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Life Expectancy in Australian Seniors with or without Cognitive Impairment: The Australia Diabetes, Obesity and Lifestyle Study Wave 3

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Abstract:

Objective: To determine prevalence of cognitive impairment (CI) and to estimate life expectancy with and without cognitive impairment in the Australian population over age 60.

Method: Adults aged 60 and older participating in the 12 year follow-up of the Australia Diabetes Obesity and Lifestyle Study (AusDiab) were included in the sample (n=1666). The mean age was 69.5 years, and 46.3% of the sample was male. The Mini-Mental State Examination was used to assess cognitive impairment. Logistic regression analysis was used to determine the effect of predictor variables (age, gender, education), measured at baseline, on cognitive impairment status. The Sullivan Method was used to estimate Total Life Expectancy (TLE), Cognitively Impaired (CILE) and Cognitive Impairment-free life expectancies (CIFLE).

Results: Odds of CI were greater for males than females (OR 2.1, 95% confidence interval: 1.2-3.7) and among Australians with low education levels compared with Australians with high education levels (OR 2.1, 95% confidence interval: 1.2-3.7). The odds of CI also increased each year with age (OR 1.1, (95% confidence interval: 1.0-1.1). It was found that in all age groups females have greater TLE and CIFLE when compared to their male counterparts.

Keywords: Sullivan health expectancy; Cognitive impairment; Australia; Prevalence

Introduction

Increases in life expectancy observed in the past decade have given rise to a need for increased focus on mental health conditions that impair cognitive function and that are strongly associated with increasing age [1]. The calculation of health expectancies has become increasingly relevant to international health policy as emphasis is placed on healthy and active aging. Healthy life expectancy is used to quantify the burden of disease and enables researchers to monitor the overall health of the population [2]. Cognitive impairment affects the functional status and quality of life not only of sufferers but also impacts their relatives and carers [2,3]. Dementia is Australia's third leading cause of death and there is no cure [4].

While data on mental health expectancies are scarce for most countries, previously published data are available for Australia but these are based on a regional study rather than data drawn from a national study [5,6]. Hence we aimed to produce the first Australian estimates of Cognitive Impairment Free Life Expectancy using cognitive function data from a national and population-based study. Additionally, recently published findings have shown a reduction in late life cognitive impairment in the UK, Denmark and Sweden and this moving target of dementia prevalence makes the conduct of this study worthwhile to investigate if similar changes have occurred in Australia [7-9].

Methods

Sample Selection and Survey Protocol and Procedures (AusDiab)

The AusDiab study is a population-based national survey of the general (non-institutionalised) Australian population aged 25 years and over residing in private dwellings in each of the six states and the Northern Territory. A stratified cluster sampling method was used and sample size selection based on estimates of national diabetes prevalence obtained from previous surveys [10]. The baseline examination was undertaken in 1999-2000 (n=11,247), with follow-up conducted in 2004-05 (n=8,798) and 2011-12 (n=6,186). Measurement of cognitive function was conducted on those who attended survey sites in the third wave of data collection (n=4,764). Data were collected using questionnaires, physical examinations, blood sampling, urine collection, anthropometry and blood pressure reading.

Figure 1 below shows the sampling frame for AusDiab follow-up in 2011-12.

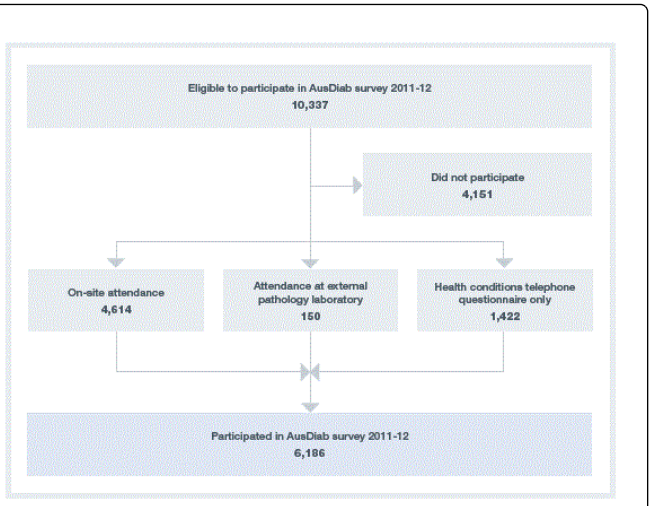

Figure 1: Sampling frame AusDiab follow-up (Source: AusDiab Report, 2013)

Study Methodology

The Mini Mental State Examination (MMSE) was used in data collection 2011-12 (AusDiab wave 3) to determine cognitive outcome with participants classed as being either cognitively impaired (score of 0-23) or not cognitively impaired (score of 24-30) [11]. The MMSE is commonly employed by clinicians to screen for cognitive impairment and dementia [12] and is the most common measure used in research on cognitive health expectancy [12]. Use of this measure allows international comparison of rates of cognitive impairment. It is a sum-score that evaluates various dimensions of cognition (memory, attention and language) and used as an index of global cognitive performance [13]. The MMSE test can be affected by level of education, cultural background and language fluency [14,15].

In this study, a high education level was defined as any learning that occurred after completion of secondary school while a low education level was defined as having either primary and/or secondary school education only.

The Sullivan Method used to estimate population health indicators was applied to determine total life expectancy, life expectancy with impairment and cognitive impairment free life expectancy [16]. This method requires age-specific prevalence (proportions) of the population in healthy and unhealthy states (often obtained from cross-sectional surveys), and age-specific mortality information taken from a period life table [16]. Cognitive Impairment Free Life Expectancy (CIFLE) reflects the number of remaining years, at a particular age, which an individual can expect to live in the absence of disease [2]. For this study, five-year age intervals were analysed with the final age group recorded as age 85+. Five-year age-specific prevalence of CI in Australia was determined using data from the AusDiab 60+ cohort. Data were stratified based on gender. Confidence intervals using this method are only produced for the computation of CI-free life expectancies.

Age-specific population and mortality data were obtained for 2012 from the Australian Bureau of Statistics [17] and cross-sectional prevalence data were obtained from the AusDiab Study (2011-12 wave).

Logistic regression analysis was used to determine the effect of various predictors on cognitive status. The variables age, gender, education level, age^2, age*gender, age*education and gender*education were all considered in developing the model. The final regression model contained 3 predictors (age, gender and education level) each of which had a unique statistically significant contribution to the model.

Results

The age and gender distribution of the sample is given in Table 1. Overall 53.7% of respondents were female. The greatest proportion of participants (30.0%) was recorded in the 60-64 age group.

	Number of Subjects		
Age (Years)	Men	Women	All
60-64	234 (14.0%)	266 (16.0%)	500 (30.0%)
65-69	187 (11.2%)	247 (14.8%)	434 (26.1%)
70-74	144 (8.6%)	170 (10.2%)	314 (18.8%)
75-79	109 (6.5%)	113 (6.8%)	222 (13.3%)
80-84	62 (3.7%)	63 (3.8%)	125 (7.5%)
85+	36 (2.2%)	35 (2.1%)	71 (4.3%)
Total	772 (46.3%)	894 (53.7%)	1666 (100.0%)

Table 1: Age and gender distribution of sample

Males recorded higher CI prevalence estimates than females in three of the six age groups. The CI prevalence for males in the 60-64 age-group was 8.6% compared to 1.7% for females, the CI prevalence for males in the 75-79 age-group was 20.7% compared to 8.6% among females and in the 80-84 age-group CI prevalence for males was 13.8% compared to 6.9% among females. Further inferences can be drawn from Figure 2 below.

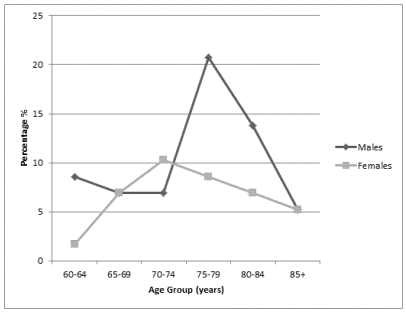

Figure 2: Cognitive Impairment Prevalence by Gender and Age-Group

Logistic regression analysis showed that holding gender and education constant, the odds of CI increase with age (OR 1.1, 95% Confidence interval: 1.0-1.1). The odds of CI also vary depending on gender with males having higher odds (OR 2.1, 95% Confidence interval 1.2–3.7). Finally, for those with a low education level the odds of CI are higher when compared to the odds of CI for those with a high education level (OR 2.1, 95% Confidence interval: 1.2-3.7).

Total life expectancy, cognitive impairment free life expectancy and life expectancy with cognitive impairment for the sample are shown in Table 2 below.

Age (years)	TLE	CIFLE	CILE	% of Total Remaining Life Spent CIF
Males				
60-64	23.5	21.1	2.4	89.8
65-69	19.4	17.2	2.2	88.7
70-74	15.4	13.6	1.8	88.3
75-79	11.9	10.1	1.8	84.9
80-84	8.9	8.1	0.8	91.0
85+	6.5	6.1	0.4	93.8
Females				
60-64	26.8	25.3	1.5	94.4
65-69	22.4	21.0	1.4	93.8
70-74	18.2	17.0	1.2	93.4
75-79	14.2	13.0	1.2	91.5
80-84	10.6	10.2	0.4	96.2
85+	7.7	7.4	0.3	96.1

Table 2: Total Life Expectancy (TLE), Cognitive Impairment-free Life Expectancy (CIFLE), Life Expectancy with Cognitive Impairment (CILE) and % of Total Life Spent Cognitive Impairment-free (CIF) for the sample by Age and Gender

Females have longer life expectancy and also spend a greater proportion of their lives without CI across all age groups when compared to their male counterparts. At age 60, males can expect to live a further 23.5 years. Of these, 21.1 years (95% confidence interval: 20.8–21.4) are expected to be CI-free and 2.4 years with CI. Comparatively, females at age 60 can expect to live a further 26.8 years (95% Confidence interval: 25.0–25.6). Of these, 25.3 years are expected to be CI-free and 0.5 years with CI. Further inferences can be drawn from Table 2 as it relates to CI and CI-free life expectancies across gender and age groups.

Discussion

In this study, the odds of CI were greater for Australian males (OR 2.1, 95% confidence interval: 1.2-3.7) and among those with low education levels (OR 2.1, 95% Confidence interval: 1.2-3.7). The odds of CI also increased each year with age (OR 1.1, 95% Confidence interval: 1.0-1.1). Females were shown to have longer life expectancies than males. For example, at age 60 females are expected to live a further 26.8 years compared with males who are expected to live a further 23.5 years. Females also spend a greater proportion of their lives without CI across all age groups when compared to their male counterparts. For example, females at age 60 are expected to spend 94.40% of the remainder of their lives without CI while males are expected to spend 89.8% of the remainder of their lives free of CI.

The novelty of these results lie in the fact that this is the first time that national population-based data have been used to measure mental health expectancies in the Australian setting. These findings allow Australia to be compared with other countries for which CI data are available using the same outcome measure. This provides a basis for evaluation of health policy and planning and a benchmark by which to assess population-level changes in risk of CI and changing CIFLE given increasing longevity of populations. The salience of this study is underscored by the fact that diseases that negatively affect cognitive function such as dementia are common, costly, and highly age related [18]. CI health expectancy data can be used to develop more meaningful guidelines and policies as it relates to the cognition of older adults and can serve to identify specific age groups that merit further study. More specifically, these results can also serve to inform the development of population health indicators–a useful marker for the health of a population. In the past, this health indicator centred primarily on physical functioning [1]. Recently though, there has been recognition of the need to also consider the mental health of populations in order to predict the services it needs [1].

The CI prevalence rates obtained in the present study can be compared to estimates from a study that reported possible cognitive impairment in Australia using a pooled dataset of Australian longitudinal studies (DYNOPTA) and two Australian Bureau of Statistics National Surveys of Mental Health and Wellbeing (NSMH) [19]. When comparing the present study to DYNOPTA and the NSMH surveys, the probable dementia category was selected as the reference since it coincided with the MMSE score cut-off for CI in the AusDiab i.e. <24. When compared to DYNOPTA, results differed greatly for both males and females between the studies. For example, males in the 65-69 and 70-74 age-groups recorded probable dementia rates of 3.02% and 6.90% respectively in DYNOPTA compared to estimates of 6.90% and 6.90% in AusDiab [19]. For females in the same age-group, probable dementia rates in DYNOPTA were recorded as 4.47% and 4.30% compared to 6.90% and 10.30% respectively in AusDiab [19]. Prevalence estimates for the 2007 NSMH Survey were also observed to be much lower than those in AusDiab. For example males in the 65-69 and 70-74 age-groups recorded probable dementia prevalence rates of 4.63% and 4.34% while females in the same age-groups had prevalence rates of 3.43% and 5.70% respectively [19]. Generally, the results of the present study are more closely aligned to the probable dementia estimates calculated using 1997 NSMH Survey rather than the estimates calculated using DYNOPTA and the 2007 NSMH. Probable dementia prevalence recorded in 1997 among males in the 65-69 age-group and 70-74 age-group was estimated at 6.72% and 11.16% while for females probable dementia estimates were 5.70% and 7.66% [19]. Differences in the results obtained between the AusDiab and these studies may be due to differences in methodology and sample selection.

Previous mental health expectancy calculations in the Australian population have looked at dementia-free life expectancies [5,6]. It is however important to quantify the burden of cognitive impairment in the population since this allows for a more comprehensive understanding of the effect of mental disability in older age groups. The availability of data for the cognitive domain, from the AusDiab Study 2012 wave of data collection facilitated the calculation of CIFLE in this study.

Data on CI-free life expectancies has been published for a few countries (e.g. in Canada and the United Kingdom) however these data are typically representative of populations in the 1990s. It is useful

to compare trends observed between these two developed countries and Australia [2,3]. Compared to their Canadian and UK counterparts, Australian males and females live longer and spend a greater proportion of their life without CI. For example, at age 65 Australian males can expect to live a further 19.4 years of which 17.2 would be spent without CI. In Canada, males at the age of 65 can expect to live a further 16.36 years of which 13.76 would be spent CI-free and in the UK males at the age of 65 can expect to live a further 15.3 years of which 11.4 would be spent CI-free [2,3]. In the case of females, Australian females 65 years of age can expect to live a further 22.4 years of which 21.0 would be spent without CI. Comparatively, Canadian females at 65 are expected to live a further 19.10 years with 15.46 of these years spent without CI while in the UK females age 65 are expected to live a further 19.5 years with 12.9 years spent CI-free [2,3].

Dementia-free life expectancies previously published in Australia in 1994 and 2008 also help to put the burden of disease calculated in this study into perspective since 'Cognitive Impairment No Dementia' is considered an intermediate state between 'No Cognitive Impairment' and dementia [3]. Using data from a field survey conducted in the over-70 population in Canberra and Queanbeyan in 1990-1991 (n=1,045) it was found that at 70 years of age, men were expected to live a further 11.95 years and women a further 15.12 years [6]. Of these years, 10.98 and 13.66 would be spent without dementia respectively [6]. More recently, using published dementia prevalence rates and complete life tables published by the Australian Bureau of Statistics, dementia-free life expectancy was calculated for the Australian population for the period 2004-2006 [5]. When the 2004-2006 study is compared to the 1990 results, total life expectancy was observed to have increased among both males and females (14.5 years and 17.3 years respectively). Additionally, when both studies are compared, there was a slight increase in years of life spent without dementia in males and females (1.45 years for males and 0.18 years for females). This is consistent with recent findings showing reduction in late life CI in Denmark, Sweden and England and Wales [7-9]. Worth noting though is that the studies highlighted utilised different methodologies. For example, the AusDiab unlike the other studies did not include those in institutions and this may explain some of the differences in the results obtained. Cut-off points for the MMSE used to classify those with CI may also have influenced the results obtained. For example, in the UK study, a score of <26 was used to classify those with CI while the present study used a score of <24. Additionally, in the Canadian study there was independent assessment by a nurse, physician, and neuropsychologist to confirm the presence or absence of CI which may have led to increased diagnostic accuracy. While inclusion of those in institutions may have led to increased CI prevalence rates in AusDiab, the adoption of stricter diagnostic criteria may have led to many previously classified as 'cognitively impaired' being considered as 'normal'.

The prevalence rates of cognitive impairment obtained in this study and reflected in logistic regression analysis showed an unexpected distribution particularly for males. This merits further analysis but the higher prevalence rates observed in males in the 75-79 and 80-84 age groups may be the result of selective attrition and also small numbers in the older age groups in the study. It was observed that the number of females and males enrolled in the study fell disproportionately from 170 to 113 and 144 to 109 (in the 75-79 age group) and again from 113 to 63 and 109 to 62 (in the 80-84 age group). This may be indicative of the fact that more females requested no further contact in AusDiab, moved abroad or suffered from severe illness and as such were ineligible to continue in the study.

The association between education level and cognitive status in other studies has been published previously [2,20]. Education is known to affect both the level of cognition and its measurement, though it is not clear whether the measure is better with or without adjustment [2]. It has been suggested that education improves health and encourages health-seeking behaviours and healthy lifestyles [21]. The role of education in screening tests such as the MMSE has been highlighted since education may influence a person's ability to display the necessary skills measured [22]. In the present study, education level was found to be a significant predictor of cognitive status. Similar findings have also been reported in studies conducted in England and Wales and the United States where it was found that differences in TLE by education groups are large in the elderly population [2,23].

While the results obtained in this research compare well with other studies, this study makes a substantial contribution to the field as to the authors' knowledge the present study is the first that reports on CIFLE in Australia. Additionally, the use of a national, population-based Australian sample from the AusDiab Study allows for greater accuracy. Previous mental health expectancy calculations in Australia utilised data from the affluent Canberra region or extrapolated data from European countries with similar characteristics. Another strength of this study lies in the use of the Sullivan Health Expectancy. This method permits comparison with other countries and also allows us to observe trends within the same country. It should be noted though that this study is not representative of those in institutions. Additionally, an assessment of cognitive status was performed only on a subset of the sample. An analysis of those for whom no data on cognition was collected (either because of non-selection or drop out) shows that a greater proportion were female (56.8%). A greater proportion of those who did not do cognitive testing also belonged to the low education category (31.7%). As both gender and education level are associated with cognitive status it may be that cognitive impairment prevalence is underestimated and CIFLE overestimated in this present study.

Conclusion

Monitoring healthy life expectancy trends is key to maintaining quality of life in older age groups, proactive policy making and development of effective interventions. The results of this study highlight the growing need for greater investment in overall health in general and mental health in particular given the disease burden (direct, indirect and non-financial costs) to individuals and their families, communities and society.

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