Is aging depressing? The relationship between aging, gender, and depression in older adults

Carla Medalia
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Abstract

Empirical evidence is inconclusive as to whether aging is depressing and if women's greater risk of depression changes with age. This paper examines the relationship between age, gender, and depression among those 51 and older using fixed effects regression for longitudinal data from the Health and Retirement Survey (HRS). Results indicate that aging does not affect depression until age 75, after which aging increases depression for both sexes, and particularly for men. The sex gap in depression decreases after age 75 because age has a stronger effect on men's depression than on women's. Controlling for changes in social and health status reduces but does not eliminate the age effect. In conclusion, the measurement of age may explain the contradictory research on aging, gender and depression. A nonlinear measure of age, such as the age spline proposed in this study, accurately represents the trend in depression at older ages.

Is aging depressing? Popular belief, as well as a consensus in the fields of gerontology and mental health, holds that aging is associated with an increased risk of depression (Newmann 1989). Most arguments for the positive association between age and depression pertain to the aging process: aging is usually associated with diminished physical and cognitive health, often comes with transitions from living with a partner to being widowed, living alone, and possibly living in a nursing home, retirement and reductions in economic stability. All of these factors are positively associated with depression, so it would make sense if aging led to an increase in depression.

In addition to this "gross" effect of the aging process, aging itself could be depressing: there could be a "net" effect of age that remains after adjusting for these other life transitions. For example, older age could be more depressing because people's social networks narrow as their peers die, because cognitive function decreases, or because people feel uneasy about their proximity to death. While there are a variety of reasons for a net age effect, the goal of this paper is not to select among possible mechanisms. Instead, I seek to establish whether there is a direct effect of aging net of other factors.

However, empirical research on aging and depression is inconclusive to say the least, and contradictory at worst. A few studies do find that depression increases with age (Luppa et al.; Sonnenberg et al. 2000), while others show the opposite – that depression actually decreases as people age (Bebbington et al. 1998; Cairney and Wade 2002; Christensen et al. 1999; Jorm 2000; Korten and Henderson 2000; Kroenke and Spitzer 1998; McGuire et al. 2009). Still other research shows that the relationship between age and depression is nonlinear, and that it follows either a U-shaped (Kessler et al. 1992; Mirowsky 1996; Mirowsky and Ross 1992) or inverse U-shaped (Newmann 1989) pattern. Finally, other studies find that there is no real relationship

between age and depression, or that the relationship is too inconsistent to pin down (Djernes 2006; Glaesmer et al. 2011; van Grootheest et al. 1999).

Research is unclear on the relationship between age and depression for many reasons, including using small and unrepresentative data sets, operationalizing age in various ways, considering different age ranges, and measuring depression with diverse instruments. Even if all of these dissimilarities could be addressed, our understanding of the relationship between age and depression would remain uncertain for several reasons. First, the vast majority of research uses cross-sectional data as opposed to longitudinal data. Cross-sectional data allows for comparisons of different people at different ages, while longitudinal data can capture the effect of age itself on the same individual over time. This is potentially problematic because some research suggests that there may be cohort differences in the relationship between age and depression (Bebbington 1996; Kessler et al. 1992; Luppa et al.; Newmann 1989). Second, research has not been able to disentangle the effect of the aging process from the potential effect of age *per se* on depression. This distinction between the gross effect of the aging process, which includes the association between age and diminished health, widowhood, and retirement, among other life changes, and the net effect of age itself on depression, is important for understanding how, and how much, caretakers can address depression among the elderly. Much of the research suggests that the increase in depression associated with age is actually attributable to decreases in health. Some research goes as far as saying that age, or "maturity", actually protects people from depression once controls for health changes are factored in (Djernes 2006; Mirowsky and Ross 1992; van Grootheest et al. 1999). However, because these assertions derive from cross-sectional data, they are inconclusive. We need to examine longitudinal data to fully understand the relationship between age and depression.

What about the role that gender plays in the relationship between age and depression? Research on gender and health has consistently found that women are more likely to be depressed than men. While part of the explanation may be biological, historical and cultural variation suggests that there is a social component to the sex gap in depression. Many social characteristics are related to an individual's risk of depression, including age, race, education, poverty, marital status, and employment status. Part of the sex gap in depression is explained by sex differences in these risk and protective factors. Whether or not the sex gap in depression remains constant over the lifespan is a topic of much debate. Like the literature on aging and depression, there are many theoretical and empirical inconsistencies regarding the relationship between gender, age and depression.

One hypothesis is that the sex gap in depression is attributable to both the social and biological implications of the reproductive years. Some research has shown that the sex gap in depression emerges during young adulthood and disappears after women go through menopause (Bebbington et al. 1998; Korten and Henderson 2000). Another hypothesis is that the sex gap in depression increases as people age, because older women are at a greater risk of becoming widowed and falling into poverty than are older men (Moen 1996; Luppa et al.). Yet another hypothesis is that the sex gap in depression should remain constant over the life course, given the evidence that throughout their lives, women are consistently at a greater risk for depression (Cairney and Wade 2002; Hopcroft and Bradley 2007; Glaesmer et al. 2011; Kessler et al. 1992; McGuire et al. 2009; Sonnenberg et al. 2000; van Grootheest et al. 1999).

To summarize, research on aging, gender, and depression is contradictory and leaves us unable to fully understand these complex relationships. Do people become more or less depressed as they age? What explains the change in depression that occurs with age? Do

changes in marital status, employment, and health explain the brunt of the change in depression? Or, does age *per se* have a direct effect on depression? What happens to the sex gap in depression as people pass through their middle and elderly years? And finally, are there cohort differences in the age trend in depression? We do not know the answers to these questions because of data and methodological limitations of previous research. In this study, I examine the relationship between gender, aging, and depression using longitudinal and nationally representative data from the Health and Retirement Study (HRS). In doing so, I find that age *per se* does not increase depression until age 75, after which point depression increases for both men and women. While social and health changes explain the majority of the increase in depression with age, I find that age itself has a net effect on depression levels. The sex gap in depression decreases after age 75 because the aging process has a stronger effect on men's depression than on women's. And finally, I find no support for the claim that the age trend in depression is due to cohort differences, which has been a major criticism of cross-sectional research. Instead, the measurement of age itself seems to be an important underlying explanation for the contradictory research on aging, gender and depression. A nonlinear measure of age, such as the age spline used in this study, more accurately represents the trend in depression over the middle to elderly years.

Theoretical Considerations

Aging and depression. As previously noted, empirical research on aging and depression is not only inconclusive, but also contradictory. The following discussion of the literature is summarized in Appendix 3.1. A few studies find that depression increases with age. For example, a meta-analysis of studies that examine the relationship between age and gender on depression during latest life (ages 75 and older) found that late-life depression is common and

often increases up to the very oldest ages (Luppa et al.). However, they note that this increase could be explained by an increase in risk factors and that age itself may not be the cause of the increase in depression (i.e., that there is no net age effect). In this meta-analysis, age is treated as a categorical variable, using five-year age increments. Another study, which examined Dutch adults between the ages of 55 and 85, also found an increase in depression for both sexes over age, using five-year age categories (Sonnenberg et al. 2000).

However, many more studies find that, contrary to popular belief, depression actually decreases as people age. For example, in another meta-analysis of the literature, Jorm (2009) found that aging *per se* reduces depression. This pattern was not initially evident, and only emerged after controlling for other risk factors. In other words, while the gross age effect was unclear, Jorm found a consistent negative relationship between depression and the net effect of age. In a study of Canadians ages 20 and older, the risk for major depressive episodes was found to decrease for both sexes over age (Cairney and Wade 2002). The study dichotomized age at 55; for both sexes, adults over age 55 were about 50 percent less likely to be depressed than adults under age 55. Another study, of adults aged 65 and older in the United States, dichotomized age at 75 (McGuire et al. 2009). They found that adults between ages 65 and 74 were more likely to be depressed than adults aged 75 or older, but did not specifically examine net versus gross age effects. Other studies operationalize age differently. A study using an Australian sample and ten-year age categories found that age is negatively correlated with depression (Christensen et al. 1999). Another Australian study, which also measured age in ten-year age categories, also found a decrease in depressive symptoms at older ages (Korten and Henderson 2000). One criticism of this study is that they are missing elderly people who are

institutionalized, who are most likely more depressed than those who are not institutionalized (Snowdon 2001).

Another common pattern is that age has a nonlinear association with depression. For example, in a study of US adults covering the age range 19 to 96, Kessler et al. (1992) found that depression followed a U-shaped pattern: depression was higher at age 25, lowest at age 50, and then higher around age 75. Mirowsky and Ross (1992) found similar results in their study of US ages 18 to 90. They argued that the age pattern is not a perfect U-shaped relationship: young adults are more depressed than middle aged adults, but the elderly are the most depressed. This study expands upon the analysis of age and depression by examining the trend in conjunction with other factors that contribute to depression, and conclude that being older is not in itself depressing.

Still other research finds that there is no real trend in the relationship between age and depression. For example, in a study of German elderly aged 60 to 85 and five-year age categories, there was no clear age pattern to depression for either men or women (Glaesmer et al. 2011). Two other studies, one of Italian elderly and another of Dutch elderly, found that there was no effect of age on the depression when controlling for other variables (Minicuci et al. 2002; van Grootheest et al. 1999). In a meta-analysis of research on depression among Caucasian elderly populations, several trends were observed: some studies showed that age was positively associated with depression, others that the association was negative, and others found no trend with age (Djernes 2006).

So, what are we to make of the relationship between age and depression? Inconsistencies in the literature derive from several factors. First, the majority of studies on aging and

depression focus on small community surveys or even clinical samples, so the findings are not necessarily generalizable to the general population. Second, the age range considered varies from study to study: some look at a wide range of ages, from 18 to 91 (thus having a small sample of elderly respondents), while others focus on the older adult population, for example, from ages 55 or 65 to 85. The conclusions we draw regarding the relationship between age and depression are likely to differ depending on if aging means comparing young adults to middle aged adults to the elderly, or if aging refers to passing through the last several decades of life. Third, age is operationalized differently, and often poorly, in many studies. In my review of the literature, I was surprised by how many studies treated age as a categorical variable (eight of the studies cited above) or a binary variable (three studies). Only five of the studies measured age using age and age-squared.

Putting age aside, a fourth reason for all of the disparities is the measurement of depression. Depression is often measured in two general ways: either as a summary score of depression severity, as in surveys like the Center for Epidemiological Studies Depression Scale (CES-D) and the Patient Health Questionnaire-Nine (PHQ-9), or it is more formally diagnosed in a clinical way, with respect to the criteria specified by the Diagnostic and Statistical Manual of Mental Disorders (DSM), in surveys such as the Composite International Diagnostic Interview (CIDI). As it turns out, studies that use the former depression severity instrument find a very different relationship between depression and age than do studies that use the diagnostic measure of clinical depression (Newmann 1989).

In her review of research on depression and aging, Newmann (1989), Newmann describes two general trends in the relationship between age and depression: a U-shaped pattern and an inverse U-shaped pattern. She finds that studies that use measures of depression severity,

such as the CES-D, often find a U-shaped relationship between age and depression. Studies that use diagnostic indicators of clinical depression, on the other hand, find an inverse U-shaped pattern. The operationalization of depression is important to studying the relationship between aging and depression. Proponents of depression severity scores are often interested in social factors associated with differences in depression between subgroups (Newmann 1989). She argues that the rise in depression toward the end of life may reflect the types of questions used in the CES-D. The CES-D incorporates four categories of questions, including depressive affect (feeling sad, depressed, or blue), somatic symptoms or "malaise" (lacking energy, could not get going, sleep problems), social isolation (nobody likes me), and positive affect (enjoying life). These dimensions may result in a potential age bias: "a number of investigators have argued that composite scale scores may be disproportionately inflated among elderly persons as a consequence of various types of physical malaise that older persons commonly experience more than their younger counterparts" (Newmann 1989:161). However, several studies have investigated this claim, separating out the depressive affect and somatic symptoms questions in the CES-D and have concluded that there is no separate age pattern between these dimensions, and that somatic symptoms do not explain the trend in the relationship between age and depression that they observe (Kessler et al. 1992; Mirowsky and Ross 1992). If the disparity in the age pattern of depression is not attributable to somatic symptoms, what is it attributable to?

As previously noted, studies that use clinical diagnostic indicators of depressive disorders generally find an inverse U-shaped relationship between age and depression over the lifespan. In other words, they find that depression decreases during the elderly years. Newmann (1989) argues that this may be explained by why and how the CIDI is used to diagnose depression. Proponents of the diagnostic approach are trying to figure out who needs help from mental health

professionals, and what kind of help they need. As a result, they aim to diagnose people with a specific disorder, such as Major Depressive Episode (MDE). According to the DSM, before someone is diagnosed with a MDE, a number of exclusionary criteria have to be ruled out so that the depression is not due to, for example, a physical illness or condition, medication, drugs or alcohol, or bereavement. These exclusionary criteria have been called into question because they may tend to produce underestimates of the prevalence of depression (Goldney, Fisher, and Hawthorne 2004; Slade and Andrews 2002), especially in the elderly population since they are more likely to attribute their depression to physical illness (Knäuper and Wittchen 1994; Newmann 1989) or bereavement (Corruble et al. 2009). Note that not all studies that use the CIDI as a measure of depression use these exclusionary criteria.

Aging per se*, or poor health associated with aging?* Another question that remains regarding the relationship between aging and depression is does aging per se have an effect on depression, or does the effect of aging operate through its association with other life changes? Much of the research suggests that the increase in depression associated with age is actually attributable to diminished health. Some studies even argue that there is a protective net effect of age, or "maturity," on depression that becomes clear when you control for health changes (Djernes 2006; Mirowsky and Ross 1992; van Grootheest et al. 1999). For example, one study concludes that "With all the functional and social statuses adjusted, predicted depression drops throughout the lifetime. The residual decline in depression suggests an underlying benefit of maturity." (Mirowsky and Ross 1992:201). However, given that these studies use cross-sectional data, they may not be able to accurately disentangle the effects of aging and declining health on depression. Longitudinal data is better suited to answering this question, because it enables an examination of health changes and aging on depression outcomes.

Gender, aging and depression. What about the role that gender plays in the relationship between age and depression? Before answering that question, let me first summarize where research stands on gender and depression in general. A predominant and consistent finding is that women are more likely to be depressed than men. While part of the sex gap explanation may be biological, historical and cultural variation suggests that there is a social component to the sex gap in depression. Many social characteristics are related to an individual's risk of depression, including employment status, marital status, education, and poverty, among others. Due to the fact that these characteristics are distributed differently between men and women, part of the sex gap in depression is explained by sex differences in these factors. Employment is probably the most notable social explanation for the sex gap in depression. Between the 1950s and 1970s, the increase in women's labor force participation explained 20 percent of the decreased sex gap in depression that was observed over that period (Kessler and McRae 1981). Between 1970 and the present, the additional increase in women's labor force participation explained 100 percent of the diminished sex gap in depression observed over the past 40 years (Medalia). In addition to employment, women are less likely to be married, more likely to fall into poverty, and experience worse health than men, all risk factors for depression. Not only are women more likely to experience personal hardships, but they are also more susceptible to adverse events that occur within their social network, since they often have more extensive and stronger social ties to their networks (Kessler and McLeod 1984). Although most would agree that more women are exposed to these risks than are men, there is disagreement as to whether or not men and women experience these hardships differently. Some argue that women are doubly disadvantaged when it comes to these undesirable life events: women are simultaneously more exposed to these hardships and also are more emotionally responsive to them (Kessler and

McLeod 1984). However, other research finds that not being currently married (Sonnenberg et al. 2000; van Grootheest et al. 1999), or having a lower income (Sonnenberg et al. 2000), have a more profound effect on men's depression than on women's. Clearly, more research is needed to sort out the role that social factors play in determining the sex gap in depression.

Research is divided as to whether or not the sex gap in the risk of depression remains constant over the lifespan. One hypothesis is that the sex gap in depression is attributable to both the social and biological implications of the reproductive years. In a study of the British population ages 16 to 64, Bebbington et al. (1998) finds that women are more likely to be depressed than men before age 55, though there is some variation in the sex gap. After age 55, however, they find that men are more likely to be depressed than women. In other words, they find evidence not only for convergence in the sex gap, but also for a reversal. Additional research has found evidence for a convergence in the sex gap in depression over the lifespan (Korten and Henderson 2000). Retirement may also contribute to a decrease in the sex gap in depression as people age. Although it is changing, historically, men have been more attached to the labor force than women, so they are at greater risk of retiring than are women. Furthermore, retiring may trigger more depression in men than in women, since research shows that decreases in income have a stronger negative effect on men's depression than on women's (Sonnenberg et al. 2000). As a result, depression may increase more for men than women after retirement, leading to a narrowing of the sex gap in depression.

Another hypothesis is that the sex gap in depression increases as people age (Moen 1996). As people enter their elderly years, they often experience significant life changes that may put them at greater risk for depression. The elderly are more susceptible to becoming widowed and to falling into poverty. Gender is integrally related to these processes. Women

are more likely to become widowed as their husbands die, since male life expectancy is lower than female life expectancy. Elderly women are also more likely to be in poverty as men, in part because of losing a spouse that may have supported them, but also because women tend to earn less and work less than men, and therefore have less savings to support them during old age. Thus, if the risk of depression does increase toward the end of life, these factors may contribute to a larger increase for women than for men, leading to further divergence in the sex gap in depression. Empirical support for this pattern is inconclusive, but in a meta-analysis of research on aging and depression, the majority of the community studies analyzed found evidence for an increase in the sex gap in depression as people passed through their elderly years (Luppa et al.).

Yet another hypothesis is that the sex gap in depression should remain constant over the life course. While it may be true that women are more at risk for becoming widowed and falling into poverty at old ages, they are also at a greater risk during their middle years, since, for example, they are less likely to be employed than men (Mirowsky and Ross 1992). Indeed, several studies find no age trend in the sex gap in depression (Cairney and Wade 2002; Hopcroft and Bradley 2007; Glaesmer et al. 2011; Kessler and McRae 1981; Kessler et al. 1992; McGuire et al. 2009; Sonnenberg et al. 2000; van Grootheest et al. 1999). Ultimately, like the research on depression and aging, it is unclear what the relationship is between sex and depression as people age through their elderly years.

Contamination by cohort effects. Some research suggests there is a need to explore the role that birth cohort may play in the relationship between age and depression (Bebbington 1996; Kessler et al. 1992; Luppa et al.; Newmann 1989). For example, in a summary of the literature, Bebbington (1996) finds a consistent decline in depression with age in a number of studies, suggesting a cohort effect of increasing levels of, and possibly earlier onset of, depression. Other

studies point out that the age effect they observe could be alternatively attributable to a cohort effect (Jorm 2000; Kessler et al. 1992), and that longitudinal data could help disentangle the perennial age-period-cohort problem.

Social status, health and depression among older populations. People of all ages are less likely to be depressed if they are married, employed, and in good health puts. There is less research on the effects of these social factors on depression specifically among older adults. However, the findings of this research are summarized here. One study found that the effect of no longer/not being married (compared to currently being married), was significantly greater for men than women – it increased men's risk of depression by about 300 percent and women's risk by about 200 percent (Sonnenberg et al. 2000). Similarly, another study found that widowhood had a stronger association with men's depression than women's (van Grootheest et al. 1999). Having a lower income increased depression among both sexes (McGuire et al. 2009), but particularly for men (Sonnenberg et al. 2000). Being employed full-time was less depressing than other employment statuses, including part-time employment (Mirowsky and Ross 1992). Unsurprisingly, poor health, which encompasses self-rated health, chronic or physical illness, functional limitations, cognitive impairments, and disability, increases depression for both sexes (Djernes 2006; McGuire et al. 2009; Sonnenberg et al. 2000).

Research Questions

In this study, I ask five primary research questions.

1. How does the gross aging process affect depression severity? Is this process the same for men and women? Based on the literature, there are several possible relationships. Aging

could be associated with both linear and nonlinear increases and decreases in depression, or there could be no observable trend over age.

2. How do other transitions, like changes in marital status, employment status, and levels of health, affect depression? Do these factors affect depression similarly for men and women?
3. Do these factors explain the effect of age on depression? Alternatively, does age have an effect on depression that is net of these other life changes? The literature suggests that entire relationship between aging and depression may be explained by the association between age and other life transitions.
4. Are there any significant cohort differences in the age pattern of depression? The literature suggests that cohort differences may explain cross-sectional age patterns in depression.
5. Finally, what happens to the sex gap in depression as people age? Does the sex gap widen, shrink, or remain constant throughout the later years of adult life? Again, the literature is not clear on what to expect with respect to the relationship between age, sex, and depression.

Data and Methods

The data for this study derive from the Health and Retirement Study (HRS). The HRS is a longitudinal and nationally representative panel survey of Americans over the age of 50. The HRS data are often used to examine changes in labor force participation, marital status, and health changes among individuals ages 50 and older. The longitudinal design of the survey allows for analysis of the effect of aging on depression; as opposed to comparing different birth cohorts of individuals at different ages at one point in time, I follow individuals as they age

through time. Among many other questions, the HRS surveys respondents about their income and work status, a variety of physical, mental and cognitive health measures. The data used in this study come from the eight survey waves collected every two years between 1994 (wave 2) and 2008 (wave 9). Wave 1 was excluded because it does not include the variable of primary interest, the CES-D short form.

Cohorts. The HRS was collected for five birth cohorts, also shown in Table 3.1. The oldest cohort in the sample is the AHEAD cohort, who was born before 1924, and was originally part of another study before being subsumed under the HRS. The first wave of data available for the AHEAD cohort is from wave 3 (1996). The next cohort, CODA (Children of the Depression), were born between 1924 and 1930, and data is available on this cohort starting with wave 4 (1998). The HRS (born between 1931 and 1941), has data from the beginning, in wave 2 (1994). The WB (War Babies) cohort were born between 1942 and 1947, and they were included in the sample beginning with wave 4 (1998). Finally, the EBB (Early Baby Boomers) cohort was born between 1948 and 1953, and they were added to the sample more recently, beginning with wave 7 (2004).

Methods. The data used in this study are longitudinal, as there are up to eight observations per individual. In order to account for the fact that I observe repeated observations on individuals, and that the error terms are likely to be correlated, I use fixed effects regression methods. Fixed effects regression includes a dummy variable for each individual in the sample. As a result, the models estimate only within-individual change in depression over time. Fixed effects regression requires that all predictor variables included in the model must also be time-varying. These include factors such as age, change in marital status, employment status, and health. With fixed effects, I am able to ask, "Does aging increase one's level of depression? Do

life changes, such as retiring, becoming widowed, or falling into poor health augment depressive symptoms? Does age have a net effect on depression after adjusting for changes in marital status, employment status, and health?" In other words, fixed effects methods measure the effect of aging and other transitions on depression. Because this method only analyzes within-person variation, fixed effects methods also control for all time invariant characteristics of an individual, such as their personality, whether or not they experienced depression at a time before the observed study period, their education, race, and all other stable characteristics.

Depression. The depression measures in the HRS are a modified version of the Center for Epidemiological Studies Depression Scale (CES-D) (Radloff 1977). Following up the earlier discussion of the types of depression instruments used in surveys, the CES-D measures depression severity and was not designed as a clinical diagnostic tool. The original CES-D consists of 20 items that ask the respondent how frequently during the past week he or she experienced a particular feeling or symptom associated with depression. Respondents indicate how often they experienced a particular feeling in the previous week, with responses ranging from 0 to 3, where 0 indicates rarely or none of the time (less than 1 day), 1 is some or a little of the time (1 to 2 days), 2 is occasionally or a moderate amount of the time (3 to 4 days), and 3 is most or all of the time (5 to 7 days). The scale is reliable, and has high internal consistency between the items (Chronbach's alpha usually around .85) (McDowell 2006). The CES-D is also considered a valid instrument for determining major depression, and it covers seven out of nine DSM IV symptoms of a Major Depressive Episode (McDowell 2006).

The modified version of the CES-D used in the HRS includes eight of the original twenty CES-D questions. Another modification is that the HRS version of the CES-D worded the questions slightly differently from the original module, asking respondents to affirm or negate

the presence of the feeling during "much of the week". This approach to scoring, called the "presence approach", has been determined to perform better than the alternative "persistence" approach method of dichotomizing the original CES-D categories (Perzynski and Townsend 2002). Although the original CES-D is not available, the modified module has the advantage that it is asked in the same exact way in every survey wave.

Age. When all survey waves and cohorts are combined, respondents are between age 51 and 115 years old[i]. However, due to the small sample size of respondents over the age of 95, age is top-coded at 95. Figure 3.1 illustrates the general trend between age and average depression levels for both sexes. The relationship between age and depression is nonlinear, but not in the way that previous research has suggested. Instead of a U-shaped or inverse U-shaped pattern, age has very little variation until age 75, after which depression increases. To account for this nonlinearity, I use a spline to divide the effects of age into two groups – the "middle-old" are between 51 and 75 years old, and the "oldest-old", who are 76 years old and older.

Sex. Sex is measured as a dummy variable for males and females. It is included in the analysis differently in different models. Most of the analysis is run separately by sex; however, at the end of the paper, sex is interacted with age in order to examine gender differences in the age pattern of depression.

Other social characteristics. In order to account for the association between aging and transitions into and out of other social statuses, I control for several individual characteristics in this study. Because of the nature of the analysis, I can only capture the effect of variables that change over the period of observation. Therefore, stable characteristics like race, ethnicity, and education are not included in the analysis. However, the fixed effects regression controls for

these variables by comparing each individual to him or herself. Since I am interested in sex differences in the age trend in depression, I analyze most models separately by sex. In addition to age, the social demographic factors include the following variables: marital status, employment status, and health. Marital status is broken down into the following categories: currently married or living with a partner is the reference group, and effects are estimated for never being married, becoming separated or divorced, and becoming widowed. Employment status includes being employed full time (the reference group), being employed part time, being partially retired, fully retired, not in the labor force, disabled, and unemployed.

Note that in addition to changes in marital status and employment status affecting depression, it is the reverse is also possible. Becoming depressed could erode the quality of one's relationship, leading to divorce; furthermore, evidence suggests that depression could cause people to withdraw from the labor force or take more sick days even if they're working (Lennon 2006). Since I observe respondents every two years, I am unable to determine whether reverse causation influences my findings. However, most research concludes that generally, changes in these social statuses are more likely to affect depression outcomes than the reverse.

Health. Because of the high correlation between depression and physical health, I will also control for health status. There are several ways to measure health status available in the HRS, including self-rated health, the number of Activities of Daily Living (ADLs) and Instrumental Activities of Daily Living (IADLs) the person has some difficulty with, and the number of chronic health conditions. While self-rated health is generally a good indicator of overall health status, since it is self-reported, it is strongly associated with depression. In this study, I measure health in the following three ways. First, the number of ADLs, including bathing, dressing, eating, getting into bed, and walking, with which the respondent experiences at

least some difficulty (ranges from 0 to 5). Second, the number of IADLs, including using the phone, money, and handling medications, with which the respondent experiences at least some difficulty (ranges from 0 to 3). Third, number of chronic health conditions acquired since the last interview (ranges from 0 to 4)[ii].

Findings

Descriptive results – depression. In order to understand the relationship between aging and depression, I begin by graphically presenting mean CES-D scores by age and sex in Figure 3.1. This figure combines all cohorts and waves of data, so the effect of aging is potentially contaminated by period and cohort effects. In Figure 3.1, there is a clear nonlinear relationship between age and the mean level of depression for both males and females. Average depression severity remains level until about age 75 for both sexes. Between ages 51 and 75, the average depression level for males is 1.2, and 1.8 for females. Since there is no age trend in depression for either sex, the sex gap in depression for the middle-old is constant at around 0.42 points, meaning that females have an average depression score that is 50 percent higher than males in this age group. After age 75, an age trend emerges, and there is an increase in depression severity for both sexes for the oldest-old. Between ages 76 and 95, the average depression score is 1.7 for males and 2.0 for females. This implies that the rate of increase in the average depression score is faster for males than females: the rate of increase for males between these two age periods was 40.8 percent and was 20.9 percent for females. At the very end of the lifespan, the observed data indicates a convergence in the sex gap in depression.

Descriptive results – social and health statuses. Before delving into the analysis, I describe the breakdown of marital status, employment status, and health, by sex and age group.

Figure 3.2, which presents the proportion of the sample by marital status, shows there is a much larger decrease in the proportion of married females than males between the middle-old and oldest-old age groups. For the middle-old, 82 percent of males and 66 percent of females are currently married. For the oldest-old, 68 percent of males and only 27 percent of females are married. Corresponding to the decrease in the proportion of married individuals, there is a dramatic increase in the proportion of widows and widowers between these age groups. For the middle-old, 5 percent of males and 17 percent of females were widowed; for the oldest-old, 24 percent of males and 63 percent of females are widowed on average. This trend is probably a product of two factors. First, women are often married to men who are older then themselves. Second, life expectancy is longer for women than men. The other marital statuses included in Figure 3.6, divorced or separated and never married, do not change as dramatically between the age groups.

Figure 3.3, which depicts employment status differences by sex and age group, shows that there are also many changes in employment status between the 51 to 75 year olds and 76 to 95 year olds. The percentage of full time employed people decreases from 38 percent for males and 28 percent for females to 3 percent and 1 percent respectively. The percentage of part-time workers also decreases between these age groups, from 4 percent (males) and 9 percent (females) to 1 percent for both sexes. In terms of retirement, the percentage of both sexes who are partially retired decreases between the age groups while the percentage of fully retired males and females increases. For the middle-old, 42 percent of males and 36 percent of females were retired. For the oldest-old, 88 percent of males and 71 percent of females were fully retired. The percentage of unemployed individuals was only one percent among the middle-old, while no one in the oldest-old group reported that they are unemployed. This makes sense given the national

retirement age of 65. The two remaining categories reflect not being in the labor force due to disability and other reasons. The percentage of disabled, not working individuals is low for both sexes and age groups. An interesting gender pattern is observed for not in the labor force due to other reasons. While only 1 percent of males are in this category at both age groups, 15 percent of middle-old females and 23 percent of oldest-old females respond that they are not in the labor force for "other reasons." This is a subsuming category, but the gender disparity probably reflects the fact that women are more likely to consider themselves to be homemakers than are men.

Finally, Figure 3.4 illustrates age trends in health by sex. Females are more likely than males to have at least some difficulty with more ADLs and IADLs than males at both points in time. Not surprisingly, the percentage of both sexes who report difficulty with these tasks increases as people age. However, according to the data, there is little to no gender gap in the number of new conditions reported, although this number also increases with age.

Question 1: How does the aging process affect depression? Is the gross relationship between aging and depression the same for males and females? To answer these questions, fixed effects regression of depression scores on age are modeled separately by sex. This model includes no additional control variables; therefore, it describes the gross association between age and depression. As a reminder, the effect of age is modeled separately for the two age groups, the middle-old (ages 51 to 75), and the oldest-old (ages 76 to 95). Results are included in Table 3.2 (Baseline Model), as well as depicted in Figure 3.5. As is shown in the figure, age has a slight positive effect on depression for middle-old males and females[iii]. Between ages 51 and 75, depression increases by 0.09 points per decade for males, which amounts to 0.23 points over the 25 year age range. For females, depression increases by 0.11 points per decade, which amounts

to 0.28 points over the 25-year age range. In terms of relative difference, this change is associated with a 10.2 percent increase in depression for males and 11.3 percent increase for females between age 51 and 75. Since the gross effect of age on depression is almost the same for both sexes, the sex gap remains constant for the middle-old, where females have higher depression scores than males.

Comparing the two age groups, Figure 3.5 shows that the gross association between age and depression is stronger for the oldest-old than for the middle-old. According to the baseline model in Table 3.2, per decade, age is associated with a 0.68 point increase in depression among oldest-old males and a 0.43 point increase in depression among oldest-old females. Between the ages of 76 and 95, depression increases by 1.36 points for males and 0.86 points for females. This absolute gross change corresponds to a 56.9 percent increase among oldest-old males and a 39.2 percent increase for females. Therefore, the gross effect of age on depression among the oldest-old is greater for males than for females. While the sample size at these oldest ages is relatively smaller, especially for men, these findings indicate that toward the very end of the life span, males experience higher depression levels than females.

Question 2: How do other factors affect depression? Is this the same for both sexes? Table 3.2 includes two models which show the results of the fixed effects regressions of CES-D on age (baseline) and all time-varying covariates together. As a reminder, the full model includes age (for both age groups), marital status, employment status, and health. In models not shown, the effects of changes in marital status, employment status, and health are very similar between models where the variables are entered separately or simultaneously. I will now describe the effects of changes in social and health statuses on depression, reserving the discussion net age effects for the next results section. Marital status transitions have a slightly

larger effect on depression severity for males than for females. Becoming divorced increases depression scores by 0.57 points for males and by 0.46 points for females. Widowhood increases depression by 0.72 points for males and 0.53 points for females. Therefore, being married is the most protective status for both sexes, and widowhood is slightly more depressing than divorce. A sex difference exists when considering the "never married" category, which has no effect on male's depression but increases female's depression by 0.60 points. While significant, the effect of being never married should be viewed critically, since a very small percentage of both sexes say they are "never married" – just 3.0 percent for each sex.

In terms of employment status, there is no significant difference in depression for either sex between being employed full time (the reference category) and two other statuses: being employed part time and being partially retired. However, when comparing full time employment to the remaining employment statuses, the protective effect of working becomes clear. Fully retiring increases depression by 0.13 points for both males and females; being unemployed increases depression by 0.40 points for males and 0.34 points for females; not working because of disability increases depression by 0.33 points for males and 0.47 points for females; and finally, not being in the labor force for other reasons increases depression by 0.30 points for males and 0.18 points for females. As previously mentioned, the association between employment and depression could potentially be due to reverse causation, which cannot be differentiated in this study. However, taken together, fully retiring and unemployment affect male and female depression levels about the same, while not working due to disability affects females more than males and not working due to other reasons affects males more than females. In other words, there is heterogeneity in the impact of employment status transitions on depression for males and females.

In terms of health, it is not surprising that any health problems, whether it be experiencing some difficulty with ADLs, IADLs, or having an increasing number of new conditions, is more depressing than being in better health. As a reminder, in this dataset, ADLs range from 0 to 5; IADLs range from 0 to 3; and the number of new health conditions since the last interview ranges from 0 to 4. For males, having at least some difficulty with each additional ADL increases depression by 0.34 points, meaning that having some difficulty with 3 ADLs increases depression by 1.02 points. For females, each additional ADL increases depression by 0.28 points, and having difficulty with 3 ADLs increases depression by 0.84 points. Comparing the magnitude of the effects of having difficulties with ADLs to IADLs on depression, IADLs increase depression less than ADLs do for both sexes. Each additional IADL that the respondent says they experience at least some difficulty with increases depression by 0.18 points for males and 0.15 points for females. The effect of having new health conditions on depression is even smaller than the effect of IADLs: each additional new health condition increases depression by 0.09 points for males and 0.11 points for females. In sum, ADLs lead to larger increases in depression than do IADLs or health conditions, and there is a slightly stronger relationship between health changes overall and male depression than with female depression.

Question 3. Do these factors explain the relationship between age and depression? Is there an effect of age on depression net of these other life transitions? As previously noted, many studies have hypothesized that depression should increase as people age, since aging is associated with diminished physical and cognitive health, becoming widowed, and no longer working, all factors associated with an increase in depression. Does the relationship between age and depression operate through these other pathways, or is there also a direct (net) effect of age

on depression? In other words, how much of aging is due to age *per se* and not attributable to the correlation between age and other factors.

The results for the middle-old are shown in Table 3.2. In the baseline model, there is a very small positive gross effect of age on depression for males and females among the middle-old. When all variables are adjusted for in the full model, the net effect of age on depression becomes statistically insignificant for middle-old males. Therefore, there appears to be no net effect of age on depression among middle-old males. For middle-old females, on the other hand, adjusting for changes in social statuses and health contributes to a reversal in the effect of age. While the gross effect of age was positive, the net effect of age becomes slightly negative. This indicates that there may be a slight protective net effect of age on depression among middle-old females after controlling for life transitions.

Although the gross age effect was very small for the middle-old, the gross effect of age on depression is larger for the oldest-old. As indicated in Figure 3.5 and the baseline model from Table 3.2, age has a positive gross association with depression for both sexes among the oldest-old. The full model in Table 3.2 shows that the net effect of age on depression remains significant after controlling for all covariates. How much of the gross age effect is explained by these life transitions? How much of the net age effect remains? To answer these questions, I compare age coefficients from the full model to the baseline model, and calculate the percentage of the gross age effect that is explained by adjusting for marital status changes, employment status changes, and health changes (see Equation 1).

Eq. 1 $$\frac{(\hat{D}^{B}_{95} - \hat{D}^{B}_{76}) - (\hat{D}^{F}_{95} - \hat{D}^{F}_{76})}{\hat{D}^{B}_{95} - \hat{D}^{B}_{76}}$$

When all variables are included in the model simultaneously, the association between age and depression is reduced by 62.5 percent for males and 80 percent for females. This means that 37.5 percent of the net age effect for males and 20 percent of the net age effect on depression for females remains unexplained. Therefore, age has a net effect on depression that is independent of changes in marital status, employment status, and health. For males, age increases depression by 0.03 points for every additional year after age 75, implying that aging 10 years leads to a predicted increase in depression score of 0.30 points. For females older than age 75, depression increases by 0.02 points for every additional year, equivalent to 0.20 points over 10 years. While these effects are not very large, they do over the long run lead to increases in depression that are commensurate with or greater than the effects of changes in marital status, employment status, and health.

In this study, I examine both the gross effect of age, which includes changes in marital status, employment status, and health, as well as the net effect of age, which is the effect of age that remains after controlling for these other changes. What factors could be included in this net effect of age on depression? One possible explanation is that people could become more depressed as they age because they're friends are dying around them, and they feel increasingly alone. Decreases in cognitive function may also be associated with both age and depression. Moving into a nursing home or into assisted living may also be related to both age and depression. Another possibility is that proximity to death may be associated with both age and depression. In additional models, not shown, I also adjust for mortality by controlling for the wave before the respondent dies. In these analyses, the net age effect actually becomes slightly stronger for both males and females (and for both age groups), while part of the effect of health on depression is absorbed by proximate mortality.

Question 4. Do cohort differences explain the age pattern in depression? Some research indicates that there may be cohort differences in depression levels, and argues that the relationship between age and depression cannot be distinguished from potential cohort effects using cross-sectional data. Since this study uses longitudinal data, it is better suited to addressing this problem. The data presented in Figures 6 and 7 show the observed average levels of depression by age and cohort for males and females, respectively. The pattern observed does not vary significantly by cohort. At a given age, cohort variation in the level of depression is small and not statistically significant. Therefore, I find no support for the claim that cohort differences in depression are driving the association between age and depression. Furthermore, there is no evidence of a cohort*age interaction on depression, unlike previous research has suggested.

Question 5. What explains the sex difference in the age trend in depression at the oldest ages? Because the sex gap in depression remained constant over age for the middle-old, here, I focus on the convergence and reversal in the sex gap in depression among the oldest-old. In order to answer this question, males and females are examined together. In addition to age, an interaction between age and sex is included in the fixed effects regression to capture the change in the sex gap in depression as people age. Note that fixed effects regression prevents the inclusion of sex itself in the model since it is a stable characteristic; however, the interaction between a stable characteristic (sex) and time variant characteristic (age) is possible to model. Table 3.3 shows the effect of age on depression for males, the effect of age on depression for females, and the sex gap in the effect of age on depression, where female scores are subtracted from male scores. The results are presented for five models, one that includes only age and the age*sex interaction, while subsequent models additionally control for marital status, employment

status, health, and all variables combined. In this way, I am able to determine if the sex gap in the age trend in depression is attributable to other factors. In the first model, only age and the age*sex interaction are included. Each additional decade after age 75 contributes to a 0.82 point increase in depression scores for males and a 0.51 point increase for women. The sex gap in the gross effect of age on depression is -0.31 points per decade. Although the sex gap in the effect of age on depression is very small, it is statistically significant. In the second model, marital status is also included. While marital status explains some of the effect of age on depression for both sexes, it does not mediate the coefficient for the sex gap in the age effect, which remains almost constant at -0.29 points. The same is true for employment status, health, and the final model where all variables are combined. The factors which explain some of the gross age effect on depression for males and females do not explain the narrowing or reversal of the age gap in depression among the oldest-old.

Conclusion

This study uses longitudinal data to examine the relationship between aging, gender, and depression among a nationally representative population of US adults over the age of 50. Given data and methodological limitations of previous research, it was unclear what I would find. The first conclusion this study demonstrates is that the relationship between the gross effect of the aging process and depression depends on how old someone is – specifically, it is conditional on being younger or older than age 75. For adults between the ages of 51 and 75, age has very small positive association with depression. After age 75, the association between age and depression becomes much steeper. Therefore, there is a nonlinear relationship between age and depression. This finding is most similar to the conclusions reached by a small number of previous studies (Kessler et al. 1992; Mirowsky 1996; Mirowsky and Ross 1992; Newmann

1989). While the positive relationship between age and depression has been previously documented (Luppa et al.; Sonnenberg et al. 2000), the story is more complex than a straightforward linear relationship. The results of this study contradict the conclusions reached by studies which found that depression decreased with age, even among the elderly (Cairney and Wade 2002; Christensen et al. 1999; Kroenke and Spitzer 1998; McGuire et al. 2009), and those that found no relationship between age and depression (Glaesmer et al. 2011; van Grootheest et al. 1999).

In general, women have higher levels of depression than men. However, the sex gap in depression narrows, and eventually reverses, among adults over the age of 75. In my review of the literature, only one other study concludes that the sex gap in depression should decrease over age (Korten and Henderson 2000). I conclude that the gross association of age and depression is stronger among elderly men than it is among elderly women. These results do not support the findings reached by studies which found no age trend in the sex gap in depression (Cairney and Wade 2002; Hopcroft and Bradley 2007; Glaesmer et al. 2011; Kessler and McRae 1981; Kessler et al. 1992; McGuire et al. 2009; Sonnenberg et al. 2000; van Grootheest et al. 1999). This study also does not support the hypothesis that the sex gap in depression is a product of the biological and social implications of the reproductive years (Bebbington et al. 1998). I find that the sex gap in depression decreases until well after menopause, and not around age 55. Finally, these results contradict the findings from studies that suggest that the sex gap in depression increases as people age (Luppa et al.; Moen 1996).

As people age, they may stop working, become divorced or widowed, and may experience diminished physical health. These transitions, which are simultaneously associated with aging and an increase in depression, completely explain the slight increase in depression

that occurs as men age from 51 to 75. In fact, after controlling for these life changes, there appears to be a slight negative association between age *per se* and depression for women. Like previous research has suggested, there may be a beneficial effect of "maturity" in preventing depression (Djernes 2006; Mirowsky and Ross 1992; van Grootheest et al. 1999). However, the maturity benefit only goes so far. After age 75, there is a negative net effect of age on depression that remains for both sexes after adjusting for transitions in marital status, employment status, and health. The most important factor explaining the age effect among the elderly is health, which alone explains about half of the gross relationship between age and depression.

However, it should be taken into consideration that my focus on marital status, employment status, and health changes does not exhaust the possible changes that occur as people age. Other factors are not examined, such as how many friends are dying, hospitalizations, and relocation to nursing homes. These factors are likely to exacerbate one's risk of depression, and may help to explain more of the effect of age on depression among. It is probable that the more factors you can control for, the more of the age effect that is explained. This is interesting, but somewhat beside the point. The fact is that changes in marital status, employment status, health, social ties, living situation, almost inevitably change as people age. They are in fact part of the aging process. The effect of aging on depression may be mitigated or postponed as people live longer and healthier, but it seems unlikely that the risk for depression will ever disappear completely for the very old. As a result, caretakers and healthcare providers should emphasize the recognition and treatment of depression in elderly loved ones and patients.

This study suggests that aging is more depressing for elderly men than for elderly women. Although women are on average more depressed than men for most of the lifespan,

there may be a reversal in the sex gap among those over age 90. Why would men take aging harder than women? It is possible that men have a latent tendency toward depression that is suppressed by the protective influence of marriage, employment, and good health. When these benefits go away, they become more depressed. However, the negative effect of age on depression is not completely explained by these other life transitions. Almost 40 percent of the age effect on depression remains after adjusting for these factors. Due to small sample sizes of the very old, we cannot be completely confident in this estimate. Future research should examine depression among nonagenarians and centenarians. However, it appears as though for both sexes, but particularly for men, it is important to monitor depression levels as people age.

The vast majority of research on aging and depression uses cross-sectional data. As a result, these studies compare depression among different cohorts, as opposed to observing the relationship between aging and depression for the same individuals. Previous research has suggested cross-sectional methods are not able to disentangle potential cohort differences in depression from the effects of age on depression. In this study, I use longitudinal data, following several cohorts of people as they age. This method allows me to measure the relationship between aging and depression for individuals. To further investigate the role that birth cohort may play, I separately examined the relationship between age and depression by cohort. I found that there were no differences in the age pattern of depression by cohort. As more data is collected by the Health and Retirement Study, it will be possible to follow more adults as they age into their elderly years. Future research should use this data to provide more information about potential cohort effects. However, the results from this study do not reaffirm the concern with cross-sectional studies that cohort effects contaminate the effect of age on depression.

Instead, it appears as though the measurement of age is more important for the different conclusions reached by previous research with respect to the effect of age on depression.

One limitation of this study is that it only uses one measure of depression – the short form CES-D. Other measures of depression could be used, including more diagnostic indicators such as the CIDI. It may be the case that the patterns observed here for levels of depression do not correspond to experiences of major depressive episodes. Additionally, this paper focuses on the population of adults ages 51 and older, which leaves questions regarding the relationship between age and depression at younger ages. Longitudinal data for younger adults would be helpful.

Ultimately, this study illustrates the importance of the measurement of age when studying depression among older adults. The nonlinear association between age and depression needs to be taken into account in future research.

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[i] In the regression models, age is divided by ten so that a one-unit increase in the dependent variable is associated with an additional decade of life.

[ii] In addition to the health outcomes examined in this study, additional health measures may also be useful to consider in future research. For example, specific types of diseases, such as hypertension, heart disease, and diabetes, may be particularly likely to affect depression outcomes.

[iii] In order to plot the predicted depression scores by age, I need an intercept. However, SAS, the program used to analyze the data in this paper, does not compute an intercept for fixed effects regression models. Other statistical packages, including STATA, do compute this statistic; the intercept is adopted from the random effects regression model. I follow this method and borrow the intercept for this figure from a random effects regression model where there are no predictor variables (null model).

Tables and Figures

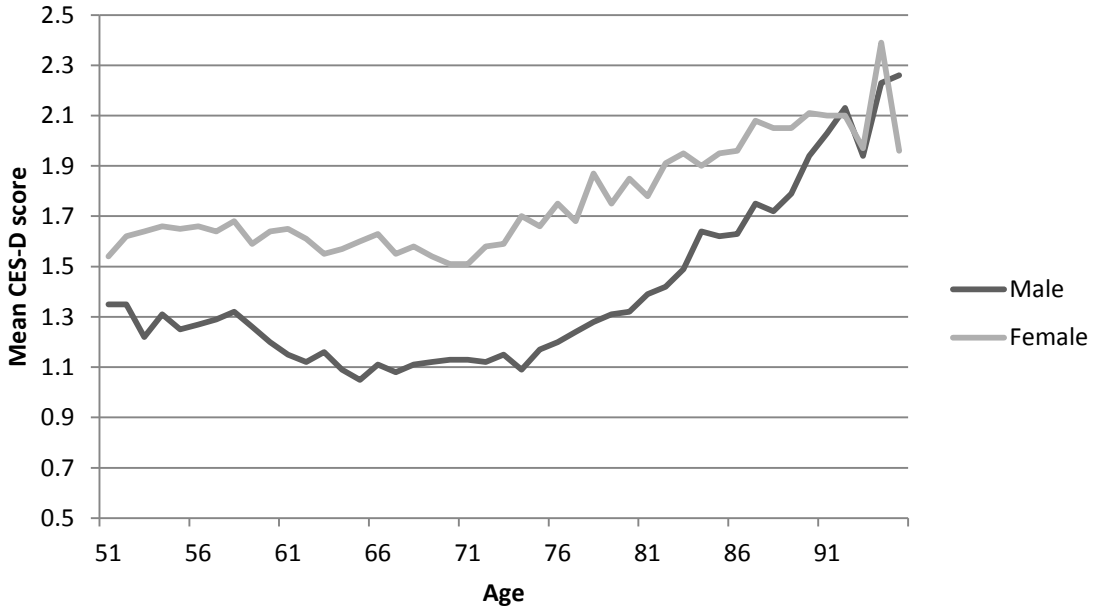
Table 3.1. Birth years and ages by cohort and survey wave

		AHEAD	CODA	HRS	WB	EBB
	Birth years	<1924	1924-1930	1931-1941	1942-1947	1947-1953
Wave	Survey Year					
2	1994			53-63		
3	1996	72-95*		55-65		
4	1998	75-95*	68-74	57-67	51-56	
5	2000	77-95*	70-76	59-69	53-58	
6	2002	79-95*	72-78	61-71	55-60	
7	2004	81-95*	74-80	63-73	57-62	51-56
8	2006	83-95*	76-82	65-75	59-64	53-58
9	2008	85-95*	78-84	67-77	61-66	55-60

*Note: due to the small sample size, respondents over the age of 95 are treated as being 95 years old.

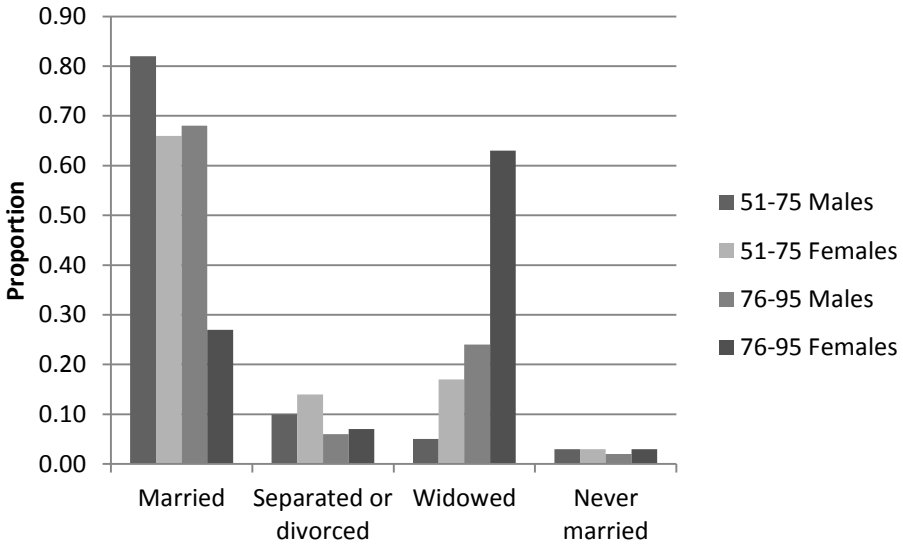
Source: Health and Retirement Survey

Figure 3.1. Average CES-D scores by age and sex (all cohorts and waves)



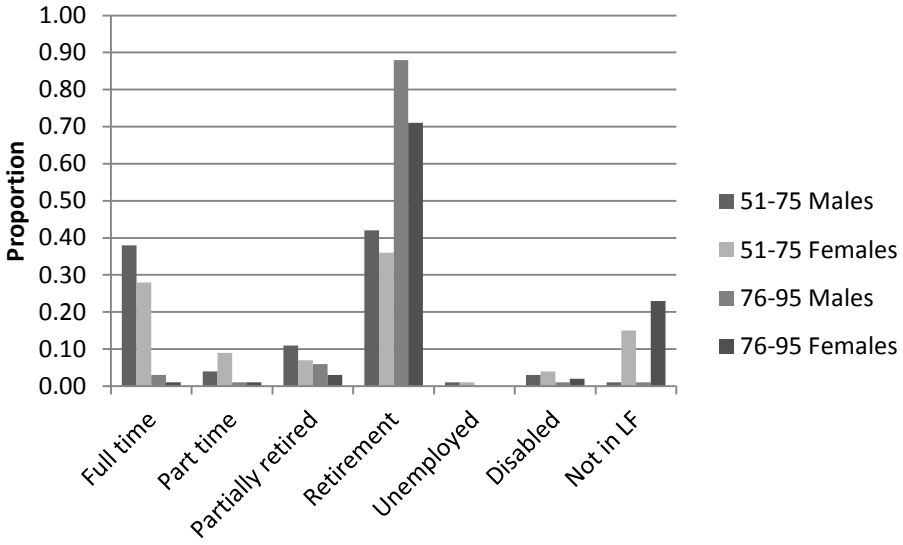
Source: Health and Retirement Survey

Figure 3.2. Marital status by sex and age group



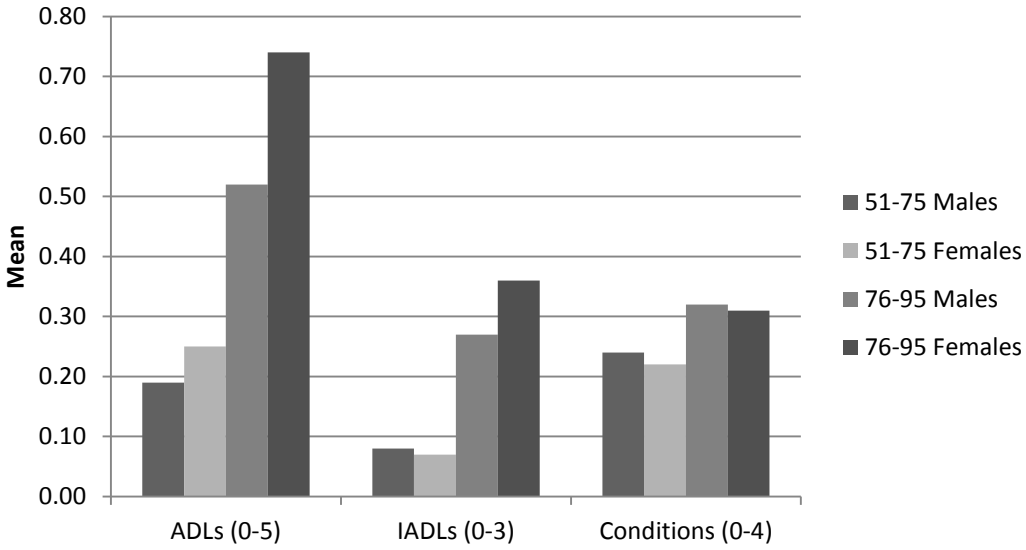
Source: Health and Retirement Survey

Figure 3.3. Employment status by sex and age group



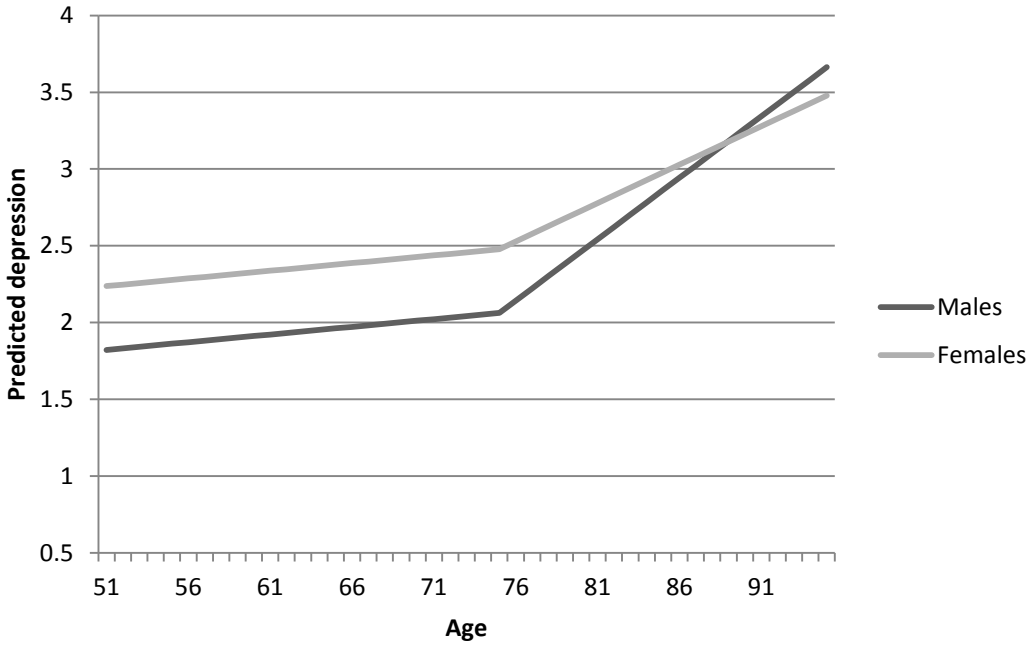
Source: Health and Retirement Survey

Figure 3.4. Health by sex and age group



Source: Health and Retirement Survey

Figure 3.5. Predicted CES-D score by sex and age, from fixed effects regression



Source: Health and Retirement Survey

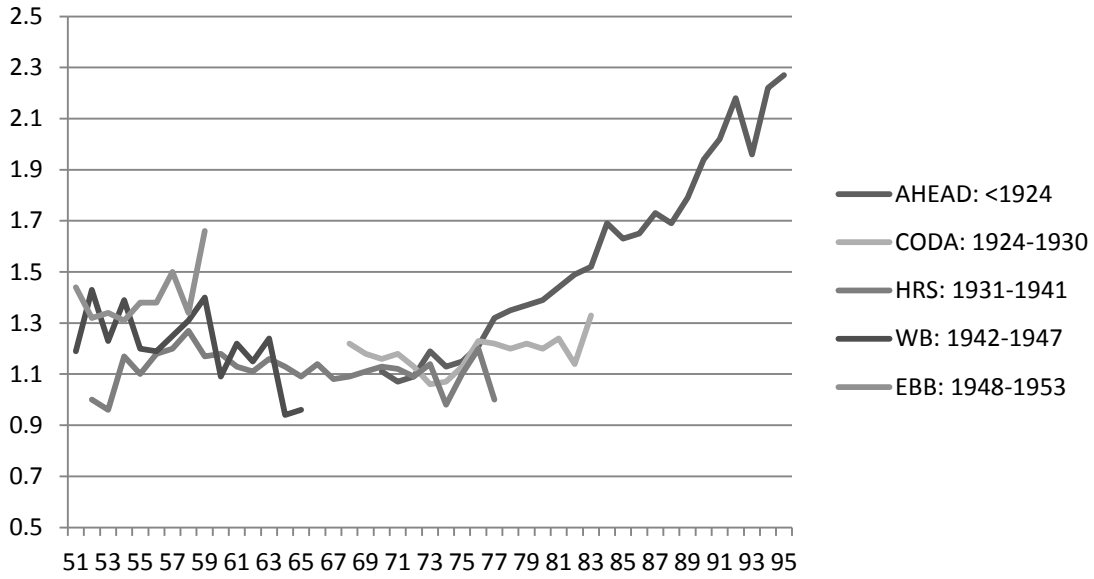
Table 3.2. Fixed effects regression by sex

	Baseline: age only, no controls						Full model: all variables					
	Male			Female			Male			Female		
	B	SE	Sig	B	SE	Sig	B	SE	Sig	B	SE	Sig
Age, in decades												
Age (51-75)	0.09	(0.02)	***	0.11	(0.01)	***	-0.03	(0.02)		-0.06	(0.02)	***
Age (76-95)	0.68	(0.04)	***	0.43	(0.03)	***	0.33	(0.04)	***	0.20	(0.04)	***
Marital status (ref=married)												
Divorced							0.57	(0.04)	***	0.46	(0.04)	***
Widowed							0.72	(0.04)	***	0.53	(0.03)	***
Never married							0.08	(0.15)		0.60	(0.11)	***
Employment status (ref=employed full time)												
Employed part time							0.01	(0.04)		0.01	(0.03)	
Partly retired							-0.02	(0.03)		-0.05	(0.03)	
Retired							0.13	(0.03)	***	0.13	(0.03)	***
Unemployed							0.4	(0.07)	***	0.34	(0.07)	***
Disabled							0.33	(0.06)	***	0.47	(0.05)	***
Not in LF							0.3	(0.09)	**	0.18	(0.03)	***
Health												
ADL							0.34	(0.01)	***	0.28	(0.01)	***
IADL							0.18	(0.02)	***	0.15	(0.02)	***
Number of conditions							0.09	(0.01)	***	0.11	(0.01)	***

Note: *=p<.05, **=p<.01, ***=p<.001

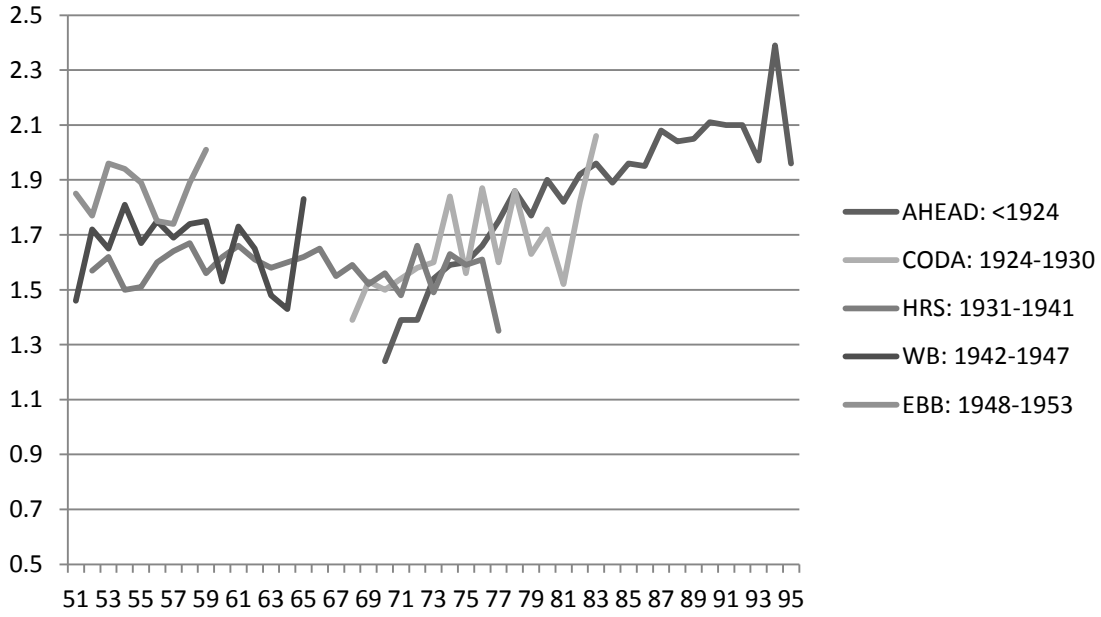
Source: Health and Retirement Survey

Figure 3.6. Average CES-D by cohort – Males



Source: Health and Retirement Survey

Figure 3.7. Average CES-D by cohort – Females



Source: Health and Retirement Survey

Table 3.3. Age*Sex interactions

	Age			Marital Status			Employment Status			Health			All variables		
	B	SE	Sig	B	SE	Sig	B	SE	Sig	B	SE	Sig	B	SE	Sig
Age, in decades (males)	0.82	(0.05)	***	0.67	(0.05)	***	0.78	(0.05)	***	0.58	(0.06)	***	0.41	(0.06)	***
Age*female	-0.31	(0.06)	***	-0.29	(0.06)	***	-0.28	(0.06)	***	-0.3	(0.07)	***	-0.27	(0.07)	***
Divorced				0.98	(0.08)	***							0.91	(0.08)	***
Widowed				0.58	(0.05)	***							0.56	(0.05)	***
Never married				1.10	(0.24)	***							1.14	(0.25)	***
Employed part time							0.04	(0.15)					-0.07	(0.17)	
Partly retired							0.18	(0.13)					0.16	(0.14)	
Retired							0.31	(0.12)	*				0.31	(0.13)	*
Unemployed							0.77	(0.60)					0.70	(0.59)	
Disabled							0.36	(0.18)	*				0.35	(0.18)	*
Not in LF							0.37	(0.13)	**				0.41	(0.14)	**
ADL										0.26	(0.02)	***	0.26	(0.02)	***
IADL										0.06	(0.03)	*	0.06	(0.03)	*
# of conditions										0.08	(0.02)	***	0.08	(0.02)	***
Age, in decades (females)	0.51			0.38			0.50			0.28			0.14		

Note: *=p<.05, **=p<.01, ***=p<.001

Source: Health and Retirement Survey

Appendix 3.1. Summary of literature on age, gender and depression

Paper	Type	Cou-ntry	Nat'l rep?	Dep var	Age range	Age measure	Gross age trend	Net age trend	Age trend in sex gap?
Bebbington et al. (1998)	X-S[1]	UK	No	CIS-R[6]	16-64	≥55, <55	↓ (F)[17]	Gross[24]	Reversal
Cairney and Wade (2002)	X-S	CA	Yes	CIDI-SF[7]	≥15	≥55, <55	↓[18]	Gross	—
Christensen et al. (1999)	X-S	AU	No	+	18-79	10-yr cat	↓	Gross	N/A
Djernes (2006)	M A[2]	+[4]	No	+	≥60	+	+	N/A[25]	N/A
Hopcroft and Bradley (2007)	X-S	+	Yes	1 Q[8]	≥18	A+Asq[15]	U[19]	None[26]	—
Glaesmer et al. (2011)	X-S	DE	Yes	PHQ-9[9]	60-85	5-yr cat	—[20]	N/A	—
Jorm (2000)	M A	+	No	+	30-65	+	~[21]	↓g[27]	N/A
Kessler et al. (1992)	X-S	US	Yes	CES-D[10]	19-96	A+Asq	U	N/A	—
Korten and Henderson (2000)	X-S	AU	Yes	CIDI[11]	18+	10-yr cat	↓	Gross	Converge
Kroenke and Spitzer (1998)	X-S	US	No	Auth.[12]	18-91	10-yr cat	↓	N/A	N/A
Luppa et al (Forthcoming)	M A	+	No	+	≥75	5-yr cat	↑	N/A	↑
McGuire et al. (2009)	X-S	US	Yes	PHQ-8[13]	≥65	≥75, <75	↓	N/A	—
Mirowsky (1996)	X-S[3]	US	Y/N[5]	CES-D	19-98	Log[16]	U	↓g	+
Mirowsky and Ross (1992)	X-S	US	Y/N	CES-D SF[14]	18-90	Log	U	↓g	N/A
Newmann (1989)	M A	US	No	+	+	+	U, Π[22]	N/A	N/A
Sonnenberg et al. (2000)	X-S	NL	Yes	CES-D	55-85	5-yr cat	↑	N/A	—
van Grootheest et al. (1999)	X-S	NL	No	CES-D	55-85	10-yr cat	↓ns[23]	None	—

See notes (next page)

Notes: [1] Cross-sectional; [2] Meta-analysis; [3] Cross-sectional plus one longitudinal follow-up; [4] Indicates many or various outcomes, measures, etc.; [5] Indicates both because several surveys were used; [6] CIS-R: Revised Clinical Interview Schedule; [7] CIDI-SF: Composite International Diagnostic Interview Short Form; [8] Did you feel depressed or very unhappy?; [9] PHQ-9: Patient Health Questionnaire-9; [10] CES-D Center for Epidemiological Studies Depression Scale; [11] CIDI: Composite International Diagnostic Interview; [12] Author's own patient questionnaire; [13] Patient Health Questionnaire-8; [14] CES-D Short form; [15] Age and age-squared; [16] Falling component (ln(age-17) and rising component (age-18); [17] Decrease, only for females; [18] Decrease; [19] U-shaped curve; [20] No trend; [21] Inconsistent trends across several studies; [22] Two trends: a U-shaped trend (CES-D), and inverse U-shaped trend (diagnostic interviews); [23] Decrease, but not significant; [24] Net effect of age is same/similar to gross effect of age; [25] Not available/tested; [26] No net effect of age; [27] Net age effect remains but is smaller than gross effect.

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