Correlates of Subjective Health across the Ageing Lifespan: Understanding Self-Rated Health in the Oldest-Old

Davina J. French, Kerry Sargent-Cox, Mary A. Luszcz

Abstract

Objectives: To examine the determinants of self-rated health (SRH) in different age groups of older adults, including the oldest-old. Methods: Variables assessing physical health, difficulty with self-care, depressive symptoms and cognitive impairment were pooled and harmonised from three Australian longitudinal studies of ageing (n=5,222). The association of these with SRH was examined in older adults aged 60-64 years, 65-74 years, 75-84 years and 85 years and older. Results: SRH was not associated with cognitive impairment or difficulty with self-care in the oldest-old, and its association with physical health was diminished compared with younger groups. Depression showed a significant relationship in all age groups, conferring an approximately fourfold increase in the likelihood of poorer SRH. Discussion: As old age progresses, self-reports of poor health become most closely related to psychological symptoms. This explains some of the paradoxes of past literature and offers important insights for health professionals working with the oldest-old.

Keywords: Self-rated health; oldest-old; depression; cognitive function; disability

The value of a general self-rated health (SRH) question for gerontology research is now well established. Responses to such a question are independently related to mortality (Idler & Benyamini, 1997) although recent research has indicated that this relationship may be moderated by socioeconomic factors (Dowd & Zajacova, 2007; Regidor, Guallar-Castillón, Gutiérrez-Fisac, Banegas, & Rodríguez-Artalejo, 2010). A decline in SRH with age has also been observed (Chen, Cohen, & Kasen, 2007; Idler, 1993) but most studies show that SRH does not decline as sharply with age as would be predicted by age-related changes in health status (Henchoz, Cavalli, & Girardin, 2008; Idler, 1993). Nevertheless, studies on mortality prediction typically control for age, for example 18 of 22 studies reported in a recent meta-analysis included age as a covariate (DeSalvo, Bloser, Reynolds, He, & Muntner, 2006).

Some authors have suggested that SRH is less closely related, or unrelated, to mortality in older respondents, especially the oldest-old (Benyamini, Blumstein, Lusky, & Modan, 2003; Jylhä, 2009). It is nevertheless important to explore the meaning of self-rated health in advanced old age. The number of persons aged 85 years and older (the most common definition of oldest-old adulthood) is increasing rapidly; it is estimated that the number of Australians in this age group will quadruple by 2050, to 1.8 million individuals or 5.2% of the population (Australian Government Productivity Commission, 2011). Understanding SRH responses for this group of oldest-old citizens is of crucial importance in planning for their future health-care needs.

The predictive value of SRH has led to an extensive literature investigating the factors that are associated with respondents' self-ratings of health. Both cross-sectionally and longitudinally, poorer SRH appears to be related to the three broad factors of physical illness burden (e.g. number of medical conditions or symptoms), functional disability and mental health (Han, Small, & Haley, 2001; Manderbacka, Lundberg, & Martikainen, 1999; Pinquart,

2001). The relative importance of these factors, however, varies with study design and population, and not all studies include indicators of all three aspects of health. Additional correlates have been investigated, particularly health behaviours such as smoking, but findings have been less consistent (Chen et al., 2007; Manderbacka et al., 1999).

Investigations of potential age differences in the correlates of SRH among older adults have been limited by a lack of samples with both a wide range of health indicators and a sufficient number of very old participants. For example Schnittker's investigation of the changing correlates of SRH across the adult lifespan was limited to an oldest group of 75 years plus (Schnittker, 2005), while two studies with large samples of individuals aged 80 years and older did not include a reliable indicator of mental health status (Ebly, Hogan, & Fung, 1996; Henchoz et al., 2008). Some research has indicated that those aged 85 years and older show a distinct profile of poorer psychological functioning (Smith & Baltes, 1997) and reduced life satisfaction (Gwozdz & Sousa-Poza, 2010) compared to younger-old adults. The lives of those who reach this 'fourth age' of human development have been summarised in this sector of the literature as increasingly dependent and dysfunctional (Baltes & Smith, 2003). However, a paradox has also been recognised in which the oldest individuals (aged 83 years and older at baseline) showed the most optimistic assessments of their health relative to their actual physical status (Idler, 1993). Gwozdz & Sousa-Poza (2010) also noted that the decline in life satisfaction that they observed in the oldest-old was associated primarily with subjective, not objective health. Since subjective assessments of health do appear, in these studies, to be both distinct from objective health and uniquely important in determining quality of life for the oldest-old, further examination of how and why self-perceptions of health change with age is clearly warranted.

Our study compares the relative importance of physical health burden, functional limitation, cognitive impairment and mental illness symptoms as correlates of general self-

rated health among older adults. The relationship of cognitive ability with SRH is of particular note, since it has been less fully investigated in past studies, particularly in combination with a full range of other health indicators. We compare adequate sized groups of those in late middle-age (60-64 years), the young-old (65-74 years), old-old (75-84 years) and oldest-old (85 years and older) in order to establish not only what SRH means for the oldest-old, but how this differs from older adults of less advanced age.

Although comprehensive data are not available, a review of the existing literature is sufficient to support a hypothesis that, with advancing age, physical health and disability will show reduced associations with SRH. Meta-analysis (of 176 effect sizes for physical illness and 118 effect sizes for functional limitations) found larger associations in those aged 60 to 75 years compared to those aged over 75 (Pinquart, 2001) while a very large data linkage study of older Americans found a decreasing relationship between SRH and number of co-morbid conditions with advancing age (Heller, Ahern, Pringle, & Brown, 2009). A study of older Dutch men also reported a weakening association between SRH and disability with age, and a non-significant relationship in those aged 80 to 90 years (Hoeymans, Feskens, Kromhout, & Van Den Bos, 1997).

The weakening relationship between SRH and measures of physical burden can be accounted for by several factors including adaptation to disabling conditions over time (Hoeymans, et al., 1997) and past experience of a positive health trajectory, which may result in a person's survival into very old age and may still feature in their self-evaluations regardless of current health status (Benyamini, et al., 2003). Further, a recent conceptual model of SRH has proposed that comparison with others may be important in reaching health evaluations (Jylhä, 2009). If comparisons are made with same-age peers, then the increasing incidence of illness and disability in the comparison group may lead the oldest respondents to discount their own disease burden as 'normal' for their age. This effect has recently been

demonstrated in a study showing that specific direction towards same-age peers, in the form of a question that asks about health in comparison to 'most people your age', results in a smaller decline in ratings with age than a general question (Sargent-Cox, Anstey, & Luszcz, 2008).

Past studies provide some support for a hypothesis that the association between SRH and mental health will remain at least stable, if not increase, with age, for example Pinquart's meta-analysis showed an increased association between mental health and SRH in those aged over 75 years (Pinquart, 2001). Studies of SRH in the oldest-old have not assessed the role of mental health to the same extent, but Ebly et al. (1996) speculated that their finding of a strong association between SRH and fatigue may be explained by unmeasured depression. Conceptually, the correlation of mental health with SRH might be expected to be strong at all ages, since the relationship may rest upon more than the recognition of mental illness symptoms as a component of 'health'. Jylhä (2009) has suggested that depression might also change the process of evaluating health, tending the respondent towards more negative self-perceptions. We propose here that both mechanisms are at work; depression both increases the burden of illness and decreases the ability to make self-enhancing comparisons. Mental illness symptoms may also be less apparent or less commonly disclosed by same age peers, thus making them less likely to be discounted during any comparison process. While our data cannot distinguish these effects, together they lead to the hypothesis of a strong and consistent relationship between depression and SRH across the ageing lifespan.

Previous studies of the relationship between cognitive impairment and SRH do not show sufficient consensus to support a hypothesis about how this relationship might change with age. Cognitive performance declines significantly with age, while the prevalence of dementia rises (Christensen et al., 1994; Jorm, Korten, & Henderson, 1987). Cognitive impairment has shown a weak association with poorer SRH among the oldest-old (Ebly et al.,

1996) and the relationship between SRH and mortality has been shown to persist in older adults with mild to moderate cognitive impairment (Walker, Maxwell, Hogan, & Ebly, 2004) but few studies of the health-related correlates of SRH have included a measure of cognitive performance. Cognitive impairment was related to SRH independently of physical illness and disability in a sample with mild dementia (Waldorff, Nielsen, & Waldemar, 2010), but in a study of institutionalized individuals there were few meaningful correlates of SRH among those with cognitive impairment (Damián, Pastor-Barriuso, & Valderrama-Gama, 2008) . In this study we include cognitive impairment as a health indicator, expecting that poorer cognition will be a burden which decreases SRH. We will also, however, conduct analyses that consider the possibility that cognitive decline impairs the respondent's ability to make judgments about their health.

The dual burden of cognitive impairment and depression is also significant among older adults (Fichter, Meller, Schröppel, & Steinkirchner, 1995). The ability to establish the independent relationships of SRH with both depressive symptoms and cognitive impairment is a significant feature of our study, which also includes a large sample of oldest-old respondents, and compares them with middle-aged and younger-old adults. This offers the capacity to make important comparisons within the age group typically described as 'older adults' and is a significant advance on previous studies that have included only the oldest-old or have studied wide adult age ranges with only small samples in the oldest age groups.

Method

Participants

Data were drawn from the Dynamic Analyses to Optimise Ageing (DYNOPTA) dataset, which has pooled and harmonised data from nine Australian longitudinal studies of ageing (Anstey et al., 2010). Three of these studies had all of the necessary measures for the

current analysis, resulting in a sample of 5,222 older Australians with data for all key variables. The contributing studies were the Australian Longitudinal Study of Ageing (ALSA), the Canberra Longitudinal Study (CLS) and the Personality and Total Health through life study (PATH). All used face-to-face interviews, with participation rates of 55 to 60% (Anstey et al., 2011; Christensen et al., 2004; Luszcz et al., 2007). ALSA collected data in Adelaide, South Australia and contributed 1,780 participants aged 64-103 years. PATH and CLS recruited in the Australian Capital Territory (ACT) and surrounding region. CLS contributed 922 cases aged 70-100 years and PATH contributed 2,520 cases aged 60-66 years. Data reported here were drawn from the first wave of each study and were collected between 1990 and 2001.

ALSA and CLS recruited both community dwelling older people and those living in nursing homes while PATH recruited only from the community. The PATH sample was randomly selected from the electoral roll; registration to vote is compulsory for Australian citizens. ALSA and CLS drew age and sex stratified samples, also from electoral rolls, and oversampled very old individuals (85+ in ALSA and 92+ in CLS). ALSA also oversampled males. These strategies resulted in a baseline sample in which males outnumbered females, even in the oldest age group. Although ALSA and CLS recruited some participants whose responses were provided by a proxy informant, proxies were not asked the SRH question and so these participants are not included in the current analyses. Further details of the DYNOPTA dataset and its contributing studies are reported elsewhere (Anstey et al., 2010).

Measures

Socio-demographics

Year and country of birth, preferred language and sex were available in all datasets. A question on marital status categorised participants as currently married/*de facto*,

divorced/separated, widowed or never married, however only 4 individuals aged 85 years and older were divorced or separated. In order to preserve large enough cell sizes for analysis this variable was collapsed to produce a binary variable denoting whether the respondent was currently living with a partner (married or *de facto*) or not (divorced, widowed or never married). Participants' educational attainment was described by a three level harmonised variable: completed high school or less (including 12 individuals with no formal education), completed some post-secondary qualification (for example a diploma or trade certificate) or completed a tertiary qualification. Employment status was recorded from self-report as 'currently employed', which included both full-time and part-time employment, versus 'not in the labour force'. A small number of participants who were currently unemployed (n = 24) were excluded.

Health indicators

Physical illness burden was operationalized as self-reported medical conditions. These were harmonised in DYNOPTA as the presence or absence of major disease groups. For the studies included here, the common disease groups reported were diabetes/endocrine disorder, cardiovascular conditions (including hypertension), chronic respiratory conditions, arthritis and cancer. Together with mental illness and cognitive impairment, which we have included as separate variables, these conditions are responsible for most of the disease burden among older Australians (Begg et al., 2007). The medical conditions variable used for this analysis described whether respondents reported having none, one, two or more than two of the five disease groups listed above.

Self-reported disability was assessed differently in each study. Our main analysis used the only functional limitation question common to all studies: whether or not respondents reported any difficulty or limitation in bathing or dressing. This was harmonised as a binary variable denoting none versus any report of difficulty with this basic self-care activity.

Additional indicators of disability were available in each study. In order to assess the sensitivity of our findings to the particular, rather severe, measure of disability that we used, two further indicators were derived. ALSA and CLS included six additional common items that were absent in PATH. They assessed ability to perform the following activities of daily living (ADLs): heavy housework, light housework, shopping, meals preparation, toileting, and transfers (in and out of bed or chair). These were harmonised to create a binary indicator of difficulty with any of these ADLs, which was missing for PATH. All studies also asked about participants' ability to walk - 1km in ALSA, 500m in CLS and both in PATH. Inspection of the PATH data revealed 93% concordance between these questions, suggesting that they could reasonably be harmonised to capture ability to walk an extended distance. The harmonised binary variable included ability to walk 1km from ALSA and PATH, and ability to walk 500m from CLS.

All studies included a measure of psychological health; ALSA used the Center for Epidemiologic Studies Depression Scale (Radloff, 1977), CLS used the Psychogeriatric Assessment Scales (Jorm et al., 1995) and PATH used a Mental Health Components Summary score computed from the SF-12 using the RAND protocol (Windsor, Rodgers, Butterworth, Anstey, & Jorm, 2006). These measures were harmonised to provide a common, binary indicator of 'probable depression' using a procedure described elsewhere (Burns et al., 2011). Cognitive impairment was assessed with the commonly used dementia screening instrument, the Mini-Mental State Examination (MMSE). While it does not provide a diagnosis of dementia, the MMSE is considered the gold standard in non-clinician screening instruments for dementia and cognitive decline (Cherbuin, Anstey, & Lipnicki, 2008). For descriptive purposes a cut-off score of 23/24 was used to report probable dementia.

Self-rated health

Self-rated health was measured as *'In general, would you say your health is…'* or

'Would you say your health nowadays is…' with four or five response options labelled 'excellent', 'very good', 'good', 'fair' and 'poor'. CLS did not use the 'very good' option so the harmonised variable reported here uses four response options with 'excellent' and 'very good' collapsed.

Data analysis

Correlates of SRH were examined using the generalized linear modelling procedure for ordinal response variables in SPSS19.0. Odds ratios show the change in odds of reporting poorer health. We first tested a model including all socio-demographic and health variables except for country of birth, where missing values compromised the sample size, and accommodation type, which resulted in empty cells in the analysis. All variables were categorical except for scores on the MMSE, where high scores indicate better performance. Reference groups were; late middle-aged, female, English language preferred, partnered, lowest educational attainment, currently employed, no medical conditions, disability or depression. In the second model interactions between age group and the physical and mental health indicators were added. The nature of significant interaction effects was further explored by repeating the analyses separately for each age group to compare the odds ratios obtained.

Demonstrating the age-related patterns of correlation between other health indicators and SRH *while controlling for cognitive ability* is not equivalent to establishing that the patterns reported are unaffected by potential lack of insight among respondents whose MMSE scores indicate probable dementia. In order to ensure that the regressions were not sensitive to any differential patterns of responding among those with cognitive impairment, the analyses were repeated on a sample that included only those participants whose MMSE score was 24 or greater. Further sensitivity analyses assessed whether there were any changes in the results when the different indicators of disability described above replaced our basic

self-care item.

Results

Table 1 describes the characteristics of our sample by age group. Around two-thirds of each age group was born in Australia or New Zealand with most of the remainder being born in Europe. On average, 90% of the sample reported that English was their native or preferred language, with this proportion rising slightly with age, and only two of the Australian-born respondents reported Aboriginal or Torres Strait Islander status. The percentage of participants living with a partner, dwelling in the community and being employed declined with age; among the oldest-old only 0.4% were employed in any capacity while 19.6% were living in a nursing home. This latter figure is in line with the rising proportion of those scoring in the 'probable dementia' range on the MMSE, however 75% of those who scored below 24 on the MMSE were living in the community. Disability showed a marked increase with age, but number of medical conditions did not. Among the older age groups, around 25% remained free of any of the disease groups reported. Both of our alternative indicators of disability included less severe forms of limitation; these affected a higher proportion of our sample than 'difficulty with bathing and dressing' and showed a sharper increase with age. More than half of the oldest-old reported difficulty with one or more ADL and 43% were unable to walk an extended distance. Probable depression was highest among the oldest-old, but displayed a U-shaped function with the late middle-aged group having a higher rate of depression than the young- and old-old.

Self-rated health declined with age; the proportion of those rating their health as excellent or very good declined by almost half and the proportion reporting poor health increased more than threefold from late middle-age to oldest-old. Nevertheless, almost two-thirds of the oldest-old group rated their general health as at least 'good'. Statistical tests (Analysis of Variance for MMSE score and Chi-squared for all other variables) revealed that

all variables except for gender differed significantly ($p < .001$) across age groups; all variables except probable depression showed a significant linear association with age. Post-hoc (Tukey's HSD) tests revealed that MMSE scores for all groups differed significantly from each other ($p < .001$).

The results from ordinal regression analysis for the entire sample are shown in table 2. Poorer self-rated health was independently associated with being older, male, less educated (compared with tertiary educated), not currently employed, speaking a language other than English, and with having more medical conditions, probable depression, difficulty with self-care or a lower MMSE score. A second analysis investigated the interactions of age group with medical conditions, difficulty with self-care, probable depression and MMSE score. Significant effects were obtained for the interaction of age group with difficulty with self-care ($\chi^2 = 19.51$, df = 3, $p < .001$) and MMSE score ($\chi^2 = 9.35$, df = 3, $p = .025$), while the association of SRH with number of medical conditions and probable depression did not differ with age. The full results of this analysis are available from the authors on request.

In order to further investigate significant interactions, the regressions were repeated for each age group separately. Inspection of the findings from these age-specific regressions (Table 3) reveals that most of the correlates of SRH that were reported for the full sample were not significantly related to SRH in the oldest-old. Sex, educational attainment and employment status were correlates of SRH only for the younger two age-groups. SRH was no longer associated with speaking a language other than English, MMSE score or difficulty with self-care in the oldest-old. The odds of poorer SRH rose with increasing number of medical conditions in all age groups, but the absolute magnitude of these relationships fell with age to the point where the difference between one and no medical conditions was not significant in the oldest-old. The only correlate of SRH that showed a significant and stable relationship across age, conferring an approximately fourfold increase in the likelihood of

poorer SRH, was probable depression.

Sensitivity analyses are reported in Table 4. Part a) of the table shows the analyses which excluded participants with probable cognitive impairment. These revealed that the pattern of results was largely unchanged; the association between MMSE scores and SRH was significantly larger despite the MMSE scores now having a narrower range, and the association between disability and SRH in the oldest-old was statistically significant, although it remained small. Part b) of the table shows the effect of replacing 'difficulty with bathing and dressing' with a binary indicator of difficulty with any of a wider range of ADLs, from doing heavy housework to using the toilet. The odds ratios were essentially unchanged both for this indicator of disability and the other variables in the analysis, which was carried out for only three age groups since most of the participants in the late middle-aged group were from the PATH study. Part c) of the table shows the effect of replacing the 'difficulty with bathing and dressing' variable with an indicator of walking ability. This variable showed a significant relationship with SRH in all groups including the oldest-old, although the size of the odds ratios still declined markedly with increasing age. The effect of depression was not changed, remaining the largest single correlate of SRH in the oldest-old group in all three sensitivity analyses.

Discussion

Our oldest-old respondents were more likely to screen positive for probable dementia and probable depression than their younger counterparts. They also reported more difficulty with self-care, but there was little evidence for a marked increase in the number of medical diagnoses they had received. Self-rated health declined with age, but approximately two thirds of oldest-old respondents reported that their health was at least 'good'. This capacity of very old adults to maintain a positive view of their health has been remarked upon in past literature (Henchoz et al., 2008; Idler, 1993), and is frequently attributed to a combination of

downward social comparison with same-age peers (Cheng, Fung, & Chan, 2007; Henchoz et al., 2008) and a cohort difference in the health expectations of the oldest-old based on their life experiences (Idler, 1993). Our study is consistent with this trend and includes a wider range of potential correlates of SRH than most previous studies.

When the data were analysed for the whole sample, age range 60 - 103 years, all of the health indicators that we assessed showed significant associations with SRH. Each additional medical diagnosis approximately doubled the odds of poorer SRH, while experiencing difficulty with bathing and dressing resulted in a threefold increase and probable depression a fourfold increase in these odds. Higher scores on the MMSE conferred a small protective effect.

The odds ratios displayed in Table 3 show that these sample-wide effects obscure important age differences in the correlates of SRH within the group usually described as 'older adults'. The change in the likelihood of poorer SRH became smaller with age for almost all correlates, depression being the exception. Our results are consistent with our hypothesis and with previous findings that the relationship between disability and SRH is reduced in those aged over 75 years (Pinquart, 2001; Schnittker, 2005). We have extended those findings by showing that some measures of disability were no longer significantly associated with SRH in the oldest-old. Our results also support our hypothesis with regard to physical illness, and extend previous findings of a weaker relationship between medical diagnoses and SRH in the oldest-old (Heller et al., 2009) since our study includes a wider range of covariates. We note that although the sample size for the oldest-old group in our study was somewhat smaller than the other age groups, the confidence intervals for the effect sizes for this group were not markedly widened, suggesting that non-significant effects were not due to the smaller sample size for this age group.

Odds ratios for depression remained approximately the same across age groups,

conferring a fourfold increase in odds of poorer SRH. The effects reported in the final column of table 3 suggest, in line with Schnittker's (2005) conclusions, that 'health' is more strongly influenced by mental health than by other indicators among the very old. Having one medical condition no longer conferred significantly poorer SRH than having no diagnoses for this age group. Having three or more diagnoses was associated with a markedly smaller reduction in SRH than at younger ages, and showed a smaller effect than depression, although confidence intervals overlapped. Sensitivity analyses were conducted to ensure that the limited indicator of disability that was available for all participants had not distorted the results, perhaps leaving the depression variable to carry unmeasured effects of other kinds of disability. Although one alternative indicator of functional disability did show a significant association with SRH in the oldest-old, this did not exceed or reduce the importance of depression.

These findings may be explained by both social comparison theory and the effect of depression on cognitive processing. While those in advanced old age may observe, through social comparison, that their physical health is not unusually poor 'for their age', and use this information to discount some illness and disability when rating their health, the prevalence of depression among same-age peers may be less observable, and thus less amenable to discounting. In addition, the presence of depressive symptomatology may be associated with a tendency towards negative self-evaluations (Jylhä, 2009), thus restricting the individual's capacity to make favourable social comparisons. For the oldest-old this results in self-ratings of health which reflect little of the increasing burden of physical disability, but may reveal an underlying problem with depression.

Our results revealed a small independent association between cognitive functioning and SRH, but this effect was not observed in the oldest-old. Analyses to check the sensitivity of the findings to the responses of those with cognitive impairment revealed that the inclusion of respondents with probable dementia may have decreased the observed association between

that measure and SRH, but exclusion of those with cognitive impairment did not result in a significant association between MMSE and SRH in the oldest-old group. The sample that included individuals with low MMSE scores showed the same relationships between SRH and physical health, depression and disability as a sample that excluded them, suggesting that individuals with poor cognition may lack insight into their cognitive incapacity, but other aspects of their health may still inform their self-ratings.

Inspection of our data revealed that individuals who screened positive for probable dementia also reported significant depressive symptomatology at twice the rate of cognitively intact individuals (14.8% versus 7.4% probably depressed). This may reflect the likelihood that, even among the oldest-old, the degree of cognitive impairment among individuals who are able to take part in research studies is typically relatively mild. Such mild cognitive impairment is likely to be recognised by the participant, and may contribute to feelings of depression. It is particularly important that future research seeks to establish whether depression is an important determinant of SRH in samples that are more severely cognitively impaired. If depression does continue to exert an influence on SRH among older adults with dementia, as it does on quality of life (Scocco, Fantoni, & Caon, 2006), this would suggest that SRH may be a useful indicator of wellbeing in this group. We second the call made by Damián et al. (2008) for further investigation of the meaning of SRH among cognitively impaired individuals.

The degree to which SRH remains a significant predictor of mortality in very old adults has been questioned, often on the basis of the reduced ability of older individuals to report their health accurately (Benyamini et al., 2003; Helweg-Larsen, Kjøller, & Thoning, 2003). Our findings provide an empirical explanation for these failures to find, in this age group, an association which is otherwise robust. For the oldest-old adult, ‘health’ is less strongly associated with the medical conditions which typically account for years of life lost

among this population, but remains strongly related to mental health, which is typically associated with morbidity rather than mortality. Our findings also shed further light upon the observation that life satisfaction in the oldest-old is strongly associated with subjective, but not objective health (Gwozdz & Sousa-Poza, 2010). Since life satisfaction is primarily a psychological construct, it too may be driven in large part by the direct and indirect effects of depression in advanced old age.

Our study makes significant advances upon previous research, both by having a distinct group of oldest-old participants large enough to test our hypotheses and by including measures of physical, cognitive and emotional health. There are however limitations to the approach that we have taken. Firstly, the sample was relatively restricted geographically and socioeconomically. Participants came from two major cities in Australia and surrounding areas, but rural respondents were under-represented. Also, two of the three DYNOPTA studies that were included were based in the ACT, where a major source of employment is the public service. This may account for the high levels of tertiary education among our sample, particularly in the younger age groups. Secondly, the process of harmonising measures across the studies has resulted in the reduction of some health indicators to binary variables. While this facilitates the interpretation and comparison of odds ratios, it may reduce the power of the analyses to demonstrate significant effects.

We are also aware that survivor effects are inherent in a study such as this. The finding that number of medical conditions does not increase markedly with age is particularly likely to be accounted for by the selective mortality of those with multi-morbidity in the older cohorts. Idler (1993) has shown that older individuals who do not survive give lower reports of their health when they are alive than those who survive, after accounting for physical health effects. Our oldest-old group may therefore contain a higher proportion of health ‘optimists’ than younger groups, although current research has not ruled out the notion that

this optimism is associated with their survival. Such effects are inherent in a study such as ours, which is cross-sectional in nature, and we cannot draw upon our findings to make any claims about the relative longitudinal effect of this set of health variables on SRH. Nor can a cross-sectional study separate age from cohort effects. Our oldest-old respondents were all born before 1910; their experiences during younger adulthood, such as the Great Depression, may have impacted upon their self-perceptions in distinct ways that will not be repeated in more recent cohorts.

Nevertheless we can draw several important conclusions from our study. Our study goes some way to explaining the finding that SRH is a poor predictor of mortality in extreme old age. We do not however concur with those who conclude that reports of health provided by the very old are unreliable (Helweg-Larsen et al., 2003). They do however have a different meaning; if we understand this fully it can provide greater clarity for both researchers and health professionals working with the oldest-old.

Expressed within the framework of Jylhä's conceptual model (Jylhä, 2009), we interpret the associations that we have observed as revealing the components of health that individuals deem relevant when reaching an evaluation of their health. Our findings suggest that, as individuals reach advanced old age, they tend to weight mental health symptoms more heavily than physical symptoms. If health information is evaluated with reference to a comparative group, then physical conditions and consequences that are perceived to be common among peers may be discounted in reaching an evaluation. Depression, however, is less easily observed in others, and so may be less subject to discounting. Depressive symptoms could also diminish the respondent's capacity for self-enhancing social comparison.

For the oldest-old patient, this means that an answer to the question 'how is your health?' may be uniquely revealing. A health professional who asks the question is likely to

be aware of the physical burden of illness and disability affecting that individual, which may cause them to overlook the possibility of undiagnosed depression in a patient whose objective physical health is indeed 'poor'. Increased awareness of the sensitivity of SRH to depressive symptoms as individuals become older could significantly improve quality of life for the oldest-old, whose health care needs will become increasingly pressing in the coming decades.

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Table 1. Sample characteristics by age group (N = 5222)

	Late middle-age	Young-old	Old-old	Oldest-old
Number of participants	2218	1311	1262	431
Age (years)				
Range	60-64	65-74	75-84	85-103
Mean (SD)	62.1 (1.3)	69.9 (3.2)	78. (2.8)	87.9 (3.2)
Female (%)	48.0	52.6	46.4	45.7
Country of Birth (%)[a]				
Australia/New Zealand	69.7	66.8	69.8	63.9
Europe	23.9	30.7	28.5	33.0
Asia	3.4	1.4	0.8	1.4
Other	3.0	1.1	0.9	1.8
Preferred language is English (%)	87.8	89.9	92.7	94.3
Living with partner (%)	78.8	76.0	60.0	35.3
Community dwelling (%)	100.0	98.9	95.7	80.4
Education (%)				
High school or less	25.9	50.6	60.7	62.6
Diploma/ certificate	43.1	36.8	31.9	30.2
Tertiary qualification	31.0	12.6	7.4	7.2
Currently employed (%)	43.6	6.9	1.3	0.4
Mini Mental State Exam.				
Mean (SD)	29.1 (1.5)	28.2 (2.1)	27.2 (2.6)	25.6 (3.5)
Probable dementia (%)	1.9	3.9	9.1	21.8
Medical conditions (%)				

None	30.6	24.5	23.9	24.8
One	37.2	40.5	41.8	42.9
Two	23.0	26.9	24.7	23.4
Three or more	9.2	8.1	9.6	8.8
Difficulty with bathing/dressing (%)	5.1	6.3	8.9	9.7
Difficulty with any ADL (%)[b]	-	19.0	29.0	51.0
Unable to walk ≥ 500m (%)	8.5	13.1	24.7	43.1
Probable depression (%)	8.9	5.6	6.9	11.4
Self-rated health (%)				
Excellent/very good	58.5	39.4	31.7	31.6
Good	28.6	38.0	39.4	34.1
Fair	10.3	18.2	21.8	26.2
Poor	2.6	4.5	7.1	8.1

[a] Total sample size for this variable is reduced to 4,921 due to 5.6% missing values.

[b] This indicator was not available for the late middle-aged group.

Table 2. Odds ratios (95% confidence intervals) for poorer self-rated health

Predictor (reference group)	Odds ratio	95% confidence intervals
Age group (vs late middle-age)		
Young-old	1.74***	1.50-2.01
Old-old	2.17***	1.85-2.56
Oldest-old	1.82***	1.43-2.32
Male (vs female)	1.29***	1.15-1.45
Non-English language preferred (vs English)	1.51***	1.26-1.82
Unpartnered (vs partnered)	0.96	0.84-1.09
Education (vs high school or less)		
Diploma/ certificate	0.92	0.82-1.04
Tertiary qualification	0.66***	0.56-0.78
Not in labour force (vs employed)	1.62***	1.38-1.91
Mini Mental State Exam score	0.94***	0.91-0.96
Medical conditions (vs none)		
One	2.09***	1.82-2.40
Two	4.09***	3.50-4.78
Three or more	6.97***	5.58-8.70
Difficulty with bathing/dressing (vs none)	3.49***	2.83-4.32
Probable depression (vs none)	4.38***	3.56-5.40

*** $p < .001$

Table 3. Odds ratios (95% confidence intervals) for poorer self-rated health by age group

Predictor (reference group)	Late middle-age		Young-old		Old-old		Oldest-old	
Male (vs female)	1.39**	(1.15-1.68)	1.45**	(1.16-1.82)	1.09	(0.87-1.36)	0.96	(0.65-1.42)
Non-English language (vs English)	1.70***	(1.27-2.28)	1.50*	(1.06-2.12)	1.64*	(1.08-2.49)	2.21	(0.94-5.21)
Unpartnered (vs partnered)	0.86	(0.69-1.07)	0.82	(0.64-1.05)	1.10	(0.89-1.37)	1.42	(0.96-2.09)
Education (vs high school or less)								
Diploma/ certificate	0.85	(0.65-1.06)	0.92	(0.73-1.16)	0.98	(0.78-1.24)	1.10	(0.73-1.65)
Tertiary qualification	0.64**	(0.50-0.82)	0.69*	(0.48-0.99)	0.71	(0.48-1.06)	0.83	(0.41-1.68)
Not in labour force (vs employed)	1.47***	(1.22-1.76)	2.91***	(1.82-4.64)	1.12	(0.41-3.09)	3.20	(0.24-42.84)
Mini Mental State Exam score	0.93*	(0.87-0.99)	0.90***	(0.85-0.95)	0.92***	(0.89-0.96)	1.00	(0.95-1.05)
Medical conditions (vs none)								
One	2.20***	(1.74-2.78)	2.34***	(1.77-3.08)	1.89***	(1.45-2.46)	1.31	(0.84-2.04)
Two	4.60***	(3.57-5.94)	3.91***	(2.88-5.29)	4.11***	(3.03-5.57)	2.31**	(1.39-3.86)
Three or more	10.95***	(7.79-15.38)	6.68***	(4.16-10.72)	4.52***	(2.95-6.94)	3.23**	(1.51-6.88)
Difficulty with bathing/dressing (vs none)	5.10***	(3.46-7.51)	6.06***	(3.90-9.44)	2.97***	(1.98-4.45)	1.47	(0.94-2.30)
Probable depression (vs none)	4.56***	(3.35-6.20)	3.26***	(2.02-5.26)	5.44***	(3.43-8.62)	4.12***	(2.32-7.31)

* $p < .05$; ** $p < .01$; *** $p < .001$

Table 4. Sensitivity analyses a) excluding participants with probable cognitive impairment; b) where disability is any ADL difficulty; c) where disability is unable to walk ≥ 500m.[a]

Predictor (reference group)	Late middle-age	Young-old	Old-old	Oldest-old
a) Participants with MMSE < 24 excluded[b]	2176	1260	1147	337
Mini Mental State Exam score	0.85*** (0.78-0.92)	0.84*** (0.7680.91)	0.91** (0.85-0.97)	0.97 (0.86-1.09)
Medical conditions (vs none)				
One	2.16*** (1.71-2.74)	2.30*** (1.83-3.05)	1.86*** (1.40-2.46)	1.27 (0.76-2.12)
Two	4.62*** (3.57-5.98)	3.79*** (2.78-5.15)	4.11*** (2.98-5.66)	2.29** (1.28-4.10)
Three or more	11.09*** (7.85-15.68)	6.53*** (4.01-10.62)	4.24*** (2.72-6.61)	3.17* (1.28-7.82)
Difficulty with bathing/dressing (vs none)	5.16*** (3.45-7.72)	6.03*** (3.85-9.44)	2.92*** (1.85-4.61)	1.72* (1.02-2.91)
Probable depression (vs none)	4.50*** (3.28-6.18)	3.19*** (1.93-5.26)	5.86*** (3.63-9.45)	3.63*** (1.83-7.20)
b) Disability is any ADL difficulty[c]		981	1221	416
Mini Mental State Exam score	-	0.91** (0.86-0.97)	0.92*** (0.88-0.96)	0.99 (0.94-1.05)
Medical conditions (vs none)				
One	-	2.26*** (1.64-3.10)	1.82*** (1.38-2.40)	1.34 (0.84-2.13)

Two	-		3.76***	(2.67-5.32)	3.72***	(2.72-5.09)	2.19**	(1.29-3.71)
Three or more	-		6.93***	(3.98-12.06)	4.30***	(2.80-6.59)	3.19**	(1.52-6.73)
Difficulty with any ADL (vs none)	-		3.84***	(2.77-5.30)	2.63***	(2.06-3.35)	1.34	(0.92-1.95)
Probable depression (vs none)	-		3.77***	(2.05-6.94)	5.44***	(3.44-8.61)	4.82***	(2.68-8.67)
c) Disability is unable to walk ≥ 500m								
Mini Mental State Exam score	0.94*	(0.88-0.99)	0.91**	(0.86-0.96)	0.90***	(0.87-0.94)	1.01	(0.95-1.06)
Medical conditions (vs none)								
One	2.11***	(1.66-2.68)	2.29***	(1.73-3.03)	1.73***	(1.32-2.27)	1.23	(0.79-1.92)
Two	4.68***	(3.63-6.05)	3.64***	(2.67-4.95)	3.54***	(2.59-4.83)	2.17**	(1.29-3.65)
Three or more	10.27***	(7.30-14.45)	5.86***	(3.65-9.41)	4.22***	(2.74-6.50)	2.88**	(1.37-6.06)
Unable to walk (vs none)	5.96***	(4.34-8.19)	6.00***	(4.34-8.30)	3.83***	(2.95-4.98)	2.14***	(1.46-3.14)
Probable depression (vs none)	4.46***	(3.27-6.09)	3.60***	(2.20-5.89)	4.96***	(3.10-7.92)	4.44***	(2.46-8.00)

* $p < .05$; ** $p < .01$; *** $p < .001$

[a] All analyses also include sex, language spoken, partner status, educational attainment and employment status.

[b] This row shows the reduced n for these analyses.

[c] This row shows the reduced n for these analyses. This indicator was available in only two studies; the sample size was insufficient to conduct this analysis for the late middle-aged group.