The urban-rural divide: Hypertensive disease hospitalisations in Victoria 2010–2015

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ABSTRACT

Background

Hypertension is present in 23–32 per cent of Australians, making it one of the most prevalent diseases in the country. It is the greatest risk factor for cardiovascular disease, the leading cause of death in Australia and it affects rural populations at a higher rate than urban residents.

Aims

The aims of this study were to investigate the differences in hypertensive disease hospitalisations across rural and urban Victoria, and to determine predicting variables.

Methods

Hospital admission data from 1 July 2010 to 30 June 2015 were obtained through the Victorian Admitted Episodes Dataset and other organisations. Data included various patient demographics for each hospital admission entry. The rates of hospitalisation for each Local Government Area were analysed. Further regression analysis was undertaken to examine the association between hypertensive disease hospitalisation and various predictor variables.

Results

From 2010–2015 11,205 hypertensive disease hospital admissions were recorded of which 64.8 per cent were female, 74.7 per cent admissions were at urban hospitals, and 65.0 per cent were public patients. Hospitalisation rates were consistently higher in rural areas than in urban areas, and rural residents on average stayed in hospital for longer. Significant predictor variables for hypertensive disease hospitalisation included various indicators of socioeconomic disadvantage, GPs per 1,000 population and GP attendance per 1,000 population.

Conclusion

Hypertensive disease hospitalisation in Victoria continues to rise and rates of hospitalisation of rural Victorians continue to be higher than their urban counterparts. Females were hospitalised almost twice as often as males. Further research is required to identify the specific factors that impede access to health services, particularly in the identified high-risk populations.

Key Words

Hypertensive disease, hospitalisation, urban, rural, Victoria

What this study adds:

1. What is known about this subject?
Hypertension is one of the leading causes of chronic disease mortality in Australia. It affects rural Australians at a higher rate than their urban counterparts.

2. What new information is offered in this study?
Despite government health promotion initiatives for improvement of cardiovascular health, hospitalisation rates for hypertensive disease continue to rise.

3. What are the implications for research, policy, or practice?
Alleviating hypertensive disease requires greater awareness, treatment and control with an increased

interest in prophylactic measurements, enabled by identifying the target population.

Background

The burden of chronic illness is greater in rural populations than in urban populations and this disparity in rural and remote areas has been attributed to several challenges.[1] These include, but are not limited to, poorer access to healthcare, lower socioeconomic status, and a higher proportion of Indigenous populations in rural areas.[2] Rural and remote populations also have a higher prevalence of health risk factors that affect chronic ill health. These risk factors include smoking, excessive alcohol consumption, obesity, physical inactivity, lower levels of education attainment, poor health literacy, physically demanding occupations (e.g., farming, and mining), as well as environmental exposure to pesticides and other chemicals.[2,3] It is these and a number of other factors linked to rurality that is associated with poorer health and higher mortality.[1-3]

Hypertension, defined by the National Heart Foundation of Australia as a blood pressure (BP) of ≥140/90mmHg, is the third leading cause of chronic disease mortality in Australia.[1] Not only is hypertension a condition in its own right, it is also widely regarded as one of the biggest risk factors that influence many other chronic illnesses, including Australia's two leading causes of chronic disease mortality: ischaemic heart disease and stroke.[4] Hypertension is present in 23–32 per cent of Australians, making it one of the most prevalent diseases in the country.[4,5] It is more prevalent in rural areas than in urban areas and also the most common cardiovascular risk factor managed by Australian general practitioners (GPs), accounting for 8.6 per cent of consultations.[3,6-8]

In addition, hypertension control in rural populations is poorer than in their urban counterparts[8] despite there being no significant differences in the approach to management of hypertension between urban and rural GPs.[3] However, urban GPs have slightly higher rates of giving advice regarding lifestyle modification (smoking, alcohol, nutrition and physical exercise) when compared to rural GPs, suggesting that there may be less preventative care in rural areas, perhaps due to a workforce shortage in these areas.[2] This is in line with some rural GPs noting that hypertension is usually only part of a consultation, rather than a consultation in its own right – time restraints associated with these types of consultations may be another factor in patient ignorance about the risk of hypertension.[9] Furthermore, GPs are less likely to initiate

antihypertensive therapy in patients that they do not see regularly, which is a particular problem for patients who see different doctors within the same clinic, a relatively common occurrence in rural settings.[9]

Alongside poor awareness, management and control of hypertension, there is also poor management and control of hypertension-induced disease in rural areas, such has chronic heart failure and chronic kidney disease.[10,11]

Several studies investigate the disparity between urban and rural healthcare across Australia or within Western Australia, as this state provides a wide range of topographical variability from urban to very remote locations. However, challenges encountered by rural Australians differ between states and territories due to variations in population, topography, geographical isolation and healthcare policies. Thus, there is a need for up-to-date data regarding other states, particularly in Victoria where more than a quarter of the country's population reside.

This study aims to investigate the differences in hypertensive disease hospitalisations across rural and urban Victoria and to determine any predicting variables.

Methods

Hospital admissions data

Hospital admissions data from 1st July 2010 to 30th June 2015 were obtained from the Victorian Admitted Episodes Dataset (VAED). The VAED provides data for each admitted patient episode from all Victorian public and private hospitals, day procedure centres, rehabilitation facilities and extended care institutions.[12]

Inclusion criteria

Data were included if met all conditions such as sex, age (within 5-year age groups), residing Local Government Area (LGA), type of patient (public or private), admission type (elective or emergency), name of hospital (public hospitals only), length of stay (LOS) in bed days, diagnosis given, and mode of separation for each admitted patient episode. Diagnoses were coded according to the International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, Australian Modification (ICD-10-AM).[13] Principal diagnoses of hypertensive disease were identified using the following ICD-10-AM classifications:

i) I10 Essential (primary) hypertension;
ii) I11 Hypertensive heart disease;
iii) I12 Hypertensive renal disease;
iv) I13 Hypertensive heart and renal disease; and
v) I15 Secondary hypertension.

Exclusion criteria

Admissions for patients from interstate, overseas or of unknown residence were excluded, as this research is concerned with Victorian residents only.

Geographic areas and populations

According to the Australian Standard Geographical Classification (ASGC)[14] Victoria consists of 79 LGAs, comprising of 31 metropolitan and 48 rural LGAs. Specifically, there are 39 Shires, 32 City Councils, 7 Rural Cities and 1 Borough. Victoria has over 300 hospitals and health services serving varying population densities of 0.47 – 4,413 people per square kilometer.[4] Data on each LGA were sourced from the 2011–2015 Census of Population and Housing Victoria[15], Regional Health Profile 2012[16] and the Australian Bureau of Statistics (ABS).[5] These datasets provided population information for each LGA including population number, Aboriginal and Torres Strait Islander population, average household income, unemployment rate, percentage of smokers, rate of GPs per 1,000 population and rate of GP attendance per 1,000 population. The datasets also included information about relative geographical and socio-economic advantage and disadvantage of each LGA, including:

i)   Index of Relative Socio-economic Disadvantage (IRSD) which measures socio-economic disadvantage according to geographic areas;
ii) Socio-Economic Indexes for Areas (SEIFA) which ranks areas of Australia into relative socio-economic disadvantage;
iii) Index of Economic Resources (IER) which examines the financial aspects of socio-economic advantage and disadvantage;
iv) Index of Education and Occupation (IEO) which reflects the education and occupational attainment of various communities; and
v)   Accessibility and Remoteness Index of Australia 2011 (ARIA+) which scores the level of geographical remoteness based on road distance to goods and services based on population size.

Data analysis

Frequencies of various patient characteristics were determined using Statistical Package for the Social Sciences (SPSS, Version 22.0) and Microsoft Excel (version 15.25.1). Patient characteristics of particular interest included age, hospital location, patient type, admission type, LOS, primary diagnosis given and separation mode, and were compared across sex and residence (metropolitan or rural).

Population figures produced by the ABS were used to determine rates of admission for hypertensive disease for rural females, metropolitan females, rural males and metropolitan males for each year within the five-year study period. These population figures were also used to calculate rates of admission for hypertensive disease for each LGA across the five-year study period. Hospital admission rates were age and sex standardised using the corresponding average population estimate for the five-year study period. Hypertensive disease admission rates and various predicting factors were analysed according metropolitan and rural residence using SPSS. Hierarchical multiple regression was used to examine the association between hypertensive disease admissions and several predicting factors including household income, unemployment rate, SEIFA, IRSD, IER, IEO, ARIA+ score, percentage of smokers, percentage of Aboriginal and Torres Strait Islander population, GPs per 1,000 population and GP attendance per 1,000 population. Significance was determined at two-tailed $p \leq 0.05$.

Results

There were 11,474 admissions to Victorian hospitals for hypertensive disease from 2010–11 and 2014–15 of which 11,205 were Victorian residents and the remaining 269 were from interstate, overseas or of unknown residence. Of the 11,205 Victorian resident admissions, 64.8 per cent (n=7,260) were females, 74.7 per cent (n=8,365) occurred at metropolitan hospitals and 65.0 per cent (n=7,283) were through the public healthcare system. Of these admissions 67.9 per cent (n=7,610) were admitted through the emergency department and 87.5 per cent (n=9,799) were given an ICD diagnosis of I10 essential (primary) hypertension. The average LOS over the five-year time period was 3.06 bed days (95 per cent CI 2.98–3.14) with rural females staying the longest at an average of 3.61 bed days (95 per cent CI 3.41–3.80). Ninety-eight per cent (n=11,053) of patients were discharged to private accommodation or other care while 0.6 per cent (n=71) left against medical advice and 0.7 per cent (n=81) died. Characteristics of all Victorian residents admitted to Victorian hospitals for hypertensive disease between 2010–11 and 2014–15 are summarised in Table 1.

Rural and metropolitan difference

Victorian rates of hypertensive disease hospitalisations increased from 0.37 in 2010–11 to 0.41 per 1,000 population in 2014–15 with the state-wide average over the five-year time period being 0.39 per 1,000 population. While rates of hospitalisation for hypertension increased overall for both females and males during the study period, admission rates declined for rural females (0.62 to 0.58 per

1,000 population) and males (0.31 to 0.28 per 1,000 population). Conversely admission rates increased for metropolitan females (0.44 to 0.54 per 1,000 population) and males (0.24 to 0.28 per 1,000 population).

The average yearly rate of admissions for hypertensive disease between 2010–11 and 2014–15 for each LGA may be seen in Figure 1a (Metropolitan Victorian females) and Figure 1b (Rural Victorian females), and Figure 2a (Metropolitan Victorian females) and Figure 2b (Rural Victorian males). The average rates of admission varied from 0.1 per 1,000 population for males in Melbourne, Nillumbik and Surf Coast to 4.0 per 1,000 population for females in Hindmarsh. Female rates of hospitalisation were consistently higher than males in every LGA except for Wyndham. Of the 79 LGAs in Victoria, female rates of hospitalisation were two or more times that of males in 35 LGAs, and three or more times that of males in 10 LGAs. Females were hospitalised with hypertensive disease four times more often than males in Moyne and five times more often than males in Loddon. The highest rates of hospitalisation for both males and females were in Hindmarsh at 2.0 and 4.0 per 1,000 population respectively.

For Victorian residents hospitalised with hypertensive disease during the five-year time period, the LOS decreased from 3.19 bed days (95 per cent CI 2.98–3.39) in 2010–11 to 2.97 bed days (95 per cent CI 2.80–3.13) in 2014–15. While LOS decreased overall for metropolitan residents, there was an upwards trend in LOS for rural Victorians. Furthermore, males were increasingly staying in hospital for longer while the LOS for females was gradually decreasing throughout the five-year time period.

The average LOS during the study period varied between 1.0 bed days in Queenscliff to 5.95 bed days in Golden Plains. Metropolitan residents had a greater range of stay (1–81 bed days) than rural residents (1–64 bed days). However, rural Victorians on average stayed in hospital for longer than their metropolitan counterparts, staying for an average of 3.50 bed days (95 per cent CI 3.34–3.66) and 2.87 bed days (95 per cent CI 2.78–2.97) respectively compared to the state-wide average of 3.06 bed days (95 per cent CI 2.98–3.14). Females stayed in hospital for slightly longer than males at 3.08 bed days (95 per cent CI 2.98–3.18) and 3.02 bed days (95 per cent CI 2.89–3.16) respectively.

Rural residents were more likely to leave hospital against medical advice than their metropolitan counterparts and a greater percentage of metropolitan Victorians died in hospital. The LGA with the highest mortality rate was Warrnambool, with 4.92 per cent hospital admissions resulting in death. There was no correlation between LOS and mortality.

Predicting factors

Regression analysis showed several significant predictors of hypertensive disease hospitalisation rates between metropolitan and rural residents as well as between males and females (Table 2). Among metropolitan residents, household income had a significant association with hypertensive disease hospitalisation rates for both females and males with OR 1.00 (95 per cent CI 1.00–1.00) and OR 1.00 (95 per cent CI 1.00–1.00) respectively. Metropolitan females had further significant predicting factors of ARIA+ score with OR 0.75 (95 per cent CI 0.61–0.93) and GPs per 1,000 population with OR 1.39 (95 per cent CI 1.01–1.91). Among rural residents, SEIFA had a significant association with hypertensive disease hospitalisation rates for both females and males with OR 0.92 (95 per cent CI 0.87–0.98) and OR 0.97 (95 per cent CI 0.94–0.00) respectively. The rate of unemployment was also a significant predictor for both females and males with OR 0.68 (95 per cent CI 0.55–0.84) and OR 0.89 (95 per cent CI 0.80–0.98) respectively. Rural females had further significant predicting factors of IEO with OR 1.02 (95 per cent CI 1.00–1.04) and GP attendance per 1,000 population with OR 1.00 (95 per cent CI 1.00 – 1.00).

Discussion

Hospitalisations for hypertensive disease in Victoria were shown to increase and this growth in overall Victorian hospitalisation rates is reflected by the escalation in hypertensive disease admissions for metropolitan residents, who make up approximately 75 per cent of the Victorian population.[5] Meanwhile, rural hospitalisation rates in this study decreased throughout the five-year study period to become almost comparable to metropolitan rates. Females were hospitalised almost twice as often as males despite hypertension affecting more men than women in Australia.[17] Further, the average LOS from 2010–2015 decreased overall among Victorians; however, rural residents were more likely to leave hospital against medical advice than their metropolitan counterparts.

The overall findings are consistent with data released by the NHFA which shows an upward trend in hypertensive disease hospitalisation rates between 1999–2000 and 2012–13. In terms of the decrease in rural hospitalisation rates, this may indicate an increase in health-seeking behaviour among rural and regional Victorians, perhaps in part due to recent health promotion initiatives such as the NHFA's Heartmoves

and Heart Foundation Walking community programs[17,18] to improve cardiovascular health.

A possible explanation for females being hospitalised twice as often as males (0.50 and 0.28 per 1,000 population respectively) is that they are more likely to visit healthcare providers, especially during reproductive years, for gynaecological health and access to birth control.[19] Frequent interaction with health care providers also means that females are more likely to be aware that they have hypertension.[19] Young males, however, do not have similar reasons to utilise health services. Furthermore, societal attitudes towards gender norms about help-seeking behaviour further reduce the likelihood of males visiting healthcare providers. It has been demonstrated that masculinity is associated with lower rates of access to healthcare and males are therefore less likely to receive preventative health.[20,21]

The decrease in LOS observed is consistent with data released by the NHFA showing a downward trend in LOS across Victoria between 1999–2000 and 2012–13.[17] Rural Victorians on average stayed in hospital for longer than their metropolitan counterparts, staying for an average of 3.50 bed days (95 per cent CI 3.34–3.66) and 2.87 bed days (95 per cent CI 2.78–2.97) respectively. A possible reason is the logistical difficulties of organising transport and accommodation for rural and remote patients, particularly for those who live greater distances from health services.[22] Other challenges faced by rural hospitals include difficulties in finding continuing care in the community and poor access to sub-acute facilities. Delays in ordering diagnostic tests, prescriptions and referrals to other service providers also contribute to prolonged LOS, though these challenges are also faced by metropolitan hospitals.[23] This finding is in contrast to other conditions for which Australians are hospitalised such as asthma, falls and congestive cardiac failure where urban populations stay longer than rural patients.[22-24] Although, rural patients with these conditions may be more likely to be transferred to other healthcare services than the hypertensive population, resulting in apparent fewer average bed days.

Further, it has been suggested that the reasons for rural residents leaving hospital against medical advice is related to patient variables such as socio-demographic characteristics, attitude towards treatment and need to take care of personal affairs; and provider variables such as dislike of the hospital environment and dissatisfaction with their care.[24] These patients are more likely to be males with

substance abuse or psychiatric illnesses.[22-24] however, this information was not provided within the dataset used.

What is known is that the burden of chronic ill health is greater in rural Australians than those who live in urban areas. Rural Australians also experience higher rates of hospitalisation, morbidity and mortality than their metropolitan counterparts for several chronic diseases, including hypertensive disease.[22] However, this study demonstrates that a greater percentage of metropolitan Victorians die in hospital. This may be due in part to the higher rates of rural Victorians leaving hospital against medical advice, subsequently resulting in relatively higher proportions of urban patients remaining in hospital until death. Alternatively, rural residents may be more likely to die prior to reaching a hospital or after self-discharging, which aligns with both the higher rates of morbidity and mortality among rural Australians and the lower rates of in-hospital deaths demonstrated by this study.

Lastly, a key finding was that admission rates had significant variation between different LGAs across the state. While rural Eastern Victorian admission rates for hypertension mirrored those in metropolitan Victoria for both males and females, Western Victoria displayed substantially higher rates of hospitalisation. Of particular concern was Hindmarsh, whose residents were more than seven times more likely to be hospitalised with hypertension than that of the state average (3.02 versus 0.39 per 1,000 population). Similarly, other LGAs had greater than four times the state-wide average rate of hospitalisation and included LGAs such as Gannawarra (2.01 per 1,000 population) Yarriambiack (1.92 per 1,000 population) and Buloke (1.64 per 1,000 population).

What these LGAs have in common is their relatively low IRSD score, meaning Victorians in these areas are at a relatively greater socio-economic disadvantage when compared to the rest of the state. However, hypertensive disease hospitalisation rates do not completely correlate with IRSD scores, as some LGAs that are considered to be relatively disadvantaged (Mildura, Central Goldfields, Brimbank, Greater Dandenong and Latrobe)[16] had lower rates of hospitalisation than the state average. This implies that while socio-economic factors may play a part in hypertensive disease hospitalisation rates to some extent, there are other contributing factors. For metropolitan residents, these predicting factors were demonstrated to be low household income, low ARIA+ score and fewer of GPs per 1,000 populations. For rural residents, low SEIFA and IEO scores, low household income and higher

unemployment rate were predicting factors for hypertensive disease hospitalisation.

Despite government health promotion initiatives that seek to improve cardiovascular health and hospitalisation rates, hypertensive disease continues to rise with a greater burden of disease among those who experience greater socio-economic disadvantage. While socio-economic differences contribute to the burden of disease and hospitalisation rates, improving socio-economic factors only addresses hypertensive disease in part. Thus the implications for clinical practice would to ensure hypertension remains front and centre for clinicians in terms of the disease's capacity to be a condition in its own right, and as one of the biggest risk factors to influence many other chronic illnesses. To address this, there is a need for greater standardised approach to up-skilling and monitoring among GPs where guidelines systematically ensure that at-risk patients are thoroughly investigated. This could include prophylactic measures as well as assessment of arterial stiffness in target populations.[25] In addition, there needs to be greater federal and state support to overcome current systemic barriers to improving hypertensive disease. This, in turn, may allow for the implementation of consistent approaches towards patient health education and adequate self-management.[26]

Strengths and limitations of this study

This study comprised of retrospective data for hypertensive disease hospitalisations. The dataset used in this study provided information on each admitted patient episode; however, waiting times, severity of illness, rates of patient readmission, or quality of treatment were not provided and therefore could not be determined or analysed. Furthermore, the significance of the data relies on the accuracy of the ICD-10-AM coding system. This requires meticulous documentation of patient information by clinical staff followed by appropriate interpretation of clinical notes and diagnoses by administrative staff, which cannot always be guaranteed. Nevertheless, the study incorporates a complete dataset of statewide hypertensive disease hospitalisations from 2010–11 to 2014–15. Whether the results of this study apply to other regions outside of Victoria is uncertain; however, it does provide insight into the urban-rural differences across Victoria where more one-quarter of the Australian population resides.[5]

Conclusion

This study demonstrated that rates of hypertensive disease hospitalisation in Victoria continue to rise due to an increase in hospitalisation of metropolitan residents. Rural Victorians continue to be hospitalised at much higher rates than metropolitan residents, and females were hospitalised almost twice as often as males despite hypertension affecting more men than women in Australia. This implies suboptimal engagement with the healthcare system by Victorian males, who therefore may not be receiving necessary preventative and potentially therapeutic care.

What is encouraging is that the average amount of time patients spent in hospital decreased over time. The potential importance of this to the healthcare system is that it may offset some of the burden of cost associated with the increasing rate of hospitalisations.

While barriers to accessing healthcare are varied and multifaceted, further research is required to identify the specific factors that impede access to health services in particularly high-risk populations. The high-risk populations identified in this study include key LGAs as well as Victorian males in general who experience a greater burden of hypertensive disease.

Hypertension is one of the most preventable diseases, yet despite this, it is often merely considered a risk factor for fatal chronic diseases rather than a disease in its own right. This is in line with hypertension usually being only part of a GP consultation, rather than a consultation in itself. Improving awareness, management and control of hypertensive diseases will not only reduce morbidity and mortality for many Australians, but also alleviate the burden of hypertensive disease on the Australian healthcare system.

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PEER REVIEW

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CONFLICTS OF INTEREST

The authors declare that they have no competing interests.

ETHICS COMMITTEE APPROVAL

The University of Melbourne Department of Rural Health Human Ethics Committee, Approval Number 1443383.1

Table 1: Characteristics of all Victorian residents admitted to Victorian hospitals and given a diagnosis of hypertensive disease between 2010–11 and 2014–15

Patient factor	Females [n=7,260]					Males [n=3,945]				
	Metropolitan residents [n=5,028]			Rural residents [n=2,232]		Metropolitan residents [n=2,820]			Rural residents [n=1,125]	
Age (years)	Frequency	Percentage		Frequency	Percentage	Frequency	Percentage		Frequency	Percentage
0 – 9	54	1.1		11	0.5	55	2.0		11	1.0
10 – 19	97	1.9		20	0.9	158	5.6		25	2.2
20 – 29	94	1.9		28	1.3	67	2.4		20	1.8
30 – 39	228	4.5		53	2.4	153	5.4		41	3.6
40 – 49	316	6.3		108	4.8	283	10.0		115	10.2
50 – 59	479	9.5		143	6.4	469	16.6		201	17.9
60 – 69	782	15.6		362	16.2	542	19.2		256	22.8
70 – 79	1228	24.4		606	27.2	552	19.6		243	21.6
80 – 89	1401	27.9		720	32.3	467	16.6		183	16.3
90 – 99	345	6.9		179	8.0	73	2.6		30	2.7
99+	4	0.1		2	0.1	1	0.0		0	0.0
Hospital location										
Metropolitan	5,006	99.6		290	13.0	2,805	99.5		264	23.5
Rural	22	0.4		1,942	87.0	15	0.5		861	76.5
Patient type										
Public	3,110	61.9		1,415	63.4	1,926	68.3		832	74.0
Private	1,619	32.2		637	28.5	787	27.9		243	21.6
Other	299	5.9		180	8.1	107	3.8		50	4.4
Admission type										
Elective	1,268	25.2		737	33.0	971	34.4		403	35.8
Emergency	3,611	71.8		1,458	65.3	1,830	64.9		711	63.2
Maternity	126	2.5		17	0.8	-	-		-	-
Other	23	0.5		20	0.9	19	0.7		11	1.0
Diagnosis										
I10 Essential (primary) hypertension	4,524	90.0		2,045	91.6	2,257	80.0		973	34.5
I11 Hypertensive heart disease	210	4.2		93	4.2	118	4.2		36	1.3
I12 Hypertensive chronic kidney disease	198	3.9		49	2.2	345	12.2		80	2.8
I13 Hypertensive heart and chronic kidney disease	32	0.6		11	0.5	54	1.9		26	0.9
I15 Secondary hypertension	64	1.3		34	1.5	46	1.6		10	0.4
Separation mode										
To private accommodation	4,499	89.5		2,044	91.6	2,594	92.0		1,012	90.0
To other care	492	9.8		141	6.3	175	6.2		96	8.5
Left against medical advice	9	0.2		38	1.7	15	0.5		9	0.8
Death	28	0.6		9	0.4	36	1.3		8	0.7
Length of stay (Days)										
Mean	2.85 (95% CI 2.74 – 2.97)			3.61 (95% CI 3.41 –3.80)		2.91 (95% CI 2.76 – 3.06)			3.30 (95% CI 3.05 – 3.58)	
Range	1 – 81			1 – 64		1 – 62			1 – 54	

Figure 1: Hypertensive disease average yearly admission rates for Victorian females by Local Government Area: 1a) metropolitan; and 1b) rural

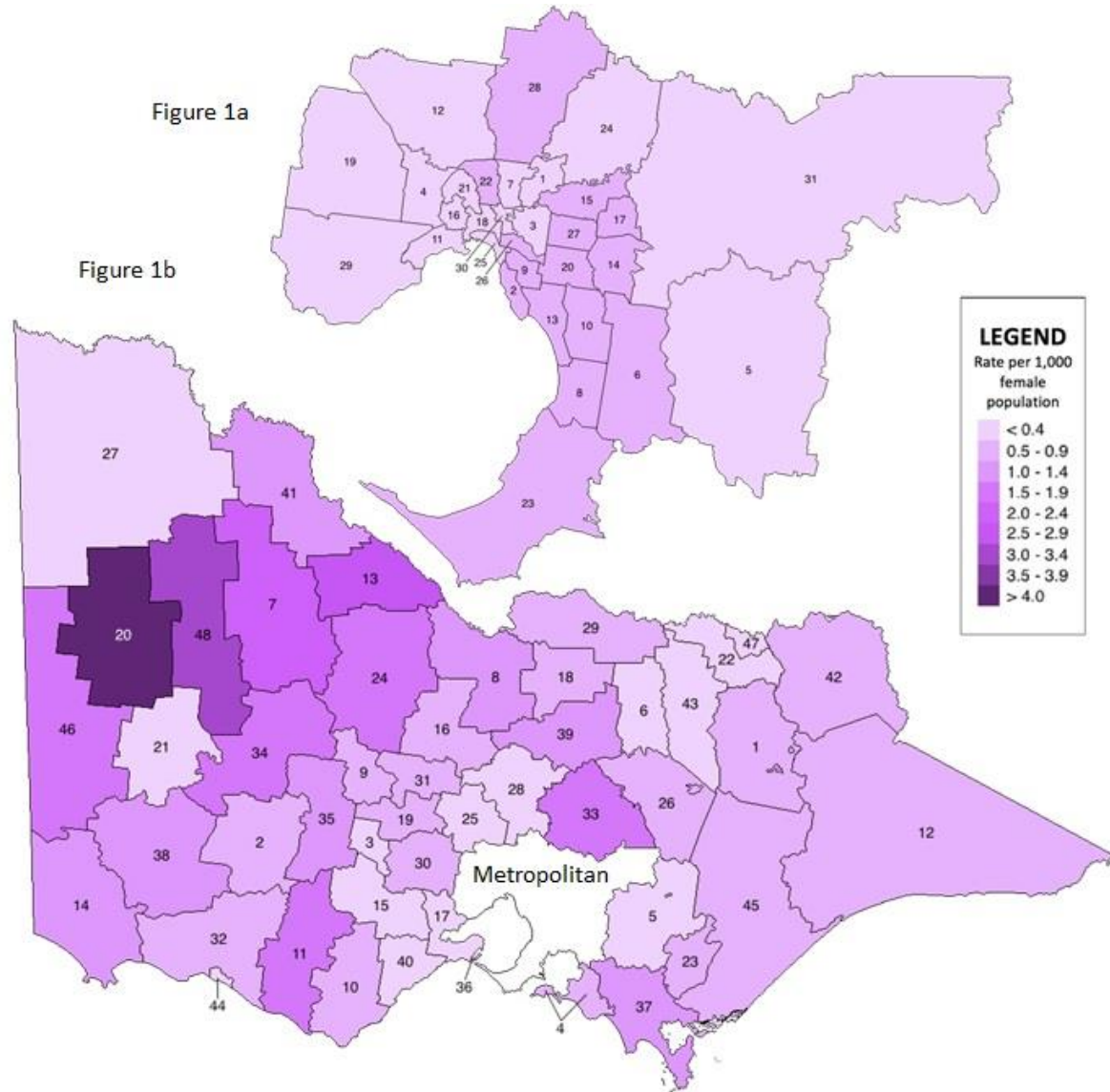| Local government areas (Rural)		Local government areas (Metropolitan)	
1	Alpine	1	Banyule
2	Ararat	2	Bayside
3	Ballarat	3	Boroondara
4	Bass Coast	4	Brimbank
5	Baw Baw	5	Cardinia
6	Benalla	6	Casey
7	Buloke	7	Darebin
8	Campaspe	8	Frankston
9	Central Goldfields	9	Glen Eira
10	Colac-Otway	10	Greater Dandenong
11	Corangamite	11	Hobsons Bay
12	East Gippsland	12	Hume
13	Gannawarra	13	Kingston
14	Glenelg	14	Knox
15	Golden Plains	15	Manningham
16	Greater Bendigo	16	Maribyrnong
17	Greater Geelong	17	Maroondah
18	Greater Shepparton	18	Melbourne
19	Hepburn	19	Melton
20	Hindmarsh	20	Monash
21	Horsham	21	Moonee Valley
22	Indigo	22	Moreland
23	Latrobe	23	Mornington Peninsula
24	Loddon	24	Nillumbik
25	Macedon Ranges	25	Port Philip
26	Mansfield	26	Stonnington
27	Mildura	27	Whitehorse
28	Mitchell	28	Whittlesea
29	Moira	29	Wyndham
30	Moorabool	30	Yarra
31	Mount Alexander	31	Yarra Ranges
32	Moyne		
33	Murrindindi		
34	Northern Grampians		
35	Pyrenees		
36	Queenscliffe		
37	South Gippsland		
38	Southern Grampians		
39	Strathbogie		
40	Surf Coast		
41	Swan Hill		
42	Towong		
43	Wangaratta		
44	Warrnambool		
45	Wellington		
46	West Wimmera		
47	Wodonga		
48	Yarriambiack		

Figure 2: Hypertensive disease average yearly admission rates for Victorian males by Local Government Area: 2a) metropolitan; and 2b) rural

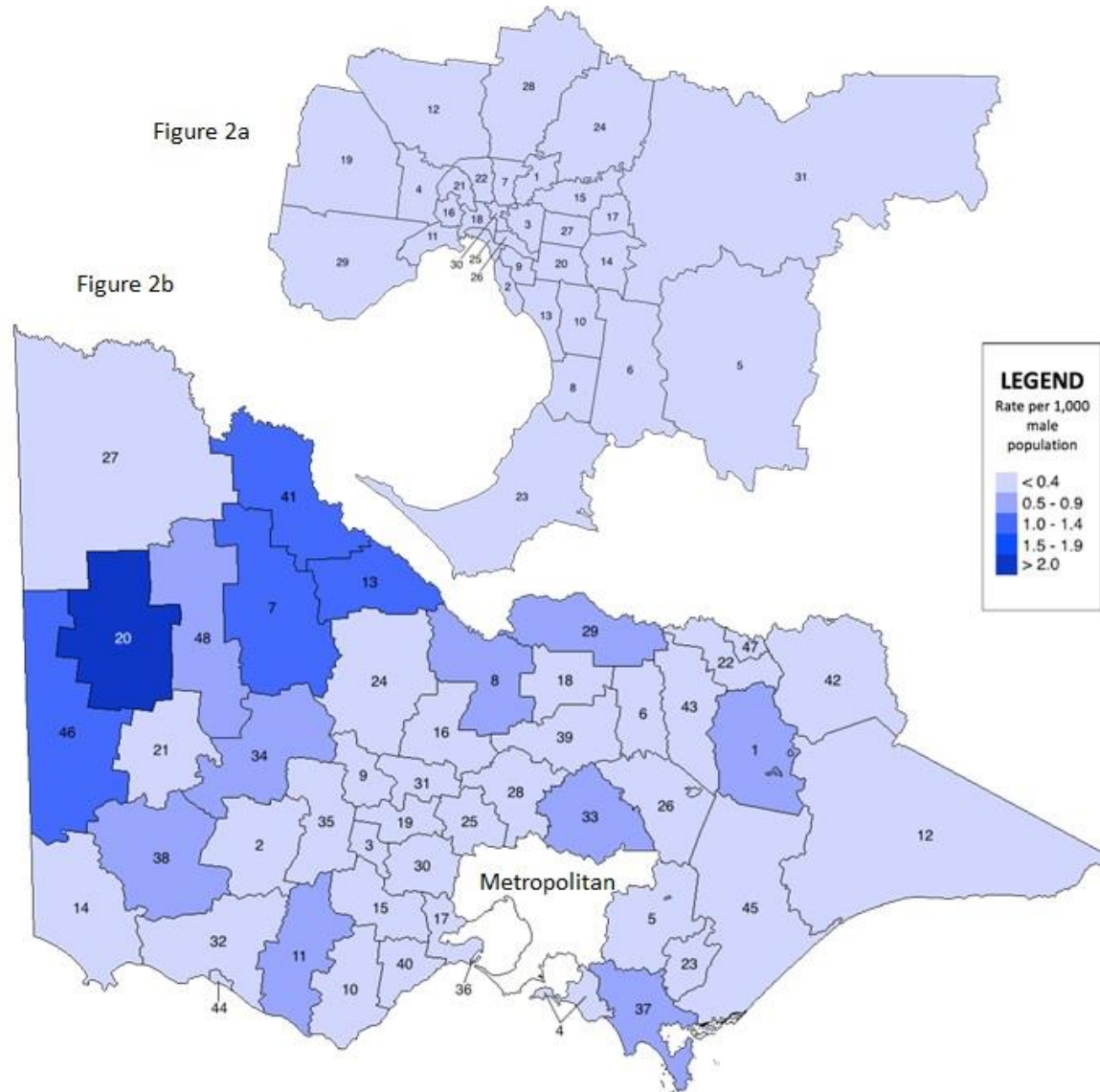| **Local government areas (Rural)**		**Local government areas (Metropolitan)**	
1	Alpine	1	Banyule
2	Ararat	2	Bayside
3	Ballarat	3	Boroondara
4	Bass Coast	4	Brimbank
5	Baw Baw	5	Cardinia
6	Benalla	6	Casey
7	Buloke	7	Darebin
8	Campaspe	8	Frankston
9	Central Goldfields	9	Glen Eira
10	Colac-Otway	10	Greater Dandenong
11	Corangamite	11	Hobsons Bay
12	East Gippsland	12	Hume
13	Gannawarra	13	Kingston
14	Glenelg	14	Knox
15	Golden Plains	15	Manningham
16	Greater Bendigo	16	Maribyrnong
17	Greater Geelong	17	Maroondah
18	Greater Shepparton	18	Melbourne
19	Hepburn	19	Melton
20	Hindmarsh	20	Monash
21	Horsham	21	Moonee Valley
22	Indigo	22	Moreland
23	Latrobe	23	Mornington Peninsula
24	Loddon	24	Nillumbik
25	Macedon Ranges	25	Port Philip
26	Mansfield	26	Stonnington
27	Mildura	27	Whitehorse
28	Mitchell	28	Whittlesea
29	Moira	29	Wyndham
30	Moorabool	30	Yarra
31	Mount Alexander	31	Yarra Ranges
32	Moyne		
33	Murrindindi		
34	Northern Grampians		
35	Pyrenees		
36	Queenscliffe		
37	South Gippsland		
38	Southern Grampians		
39	Strathbogie		
40	Surf Coast		
41	Swan Hill		
42	Towong		
43	Wangaratta		
44	Warrnambool		
45	Wellington		
46	West Wimmera		
47	Wodonga		
48	Yarriambiack		

Table 2: Regression analysis of Victorian residents hospitalised for hypertensive from 2010–11 to 2014–15

	Females					
	Metropolitan			Rural		
Predictor	OR	95% CI	p-value	OR	95% CI	p-value
SEIFA	1.00	0.98 – 1.01	0.846	0.92	0.87 – 0.98	0.008*
IRSD	1.00	0.99 – 1.01	0.959	1.03	1.00 – 1.07	0.077
IER	1.00	1.00 – 1.01	0.098	1.02	1.00 – 1.04	0.058
IEO	1.00	0.99 – 1.01	0.942	1.02	1.00 – 1.04	0.045*
ARIA+ score	0.75	0.61 – 0.93	0.010*	1.12	0.84 – 1.49	0.44
GPs per 1,000 population	1.39	1.01 – 1.91	0.041*	1.05	6.62 – 1.78	0.848
GP attendance per 1,000 population	1.00	1.00 – 1.00	0.392	1.00	1.00 – 1.00	0.035*
Household income	1.00	1.00 – 1.00	0.005*	1.00	1.00 – 1.01	0.619
Unemployment rate	1.00	0.95 – 1.04	0.919	0.68	0.55 – 0.84	0.001*
Percentage of smokers	1.00	0.98 – 1.03	0.65	1.02	0.97 – 1.07	0.426
Percentage of Aboriginal and Torres Strait Islander population	1.08	0.73 – 1.60	0.392	1.01	0.74 – 1.39	0.947
	Males					
	Metropolitan			Rural		
Predictor	OR	95% CI	p-value	OR	95% CI	p-value
SEIFA	1.00	0.99 – 1.01	0.935	0.97	0.94 – 0.00	0.028*
IRSD	1.00	1.00 – 1.00	0.843	1.02	1.00 – 1.03	0.061
IER	1.00	1.00 – 1.00	0.229	1.00	1.00 – 1.01	0.307
IEO	1.00	1.00 – 1.00	0.76	1.01	1.00 – 1.02	0.164
ARIA+ score	0.95	0.84 – 1.07	0.361	1.14	0.99 – 1.30	0.063
GPs per 1,000 population	1.12	0.93 – 1.34	0.229	1.08	0.85 – 1.39	0.507
GP attendance per 1,000 population	1.00	1.00 – 1.00	0.636	1.00	1.00 – 1.00	0.253
Household income	1.00	1.00 – 1.00	0.013*	1.00	1.00 – 1.00	0.373
Unemployment rate	1.01	0.98 – 1.03	0.582	0.89	0.80 – 0.98	0.019*
Percentage of smokers	1.00	1.99 – 1.01	0.699	1.02	0.99 – 1.04	0.127
Percentage of Aboriginal and Torres Strait Islander population	1.13	0.90 – 1.42	0.27	0.99	0.85 – 1.15	0.861
* p<0.05						