CVD be assessed objectively, rather than using self-reported measures, in order for valid conclusions to be drawn.

Prevalence of CVD hospital morbidity and mortality

The available studies on hospital morbidity for CVD showed that CVD was higher among all immigrants from Middle Eastern, other European and South Asian regions compared with the Australian-born population. Conversely, similar immigrant groups reported completely conflicting occurrences of CVD morbidity compared with the Australian-born population.[1,25] This combination of high and lower findings of morbidity may indicate that the diagnosis code for CVD varied between the International classification of diseases ninth and tenth revisions in different studies. In addition, immigrants were grouped into large regional groups according to different criteria. This inconsistancy may have affected the findings.

The mortality rates for CVD were higher among male and female immigrants from the Middle East, Poland, Scotland, and South Asia[21] compared with the Australian-born population. While similar immigrant groups in different studies showed conflicting results, this may be due to different classification methods used to group immigrants regionally.[25] Therefore, it may not be possible to perform a direct comparison of studies.

Prevalence of CVD risk factors

The prevalence of biomedical risk factors for CVD is higher among Middle Eastern, and other Southern European immigrants compared with the host population.[1,22] This may be explained by environmental risk factors such as dietary habits, smoking, and physical inactivity; medical factors such as high lipid levels, high blood pressure and obesity; and genetic predisposition.[31,32]

The incidence of high blood pressure was lower among all the immigrant groups compared with the Australian-born population, except for male immigrants from Eastern Europe and Italy (Southern Europe). This suggests that higher smoking rates[31] and higher sodium intake may combine to elevate blood pressure in these particular immigrants.[32] Lower HDL-C levels were more common among Middle Eastern and Southern European women, and this may be explained by lower levels of physical activity and a diet high in saturated fats. The evidence suggests that those who were physically active had higher HDL levels.[33] Also, the HDL/TC ratio was lower among all immigrants from the Middle East, as well as in Southern European women immigrants. This may be explained by the influence of the acculturation process on these immigrants' lifestyles. In particular, diet may increase their risk of lower HDL/TC ratios,[34] and it has been found that Southern Europeans who migrate to Western societies are at a higher risk of developing lower HDL/TC ratios compared with those who live in Southern Europe.[35]

The prevalence of tobacco smoking was higher in the majority of male immigrants compared with their Australian-born counterparts. Similar associations between high levels of smoking and immigrants were found in other Western countries.[4,35] Increased tobacco smoking might be due to social isolation and boredom. Regarding physical activity, the majority of immigrants reported a higher level of physical inactivity compared with the Australian-born population. Overweight and obesity were found to be more frequent among Middle Eastern and Southern Europeans than the Australian-born population. Increased overweight and obesity and inactivity in immigrants might be explained by the fact that the immigrants who migrated from an agricultural environment to a Western industrial society may

have reduced their level of physical activity, which was predominantly undertaken through domestic chores and traditional culture-related community recreation activities, and may now lead a sedentary lifestyle and have undergone changes in dietary patterns.[36] High alcohol consumption compared with the Australian-born population was found in immigrants from both the UK and Ireland, and New Zealand, which might be explained by cultural influences.[37] Although the hospital morbidity and mortality rates for CVD were higher among South Asian immigrants, the picture on higher morbidity and mortality differences remains unclear. This may indicate that the traditional Framingham risk factors for CVD may not relate to South Asian immigrants.[38]

Limitations

All published studies were conducted 10 or more years ago using different immigrant subgroup classifications. Therefore, these findings may not accurately reflect the contemporary prevalence of CVD among immigrants in Australia. In addition, the majority of immigrants came to Australia under the post-war migration programme. At this time, the immigrants who arrived in Australia were young to middle-aged, and therefore they are currently approaching old age. If the risk factors for CVD are also associated with ageing,[39,40] the present prevalence might be increased. In addition, the demographic trend in Australia has also changed during last two decades,[41] and the estimated Asian population itself is predicted to increase by 16% by 2025.[42] These factors may therefore also challenge the previous findings.

Conclusion

Therefore, we conclude that the available data on the prevalence of hospital morbidity and mortality due to CVD are insufficient to draw distinct conclusions, and that more studies need to be conducted using well established and properly designed data. Moreover, future studies need to be conducted using objective screening techniques such as blood tests and electrocardiograms to obtain clinical estimations. In addition, immigrant groups need to be grouped according to Australian standard country classifications, or based on any other internationally accepted classification system, to enable direct comparisons nationally and internationally.

Furthermore, future theory-based and culturally sensitive targeted intervention programs need to be carried out to decrease modifiable risk factors for cardiovascular disease, such as being overweight or obese, physical inactivity and smoking, among the majority of regional immigrant groups who are living in Australia.

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Competing interests

The authors declare that they have no competing interests.

References

1 Young CM, Coles A. Immigrants in Australia: a health profile. Women's health, use of medical services, medication, lifestyle and chronic illness. Some findings from the 1989–90 National Health Survey. Australian Institute of Health and Welfare Ethnic Health Series. AIHW, 1992.

2 Kahattar R, Swales JD, Senior, R, Lahiri A. Racial variation in cardiovascular morbidity and mortality in essential hypertension. *Heart* 2000; 83: 267-71.

3 Balarajan R. Ethnicity and variation in mortality from heart disease. *Health Trends* 1996; 28: 45-51.

4 Rissam HS, Kishore S, Trehan N. Coronary artery disease in young Indians — the missing link. *J Indian Acad Clin Med* 2001; 2 (3): 128-31.

5 Kliewer EJ. Immigrant health and the use of medical services: results from the longitudinal survey of immigrants to Australia. In: Affaires. Department of Immigration and Multicultural Affairs, ed. Canberra: DIMA, 1997.

6 Marmot MG, Syme SL. Acculturation and coronary heart disease in Japanese-Americans. *Am J Epidemiol* 1976; 104: 225-47.

7 Sheth T, Nair C, Nargundkar M, et al. Cardiovascular and cancer mortality among Canadians of European, South Asian and Chinese origin from 1979 to 1993: an analysis of 1.2 million deaths. *CMAJ* 1999; 161: 132-8.

8 Cappuccio FP. Epidemiological transition, migration, and cardiovascular disease. *Int J Epidemiol* 2004; 33: 387.

9 Hyman I. Setting the stage: reviewing current knowledge on the health of Canada immigrants: what is the evidence and where are the gaps? *Can J Public Health* 2004; 95: 14-18.

10 Australian Bureau of Statistics. Migration, Australia, 1999-2000. Canberra: ABS, 2001. (ABS Cat. No. 3412.0.)

11 Gadd M, Johansson J, Wandell P. The trend of cardiovascular disease in Sweden. *Eur J Epidemiol* 2005; 20: 755-60.

12 Gad R, Nurit L, Ada T, Yitzhak P. Chronic disease prevalence in immigrants to Israel from the former USSR. *J Immigr Health* 2002; 4: 29-33.

13 Muennig P, Jia H, Khan K. Hospitalization for heart disease, stroke, and diabetes mellitus among Indian-born persons: a small area analysis. *BMC Cardiovasc Disord* 2004; 4: 19.

14 Yusuf S, Hawken S, Ounpuu S, et al. Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTER-HEART study): case-control study. *Lancet* 2004; 364: 937-52.

15 Yusuf S, Reddy S, Ounpuu S, Ananda S. Global burden of cardiovascular disease, part 1: general considerations, the epidemiological transition, risk factors, and impact of urbanization. *Circulation* 2001; 104: 2746-53.

16 Australian Institute of Health and Welfare, National Heart Foundation of Australia. Heart, stroke and vascular diseases — Australian facts, 2004. Canberra: AIHW and HFA, 2004. (AIHW Cat. No. CVD 27.)

17 National Health and Medical Research Council. Handbook series on preparing clinical practice guidelines. Canberra: NHMRC, 1999.

18 Wilson A, Bekiaris J, Wise M, Hawe P. The Good Heart, Good Life Survey. Self-reported cardiovascular disease risk factors, health knowledge and attitudes among Greek Australians in Sydney. *Aust J Public Health* 1993; 17: 215-221.

19 Rissel C, Russel C. Heart disease risk factors in the Vietnamese Community of South Western Sydney. *Aust J Public Health* 1993; 17: 71-3.

20 Ireland PD, Giles GG. Blood pressure in the Australian- and Italian-born: a Melbourne suburb revisited after 20 years. *Aust N Z J Public Health* 1996; 20: 143-8.

21 Young C. Migration and mortality: the experience of birth groups in Australia. *Int Migr Rev* 1987; 21: 531-54.

22 Bennet S. Inequalities in risk factors and cardiovascular mortality among Australia's immigrants. *Aust J Public Health* 1993; 17: 251-61.

23 Hsu-Hage BH, Wahlqivst M. Cardiovascular risk in adult Melbourne Chinese. *Aust J Public Health* 1993; 17: 306-13.

24 Kliewer EB, Butler JRG. Hospital morbidity patterns and cost of immigrants in Australia. Canberra: The National Centre for Epidemiology and Population Health, Australian National University, 1995.

25 Singh M, de Looper M. Australian health inequalities: birthplace. Canberra: Australian Institute of Health and Welfare, 2002. (AIHW Cat. No. AUS 27.)

26 d'Espaignet ET, Stevenson C. Differences in cause of hospitalisation in New South Wales. In: Immigrants in Australia: a health profile. Ethnic Health Series Number 1. Canberra: Australian Institute of Health and Welfare,1992. (AIHW Cat. No. AIHW 185.)

27 Taylor R, Chey T, Bauman A, Webster I. Socio-economic, migrant and geographic differentials in coronary heart disease occurrence in New South Wales. *Aust N Z J Public Health* 1999; 23: 20-6.

28 Young C. Mortality, the ultimate indicator of survival: the differential experience between birthplace groups. In: Donovan J, d'Espaignet EM, Merton C, van Ommeren M (eds). Immigrants in Australia: a health profile. Canberra: Australian Government Publishing Service, 1992: 34–70.

29 National Heart Foundation. Risk factor prevalence study. Canberra: NHF, 1989.

30 Powell AE, Davies HT, Thomson RG. Using routine comparative data to assess the quality of health care: understanding and avoiding common pitfalls. *Qual Saf Health Care* 2003; 12: 122-8.

31 Hennekens C. Increasing burden of cardiovascular disease current knowledge and future direction for research. *Circulation* 1998; 97: 1095-102.

32 Manson J, Tosteson H, Ridker PM, et al. The primary prevention of myocardial infarction. *N Engl J Med* 1992; 326: 1406-16.

33 Panagiotakos DB, Pitsavos C, Chrysohoou C, et al. Effect of leisure time physical activity on blood lipid levels: the ATTICA study. *Coron Artery Dis* 2003; 14: 533-9.

34 Rubinstein ALE, Goldbourt U, Reisin LH. Lipids and lipoproteins in new immigrant Ethiopian Jews in Israel. *Am J Epidemiol* 1988; 128: 153-64.

35 Covas MI. Olive oil and the cardiovascular system. *Pharmacol Res* 2007; 55: 175-86.

36 Syed AA, Irving JA, Redfern CP, et al. Low prevalence of the N363S polymorphism of the glucocorticoid

receptor in South Asians living in the United Kingdom. *J Clin Endocrinol Metab* 2004; 89: 232-5.

37 Hasin D, Rahav G, Meydan J, Neumark Y. The drinking of earlier and more recent Russian immigrants to Israel: comparison to other Israelis. *J Subst Abuse* 1998; 10: 341-53.

38 Jaumdally J, Lip YH, Varma C. Traditional risk factors for coronary atherosclerosis in Indo Asians: the need for a reappraisal. *Curr Pharm Des* 2006; 12: 1611-21.

39 Koya DL, Egede LE. Association between length of residence and cardiovascular disease risk factors among an ethnically diverse group of United States immigrants. *J Gen Intern Med* 2007; 22: 841-6.

40 Dominguez LJ, Galioto A, Ferlisi A, et al. Ageing, lifestyle modifications, and cardiovascular disease in developing countries. *J Nutr Health Aging* 2006; 10: 143-9.

41 Australian Bureau of Statistics. Australian Social Trends, 2001. Canberra: ABS, 2001. (ABS Cat. No. 4102.0.)

42 Department of Immigration and Multicultural Affairs. Population trends and prospects, 1997. Canberra: DIMA.

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