Study Protocol

Ageing, chronic disease and injury: a study in western Victoria (Australia)

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Significance for public health

The pattern of chronic disease and injury and its relationship with age, sex and location has not been described for the region. This study will collect new data and collate existing databases to provide a comprehensive snapshot of the health and safety across western Victoria, Australia. Baseline data collected in the project will be used to forecast disease burden into the future, based on Australian Bureau of Statistics models. In order to determine gaps in service delivery, plan future interventions including prevention strategies, and evaluate their effectiveness, it is essential to have a contemporary evidence base and processes in place for monitoring on-going change. The profiles will provide important information for targeting appropriate allocation of resources and care transition needs, and to deal with burden of disease and injury. This study establishes a profiling model that can be replicated in other geographical regions, and will be particularly useful in non-metropolitan settings.

Abstract

Background: An increasing burden of chronic disease and associated health service delivery is expected due to the ageing Australian population. Injuries also affect health and wellbeing and have a long-term impact on health service utilisation. There is a lack of comprehensive data on disease and injury in rural and regional areas of Australia. The aim of the Ageing, Chronic Disease and Injury study is to compile data from various sources to better describe the patterns of chronic disease and injury across western Victoria.

Design: Ecological study.

Methods: Information on demographics, socioeconomic indicators and lifestyle factors are obtained from health surveys and government departments. Data concerning chronic diseases and injuries will be sourced from various registers, health and emergency services, local community health centres and administrative databases and compiled to generate profiles for the study region and for sub-populations within the region.

Expected impact for public health: This information is vital to establish current and projected population needs to inform policy and improve targeted health services delivery, care transition needs and infrastructure development. This study provides a model that can be replicated in other geographical settings.

Introduction

Australia is facing a rapidly ageing population and with this, the burden of chronic disease is increasing.[1] The current fertility, life expectancy and migration trends are expected to continue over the coming decades and will have implications for delivery of health services. It is projected that one quarter of Australians will be aged 65 years and over by 2044-45, almost double the present proportion.[2] An increase in the proportion of government health spending is projected from 5.7% of the Gross Domestic Product in 2002-03, rising to around 10.3% in 2044-45.[2] The expected growth in regional and rural populations will further contribute to an increased need for health services in these areas.[3] Injuries also impact on health and wellbeing and can exacerbate chronic health problems resulting in long-term health service use.[4] In order to inform policy and adequately plan improved delivery of health services, it is vital to establish the health service needs of the population. Such information could assist in developing innovative models of care to address the health service needs of an ageing population as well as reducing the demand by implementing effective preventative strategies.

Inequalities in rural and regional health service delivery are evident, not just in Australia[5] but also in other countries across the world.[6-8] While health statistics can be abstracted from large-scale state and national surveys, locally-generated evidence is better poised to characterise small area differences. Our data will relate to a range of chronic diseases and injuries, some of which are peculiar to regional, remote and farming communities. The needs of such sub-populations are rarely addressed in broader surveys. The Ageing, Chronic Disease and Injury (ACDI) study was launched in 2015 to address this need.

Aim

The ACDI study aims to provide a comprehensive snapshot of the health and wellbeing of older adults living in western Victoria. The purpose of this paper is to describe the methods that will be utilised for the study and discuss key demographic features of the study population. Specific aims of the study are to: i) describe the extent of chronic disease and injury in the region; ii) highlight age-, sex- and location-

related variations in the patterns of chronic disease and injury throughout the region; iii) document associations between socioeconomic status, location remoteness and accessibility, lifestyle risk factors such as smoking, alcohol consumption, physical inactivity, obesity and the burden of chronic disease and injury.

Where is the study region located?

Victoria is the second most populous state of the eight Australian states and territories (Figure 1).[9] There are 79 discrete geographical regions or Local Government Areas (LGAs) in Victoria.[10] The study region includes 21 of the 79 Victorian LGAs and represents nearly one-third of the state by area (Figure 1). Based on the 2011 Census of Population and Housing, the 2013 Estimated Resident Population (ERP) of the study region is 617,794.[11] Greater Geelong (ERP=221,515), Ballarat (ERP=98,684) and Warrnambool (ERP=33,300) are the three most populous LGAs in the region (Table 1).[1,12-14]

What is already known about the study region?

Life expectancy

According to the most recent figures, life expectancy at birth for men in the region ranges from 75.7 years in Northern Grampians to 81.2 years in Surf Coast.[12] Life expectancy is 80.3 for all Victorian men[12] and 79.3 for all Australian men.[15] For women, life expectancy at birth ranges between 82.0 years in Hepburn to 86.3 years for Surf Coast.[12] Life expectancy is 84.4 years for all Victorian women[12] and 83.9 years for all Australian women.[15]

Accessibility and remoteness

The LGAs in the region range from *highly accessible* to *moderately accessible* based on Accessibility/Remoteness Index of Australia (ARIA) classification (Table 1). ARIA scores are generated by taking into account distance from localities to different town categories, access to goods and services and opportunities for social interaction.[16] Scores are grouped into five categories ranging from highly accessible (ARIA score 0.00-1.84), accessible (ARIA score >1.84-3.51), moderately accessible (ARIA score >3.51-5.80), remote (ARIA score >5.80-9.08) and very remote (ARIA score >9.08-12.00). Three LGAs in the region are classified as *moderately accessible* and the remaining are either *highly accessible* or *accessible*; there are no LGAs in the *remote* or *very remote* categories.[17] The study region covers highly productive agricultural areas in the southwest for dairying and grazing to larger acreages suited to broad acre farming in the west and north western regions. The majority of these farms remain family owned and operated.[13]

Socioeconomic status

The study region has a wide range of socioeconomic status shown by Index for Relative Socioeconomic Advantage and Disadvantage (IRSAD) scores (Table 1). Scores lower than 1000 indicate relatively lower socioeconomic advantage and higher disadvantage. The LGAs falling in the lowest 10% are given a decile number of 1 (most disadvantaged) and those in the highest 10% are given a decile number of 10 (most advantaged).[18] Central Goldfields has the lowest IRSAD score in the entire state of Victoria. Surf Coast has the highest IRSAD score (decile 10) in the region and ranks seventh out of 79 LGAs in Victoria.

Access to health services

Health services in the study region include a mix of public and private providers. The major bulk of trauma services in the region are provided through 24-hour Emergency Departments located in the cities of Geelong, Ballarat, Warrnambool, Horsham and Hamilton.[14] In addition, there are rural trauma centres and hospitals (including Bush Nursing Hospitals) in the study region providing primary care and referral services.[19] The LGA of Queenscliffe has the highest number of General Practitioners per 1000 population whereas West Wimmera has the lowest (2.9 *versus* 0.3) (Table 1). The proportion of adults having private health insurance is highest in Surf Coast (54.0%) and lowest in Central Goldfields (28.9%). The LGAs of Hindmarsh and Queenscliffe have the highest hospital inpatient separations in the region (694.3 per 1000 and 651.4 per 1000), whereas Surf Coast has the lowest (338.7 per 1000).[20]

Lifestyle factors and obesity levels

Information on self-reported prevalence of current smoking, risk of alcohol-related harm, obesity and physical inactivity corresponds to data from the Victorian Population Health Survey (VPHS) 2011-2012.[21] The VPHS is a Computer Assisted Telephone Interview of individuals aged 18 years and over residing in private dwellings. For 2011-2012, data were based on a sample of 33,673 with a response of 66.8%. Detailed information on lifestyle factor definitions and methods utilised by the VPHS is described in the survey report.[21] Table 2 summarises findings relevant to the study region some of which are discussed here.

Smoking status: adults living in Pyrenees reported the highest prevalence of current smoking in the region (23.2%) and those living in Horsham reported the lowest (11.1%). The prevalence at the state level was 15.7%. Prevalence of current smoking in men was also the highest in Pyrenees (26.7%) as compared to the Victorian estimate of 18.5%. The highest prevalence of current smoking in women was reported in Yarriambiack (23.2%) as compared to the Victorian estimate of 12.9%. LGAs with the lowest reported prevalence of current smoking in men and women were Warrnambool (11.5%) and Horsham (5.9%) respectively. Physical activity: adults living in Hepburn reported the highest prevalence of insufficient physical activity/sedentary lifestyle in the study region, 38.3% as compared to 32.1% in Victoria. LGAs with a high prevalence of sufficient physical activity were Queenscliffe (78.3%), Moyne (72.4%), Yarriambiack (71.3%) and Southern Grampians (71.2%). The measure was 63.9% at state level.

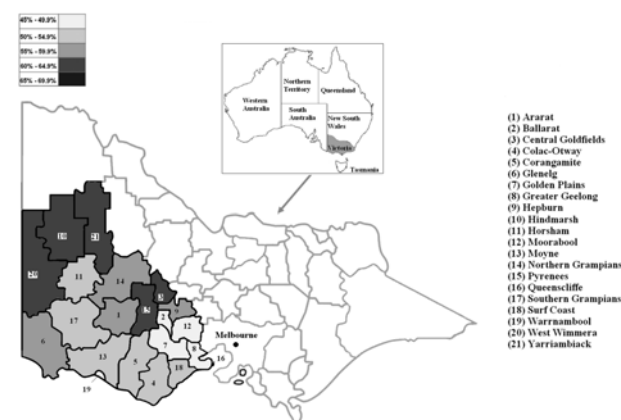*Obesity*: a higher proportion of adults living in Yarriambiack

Figure 1. Location of the Ageing, Chronic Disease and Injury study region. Local Government Areas included in the study are shaded according to the percentage of individuals aged 40 years and over. Data for graphic were obtained from the Department of Health and Human Services, State Government of Victoria, Australia.[21]

(30.9%), Central Goldfields (25.5%), and West Wimmera (24.3%) reported being obese as compared to the state estimate of 17.3%. The LGA with the lowest prevalence of self-reported obesity in the study region was Queenscliffe (9.1%).

Risky/high risk alcohol intake: overall, a higher proportion of men reported risky/high risk alcohol consumption as compared to women in each of the LGAs in the study region as well as the state. Queenscliffe reported the highest proportion of adults (60.1%) consuming alcohol at risky/high-risk level for short-term harm. The prevalence at the state level was 45.3%.

Design and methods

The study population

The ACDI study is population-based, ecological in design and focuses on the population aged 40 years or older residing in western Victoria; this grouping makes up nearly 51% (~316,000) of the total population in the study region.[11] There is a general pattern of an increasing proportion of population aged 40 years or older in the western parts of the region with some exceptions (Figure 1). The LGAs with the highest proportion of those over 40 years of age are Queenscliffe (67.0%), Pyrenees (62.9%), Yarriambiack (61.9%), West Wimmera (60.9%), Central Goldfields (60.7%), and Hindmarsh (60.5%).

Data sources for the ageing, chronic disease and injury study

We will source data on chronic disease and injury incidence, preva-

lence and mortality from existing local, national and state registries and databases. Prevalence data will be presented as aggregate summary statistics for disease and injury according to age, sex, year and location. Registries to be accessed include, but are not limited to: i) the Victorian Cancer Registry (VCR), a population-based cancer registry that provides comprehensive information for cancer control.[9] Notifications about cancer diagnoses are provided to the VCR by hospitals, pathology laboratories and cancer screening registers; ii) the National Diabetes Services Scheme, established in 1987, is administered by Diabetes Australia to provide access to diabetes-related products at subsidised rates as well as other support services. Registration is voluntary and free of charge for Australians with a diagnosis of diabetes mellitus with the number of registrants growing to over 1 million since its inception;[22] iii) the Victorian Admitted Episodes Dataset (VAED) records details of inpatient admissions to all (*i.e.* both Public and Private) Victorian hospitals.[23] The Victorian Emergency Minimum Dataset (VEMD) is another state wide register that maintains records of Emergency Department presentations.[24] In addition to VAED and VEMD, separations data from individual hospitals located within the study region will also be abstracted; iv) Medicare Australia provides access to health services for Australian residents and certain categories of visitors to Australia. It covers free or subsidised treatment by health professionals under the Medicare Benefits Schedule (MBS) and access to medicines under the Pharmaceutical Benefits Scheme (PBS).[25] MBS and PBS data will be accessed for providing patterns of health service utilisation in terms of MBS claims and prescription dispensing; v) the Australia Orthopaedic Association National Joint Replacement Registry, established in 1999, receives data from all hospitals undertaking joint replacement procedures and will be accessed for the information within the region;[26] vi) the Australia and New

Table 1. Demographic and socioeconomic characteristics of the study region. Data were obtained from the Australian Bureau of Statistics.[1,12-14]

Local Government Area	ERP 2013 (M)	ERP 2013 (F)	ERP 2013 total (% of study region)	Median age, years	IRSAD score, median	IRSAD decile	ARIA score, median	ARIA category	GPs per 10,000 pop.	% PHI
Ararat	5791	5416	11,207 (1.8)	45	938	2	1.8	Accessible	1.1	36.3
Ballarat	48,086	50,598	98,684 (15.9)	37	969	4	0.5	Highly accessible	1.2	38.7
Central Goldfields	6280	6322	12,602 (2.0)	48	888	1	1.3	Highly accessible	0.9	28.9
Colac-Otway	10,437	10,257	20,694 (3.3)	42	946	3	1.8	Highly accessible	1.1	36.6
Corangamite	8266	7871	16,137 (2.6)	43	970	5	2.0	Accessible	1.1	42.0
Glenelg	9940	9581	19,521 (3.1)	43	943	3	2.9	Accessible	1.2	33.9
Golden Plains	10,354	9797	20,151 (3.2)	39	1011	8	1.0	Highly accessible	0.5	45.0
Greater Geelong	109,221	112,294	221,515 (35.8)	39	980	5	0.5	Highly accessible	1.3	46.0
Hepburn	7253	7590	14,843 (2.4)	46	967	4	1.1	Highly accessible	1.6	35.7
Hindmarsh	2870	2825	5695 (0.9)	47	929	1	4.4	Moderately accessible	1.4	32.2
Horsham	9747	9940	19,687 (3.1)	40	971	5	3.2	Accessible	0.6	38.1
Moorabool	15,222	15,098	30,320 (4.9)	39	995	7	0.8	Highly accessible	0.7	42.5
Moyne	8126	8151	16,277 (2.6)	41	1005	7	1.9	Accessible	0.6	46.3
Northern Grampians	5984	5815	11,799 (1.9)	45	926	1	2.5	Accessible	1.0	33.8
Pyrenees	3359	3411	6770 (1.0)	47	930	1	1.5	Highly accessible	0.7	33.2
Queenscliffe	1430	1628	3058 (0.4)	55	1047	9	0.7	Highly accessible	2.9	51.6
Southern Grampians	7940	8205	16,145 (2.6)	44	978	5	2.7	Accessible	1.1	41.3
Surf Coast	14,233	14,049	28,282 (4.5)	40	1060	10	1.1	Highly accessible	1.2	54.0
Warrnambool	16,364	16,936	33,300 (5.3)	38	970	4	1.4	Highly accessible	1.6	36.0
West Wimmera	2077	2012	4089 (0.6)	46	977	5	4.1	Moderately accessible	0.3	36.2
Yarriambiack	3572	3446	7018 (1.1)	48	943	2	3.9	Moderately accessible	0.7	32.4
Study Region	306,552	311,242	617,794							

ERP, Estimated Resident Population; IRSAD, Index of Relative Socioeconomic Advantage and Disadvantage; ARIA, Accessibility; GPs, General Practitioners, PHI, Private Health Insurance.

Zealand Dialysis and Transplant Registry collects and records incidence, prevalence and outcome data for patients with end stage kidney failure. Dialysis and kidney transplant units in Australia and New Zealand also contribute to this registry;[27] vii) Community Rehabilitation Centres are located throughout the region and will provide vocational rehabilitation data that will complement data sourced from hospital attendances and through Medicare.

Ethics approval

The study has been approved by the Human Research Ethics Committee at Barwon Health (project 15/11).

Discussion

The ACDI study is the first of its kind to provide a comprehensive account of the burden of disease and injury in western Victoria. A major strength of the study is its inclusion of a large geographic study population with varying degrees of remoteness. The importance of this aspect of the study relates to reported regional differences in the level of engagement with the health system by Australian residents.[5] While the numbers of public hospital separations are found to increase with the remoteness of the patients' place of residence, the instances of contact with general practitioners and specialists are relatively low for residents from regional and remote locations compared with those from urban areas.[5] There is thus a clear need to address this imbalance and encourage greater availability and usage of primary health care in

rural, regional and remote communities to avert potentially preventable hospital admissions. Our study region includes geographical areas from the most socioeconomically disadvantaged to some of the most advantaged in the state. This wide variation in demographic and socioeconomic indicators provides an opportunity to investigate their associations with disease burden and outcomes. Health inequities relating to socioeconomic position in Australia are exemplified by the greater mortality rates associated with chronic conditions such as stroke, coronary heart disease and respiratory illnesses among socially disadvantaged groups.[28] Availability of quality datasets, mandatory reporting for certain diseases (particularly cancers) and periodically administered national and state level health surveys will enable estimation of chronic disease and injury burden not only for our entire study region but also for different sub-populations. This study provides a framework for identifying sub-populations that would benefit from targeted interventions for disease prevention, access to health services and care transition needs to address health inequities in people who are financially or otherwise disadvantaged.[29] By collating data from existing health and administrative databases and emergency service records in combination with reported statistics for socio-demographic indicators and lifestyle factors, we will develop an informative summary of the health and wellbeing of the older populations in western Victoria. The aggregate data will be presented for the whole region and for sub-populations stratified by age, sex and location. While this study draws on a network of data pertinent to our study region, the methods described here provides a framework that can be replicated to develop detailed profiles for other clearly-defined geographical regions, particularly in non-metropolitan settings. These profiles will provide useful information for predicting future health service needs and identifying

Table 2. Prevalence of lifestyle risk factors in the study region.

Local Government Area	Current smoker*			Sedentary or insufficient physical activity°	Mostly sitting occupation	Obese#			Risky/high risk alcohol user (short-term risk of harm)§		
	Male	Female	Person	Person	Person	Male	Female	Person	Male	Female	Person
Ararat	16.1	16.0	16.8	30.0	32.2	20.8	19.9	20.9	59.7	45.4	52.4
Ballarat	21.9	9.6	15.6	30.3	43.5	19.6	18.0	18.8	60.6	43.6	51.6
Central Goldfields	21.5	9.0	15.1	30.2	26.8	28.1	21.8	25.5	59.8	29.0	44.5
Colac-Otway	19.7	11.9	15.8	31.9	22.6	13.8	18.8	16.2	66.1	46.9	56.2
Corangamite	16.6	19.3	17.5	24.1	24.8	26.9	14.5	20.4	60.5	41.6	50.5
Glenelg	21.2	20.3	19.9	29.9	34.1	23.6	19.2	21.7	65.3	38.8	52.9
Golden Plains	17.3	9.2	13.4	26.5	40.2	15.7	17.2	16.2	55.6	45.4	50.9
Greater Geelong	25.1	14.8	20.8	28.3	41.2	17.2	22.0	19.4	61.4	44.7	52.4
Hepburn	15.2	12.8	14.4	38.3	43.7	12.8	19.7	16.6	58.0	43.8	49.9
Hindmarsh	22.1	17.3	19.8	30.4	24.9	19.9	23.7	22.0	68.7	36.3	53.0
Horsham	16.6	5.90	11.1	31.8	28.2	15.9	27.5	21.4	49.3	33.4	41.3
Moorabool	15.6	12.0	13.9	34.8	45.8	21.1	21.0	20.7	55.9	38.6	47.4
Moyne	23.4	10.5	16.7	22.8	25.4	20.1	18.0	18.7	68.6	43.0	53.7
Northern Grampians	13.1	15.7	14.3	36.3	33.8	20.4	20.9	20.6	54.9	27.0	54.9
Pyrenees	26.7	21.1	23.2	23.6	20.1	22.7	19.5	21.4	65.5	45.0	55.5
Queenscliffe	24.5	12.1	16.6	20.7	48.5	12.8	5.4	9.10	70.6	50.6	60.1
Southern Grampians	11.8	12.8	12.2	25.6	18.3	18.4	18.6	18.5	68.6	42.5	55.2
Surf Coast	21.4	8.1	14.1	27.8	42.0	11.7	12.9	12.5	70.7	41.3	55.6
Warrnambool	11.5	11.1	11.4	30.7	34.9	16.5	18.3	17.5	54.1	40.6	47.2
West Wimmera	15.1	14.2	14.6	31.3	23.9	17.2	32.1	24.3	67.3	48.2	58.0
Yarriambiack	20.3	23.2	20.9	25.4	24.5	34.2	28.3	30.9	62.1	50.3	55.3
Victoria	18.5	12.9	15.7	32.1	48.1	17.4	17.2	17.3	52.6	38.3	45.3

Data are presented as percentage of population aged 18 years and over and were obtained from the Victorian Population Health Survey 2011-2012.[21] *Adults who reported smoking daily or occasionally. °Less than 150 minutes or fewer than five sessions of moderate intensity physical activity per week. #Body Mass Index >30 kg/m². §Based on the 2001 National Health and Medical Research Council guidelines (consuming >7 standard drinks on any one day for men and five to six standard drinks on any one day for women).

gaps in service delivery. In Australia, due to universal access to free or subsidised public health services through Medicare, a comprehensive record of health service usage is maintained.[30] Accessing Medicare data will enable us to understand patterns of health service utilisation by the study population in terms of consultations with health care providers and having prescriptions filled. Ecological studies, however, are subject to various limitations and biases.[31] As data are analysed at a population level rather than an individual level, inferring individual associations can be erroneous; a phenomenon referred to as ecological fallacy. For example, using a single median IRSAD score for an entire LGA is based on the assumption that all residents have the same level of socioeconomic advantage and disadvantage. Populations may be socioeconomically heterogeneous especially in the more densely populated LGAs. Furthermore, it is likely that the actual number of persons with chronic disease will be higher than what is being captured by a collation of disease-specific databases, for example the National Diabetes Services Scheme. Last, even though only de-identified aggregate data will be used, registers generally do not release data for low prevalence disorders to ensure confidentiality. This could lead to an underestimation of disease burden in areas where disease numbers are low. Within these constraints, this study aims to determine the burden of chronic disease and injury in western Victoria and provide direction for future longitudinal and data linkage studies.

Conclusions

The ACDI study provides a model for utilising routinely collected data for determining the burden of chronic disease and injury, which can be replicated in other geographical regions.

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References

1. Australian Bureau of Statistics. Population projections Australia. 2012 (base) to 2101.3222.0. Canberra, ACT: ABS, 2013.

2. Productivity Commission. Economic Implications of an Ageing Australia. Canberra, ACT: 2005.

3. Banks E. Cohort profile: the 45 and up study. Int J Epidemiol 2008;37:941-7.

4. Cripps R, Harrison JE. Injury as a chronic health issue in Australia. Canberra, ACT: AIHW; 2008.

5. Australian Institute of Health and Welfare. Australian health expenditure by remoteness: a comparison of remote, regional and city health expenditure. Health and welfare expenditure series no. 50. Canberra: AIHW; 2010.

6. Govender V, Chersich MF, Harris B, et al. Moving towards universal coverage in South Africa? Lessons from a voluntary government insurance scheme. Glob Health Action 2013;6:19253.

7. Mackenbach JP, Stirbu I, Roskam AJR, et al. Socioeconomic inequalities in health in 22 European countries. N Engl J Med 2008;358:2468-81.

8. US Department of Health and Human Services, Tracking Healthy People 2010, US Governemt Printing Office: Washington, DC, USA; 2000.

9. Cancer Council Victoria. Victorian Cancer Registry. (Online) 2014. Available from: http://www.cancervic.org.au/research/registry-statistics/vcr

10. Australian Bureau of Statistics. Australian Standard Geographical Classification. ASGC. (Online) 2014. Available from: http://www.abs.gov.au/websitedbs/D3310114.nsf/home/Australian+Statistical+Geography+Standard+%28ASGS%29

11. Australian Bureau of Statistics. Census of Population and Housing, Basic Community Profile. (Online) 2011. Available from: http://www.abs.gov.au/ausstats/abs@.nsf/mf/2001.0

12. Department of Health and Human Services. Life expectancy at birth: Victoria 2003 - 2007. Melbourne, VIC: DHHS; 2014.

13. The Department of Economic Development, Jobs, Transport, and Resources. Industry Profiles. (Online) 2015. Available from: http://agriculture.vic.gov.au/agriculture/food-and-fibre-industries/industry-profiles

14. Department of Health,Victoria. Public emergency department status. (Online) 2014. Available from: http://performance.health.vic.gov.au/Home/Emergency-department-status.aspx.

15. Australian Bureau of Statistics. Life expectancy trends-Australia. Cat. No. 4102.0. Canberra, ACT: 2011.

16. Commonwealth Department of Health and Aged Care. Measuring Remoteness: Accessibility/Remoteness Index of Australia (ARIA). Occasional Papers: New Series Number 14. 2001. Canberra, ACT; 2001.

17. Department of Health, Victoria. Health status of Victorians. LGA by ARIA category. (Online) 2011. Available from: http://www.health.vic.gov.au/healthstatus/atlas/html/lga_by_aria_category.html

18. Australian Bureau of Statistics. 2033.0.55.001 - Census of Population and Housing: Socio-Economic Indexes for Areas (SEIFA), Australia. Canberra, ACT: 2014.

19. Department of Health and Human Services. Victorian State Trauma System: Regional trauma services locations. (Online) 2014. Available from: http://www.health.vic.gov.au/trauma/regional-services/regional-services-locations.htm

20. Department of Health and Human Services. Local Government Area profiles. Melbourne, VIC: 2014.

21. Department of Health. Victorian Population Health Survey 2011-

2012, survey findings. Melbourne, VIC: 2015

22. Diabetes Australia. National Diabetes Services Scheme. (Online) 2015. Available from: http://www.ndss.com.au/

23. Department of Health and Human Services. Victorian Admitted Episodes Dataset (VAED). (Online) 2015. Available from: http://www.health.vic.gov.au/hdss/vaed/

24. Department of Health and Human Services. Victorian Emergency Minimum Dataset (VEMD). (Online) 2015. Available from: http://www.health.vic.gov.au/hdss/vemd/

25. Department of Human Services. Medicare Statistics. (Online) 2015. Available from: http://www.humanservices.gov.au/corporate/statistical-information-and-data/medicare-statistics

26. Data Management & Analysis Centre, School of Population Health, University of Adelaide. Australian Orthopaedic Association National Joint Replacement Registry. (Online) 2015. Available from: https://aoanjrr.dmac.adelaide.edu.au/

27. Australia and New Zealand Dialysis and Transplant Registry. ANZ-DATA. (Online). Available from: http://www.anzdata.org.au/v1/structure.html

28. Australian Institute of Health and Welfare. Chronic diseases and associated risk factors in Australia, 2001. Canberra: AIHW; 2002.

29. Wilson AJ, Oldenburg BF, Lopez AD. Targeted approaches for reducing inequities in chronic disease. Med J Aust 2003;179:231-2.

30. Department of Human Services. Medicare services.(Online) 2015. Available from: http://www.humanservices.gov.au/customer/subjects/medicare-services

31. Greenland S. Ecologic versus individual-level sources of bias in ecologic estimates of contextual health effects. Int J Epidemiol 2001;30:1343-50.