

Gender differences in the trajectories of late-life depressive symptomology and probable depression in the years prior to death

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ABSTRACT

Background: Gender differences in depression are well established. Whether these differences persist into late life and in the years preceding death is less clear. There is a suggestion that there is no increased likelihood of depression in late life, but that there is an increase in depressive symptomology, particularly with proximity to death. We compared trajectories of probable depression and depressive symptomology between men and women over age and distance-to-death metrics to determine whether reports of depressive symptoms are more strongly related to age or mortality.

Methods: Participants (N = 2,852) from the Dynamic Analyses to Optimise Ageing (DYNOPTA) project had a mean age of 75 years (SD = 5.68 years) at baseline and were observed for up to 16 years prior to death. Multi-level regression models estimated change in depressive symptomology and probable depression over two time metrics, increasing age, and distance-to-death.

Results: Increases in depressive symptomology were reported over increasing age and in the years approaching death. Only male participants reported increased probable depression in the years preceding death. Models that utilized distance-to-death metrics better represented changes in late-life depression, although any changes in depression appear to be accounted for by co-varying physical health status.

Conclusions: As death approaches, there are increases in the levels of depressive symptomology even after controlling for socio-demographic and health covariates. In line with increases in suicide rates in late life, male participants were at greater risk of reporting increases in depressive symptomology.

Key words: aging, depression, mortality, self-rated health, sub-syndromal depression

Introduction

There is a considerable body of evidence that identifies women as reporting higher levels of depression across most of the adult lifespan (Bebbington, 1998; Piccinelli and Wilkinson, 2000). In late life, the evidence for these gender differences is mixed. Whilst there is evidence that gender differences disappear (Barefoot *et al.*, 2001; van't Veer-Tazelaar *et al.*, 2008; Pachana *et al.*, 2012), other studies purport that these differences persist into late life (Osborn *et al.*, 2002; Zunzunegui *et al.*, 2007). It

has been suggested that the disparity in these findings can be attributed to a range of study design effects (Burns *et al.*, 2012a). Indeed, of those studies cited, those studies that indicated that gender differences remained in old age typically had larger samples. Furthermore, attrition of participants, due to their advanced age, has made obtaining accurate estimates of within-person change in depression in older adults problematic (Snowdon, 2001). There is also some evidence to suggest that these contrasting findings of late-life depression may be compounded by changes in depressive symptomology that reflects increases in sub-syndromal depression and not a level of symptomology that would reflect clinical depression (Bergdahl *et al.*, 2005; Steffens *et al.*, 2009). It is suggested that rates of sub-syndromal depression in late life are almost three times those with clinical depression (VanItallie, 2005).

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A confounding issue in delineating the course of late-life depression is the impact of impending death. Depression is associated with higher risk of mortality and higher levels of depression are reported in the years prior to death (Saz and Dewey, 2001; Anstey and Luszcz, 2002). There is evidence that decline in well-being, including depression, is more substantial when utilizing a distance-to-death metric rather than chronological age time metric (Gerstorff *et al.*, 2008b; 2010). However, there is only limited evidence to describe the extent to which gender differences in depression are maintained in the years approaching death (Anstey and Luszcz, 2002). Indeed, in contrast with those findings that indicate women as being at greater risk of depression, Anstey and Luszcz (2002) demonstrated that men with incident depression were most vulnerable to mortality. Whether gender differences in the trajectories of both probable depression and depressive symptomology are similarly indicated over a distance-to-death metric remains to be explored.

The current study utilizes the Dynamic Analyses to Optimise Ageing (DYNOPTA) project (Anstey *et al.*, 2010) to compare gender differences in depression over time in a sample of older adults who had died. Specifically, we compare gender differences in the trajectories of depression over age and distance-to-death metrics. Our comparisons utilize measures of depression operationalized as both probable depression and depressive symptomology. Finally, the role of physical health has been implicated as an important confounding issue in describing the relationship between mental health and mortality (Batterham *et al.*, 2012). Consequently, we will control for self-rated health (SRH) status in exploring changes in probable depression and depressive symptomology. SRH was introduced into social and medical research as a cost-efficient alternative to clinical assessments of health status (Maddox, 1999). Reflecting respondents' rating of their general health, SRH has become an important component in the measurement of overall health status in both clinical and epidemiological research. Associations between SRH with chronic illness, number of physical symptoms, somatization, hypochondriasis, functional disability, and physicians' health ratings have been reported (Barsky *et al.*, 1992). Poor SRH is a strong predictor of stroke, functional decline, nursing home entry, falls, driving cessation, increased health service utilization, and mortality (Blaum *et al.*, 1994; Lee and Shinkai, 2003; Anstey *et al.*, 2006a; 2006b).

Aims

This study will therefore be guided by three aims. First, we will evaluate whether age or a distance-

to-death metric best reflect changes in depressive symptomology and probable depression for both males and females in a sample of older decedents. Second, we will compare the differences in trajectories of depressive symptomology and probable depression between males and females. Third, we will examine whether changes in age and/or mortality-related depressive symptomology and probable depression are accounted for by co-varying SRH.

Methods

Participants

Data for these analyses were drawn from the DYNOPTA project (Anstey *et al.*, 2010). The DYNOPTA project pools data from nine Australian longitudinal studies of aging and comprises the Australian Longitudinal Study of Ageing (ALSA), the Australian Longitudinal Study of Women's Health (ALSWH), the Australian Diabetes, Obesity and Lifestyle study (AusDiab), the Blue Mountains Eye Study (BMES), the Canberra Longitudinal Study (CLS), the Household, Income and Labour Dynamics in Australia Study (HILDA), the Melbourne Longitudinal Studies on Healthy Ageing (MELSHA), the Personality and Total Health (PATH) through Life Study, and the Sydney Older Person Study (SOPS). The harmonization of existing studies, by pooling data or parallel analysis, is increasingly recognized as an important method that adds value to, and addresses the limitations of, investment in individual longitudinal studies (Piccinin and Hofer, 2008). Overall, the pooled DYNOPTA dataset comprised 50,652 respondents at baseline. For this study, participants ($N = 2,852$) were only selected if they reached mortality by the year 2006, which was the last date of mortality information common to all contributing studies. Participants were aged 45–105 years (mean = 73.35 years; $SD = 8.97$ years) at baseline, were observed for up to 16 years (mean = 7.78 years; $SD = 2.97$ years) prior to death, and provided between two and four observations (mean = 2.5 observations).

Measures

DEPRESSION

Mental health is a key focus of the DYNOPTA project, yet no single depression scale was common to all the contributing studies. The harmonization of a depression scale and creation of a binary variable that reflects "probable depression" has previously been described and examined in the DYNOPTA study (Burns *et al.*, 2012b; 2013). In summary, each contributing study to DYNOPTA included one of four scales that are frequently used to assess

depression or affective disorders, each with sound psychometric properties, validity, and clinical utility. These scales included the Mental Health Index from the Short-Form Health Survey-36 (SF-36) used in the ALSWH mid-life and old samples, AusDiab, and HILDA; the Mental Health Components Summary score from the shorter SF-12 used in the PATH study; the Centre for Epidemiological Studies Depression Scale (CESD) used in the ALSA and SOPS studies; and the Psychogeriatric Assessment Scales (PAS) used in the CLS and MELSHA studies. We standardized each of these scales to form a continuous measure of depressive symptomology and then defined a common cut-point to identify those DYNOPTA respondents with likely or probable depression by considering the various cut-points for the individual scales reported in the literature that have been validated to external criteria (Burns *et al.*, 2012a). The study was approved by the Human Research Ethics Committee at The Australian National University.

TIME

Two time metrics were utilized: the first, age, reflects the number of years since baseline measurement and is annualized to reflect increasing chronological age, and the second, distance-to-death, reflects the number of years from an observation point to the year of death.

COVARIATES

Our models adjusted for demographic characteristics including baseline age, health, education, partner status, and residential status. SRH was measured using the global health item from the SF-36, which requires participants to describe their general health on a five-point rating scale from “1: excellent” to “5: poor.” SRH was recoded into a binary variable to reflect “excellent/good” (the reference category) and “fair/poor” SRH. The SF-36 SRH item loads onto a general health subscale which subsequently reports stronger associations with the Physical Health Component Score. Replication of the SF-36 factor structure in the DYNOPTA study has previously been validated (Bartsch *et al.*, 2011). Education was classified into three levels relating to the extent of school and tertiary education participants reported: “no post-school education” (the reference category); “post-school non-tertiary education;” “post-school tertiary education.” Participants’ partner status was classified into two categories: “partnered” (the reference category) or not partnered.” Residential status was classified as either “living in the community” (the reference category) or in “residential care home.” SRH, partner status, and residential status were in-

cluded as time-varying covariates. Finally, due to the source of our data being elicited from a harmonization project, we adjusted analyses for a series of dummy codes for each contributing study to the DYNOPTA project.

Statistical analysis

Statistical analyses were undertaken in STATA v.10. We utilized mixed models with random intercept and slopes to examine differences in the change of depressive symptomology between gender, over age, and distance-to-death metrics. For the analysis of probable depression, we utilized a random intercept logistic regression model to derive estimates of probable depression. Both analytical methods employ maximum likelihood estimation. All analyses were stratified by gender and adjusted for age, partner status, residential status, education, SRH, and an identifier of contributing study. The inclusion of quadratic time metric effects, in all analyses, did not improve model fit and were therefore excluded from the results reported here.

Results

A comparison of the baseline covariates between male and female participants is reported in Table 1. A number of significant differences were observed. At baseline, males were more likely to be educated post high school, partnered, living in residential care, older, and to have good SRH. Due to the nature of the contributing longitudinal studies of aging, attrition past the second observation, particularly for males, was observed. Gender differences in depression were observed; male participants were less likely to report probable depression and reported lower levels of depressive symptomology at baseline.

Depressive symptomology

We compared changes in levels of depressive symptomology between male (Table 2) and female (Table 3) participants over two time metrics. Over an age metric, results indicated a small increase in depressive symptomology over time for both male ($\beta = 0.021$; SE = 0.007; $p < 0.01$) and female ($\beta = 0.018$; SE = 0.005; $p < 0.001$) participants, suggesting increasing levels of depressive symptomology with increasing age. Subsequently adjusting for SRH improved model fit, however small increases in depressive symptomology over increasing age were now only estimated for males ($\beta = 0.016$; SE = 0.007; $p < 0.05$). Changes in depressive symptomology over a distance-to-death metric were also reported for both male ($\beta = 0.032$; SE = 0.007; $p < 0.001$) and female ($\beta = 0.023$; SE = 0.004;

Table 1. Sample descriptive statistics by gender at baseline

	MALE (N = 756)		FEMALE (N = 2,096)		TEST STATISTIC
	N/M	%/SD	N/M	%/SD	
Depression (N, %)					
Not depressed	705	93.2	1,891	90.2	$\chi^2 = 6.26; p < 0.05$
Probable depression	51	6.7	205	9.8	
Symptomology score	-0.08	0.96	0.07	0.02	$t = 3.53; p < 0.001$
Education (N, %)					
High school	421	55.7	1,641	79.2	$\chi^2 = 171.98; p < 0.001$
Post-school non-tertiary	283	37.4	335	16.8	
Post-school tertiary	52	6.9	120	4.1	
Number of Observations (N, %)					
2 observations	585	77.4	1,118	53.3	$\chi^2 = 103.33; p < 0.001$
3 observations	122	16.1	681	32.5	
4 observations	49	6.5	297	14.2	
Partner status (N, %)					
Partnered	508	67.2	1,149	54.8	$\chi^2 = 34.96; p < 0.001$
Not partnered	248	32.8	947	45.2	
Residential status (N, %)					
Community living	729	96.4	2,068	98.7	$\chi^2 = 14.68; p < 0.001$
Residential	27	3.6	28	1.3	
Self-rated health (N, %)					
Good	513	67.9	1,386	66.1	$\chi^2 = 0.75; p < 0.05$
Poor	243	32.1	710	33.9	
Age (M, SD) (range: 45–103 years)	78.24	6.71	71.58	9.03	$t = 18.51; p < 0.001$
Distance-to-death (M, SD) (range: 2–15 years)	7.96	3.58	7.72	2.71	$t = 1.92; p = 0.055$
Time (M, SD) (range: 1–13 years)	2.36	3.19	2.76	2.91	$t = 4.87; p < 0.001$

Table 2. Changes in level of depressive symptomology over time for males

	AGE (β (SE))		DISTANCE-TO-DEATH (β (SE))	
	MODEL 1	MODEL 2	MODEL 3	MODEL 4
Fixed effects estimates				
Intercept	-0.135 (0.050)**	-0.391 (0.047)***	0.110 (0.063)	-0.220 (0.060)***
Slope	0.021 (0.007)**	0.016 (0.007)*	0.032 (0.007)***	0.020 (0.006)***
SRH		0.740 (0.044)***		0.721 (0.044)***
Random effects estimates				
Intercept	0.516 (0.047)	0.320 (0.038)	0.660 (0.085)	0.437 (0.071)
Slope	0.000 (0.000)	0.000 (0.000)	0.006 (0.001)	0.003 (0.001)
Covariance of time and slope	0.000 (0.000)	0.000 (0.000)	0.040 (0.010)	0.022 (0.008)
Residual variance	0.458 (0.025)	0.455 (0.025)	0.440 (0.024)	0.449 (0.025)
Goodness of fit indices				
LL	-2,265.9	-2,142.2	-2,253.2	-2,137.0
AIC	4,557.8	4,312.3	4,532.4	4,301.9
BIC	4,628.8	4,388.7	4,603.4	4,378.3

Notes: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. Model 1 and 3 estimates residualized for baseline age, baseline partner status, education, residential status, self-rated health, and time-varying partner status and residential status. Model 2 = Model 1 and self-rated health; Model 4 = Model 3 and self-rated health.

SRH = self-rated health; LL = log-likelihood value; AIC = Akaike information criteria; BIC = Bayesian information criteria.

Table 3. Changes in level of depressive symptomology over time for females

	AGE (β (SE))		DISTANCE-TO-DEATH (β (SE))	
	MODEL 1	MODEL 2	MODEL 3	MODEL 4
Fixed effects estimates				
Intercept	0.080 (0.031)**	-0.116 (0.031)***	0.251 (0.037)***	-0.040 (0.38)
Slope	0.018 (0.047)***	0.006 (0.004)	0.023 (0.004)***	0.010 (0.004)**
SRH		0.515 (0.26)***		0.507 (0.026)***
Random effects estimates				
Intercept	0.625 (0.030)	0.530 (0.027)	0.737 (0.046)	0.612 (0.042)
Slope	0.000 (0.000)	0.000 (0.000)	0.003 (0.001)	0.003 (0.001)
Covariance of time and slope	0.000 (0.000)	0.406 (0.012)	0.024 (0.005)	0.019 (0.005)
Residual variance	0.409 (0.012)	0.406 (0.012)	0.407 (0.012)	0.406 (0.012)
Goodness of fit indices				
LL	-7,260.0	-6,887.9	-7,249.1	-6,884.3
AIC	14,546.1	13,803.7	14,524.2	13,796.5
BIC	14,632.4	13,896.2	14,610.4	13,889.0

Notes: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. Model 1 and 3 estimates residualized for baseline age, baseline partner status, education, residential status, self-rated health, and time-varying partner status and residential status. Model 2 = Model 1 and self-rated health. Model 4 = Model 3 and self-rated health.

SRH = self-rated health; LL = log-likelihood value; AIC = Akaike information criteria; BIC = Bayesian information criteria.

Table 4. Changes in level of depression likelihood over time for males

	AGE (OR (SE))		DISTANCE-TO-DEATH (OR (SE))	
	MODEL 1	MODEL 2	MODEL 3	MODEL 4
Fixed effects estimates				
Slope	0.998 (0.039)	0.991 (0.040)	1.073 (0.037)*	1.036 (0.036)
SRH		10.405 (2.908)***		10.140 (2.854)***
Random effects estimates				
rho	0.506 (0.075)	0.416 (0.085)	0.496 (0.075)	0.421 (0.085)
Goodness of fit indices				
LL	-434.3	-387.8	-432.1	-387.3
AIC	888.5	797.7	884.1	796.7
BIC	943.1	857.7	938.7	856.7

Notes: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. Model 1 and 3 estimates residualized for baseline age, baseline partner status, education, residential status, self-rated health, and time-varying partner status and residential status. Model 2 = Model 1 and self-rated health. Model 4 = Model 3 and self-rated health.

SRH = self-rated health; LL = log-likelihood value; AIC = Akaike information criteria; BIC = Bayesian information criteria.

$p < 0.001$) participants, indicating an increase in depressive symptomology for each year approaching death. Similar to those analyses that utilized an age metric, adjusting for SRH improved model fit for the models that utilized a distance-to-death metric. However, increases in depressive symptomology were estimated for both male ($\beta = 0.020$; $SE = 0.006$; $p < 0.001$) and female ($\beta = 0.010$; $SE = 0.004$; $p < 0.01$) participants. A visual comparison of goodness of fit indices, whereby smaller values reflect better fitting models, indicates that those models that utilized a distance-to-death metric are a better method for describing change in depressive symptomology for both males and females. Of particular importance, we note that most of the variance in depressive symptomology was ac-

counted for at the intercept indicating little variance in how individuals changed their symptomology over both time metrics. For both time metrics, males were estimated to have lower intercepts, but a greater increase in rates of change in depressive symptomology compared to females. Most notable is the influence of poor health status on depressive symptomology where rates of change in depressive symptomology were attenuated after adjusting for SRH, particularly for female participants (see Figures 1a and b).

Probable depression

We repeated our analyses by replacing our continuous depression measure with a binary measure that reflected probable depression (Tables 4 and 5).

Table 5. Changes in level of depression likelihood over time for females

	AGE (OR (SE))		DISTANCE-TO-DEATH (OR (SE))	
	MODEL 1	MODEL 2	MODEL 3	MODEL 4
Fixed effects estimates				
Slope	1.012 (0.023)	0.970 (0.023)	1.058 (0.022)**	1.001 (0.022)
SRH		6.924 (1.124)***		6.712 (1.100)***
Random effects estimates				
rho	0.642 (0.029)	0.607 (0.034)	0.643 (0.029)	0.612 (0.033)
Goodness of fit indices				
LL	-1,615.1	-1,488.0	-1,611.6	-1,488.8
AIC	3,250.2	2,998.0	3,243.2	2,999.6
BIC	3,316.6	3,070.8	3,309.5	3,072.3

Notes: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. Model 1 and 3 estimates residualized for baseline age, baseline partner status, education, residential status, self-rated health, and time-varying partner status and residential status. Model 2 = Model 1 and self-rated health. Model 4 = Model 3 and self-rated health.

SRH = self-rated health; LL = log-likelihood value; AIC = Akaike information criteria; BIC = Bayesian information criteria.

Unlike our earlier analysis of the changes in depressive symptomology over the age metric, the likelihood of participants reporting probable depression was stable over time for both males and females. Both male (OR = 1.073; SE = 0.037; $p < 0.05$) and female (OR = 1.058; SE = 0.022; $p < 0.01$) participants reported increased likelihood of reporting probable depression in the years approaching mortality in models unadjusted for SRH. However, these effects appeared to be accounted for with the inclusion of SRH which was itself a significant predictor of probable depression for male and female participants across both time metrics. A visual comparison of goodness of fit indices indicated little change in model fit between models that utilized either distance-to-death or age metrics.

Discussion

In this study, we compared trajectories of probable depression and depressive symptomology over age and distance-to-death metrics between males and females in a sample of older adults who had died. For analyses of both probable depression and depressive symptomology, comparison of goodness of fit indices supports an increasing body of evidence that suggests that change in late-life mental health is best interpreted in the context of time to mortality rather than as an aging process (Gerstorff *et al.*, 2008a; 2010). Overall, there was no evidence for increased likelihood of probable depression with increasing age. Whilst there was limited support for the increased likelihood of probable depression in the years leading to death, this effect was accounted for by SRH. The evidence for an increase in depressive symptomology with increasing age and approaching mortality was more clear and

substantive. Whilst increases in depressive symptomology with increasing age were reported, the increase in depressive symptomology in those models that utilized a distance-to-death metric was more marked. However, adjusting for SRH significantly accounted for much of this effect, particularly for females. These findings suggest that late-life depressive symptomology may be strongly influenced by comorbid physical health conditions. Alternatively, a common-cause hypothesis may posit that declines in both physical and mental health states may reflect deterioration in other underlying organic processes which are mortality-related (Anstey *et al.*, 2003).

Whilst our results confirm earlier findings in relation to gender differences in depression (Bebbington, 1998; Anstey and Luszcz, 2002), we also present new findings on gender differences in the trajectories of late-life depression, particularly in relation to the changes that occur in the years leading to mortality. In fully adjusted models, female participants reported higher levels of depressive symptomology, but males reported increases at a rate twice that of females such that over distance-to-death there are no apparent sex differences in the year preceding death (see Figure 1b). This supports prior research that identified incident depression as a greater risk for mortality amongst men (Anstey and Luszcz, 2002). This pattern of increasing depressive symptomology, particularly in our older male participants, confirms findings relating to the increase in rates of suicide in older men (Mitty and Flores, 2008), a pattern that is well established in Australian national prevalence rates (ABS, 2012). Indeed, there is evidence that increased depression in late life is a major risk factor for suicide (Conwell, 1992). It remains to be determined whether these changes in depressive symptomology in the years preceding death for men are an artifact of

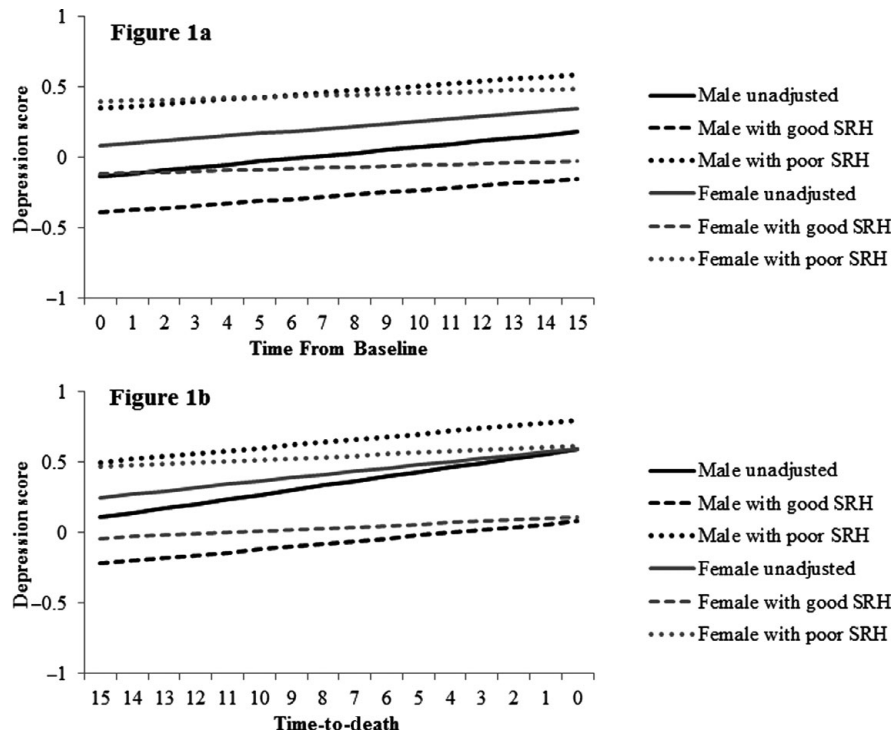


Figure 1. Model implied depression scores for males and females unadjusted and adjusted for self-rated health (SRH) over age (Figure 1a) and distance-to-death (Figure 1b) metrics.

approaching death or a decline in other health-mortality-related conditions which might manifest themselves in increased depression, or whether increased depression is itself a risk factor for early mortality. That the effect for increasing depressive symptomology is particularly noticeable amongst males warrants further attention. Whilst it is established that females generally report higher levels of depression or symptomology, it appears that the context of increasing proximity to death is adversely affecting males more so than for females and supports some prior findings (Anstey and Luszcz, 2002). The reasons remain unclear. It may be that males are more vulnerable to late-life changes in physical, social, and cognitive functioning, or it could be associated with a loss of identity in late life, particularly as many of these older males would have centered a significant weight to their images of self-worth and identity in their working lives.

We do acknowledge a number of limitations of this study. Primarily, these relate to our measure of depression and the nature of the pooled dataset. First, we lacked data on clinical diagnosis of depression and relied on a harmonized measure of four mental health scales that were standardized across a number of independently designed population surveys. Depression and our covariates were harmonized so as to remain comparable across studies; the need to rescale responses onto a common metric may have resulted in a loss of variability compared

to the original data, possibly reducing the precision of our estimates. The pooled DYNOPTA dataset includes studies with both narrow and broad age-ranges, which when coupled with baseline years that span the 1990s, results in the aggregation of differing birth cohorts. It is possible that younger birth cohorts experience different late-life depression trajectories compared to older birth cohorts. However, confounds that were potentially introduced by study differences were minimized by aligning measures on a common scale and adjusting for study effects in our analyses.

Despite these limitations, these findings add important information to the delineation of the course of late-life depression and approaching death. We have identified the utility of observing mental health changes over a distance-to-death metric rather than an age (distance-from-birth) metric. First, we have demonstrated that changes in mental health in late life are mostly unrelated to age and more closely related to one's death. Second, we show that much of the mental health change that occurs in the years leading to death could be explained by other co-morbid health conditions. There is some evidence that increased depression in the years preceding mortality is related to morbidity and associated functional limitations (Batterham *et al.*, 2012), and whilst our results are adjusted for SRH, these issues remain to be more fully explored. It is likely that there is a complex association between physical

health, depression, suicide, and mortality, which remains to be explored. Over the time-to-death metric, the impact of poor SRH was a particular vulnerability for males in this study (see Figure 1b). Significantly, the DYNOPTA project incorporates a large population-based sample on which data were available for up to 4 observations for 16 years from death; indeed, we specifically excluded those participants who only provided depression data at baseline. Importantly, our estimates are adjusted for baseline education, age, and time-varying partner status, residential status, and SRH. However, future research should extend our findings to determine how within-person change in these covariates moderates the trajectories of late-life depression and whether their impact is invariant between gender groups.

To conclude, context is important to understanding late-life changes in depressive symptomology; mortality is more important than increasing age. Whilst changes in probable depression were not observed in fully adjusted models for either male or female participants, increasing levels of depressive symptomology in the years approaching death were still reported. Over both time metrics, females reported higher levels of depressive of symptomology and probable depression, although it was the male participants who reported higher rates of change. Overall, our findings show that males report increasing levels of depressive symptomology approaching death, particularly when they experience poor physical health. This may have particular significance for aged care and health service provision; whilst such services for older people in the later years of their lives often focus on their physical health needs, clinicians need to be aware of the associated mental health needs and design services to address overall health and well-being.

Conflict of interest

None.

Description of authors' roles

All authors have read and approved the final version of this paper. Specifically, Burns formulated the research question, determined the analytical methods, and undertook the statistical analysis, and led the writing of the paper. Luszcz supervised the data collection, formulated the research question, and contributed to writing the paper. Kiely and Butterworth contributed to the analytical method and analyses, and helped in writing the paper. Browning, Mitchell, and Anstey supervised the data collection and contributed to writing the paper.

Acknowledgments

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