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Original Article

Cardiovascular risk levels in general practice patients with type 2 diabetes in rural and urban areas

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Abstract

Objective: *To investigate the change of cardiovascular risk factor from 2000 to 2002 in general practice patients with type 2 diabetes in urban and rural areas, and the association between cardiovascular risk (both single risk factors and coronary heart disease absolute risk (CHDAR)) and rurality in three years.*

Methods: *In total, 6305 patients were extracted from 16 Divisions (250 practices). Multivariate regression at Division, practice and patient levels was conducted with adjustment for age and gender.*

Results: *In each of the three years, most single individual risk factors and CHDAR were high. Comparing 2002 with 2000:* for urban patients *in 2002 total cholesterol (OR 0.85) and low-density lipoprotein (OR 0.81) significantly decreased, and high-density lipoprotein (HDL) (OR 1.16) significantly increased;* for rural patients *in 2002 HbA1c (OR 0.85) significantly decreased and HDL (OR 1.22) significantly increased; and CHDAR significantly improved only in urban patients (OR 0.93) in 2002. In 2002 rural patients were still more likely to be overweight/obese (OR 1.16), be current smokers (OR 1.36), and have worse HDL (OR 0.84) and triglycerides (OR 1.23) than their urban counterparts.*

Conclusion: *Some key individual risk factors and CHDAR did not improve in rural patients with type 2 diabetes despite a number of programs designed to provide comprehensive care to rural patients with diabetes. More emphasis is needed on supporting access to lifestyle changes (such as smoking, diet and physical activity) in rural primary health care.*

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Introduction

Cardiovascular disease (CVD) is the leading cause of disease burden and death in the world, including Australia. One of the major risk factors for CVD is diabetes. The prevalence of type 2 diabetes is increasing dramatically because of the ageing of the population and a rising prevalence of obesity and sedentary lifestyle in our society.[1–3] People with diabetes are 2–4 times more likely to develop CVD than those without diabetes,[4] with about 65% of people with diabetes dying of it.[5] The risk of developing CVD increases when diabetes is present with other risk factors, such as tobacco smoking, physical inactivity, high blood pressure, high blood cholesterol, and overweight and obesity. However, much of the burden of CVD is avoidable and might be decreased by preventing and reducing modifiable risk factors such as diet, smoking, physical inactivity, diabetes, high blood lipids and blood pressure.[6,7]

Coronary heart disease absolute risk (CHDAR) is the probability of developing coronary heart disease (CHD) over a given time period. Because the estimation of CHDAR allows multiple CVD risk factors to be considered, it has been recommended by many authorities as a clinical guide to prioritise treatment.[8–12]

Many aspects of the health of people in rural Australia differ from those of their counterparts in urban areas. These are related to economic resources, level of income and education, access to health care and environmental quality.[13] Worldwide, people in rural areas experience a higher risk of diabetes or/and CVD than those in urban areas.[14–16] For example, in Australia, the prevalence of CVD in regional areas was 8% higher for male and 6% higher for female individuals than in major cities between 1997 and 1999.[16] People from remote areas were more likely than those from major cities or regional areas to die of diabetes-related causes in

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***What is already known on this subject*:**
- *Patients with diabetes are 2–4 times more likely to develop cardiovascular disease than those without diabetes, with a mortality rate of 65%.*
- *CHDAR allows multiple cardiovascular disease risk factors to be considered, so it has been recommended by many authorities as a clinical guide to prioritise treatment.*

***What this study adds*:**
- *Despite some improvements in rural areas, many individual risk factors were worse among rural patients compared with urban patients with type 2 diabetes, and neither these nor CHDAR improved over three years.*
- *More support is needed for rural general practice to improve its management of lifestyle and physiological risk factors.*

2001–2003 (94.0 deaths per 100 000 population in remote areas, compared with 49.8 and 56.3 in major cities and inner regional areas, respectively).[17] Evidence from Australia[18] and overseas[19] suggests that the health care needs of people living in rural areas are still not being met.

Primary health care, particularly in general practice, has an important role in identifying and managing CVD risk factors in their patient populations.[20] There have been no previous published reports comparing single and absolute CHD risk of general practice diabetic patients between urban and rural areas. This study has analysed national data from diabetes registers held by 16 Divisions of General Practice – 250 practices across Australia, in order to investigate the trend in CVD risk factor levels from 2000 to 2002 for both urban and rural patients with type 2 diabetes, and the association between CVD risk (both single risk factors and total CHD risk – CHDAR) and rurality over three years during which a number of national rural general practice initiatives were launched, including the More Allied Health Services (MAHS) program.[21]

Methods

The Divisions Diabetes and CVD Quality Improvement Project (DDCQIP)[22] is part of the National Divisions Diabetes Program (NDDP) in Australia. This project collected three years' data (2000–2002) from 23 Divisions of General Practice across Australia which had used CARDIAB (Division-based electronic diabetes registration system),[23] and collated it in 2003.[22] Sixteen Divisions (250 practices) that operated active registers over three years were included. Ethics approval for the DDCQIP was obtained from the University of New South Wales Human Research Ethics Committee.

A total of 6305 (20.4%) eligible patient records from the register were included. Patients were excluded from this study if they had diabetes which was not type 2, they had no smoking records, they were of Indigenous Australian descent,[24,a] or they had previous or new myocardial infarction, stroke or coronary artery bypass graft. The CHDAR for those included was calculated from: gender, age at diagnosis, duration of diabetes, ethnicity, systolic blood pressure, HbA1c (glycated haemoglobin), total cholesterol (TC), high-density lipoprotein (HDL) and smoking status using the United Kingdom Prospective Diabetes Study (UKPDS) risk spreadsheet for populations.[25] All the participants were categorised into urban or rural patients using the Rural, Remote and Metropolitan Area Classification to identify patients living in rural zones, based on the patient postcode.[26] The targets for diabetes care in this study[b] were based on the Australian guidelines for Diabetes Management in General Practice.[27] The 15% of cut-off for high CHDAR is based on the UK National Institute for Clinical Excellence guidelines.[12]

The characteristics of participants were analysed using SPSS14.0 (SPSS Inc.,Chicago IL, USA) and compared using MLwiN (University of Bristol, Bristol, UK).[28] Continuous variables were compared by multilevel multivariate linear regression, and categorical variables by multilevel multivariate logistic regression. All regressions were adjusted for clustering effects at the multilevels (patients are nested within practices and Divisions of General Practice).

Results

In the 16 Divisions where registers were ongoing and active from 2000 to 2002, the number of eligible patient records on the diabetes register increased more than

[a]Indigenous Australians were excluded because they were represented in very low numbers in the registers, and because there was evidence that CHDAR based on studies such as Framingham or UKPDS underestimated the risk in Indigenous Australians.

[b]HbA1c $\leq$7% , TC <4.0 mmol/L, LDL <2.5 mmol L^{-1}, TG <2.0 mmol L^{-1}, HDL $\geq$1.0 mmol L^{-1} or blood pressure <130/85 mmHg.

TABLE 1: *Means (standard deviation) of CVD risk factors and CHDAR in urban and rural areas over time*

	2000		2001		2002	
	Urban	Rural	Urban	Rural	Urban	Rural
Age (years)	61.0 (12.4)	64.2 (11.5)	60.0 (12.5)	63.7 (12.1)	60.2 (12.9)	63.9 (12.1)
Duration (years)	3.5 (5.7)	4.8 (7.0)	3.2 (5.2)	4.4 (6.7)	4.0 (5.8)	4.8 (6.5)
BMI (kg m^{-2})	30.1 (5.9)	31.2 (6.2)	30.0 (5.3)	31.3 (6.1)	30.7 (6.2)	31.3 (6.1)
SBP (mmHg)	135.9 (15.7)	135.7 (16.5)	133.7 (15.3)	137.4 (17.6)	134.3 (16.7)	137.8 (17.0)
DBP (mmHg)	80.0 (9.0)	78.9 (9.9)	79.3 (8.2)	78.5 (10.0)	79.6 (9.1)	78.6 (10.2)
TC (mmol L^{-1})	5.2 (1.0)	5.2 (1.2)	5.2 (1.0)	5.2 (1.4)	5.0 (1.1)	5.2 (1.2)
HDL (mmol L^{-1})	1.2 (0.4)	1.2 (0.4)	1.2 (0.6)	1.2 (0.5)	1.2 (0.3)	1.2 (0.4)
LDL (mmol L^{-1})	3.1 (0.9)	3.1 (0.9)	3.1 (1.0)	3.0 (0.9)	2.9 (0.9)	3.0 (0.9)
TG (mmol L^{-1})	2.1 (1.5)	2.4 (1.7)	2.3 (1.9)	2.3 (1.9)	2.1 (1.6)	2.4 (2.6)
HbA1c (mmol L^{-1})	7.4 (1.6)	7.5 (1.6)	7.4 (1.7)	7.5 (1.7)	7.3 (1.5)	7.3 (1.5)
Current smoker (%)	13.3	13.2	12.4	12.4	13.5	14.5
CHDAR (%)	19.0 (12.4)	22.3 (13.4)	18.3 (12.5)	21.1 (12.9)	18.3 (12.8)	21.8 (13.7)

BMI, body mass index; CHDAR, coronary heart disease absolute risk; CVD, cardiovascular disease; DBP, diastolic blood pressure; HbA1c, glycosylated haemoglobin; HDL, high-density lipoprotein; LDL, low-density lipoprotein cholesterol; TG, total triglycerides; SBP, systolic blood pressure; TC, total cholesterol.

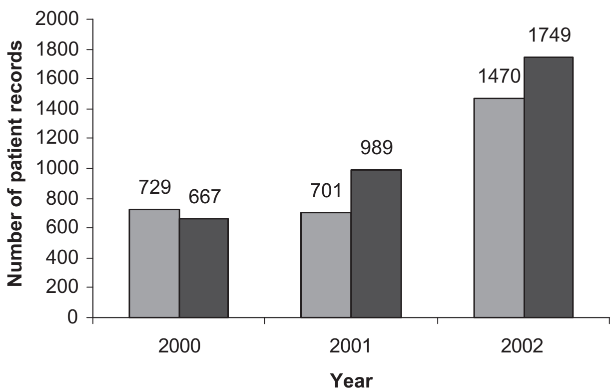

FIGURE 1: *Number of (■) urban and (■) rural patient records on the diabetes register over time.*

twofold in both urban and rural areas from 2000 to 2002 (Fig. 1). The characteristics of patients with type 2 diabetes in urban and rural areas over time from 2000 to 2002 are shown in Table 1. In the three years, except for diastolic blood pressure, the population means of other single individual risk factors exceeded the target levels,[27] and total CVD risk (CHDAR) was above the accepted cut-off (15% risk of a CHD event over the next 10 years).[12] Mean levels of CHDAR were significantly higher in male than female individuals over time for both urban and rural areas. However, the difference in all the risk factors investigated for male compared with female individuals was variable in statistical significance with time for either urban or rural areas.

Comparisons of CVD single risk factors and CHDAR over time

There was no significant difference with regard to patient age and gender within three years ($P > 0.05$) for both urban and rural patients. Table 2 shows the comparison of CVD risk factors between 2000 and 2002 adjusted for age and gender at Division, practice and patient levels. *For urban patients* TC (OR 0.85) and low-density lipoprotein (LDL) (OR 0.81) significantly decreased in 2002, and duration (OR 1.17) and HDL (OR 1.16) significantly increased in 2002. *For rural patients* HbA1c (OR 0.85) significantly decreased in 2002, duration (OR 1.14) and HDL (OR 1.22) significantly increased in 2002. Among urban patients, CHDAR significantly decreased from 2000 to 2002 (from 19.0% to 18.3%, OR 0.93), but it did not significantly change among rural patients. Some of the risk factors were affected by clustering at practice level, but not by clustering at Division level.

Relationship of single CVD risk and CHDAR with rurality

The relationship of CVD risk with rurality over time was investigated with adjustment for age and gender using multilevel analysis (patients, practices and Divisions). In 2000 and 2001, rural patients were significantly more likely to be overweight/obese than urban patients (OR 1.29 in 2000; OR 1.23 in 2001). In 2000, rural patients had significantly higher plasma triglyceride (TG) levels (OR 1.28) than urban patients. However,

TABLE 2: *Odds ratio (95% CI) and variance (SE) for comparison of CVD risk between 2000 and 2002 by area (adjusted for age and gender at Division, practice and patient levels)*

	Urban				Rural			
		Variance (SE)				Variance (SE)		
	OR (95% CI)	Divisions	Practices	Patients	OR (95% CI)	Divisions	Practices	Patients
Duration (years)	1.17 (1.07, 1.22)		0.048 (0.011)	0.641 (0.019)	1.14 (1.05, 1.24)		0.024 (0.008)	0.698 (0.018)
BMI (kg m^{-2})			0.089 (0.023)	0.822 (0.030)				0.872 (0.023)
SBP (mmHg)			0.076 (0.017)	0.835 (0.025)			0.022 (0.009)	0.892 (0.024)
DBP (mmHg)			0.092 (0.019)	0.806 (0.024)			0.021 (0.008)	0.871 (0.023)
TC (mmol L^{-1})	0.85 (0.76, 0.94)		0.024 (0.012)	0.946 (0.030)				0.935 (0.032)
HDL (mmol L^{-1})	1.16 (1.03, 1.32)			0.841 (0.032)	1.22 (1.04, 1.43)			0.888 (0.035)
LDL (mmol L^{-1})	0.81 (0.70, 0.93)		0.039 (0.017)	0.931 (0.037)				0.905 (0.038)
TG (mmol L^{-1})			0.039 (0.014)	0.927 (0030)				0.966 (0.034)
HbA1c (mmol L^{-1})			0.052 (0.016)	0.937 (0.031)	0.85 (0.76, 0.95)		0.030 (0.012)	0.947 (0.030)
Current smoker (%)			0.180 (0.085)				0.130 (0.062)	
CHDAR (%)	0.93 (0.89, 0.98)		0.005 (0.002)	0.221 (0.006)			0.005 (0.002)	0.237 (0.006)

Standardised variables were used. Smoking was tested for significance by multilevel multivariate logistic regression, and the rest of variables by multilevel multivariate linear regression. Variance is significant if variance/standard error >1.96. Only statistically significant estimates are shown in the Table. BMI, body mass index; CHDAR, coronary heart disease absolute risk; CVD, cardiovascular disease; DBP, diastolic blood pressure; HbA1c, glycosylated haemoglobin; HDL, high-density lipoprotein; LDL, low-density lipoprotein cholesterol; TG, total triglycerides; SBP, systolic blood pressure; TC, total cholesterol.

TABLE 3: *Odds ratio (95% CI) and variance (SE) for relationship of CVD risk with rurality in 2002 (adjusted for age and gender at Division, practice and patient levels)*

		Variance (SE)		
In 2002	OR (95% CI)	Divisions	Practices	Patients
Duration (years)		0.040 (0.017)	0.042 (0.011)	0.684 (0.019)
BMI (kg m^{-2})	1.16 (1.02, 1.32)		0.033 (0.012)	0.876 (0.026)
SBP (mmHg)			0.057 (0.014)	0.852 (0.024)
DBP (mmHg)			0.045 (0.012)	0.841 (0.024)
TC (mmol L^{-1})				0.943 (0.031)
HDL (mmol L^{-1})	0.84 (0.72, 0.98)			0.872 (0.033)
LDL (mmol L^{-1})				0.945 (0.037)
TG (mmol L^{-1})	1.23 (1.11, 1.37)			0.950 (0.031)
HbA1c (mmol L^{-1})			0.038 (0.014)	0.950 (0.031)
Current smoker (%)	1.36 (1.08, 1.71)			
CHDAR (%)			0.018 (0.008)	0.801 (0.021)

Standardised variables were used. Smoking was tested for significance by multilevel multivariate logistic regression, and the rest of variables by multilevel multivariate linear regression. Variance is significant if variance/standard error >1.96. Only statistically significant estimates are shown here. BMI, body mass index; CHDAR, coronary heart disease absolute risk; CVD, cardiovascular disease; DBP, diastolic blood pressure; HbA1c, glycosylated haemoglobin; HDL, high-density lipoprotein; LDL, low-density lipoprotein cholesterol; TG, total triglycerides; SBP, systolic blood pressure; TC, total cholesterol.

the other risk factors were similar in rural and urban patients in both 2000 and 2001. In 2002, as shown in Table 3, patients were still significantly more likely to be overweight/obese (OR 1.16) and to be current smokers (OR 1.36) in rural areas than in urban areas. Some blood lipids – HDL (OR 0.84) and TG (OR 1.237) – were significantly worse in rural patients than in urban patients. Mean levels of HbA1c, blood pressure and CHDAR were similar between urban and rural patients over each of the three years ($P > 0.05$).

Discussion

Our data were extracted from 16 Divisions and 250 practices across Australia. To date, this dataset is the largest diabetes data source extracted longitudinally from general practice. Although we consider these data are indicative only, and not representative of all general practice, we believe it provides evidence on the quality of preventive care for people with diabetes in Australian general practice.

Since 1996, there have been a number of national programs to support diabetes care in general practice, such as the NDDP, which includes the Practice Incentives Program and Service Incentive Payment since 2001. And some of the national and Divisional programs (such as MAHS and practice nurse) have specifically focused on improving access to health care in rural areas. The impact of them might be reflected in that, from 2000 to 2002, there were significant improvements for some lipids (TC, HDL and LDL) in patients from urban areas, and for HDL and HbA1c in patients from rural areas. However, in both urban and rural areas, during the study period, nearly all the CVD risk factors in patient with type 2 diabetes still exceeded targets defined in the guidelines. This suggests that the management of CVD risk in patients with type 2 diabetes in both urban and rural areas is still suboptimal and in need of greater attention. It might also indicate that the impact of medical care is limited, and that attention is also needed to the social infrastructure which would support healthier lifestyles, including better town planning and more access to opportunities for improved nutrition and regular physical activity.

Although blood pressure and HbA1c were not significantly different between urban and rural patients over the three years in this study, a number of other risk factors were worse in rural than urban patients, especially obesity, smoking and some lipids. Moreover, CHDAR improved in urban patients, but not in rural patients, over the period of the study. This is consistent with survey data which show a higher prevalence of cardiovascular risk factors in rural populations compared with their urban counterparts.[16] The reasons for this are unclear, but it might be due to a number of factors, such as more entrenched lifestyles and more restricted access to health services in rural areas.[29] This suggests a greater need for the national programs and other initiatives to support practices to provide interventions aimed at modifying lifestyle (such as smoking, diet and physical inactivity) among rural patients. Unless lifestyle factors associated with poor diabetes and CVD management are addressed, it seems unlikely that a reduction will be achieved in the high rates of complications and mortality of patients with diabetes in rural areas of Australia that have been the case in recent years.[17]

There are some limitations in this study. The limited number of Divisions in the study (16 Divisions) means that it was not possible to analyse subgroups within the rural population as a whole. Other research suggests that there are different patterns of mortality between different types of rural areas.[30] It would be valuable to investigate whether this is also reflected in patterns of diabetes care and its intermediate outcomes. The other limitation of the study is that it covers the period between 2000 and 2002. However, there are no comparable data collections available since this time, and national programs to support diabetes care in general practice remain substantially unchanged since then. Our study is a repeated cross-sectional study which is unable to draw a clear causal inference. We have adjusted for age and gender and the effect of clustering at multiple levels (patients, practices and Divisions) over time in an effort to adjust for differences between practices and their populations. Longitudinal studies of these risk factors in general practice will be important to determine whether initiatives since 2002 have reduced the risk of rural patients with diabetes; however, currently no such studies have been initiated.

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