Medical Science

Volume 2, Issue 3, 246–260.
DOI: 10.3934/medsci.2015.3.246
Received date 1 July 2015,
Accepted date 14 August 2015,
Published date 18 August 2015

http://www.aimspress.com/

Research article

A Descriptive Study of Health, Lifestyle and Sociodemographic Characteristics and their Relationship to Known Dementia Risk Factors in Rural Victorian Communities

Kaye Ervin [1,*], Julie Pallant [1], Daniel R. Terry [1], Lisa Bourke, David Pierce [1], and Kristen Glenister [1]

[1] Department of Rural Health, University of Melbourne, Vic, Australia

* **Correspondence:** Email: ervink@humehealth.org.au.

Abstract: It is essential to determine the key health risk factors among populations to specifically plan future services and explore interventions that modify risk factors for communities. This aims to reduce risks and delay the onset of chronic conditions, which frequently results in dementia, particularly for small rural communities which experience health workforce shortages, a higher proportion of those in the chronic conditions age group, and reduced access to care. The aim of the study was to determine existing rates of chronic disease, and current lifestyle and sociodemographic factors which may predispose the population to higher risk of dementia. Residents from three shires in rural Victoria, Australia were recruited by random and non-random sampling techniques to complete a survey regarding health perceptions, pre-existing illnesses, health behaviors and social activity in their community. A total of 1474 people completed the survey. Positive factors reported were social participation and low rates of smoking. Negative factors included low rates of physical activity, high rates of obesity and high rates of chronic conditions that indicate significant risk factors for dementia in these communities. Although some factors are modifiable, these communities also have a large population of older residents. This study suggests that community interventions could modify lifestyle risk factors in these rural communities. These lifestyle factors, age of residents and the current chronic conditions are also important for rural service planning to increase preventive actions, and warn of the likely increase in the number of people developing chronic conditions with predispositon to dementia.

Keywords: rural; health risks; lifestyle factors; education; social interaction; chronic conditions; dementia

1. Introduction

The prevalence of chronic conditions is increasing in Australia with more than half of the population aged 65–84 years having five or more long term conditions, which now contributes to 80% of disease burden in Australia [1]. Because chronic conditions are frequently a precursor to the development of dementia, rates of chronic conditions and health behaviors that predispose to chronic conditions also impact on rates of dementia prevalence. Risk factors for chronic disease also translate as risk factors for dementia.

Dementia is a progressive disease that affects memory, thinking, behavior and the ability to perform everyday activities. Dementia has an insidious onset typically characterized by a decline in cognitive function, including memory and reasoning. It is one of the main causes of dependence and disability in older people [2] yet currently there is no cure [3].

The number of people living with dementia worldwide is estimated to be 44 million and this is predicted to double by 2040 [3,4]. The global economic impact of dementia is estimated to be over six billion US dollars, and rising, while the social impact on informal and formal care provision will be significant [2,5,6]. Many countries consider the care of people living with dementia to be a national priority, and invest in resources and education to better inform health workers, unpaid caregivers, relatives and members of the wider community. Several countries have national plans or strategies [7].

Within Australia, 330,000 people have a diagnosis of dementia; with one in ten Australians over the age of 65 living with the disease. The health care cost in Australia alone is more than five billion (AUSD) dollars annually [8]. Specifically, there were approximately 20,000 new cases of dementia in Victoria in 2011 [9] and the prevalence of dementia is forecast to increase by over 200% in the Hume region of Victoria by 2050 [10]. The Hume region is located in the North East of Victoria and includes 12 Local Governments or Shires and has a population of 267,071 people [11].

There is persuasive evidence that the dementia risk for populations can be modified. The future course of the global dementia epidemic is likely to depend crucially upon the success of efforts to improve global public health. While risk factors such as low education, hypertension, smoking and diabetes are well known for causal link with dementia [2], little is known about the specific risk factors among subgroups within rural and regional populations. Other risk factors such as age and genetics, while not modifiable, are also important to consider when planning future service provision.

A research team from the University of Melbourne, Department of Rural Health undertook a health and well-being survey of residents in three of the 12 local government areas within the Hume region, specifically in the Shires of Moira, Wangaratta and Greater Shepparton. While dementia prevalence was not specifically captured within the survey, key dementia risk factors across the regions were captured and are reported here. The strength of the study is that the majority of participants were an older cohort and are of particular interest with dementia risk research.

The aim of this paper is to explore factors related to dementia risk among rural residents in northern Victoria. These findings from the Hume region may be important for other similar settings raising awareness about health planning needs, addressing identified risk factors and promoting those protective factors identified.

2. Methods

2.1. Recruitment

A number of recruitment methods were utilized for the study. Initially a survey and plain language statement were mailed to households in Moira, Wangaratta and Shepparton Shires. Names were randomly selected from telephone directories for each area and addressed to participants by name, asking the person in the household with the most recent birthday (aged of 16 years or older), to complete the survey and return it in the pre-paid envelope. This survey was distributed to 2901 households between September and October 2014. All households were sent a reminder postcard 10 days later. A second wave of identical surveys was mailed out to non respondents three weeks after the postcard mail out.

Recruitment by random sampling was supplemented using surveys and plain language statements distributed in public areas of major towns and in busy waiting areas, such as medical clinics, pathology collection centers, community libraries, post offices and local corner stores in the more rural areas. Simultaneously, an online version of the survey was distributed to known community contacts among the research team, such as health service staff, sporting and social groups.

Utilizing a number of different recruitment methods in a single study is becoming increasingly popular [12], as recruitment is acknowledged as one of the biggest challenges to research. Heterogeneous strategies for recruitment have proven effective [13]. There is evidence that using diverse and comprehensive methods to recruit participants increases the response rate and reduces selection bias [14]. In addition the research team was interested to test response rates for the different recruitment methods to inform further research.

2.2. Survey tool

The questionnaire was comprised of thirty five questions, divided into four sections. The sections included (i) demographic data; (ii) health perceptions, pre existing illnesses and health behaviors; (iii) health services, barriers to utilization and perceptions of health services; and (iv) social and cultural perceptions in the local community. Each question underwent face and content validation, while psychometric properties had been evaluated within the research team. Some questions mirrored the Crossroads Undiagnosed Disease Study (CUDS) that was conducted in the Hume area more than a decade earlier [15]. Other questions were measures validated in other studies.

Questions related to the level of education, age, gender, pre-existing illnesses, height, weight, exercise, alcohol consumption, cigarette use and social attendance are discussed in this paper, based on established causal links with dementia. Education was measured in six categories, ranging from Year 9 or less to university degree or higher. Age was measured in years, gender as male/female, weight in kilograms and height in centimeters. In addition, one question asked ‘how many days a week do you normally exercise for 30 minutes or more?’ and ‘do you socialize or attend social events, such as volunteering, dancing, exercise groups, community groups, book clubs, catching up with friends’? Respondents were asked ‘if you drink alcohol, how many drinks of alcohol would you have in a week?’ and ‘do you currently smoke cigarettes/cigars/pipes?’ and if so how many each day. A list of 14 illnesses were provided and respondents were asked to identify if they had been diagnosed with

each condition ‘never’, ‘diagnosed within the last 2 years’, ‘diagnosed more than 2 years ago and condition has impact on my life now’ and ‘diagnosed more than 2 years ago, condition has no impact on my life now.’ The survey tool is available from the corresponding author and can also be found at (http://www.ruralhealth.unimelb.edu.au/research/projects%20and%20publications/index.html)

From their self-reported height and weight, BMI was calculated (kg/m^2) to identify underweight (less than 20), normal weight (20–24), overweight (25–29) and obese (30 or greater) [16].

2.3. Analysis

Data were entered into Microsoft Excel and SPSS v20.0 for analysis. Descriptive statistics (frequencies and percentages) were generated for all items [17]. Chi-square tests were used to explore the impact of factors such as gender and age on dementia risk factors. Due to the skewed distribution of age it was collapsed into three groups for statistical analyses (16–49 years, 50–65 years and 66 years and over). Statistical significance was set at $p < 0.05$ and effect size statistics were calculated using Cohen’s [18] criteria to judge whether the effect was small, medium or large. To assess the impact of gender (male Vs female) the phi coefficient was used (small = 0.01, medium = 0.30, large = 0.50), and for assessing age (3 age categories) Cramer’s V were calculated (small = 0.07, medium = 0.21, large = 0.35).

2.4. Ethical approval

Approval to conduct the research was granted by the University of Melbourne Human Research Ethics Advisory Group. By completing and returning the survey, participants gave consent for the responses to be included in the study and in this way remained anonymous.

3. Results

A total of 989 random surveys were returned representing a 34% response rate. For the random sampling method (mail out) there were 224 respondents to the second wave. The response of these 224 late responders was compared to the first wave of responders as an estimate of bias. There were no statistical differences between the first wave of respondents and the second wave of respondents on any of the measures reported in the study. This suggests that the results reported are valid.

For the other recruitment methods a further 392 non-random surveys were returned via mail and 93 online surveys were completed. This is a total of 1474 completed surveys. The survey responses for each type of recruitment are stratified into regions as shown in Table 1.

Table 1. Survey responses by region.

Region	Random	Non-random paper	Non-random Online	Total return
Greater Shepparton	476	141	35	652
Wangaratta	278	29	12	319
Moira	235	222	46	503
Total	989	392	93	1474

The demographics of the participants are shown in Table 2. There was an even distribution of men and women, (51% and 49% respectively), with similar gender ratios for each region. Overall 17% reported completing tertiary qualifications, which varied between 16% to 20% across the three regions. The number of people classified as overweight or obese was 68%, which was similar for each region. The median age of participants was 60 years. Participants aged over 65 years varied for each region, with the smallest proportion from Wangaratta and the larger percentage for Greater Shepparton. Overall, participants aged over 65 years totaled 29%. With the exception of participants aged over 65 years, the regions are relatively homogenous across many demographic aspects.

Table 2. Demographic characteristics.

Characteristic	Shepparton *n* = 650 (45%)	Moira *n* = 489 (33%)	Wangaratta *n* = 315 (22%)	All regions *n* = 1454 (100%)
Age (years)				
– Median (IQR)	58 (48, 68)	60 (47.5, 71)	60 (50, 69)	60 (48, 69)
– Range	16–97	16–93	16–97	16–97
Aged over 65	226 (44.0%)	174 (34.0%)	114 (22.0%)	514 (29.0%)
Gender				
– Males	335 (52.0%)	204 (43.0%)	161 (52.0%)	682 (51.0%)
– Females	306 (48.0%)	275 (57.0%)	148 (48.0%)	655 (49.0%)
Education				
– Year 12 completion	55 (8.7%)	51 (11.0%)	35 (11.0%)	135 (10.0%)
– Technical And Further Education certificate	54 (8.3%)	30 (6.3%)	28 (9.0%)	135 (10.0%)
– Diploma or trade	100 (15.4%)	72 (15.0%)	44 (14.0%)	201 (15.0%)
– University degree	129 (20.0%)	97 (20.0%)	48 (15.6%)	225 (17.0%)
BMI range				
– Overweight	219 (36.7%)	166 (38.0%)	111 (40.0%)	608 (38.0%)
– Obese	183 (31.0%)	124 (28.0%)	83 (30.0%)	486 (30.0%)

Self reported health conditions and health behaviors of participants were also consistent across the three regions so further results are shown as a whole of the combined regions. Table 3 highlights the number of participants who reported receiving a diagnosis of any major disease or health condition. This reflects some discrepancy in diagnosed and undiagnosed diseases. For example, Table 2 indicates that 30% of participants' BMIs were in the obese range, whereas only 16% of the participants reported receiving a formal diagnosis of obesity. In addition, 13% of the participants had received a diagnosis of diabetes, 16% a diagnosis of heart disease and 4% had been diagnosed as having had a stroke. A substantial proportion of the sample had received a diagnosis of hypertension (46%) or depression (25%).

Ninety percent of the participants reported that they did not smoke and 38% reported that they did not consume alcohol. Of those who reported drinking, 12% drank more than the recommended guidelines of 14 drinks per week. Over half of the sample (55%) did not meet the current recommended guidelines for exercise. Forty five percent of respondents did report exercising for 30 minutes per day, five days per week. Twenty percent of the participants reported that they did not participate in social events.

Table 3 shows the rates of self reported diagnosed chronic conditions identified by gender. Diagnosis of stroke, obesity or hypertension did not vary significantly between genders. There were more males than females diagnosed with diabetes and heart disease, but more females with diagnosed depression. Modifiable risk factors such as drinking more than the recommended guidelines and non-socialization was significantly higher in males, while low rates of exercise was higher for females. Rates of smoking were equivalent for both genders. More females than males abstain from alcohol.

Table 3. Comparison of gender for self reported health conditions and behaviors for dementia risk factors.

Risk factor	Total sample *n* (%)	Males *n* (%)	Females *n* (%)	X^2	*Effect size
Diagnosis of stroke	42 (4%)	28 (5%)	14 (3%)	0.027	−0.067
Diagnosis of diabetes	148 (13%)	94 (17%)	54 (10%)	0.001	−0.104
Diagnosis of heart disease	176 (16%)	112 (20%)	64 (12%)	< 0.001	−0.114
Diagnosis of obesity	173 (16%)	68 (13%)	105 (20%)	0.006	0.084
Diagnosis of depression	269 (25%)	103 (19%)	165 (30%)	< 0.001	0.124
Diagnosis of high blood pressure	547 (46%)	289 (49%)	257 (43%)	0.045	−0.058
Reported smoking	138 (10%)	70 (10%)	66 (10%)	0.898	−0.004
Does not drink alcohol	490 (38%)	173 (27%)	306 (48%)	< 0.001	−0.082
Drinks more than 14 alcoholic drinks per week	155 (12%)	147 (20%)	33 (4%)	< 0.001	0.153
Does not meet the recommended guideline for exercise (30 minutes or more 5 days per week)	566 (55%)	248 (44%)	317 (60%)	< 0.001	−0.118
Does not attend social events	271 (20.0%)	166 (25%)	101 (16%)	< 0.001	−0.112

* Effect size calculated using phi coefficient (Cohen's criteria for 0.10 for small effect, 0.30 for medium effect and 0.50 for large effect).

Self reported diagnosed chronic conditions were further analyzed by age groups. Apart from depression and obesity, which did not vary significantly in rates of diagnosis across all age groups, all other rates of diagnosed chronic conditions increased with age. These results are shown in Table 4.

As expected, rates of diagnosed heart disease and hypertension increased significantly with age, with a large effect size. Similarly, diagnosed diabetes increased with age with a moderate effect size. The rates of stroke were too low in the 16–49 age group to analyse X^2 by age, or calculate Cramer's V, but there was a trend of increasing diagnosis with age.

There was no relationship between rates of diagnosed depression with age, with lower rates in the older age group, and highest in the 50–65 year age group. Although rates of diagnosed obesity did increase slightly with age, it was not statistically significant.

As shown in Table 4, modifiable risk factors were also analyzed by age group. Rates of consuming more alcohol than the recommended guidelines of 14 drinks per week was highest in the 50–65 year age group, with a moderate effect size. Similarly, rates of smoking was highest in the 50–65 year age group. There was a trend of decreasing socialization with age, though this was not

significant. Frequency of exercise decreased with age, with analysis showing those not meeting the recommended guidelines of 30 minutes of exercise, five times a week increasing with each age group.

Table 4. Comparison of age groups for self reported health conditions and behaviors for dementia risk factors.

Risk factor	16–49 yr age group *n* (%)	50–65 yr age group *n* (%)	66+ yr age group *n* (%)	X^2	*Effect size
Diagnosis of stroke	2 (5)	13 (31)	27 (64)		
Diagnosis of diabetes	21 (14)	43 (29)	83 (57)	< 0.001	0.219
Diagnosis of heart disease	7 (4)	42(24)	125 (72)	< 0.001	0.381
Diagnosis of obesity	42 (26)	62 (36)	63 (38)	0.073	0.070
Diagnosis of depression	81 (31)	112 (42)	73 (27)	0.811	0.020
Diagnosis of high blood pressure	56 (10)	205 (38)	279 (52)	< 0.001	0.424
Reported smoking	50 (38)	65 (49)	17 (13)	< 0.001	0.163
Drinks more than 14 alcoholic drinks per week	24 (16),	80 (52)	50 (32)	< 0.001	0.341
Does not meet the recommended guideline for exercise (30 minutes or more 5 days per week)	86 (18)	184 (40)	193 (42)	< 0.001	0.178
Does not attend social events	58 (22)	102 (38)	106 (40)	0.209	0.049

* Effect size calculated using Cramer's V (Cohen's criteria for small = 0.07, medium = 0.21, large = 0.35).

4. Discussion

The findings from this study in the Hume region suggest that a substantial proportion of rural Victorians are engaging in unhealthy lifestyles which may predispose them to developing a variety of chronic diseases, including dementia. There are high rates of self reported existing chronic conditions, such as diabetes (13%), hypertension (46%) and heart disease (16%). There are also a number of existing risk factors which are modifiable, such as high rates of obesity (30%) and high rates of people who do not meet the recommended guidelines for exercise (63%). Protective factors reported include low rates of smoking (10%) and high rates of social participation (80%).

4.1. Education

There is considerable evidence regarding the link between dementia incidence and access to secondary and tertiary education [19–21]. There are a number of possible reasons proposed to explain this, including increased brain reserve which compensates for deficits [21], efficiency of neural networks, which again provides a compensatory effect, and cofounding aspects such as people

with higher educational attainment, are also more likely to have superior health care [2]. One study found that lower educational attainment was associated with significantly higher risk factors, and this effect was more pronounced for females than males [22]. In this study, overall 12% of males and 23% females had achieved tertiary qualifications (17% overall). The Australian Bureau of Statistics [23] reported that 13% of Moira, 17% of Greater Shepparton and 20% of the Rural City of Wangaratta residents had attained a tertiary qualification, which is similar to the results found in this study. The findings here then suggest that more than 80% of people in the study area do not have higher education as a protective factor against the risk of developing of dementia. This education disadvantage may not be immediately reversible in rural areas but does suggest more active approaches in rural communities to promote education may be appropriate.

4.2. Age

Age is a non-modifiable risk factor for dementia, and therefore the age of the population being studied provides an indication of potential incidence within a given timeframe. It is thought that dementia probably develops over a lengthy time period, with the earliest detectable signs of brain plaques occurring in the fifth decade of life [24]. One in ten people over the age of 65 years have dementia [8]. In this study, 29% (n = 514) of respondents reported being 65 years or older. This is congruent with the demographic profile, with 25% of the three regions combined reported to be over 65 years. According to the Australian Bureau of Statistics (ABS), just over 8,100 (29%) people are aged over 65 years in the Moira shire [23]. Similarly, Greater Shepparton has 12,363 (20%) people aged over 65 years and Wangaratta has 6,962 (26%) people over 65 [23]. For the three regions, this equates to a minimum of 270 people per year for the next five years who will likely be diagnosed with dementia, with the risks increasing in proportion to age and doubling every five years [25]. This is likely to be greater additional health burden to be addressed in rural areas compared to urban areas because of the generally older rural demographic. These projections exclude younger onset dementia which although much smaller numerically, is also increasing in prevalence [25]. There were more people aged over 65 years as participants in this study compared to the ABS figures, which is likely to be a result of the initial recruitment method.

4.3. Lifestyle

Lifestyle factors are modifiable and often the target of health promotion activities. Smoking, alcohol consumption, levels of physical activity and dietary habits are all reported in this study due to the extremely important relationship between these known causal factors and dementia. Ten percent of respondents in the study reported currently smoking cigarettes. Statistics for the Hume region show far greater numbers than this for Shepparton (25%) and Moira (27%) [26]. There is strong evidence to support an association between current smoking and the incidence of dementia [27]. Early studies, widely promoted by the tobacco industry, suggested that cigarette smoking may be protective against dementia, which has since been discredited [27]. The lower number reporting to be smokers in this study may be related to the age of the respondents, smoking may be more prevalent in younger age groups.

Despite alcohol consumption being implicated as a causal factor in multiple diseases and injuries, light to moderate alcohol intake does not increase dementia risk [28]. It is suggested that

moderate drinkers are at lower risk of dementia than people who abstain or drink heavily [29]. Moderate drinking is defined as 1–14 units per week, heavy drinking is defined as drinking at levels above moderate [2]. Heavy alcohol consumption is associated with alcohol-related dementia. In this study, 53% reported moderate levels of drinking, while 38% (n = 524) reported abstinence and 18% reported heavy consumption (above 14 drinks per week). Despite the evidence supporting moderate alcohol consumption as protective against dementia, experts warn that non drinkers should not be advised to take up alcohol consumption until more research provides conclusive evidence [2]. The rates of heavy consumption of alcohol is of concern for alcohol related dementia risk in the region but a positive finding is that more than half drank at levels which are considered protective. This result should be interpreted with caution however, as self reported tools have shown that respondents underestimate their levels of consumption and the survey did not specify standard drinks (10gms of alcohol) [30].

Forty five percent of respondents reported exercising for a minimum of 30 minutes per day, five times a week, which is the current recommendation for health [31]. This equates to more than half (55%) not meeting the recommended guidelines for exercise. In comparison, Hume region statistics show that in all the regions in this study, only 22–25% of participants did not meet the current guidelines [32]. However, it must be noted the Hume regional health status profiles statistics are based on estimations rather than actual numbers which may provide some indication of the wide differences [32]. These data on rates of exercise add to the argument that active promotion of regular exercise is an important general health, including dementia limiting, activity in rural communities.

It was also found that only smaller numbers of participants aged over 65 years reported meeting the current guidelines for exercise. This trend is worrying, given that recent research shows exercise has the ability to delay and even reverse cognitive deficits in people with early symptoms of dementia [33]. Physical activity or exercise is ranked as a leading health indicator [34] with strong cardiovascular benefits and so has both a direct and indirect link to dementia prevention [35]. Results from numerous studies demonstrate that physical activity is associated with a reduced risk of dementia [2]. These data again reinforce the need, not only for general exercise programs in rural communities but also programs specifically targeted at those over 65 years.

4.4. Social participation

The majority of respondents in the study reported belonging to social groups (80%), though this declined slightly for participants over 65 years old. The high rates of social participation is a positive finding given that social participation provides cognitive stimulation through active intellectual involvement, compared to activities such as television watching [2]. It should be remembered that reduction in social participation is often a pro-dromal sign of dementia itself, including apathy and depression thought to be caused by the difficulties of the cognitive impairment. The high rates for social participation found in this study are positive for all health benefits including reduced risk of dementia.

It should also be acknowledged that high rates of social participation is an important element in the lives of many rural people [36]. Previous studies have shown that regular participation in social or leisure activities such as travelling, odd jobs, knitting, reading, writing, games or gardening were associated with a lower risk of subsequent dementia [37,38]. In addition, improved quality of life and perceived better overall health is reported in people who participate socially [39], though one study

showed that it was not a predictor of successful ageing – defined as the absence of disease [40]. This study suggests that there is a firm base of desirable social engagement in the rural communities studied. Identifying key factors associated with this, to support their continuation, may be an important health planning approach for rural communities. Furthermore, social participation may be a factor in promoting positive health behaviors, such as walking groups, social sporting activities, and so forth.

4.5. Depression

Dementia and depression are often concurrent, though the mechanism for this is poorly understood nevertheless; depression is associated with disability, co-morbidity and health care costs, all of which worsen dementia prognosis. It has been proposed that depression could be a symptom of dementia, a pro-dromal phase or an independent risk factor [41,42]. Regardless, there is a positive association between depression and onset of dementia [2]. In this study, a high proportion (n = 269) of respondents reported being diagnosed with depression, 19% were male and 30% were female. Rates of depression peaked in the 50–65 year age group, previous findings mean that this group is particularly vulnerable to late life dementia [43]. Although the study was not specifically measuring dementia, the association between dementia and depression [44], suggests that the interconnectedness between depression, health risk factors and health behaviors may provides some insight into the impact that may be linked with potential dementia occurring within the community.

4.6. Cardiovascular risk

Hypertension, obesity, hypercholesterolaemia and diabetes are all positively associated with the incidence of dementia [45]. There is particularly strong evidence for an association between midlife hypertension and hypercholesterolaemia and later life dementia [46]. Worryingly, 46% of the study participants reported a diagnosis of high blood pressure or high cholesterol (the question was combined). Studies that have attempted to determine the effects of antihypertensives and statins found that there was not sufficient significant evidence that it prevented the development of dementia in people with hypertension or hyperlipadaemia [2]. These findings suggest that prevention of hypertension and hyperlipadaemia is the only key to reducing the prevalence of cardiovascular related dementia.

Only 16% of the sample in this study reported that they had been diagnosed with obesity. Of those who reported their height and weight (which subsequently allowed calculation of body mass index) 30% may be considered obese according to current guidelines. This is congruent with current statistics, with 60% of adult Australians being overweight or obese [16]. Obesity predisposes populations to all other cardiovascular risks and subsequently increases the risk of dementia.

Lastly, diabetes is one of the most common chronic conditions in Australia [47]. In this study 13% reported a diagnosis of diabetes. The World Alzheimer's Report (2014) confirms a particularly strong and consistent association between diabetes and subsequent onset of dementia, and the important implications for prevention.

5. Limitations

Clearly, this study under-represents residents between 16 and 50 in these population areas. The greatest response to the survey came from randomly surveyed participants. The recruitment method used for this group was the telephone directory. This likely biased the recruitment toward older age groups, as younger age groups are less likely to have fixed telephone lines [48].

Although the response rate could be considered low, a study of response rates of six well regarded journals found that the average response rate was below 40% [49]. It is unwise to define a level above which a response rate is acceptable, as this depends on many local factors [50]. While it is acknowledged that non-response bias represents a significant threat to validity, high response rates are also found to contain bias [51]. One method of validating results when response rates are low is to compare non responders to responders. Late responders can also be used as surrogates for non responders as previous research has shown they are similar in their responses [52].

The question relating to alcohol did not ask participants about standard drinks (10gm alcohol) but rather 'how many drinks'. This would most likely lead to underestimation and the levels of drinking may be much higher than that reported. Overall, the use of a self reporting measurement tool, such as the one utilized in this study, is known to produce socially desirability bias, where participants over report healthy behaviors and under report unhealthy behaviors [30].

6. Conclusion and Recommendations

Rural communities are known to experience poorer health than their urban counterparts [53], but many of the contributing factors are modifiable. Modifying risk factors for dementia is an important strategy to minimize the current burden on the health system and makes economic sense if it delays or prevents the incidence. While the financial burden of dementia is considerable, and increasing in rural areas [10], this is compounded by the workforce shortages in rural health services [54]. The ageing population in the Hume region, while not modifiable, is important to consider when planning health services, especially as dementia incidence increases with age.

Rural communities are recognized as being disadvantaged in terms of access to health care and scarcity of resources [55]. It is imperative that communities can predict their future health care needs in order to provide the best possible care. While world-wide and national studies describing trends are useful, local level data is also essential, especially in rural areas where long term planning and recruitment is necessary to fill predicted needs. This study suggests that planning for a potential increase in people with dementia is a reality for areas of the Hume region.

Cardiovascular and related lifestyle risk factors for dementia are the most modifiable of all risk factors for dementia incidence, and are frequently the focus of public health promotion programs and activities. Interventions that are aimed at increasing rates of exercise across all age groups in the study area are imperative to reverse the trend of high risk factors for dementia. In addition to exercise positively impacting on cognitive function, it impacts positively on other risk factors such as obesity and in turn other chronic conditions such as hypertension, hyperlipadaemia and diabetes [2]. Exercise as an intervention alone has the ability to influence all chronic condition outcomes, as well as preventing occurrence in the first instance.

While lifestyle changes, such as increasing the rate of exercise, are acknowledged as difficult to achieve for multi-factorial reasons, the benefit in risk reduction for dementia and other chronic

conditions in later life is substantial [2]. Physical activity is a strong predictor for successful ageing, defined as the absence of disease, the maintenance of function and active engagement with life [56]. Targeted interventions to reverse the trends of the negative findings, particularly reported low rates of exercise, are essential. There are many proven community wide initiatives to improve physical activity in populations, which could be readily adapted by local governments, including mass media campaigns, physical activity clubs and worksite based exercise groups [34,57,58]. Given strong social participation, collective and social activities could be a means to promoting healthier lifestyles.

The positive findings from this study should also be reinforced; reported low rates of smoking and excellent rates of social participation are important in risk reduction for dementia. These findings could serve as a platform for further research to inform other small rural communities in reducing these dementia risk factors.

Acknowledgements

The authors would like to thank Adam Syme, Nicole Roberts, Rebecca Drew, Tony Conti, Maddalena Cross and Deborah Butcher for assistance with questionnaire distribution and data entry and all those who completed the questionnaire. We also acknowledge the Australian Government Department of Health University Department of Rural Health Program for funding.

Conflict of Interest

The authors declare no conflict of interests regarding this paper.

References

1. Stone G, Packer T (2010) Evaluation of a rural chronic disease self management program. *Int Electro J Rural Remote Health* 10(1203).
2. Alzheimers Disease International. (2014) Dementia and risk reduction. An analysis of protective and modifiable factors. World Alzheimers Report 2014.
3. Schrijvers EMC. (2011) Biomarkers and Risk Factors of Dementia. The Netherlands: Erasmus University Rotterdam.
4. Prince M, Bryce R, Albanese E, et al. (2013) The global prevalence of dementia: a systematic review and metaanalysis. *Alzheimer's Dementia* 9(1): 63-75.e2.
5. Harding R, Gao W, Jackson D, et al. (2015) Comparative analysis of informal caregiver burden in advanced cancer, dementia and acquired brain injury. *J Pain Symp Manag.*
6. Hutchinson K, Roberts C, Kurrle S, et al. (2014) The emotional well-being of young people having a parent with younger onset dementia. *Dementia*.
7. Alzheimer's Disease International. (2012) National Alzheimer and Dementia Plans Planned Policies and Activities. Conference proceedings, London, April 2012.
8. Gillings D (2014) World Dementia Envoy opening the Global Dementia Legacy Event 19th June 2014. http://dementiachallengedhgovuk.
9. Alzheimers Australia. (2014) Dementia Statistics for Victoria. https://vicfightdementiaorgau/vic/research-and-publications/reports-and-publications/dementia-statistics

-for-victoria.
10. Deloitte Access Economics. (2013) Dementia Prevalence Data Alzheimers Australia https://vicfightdementiaorgau/vic/research-and-publications/reports-and-publications/dementia-statistics-for-victoria).
11. Victoria SGo (2013) Regional Health Status Profiles 2011-2012. Melbourne, Victoria, Australia: State Government of Victoria, Department of Health; Contract No.: Document Number.
12. Leung B, McDonald S, Kaplan B, et al. (2013) Comparison of sample characteristics in two pregnancy cohorts: community-based versus population-based recruitment methods. *BMC Med Res Methodol* 13(49).
13. Manca D, O'Beirne M, Lightbody T, et al. (2013) The most effective strategy for recruiting a pregnancy cohort: a tale of two cities. *BMC Pregna Childbirth* 13(75).
14. Sanders K, Stuart A, Merriman E, et al. (2009) Trials and tribulations of recruiting 2,000 older women onto a clinical trial investigating falls and fractures: Vital D study. *BMC Med Res Methodol* 9(78).
15. Simmons D (2005) Characteristics of hypertensive patients and their management in rural Australia. J *Hum Hypertens* 19(6): 497-499.
16. Australian Government Department of Health. (2013) Clinical Practice Guidelines for the Management of Overweight and Obesity in Adults, Adolescents and Children in Australia. http://wwwhealthgovau/internet/main/publishingnsf/Content/obesityguidelines-indexhtm.
17. Munro BH (2005) Statistical methods for health care research. 5th ed. Philadelphia: Lippincott Williams & Wilkins.
18. Cohen J (1988) Statistical power analysis for behavioural sciences. 2nd ed(Hillsdale, NJ.).
19. Mortimer J (1988) Do psychosocial risk factors contribute to Alzheimer's disease? Etiology of dementia of Alzheimer's type.
20. Stern Y, Gurland B, Tatemichi T, et al. (1994) Influence of education and occupation on the incidence of Alzheimer's disease. *JAMA* 271(13): 1004-1010.
21. Stern Y (2012) Cognitive reserve in ageing and Alzheimer's disease. *Lancet Neurology* 11(11): 1006-1012.
22. Mortimer J, Graves A (1993) Education and other socioeconomic determinants of dementia and Alzheimer's disease. *Neurology* 1993.
23. Australian Bureau of Statistics. (2011) Census of Population and Housing 2006 and 2011. profileid.
24. Braak H, Braak E, Bohl J, et al. (1998) Evolution of Alzheimer's disease related cortical lesions. *J Neural Transmis Suppl* 54: 97-103.
25. Vieira R, Caixeta L, Machado S, et al. (2013) Epidemiology of early-onset dementia: a review of the literature. *Clin Prac Epidemiol Mental Health* 9: 88-95.
26. Department of Health. (2013) 2012 Regional health status profiles—Hume Region. Melbourne, Victoria: Department of Health.
27. Chang C, Zhao Y, Lee C, et al. (2012) Smoking, death and Alzheimer's disease: a case of competing risks. *Alzheimer Dis Assoc Disord* 26(4): 300-306.
28. Letenneur L, Larrieu S, Barberger-Gateau P (2004) Alcohol and tobacco consumption as risk factors of dementia: a review or epidemiological studies. *Biomed Pharmacotherapy* 58(2): 95-99.
29. Ronskley P, Brien S, Turner B, et al. (2011) Association of alcohol consumption with selected

cardiovascular disease outcomes: a systematic review and meta-analysis. *BMJ* 324: 671.
30. Grimm P (2010) Social Desirability Bias. *Marketing Research* 2
31. Centres for Disease Control and prevention. (2014) How much physical activity to adults need? http://wwwcdcgov/physicalactivity/everyone/guidelines/adultshtml.
32. Victorian Government Department of Health. (2012) 2012 regional health status profiles. Hume region. State Government of Victoria.
33. Lui-Ambrose T (2012) Impact of regular exercise on cognitive function. Second International Conference on Aging—5-6th November 2012; Vancouver, Canada.
34. Kahn E, Ramsey L, Brownson R, et al. (2002) The effectiveness of interventions to increase physical activity: a systematic review. *Am J Prevent Med* 22.
35. Rolland Y, Abellan van Kan G, Vellas B (2008) Physical activity and Alzheimer's disease: from prevention to therapeutic perspectives. *J A Med Dir Assoc* 9(6): 390-405.
36. Tonts M (2005) Competitive sport and social capital in rural Australia. *J Rural Studies*21: 137-149.
37. Fabrigoule C, Letenneur L, Dartigues J, et al. (1995) Social and leisure activities and risk of dementia: a prospective longitudinal study. *J Am Geriatrics Soc* 43(5): 485-490.
38. Sattler C, Toro, Schonknecht P, et al. (2012) Cognitive activity, education and socioeconomic status as preventive factors for mild cognitive impairment and Alzheimers disease. *Psychiat Res* 196(1): 90-95.
39. Holt-Lunstad J, Smith T, Bradley Layton J (2010) Social relationships and mortality risk: a meta-analytic review. *PLoS Med* 7(DOI:10.1371/journal.pmed.1000316).
40. Hodge A, English D, Giles G, et al. (2013) Social connectedness and predictors of successful ageing. *Maturitas* 2013;doi.org/10.1016/j.maturitis.2013.05.002.
41. Bennett S, Thomas J (2014) Depression and dementia: Cause, consequence or coincidence? *Mauritas*
42. Boland R (2000) Depression in Alzheimer's disease and other dementias. *Curr Psychiat Reports* 2(5): 427-433.
43. Breno S, Diniz M, Butters S, et al. (2013) The British Journal of psychiatry late-life depression and risk of vascular dementia and Alzheimer's disease: systematic review and meta-analysis of community-based cohort studies 202(5): 329-335.
44. Butters M, Young J, Lopez O, et al. (2008) Pathways linking late-life depression to persistent cognitive impairment and dementia. *Dialogues Clin Neurosci*: 354-357.
45. Bretler M, Claus J, Grobbee D, et al. (1994) Cardiovascular disease and distribution of cognitive function in elderly people: the Rotterdam study. *BMJ* 308(6944): 1604-1608.
46. Skoog I, Lernfelt B, Landahl S, et al. (1996) 15-year longitudinal study of blood pressure and demnetia. *Lancet* 347(9009): 1141-1145.
47. Baker IDI Heart & Diabetes Institute. (2012) Diabetes:the silent pandemic and its impact on Australia. http://wwwdiabetesvicorgau/images/stories/PDF_files/2012/120314_Diabetes_management_booklet_FINALpdf.
48. Australian Communications and Media Authority. (2009) Convergence and Communications. Report 1: Australian household consumers' take-up and use of voice communications services. Australian Government;Canberra.
49. Sivo S, Saunders C,Chang Q, et al. (2006) How low should you go? Low response rates and the validity of inference in is questionnaire research journal of the association for information

systems 7(6): 351-414.
50. Kelley K, Clark B, Brown V, et al. (2003) Good practice in the conduct and reporting of survey research. *Int J Qual Health Care*. DOI: http://dx.doi.org/10.1093/intqhc/mzg031
51. Kelly B, Fraze T, Hornik R (2010) Response rates to a mailed survey of a representative sample of cancer patients randomly drawn from the Pennsylvania Cancer Registry: a randomized trial of incentive and length effects. *BMC Med Res Methodol* 10(65).
52. Welch W, Barlau A (2014) Addressing Survey Nonresponse Issues: implications for ATE principal investigators, evaluators, and researchers. *Nat Sci Founda.*
53. Australian Bureau of Statistics. (2014) Patient Experiences in Australia: Summary of Findings, 2013-14 http://wwwabsgovau/ausstats/abs@nsf/mf/48390?OpenDocument.
54. Australian Institute of Health and Welfare A, Canberra. Rural, regional and remote Health—Indicators of health system performance. Rural Health Series, AIHW, Canberra. 2008;10(PHE103).
55. Letvak S (2002) The importance of social support for rural mental health. *Mental Health Nursing* 23(3): 249-261
56. Rowe J, Kahn R (1997) Successful aging. *Gerontologist* 37: 433-440.
57. Chau J (2007) Physical Activity and Building Stronger Communities. NSW centre for physical activity and health. Premier's Council for Active Living. Report No. CPAH07-001.
58. Centers for Disease Control and Prevention. (2011) Strategies to Prevent Obesity and Other Chronic Diseases: The CDC Guide to Strategies to Increase Physical Activity in the Community. US Department of Health and Human Services Atlanta.

AIMS Press