Historical Changes in the Gender Gap in Depression in the United States, 1971 to 2008

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ABSTRACT

Depression is a major public health concern that typically affects women more than men. Social factors have been shown to explain some of the sex gap. Furthermore, an earlier study concluded that the increase in women's employment between the 1950s and 1970s contributed to a decrease in the sex gap in depression. Since then, significant social changes have occurred in the realms of gender, work, and family. This paper updates the debate on sex and depression by investigating whether there have been changes in the sex gap in depression since 1970, and if so, what explains those trends? Using data from the National Health and Nutrition Examination Survey, I find that women are less depressed now than forty years ago, and as a result, that the sex gap in depression has decreased. The narrowing of the sex gap is attributable to the increase in female employment over this period.

Depression is a major public health concern, affecting approximately 6 to 17 percent of Americans over their lifetimes, depending on the study (Ronald C. Kessler 2006). According to the World Health Organization, depression is among the leading causes of disability worldwide and is the third leading contributor to the global burden of disease (World Health Organization 2008). However, the risk for depression is not uniformly distributed between the sexes. Research has consistently shown that women are more likely to experience depression than men (Clancy and Gove 1974; Gove and Tudor 1973; L. Radloff 1975; Ronald C. Kessler et al. 1993; Ronald C. Kessler 2003; Bird and Rieker 2008). Although estimates of women's excess depression varies, community studies find that women are between 1.5 and 3 times more likely to be depressed than men (Ronald C. Kessler 2006). There are many explanations for the sex gap in depression, including biological and hormonal explanations, comorbidity between depression and other conditions and diseases, and social explanations, including education, employment status, marital status, parental status, income, poverty, and race, among others. While all of these factors are likely to play a role, social factors in particular may help to explain historical variation in the sex gap in depression. Research has shown that where men's and women's social roles are similar, their depression levels are also similar (John Mirowsky and Catherine E. Ross 2003; Ronald C. Kessler and McRae 1981).

One study examined the trend in the relationship between sex and depression between 1957 and 1976 (Ronald C. Kessler and McRae 1981). Given the "sex role hypothesis," which predicts that the relationship between sex and distress should decline as sex roles become more comparable, the authors hypothesized that the increase in women's labor force participation, the increase in women's educational attainment, and other changes in marital status and parental status would lead to a narrowing of the sex gap in psychological distress. The findings from this

study indicate that although women had higher levels of distress in both years, the sex gap was larger in the 1950s then in the 1970s. In assessing the relevance of the sex role hypothesis in explaining this trend, the authors found that the increase in women's labor force participation explained 20 percent of the changing relationship between gender and distress. Labor force participation was in fact the only compositional change to explain the decrease in sex gap in distress over this period.

Since 1976, there have been dramatic changes in the United States that have led to greater equality between men and women. For example, while educational attainment has increased for both sexes, this trend has been especially true for women. As women have entered the labor force in greater numbers, fertility rates have declined, and marriages have been postponed to older ages. Only a few studies have undertaken an historical perspective to examining the relationship between social changes and changes in the sex gap in depression (R.C. Kessler, K.A. McGonagle, et al. 1994; Ronald C. Kessler and McRae 1981; Klumb and Lampert 2004; Meertens, Scheepers, and Tax 2003). However, these studies are either out of date or have study design limitations in the methods or unit of analysis. As a result, we do not know what impact these social changes have had on the sex gap in depression since the 1970s. In short, we need an update on Kessler and McRae's social examination of the trend in the sex gap in depression (Ronald C. Kessler and McRae 1981).

In this paper, I document trends in depression over the past 40 years for men and for women. Furthermore, I investigate whether or not there have been changes in the sex gap in depression. If so, what explains those trends? In my analysis, I undertake a social perspective to understanding the changing relationship between sex and depression. Specifically, I examine the

importance of changes in employment, marital status, poverty, and parental status on trends in depression.

In addition to the literature on sex and depression, this study fits into the body of research that examines the relationship between social changes and other dimensions of public health. For example, research has shown that female employment has led to improvements in self-rated health among women, leading to a convergence in the sex gap in self-rated health (Schnittker 2007). As gender equality increases, women have adopted many of the same risky behaviors as men, such as smoking and drinking (Bird and Rieker 2008; Rogers et al. 2010; Smith 2004). Such increases in female smoking rates have reduced the sex difference in mortality by 23 percent (Preston and H. Wang 2006:641), and increases in female smoking and alcohol consumption have also decreased men's excess heart disease mortality (Crawley, Foley, and Shehan 2008).

To examine trends in the sex gap in depression, I use data from two waves of the National Health and Nutrition Examination Survey (NHANES): NHANES I, which was fielded between 1971 and 1975, and the 2005 to 2008 Continuous NHANES. I find that the sex gap in depression has decreased over this period, and that convergence in the sex gap is attributable to the decrease in depression among women. This historical change in the sex gap in depression could be explained by one or both of the following two factors. First, the relationship between social demographic characteristics and the risk of depression for men and/or women could have changed over this period. Second, compositional changes in employment, education, marital status, and other attributes could be at play. I conclude that a particular compositional change, the increase in female employment, is responsible for the decrease in the sex gap in depression over the past 40 years.

RESEARCH ON GENDER AND DEPRESSION

Depression is an important public health concern, affecting millions of Americans a year (Ronald C. Kessler 2006). Consistently, research has shown that women are more likely to have depression than men. Estimates of women's excess depression ranges between 1.5 to 3 times the rates of men (Bird and Rieker 2008; Ronald C. Kessler 2003; J. Mirowsky and C.E. Ross 1989; Van de Velde, Bracke, and Levecque 2010).

Why is there such a robust sex gap in the prevalence of depression? Before summarizing the explanations offered by the literature, it is important to address a factor that does *not* contribute to the sex gap. Research has found that the sex gap in depression reflects a real difference in health and is not attributable to differences in help-seeking behaviors or reporting (Bird and Rieker 2008; Veroff, Douvan, and Kulka 1981). Other research also indicates that there is no evidence for women and men labeling symptoms and addressing severity differently (Verbrugge 1985). Furthermore, the sex gap in depression is found in nationally representative surveys in addition to clinical settings.

Explanations used to explain the sex gap generally fall into four categories. One potential explanation for the gender difference in depression derives from whether the episode is the first onset of depression or a recurrence of depression. Research has shown that female's larger risks for depression and anxiety in childhood and adolescence puts them at risk later in life (Piccinelli and Wilkinson 2000). Kessler (2006) argues that while there is a significant gender difference in the risk of first onset, there are mixed results for the sex gap in recurring depressive episodes, often depending on the subject's history of depression. Due to limitations of data, I am unable to address the difference in first onset and recurring episodes of depression. While the sex gap in the rates of depression may be due to a confluence of first onset and recurring

episodes, this study's focus on historical change and the relationship between social demographic characteristics and the sex gap in depression should still be relevant.

The second explanation is that there are biological determinants and hormonal differences between men and women that contribute to the sex gap in depression. For example, some argue that genetic predisposition (Risch et al. 2009), immune function and the cardiovascular system (Bird and Rieker 2008; Hemingway and Marmot 1999), may interact with psychological processes. There is less consistent evidence for the role of hormones (Ronald C. Kessler 2006; Young and Korszun 2010). Furthermore, in a review of the literature on gender differences in depression, there was no evidence in for genetic and biological factors of the sex gap in depression (Piccinelli and Wilkinson 2000).

Third, comorbidity between depression and other diseases may explain part of the sex gap in depression. Research has established that certain conditions may exacerbate depressive symptoms. For example, empirical evidence finds that comorbidity between chronic pain and depression accounts for some of the sex gap in depression (Haley, Turner, and Romano 1985). Obesity, which is more common among adult women than men (Hedley et al. 2004) , is also strongly associated with risk of depression (Ma and Xiao 2009). There is also evidence for comorbidity with other psychiatric disorders; for example, with depression are more likely to have comorbid anxiety, while depressed men are more likely to have comorbid substance abuse or dependence (Bird and Rieker 2008; Breslau, Schultz, and Peterson 1995). In addition to diseases and conditions exacerbating depression, research also suggests that depression may affect health outcomes. For example, one study found that depression increases the probability of reporting poor self rated health by 15 percent for both sexes, but that depression has a slightly larger effect on women's self-rated health than on men's (Case and Paxson 2005). Furthermore,

another study found that sex differences in psychosocial factors likely contribute to the sex gap in non-fatal chronic disease and milder acute problems, but not to the sex gap in acute or serious conditions (Verbrugge 1985).

Finally, social explanations include demographic characteristics that make women more susceptible to experiencing stressful events or interpreting those events in such a way that leads to a depressive episode. It is likely that all of these explanations, including one's history of depression, biological factors, comorbid diseases and conditions, and social factors, work together to determine an individual's tendency toward depression. Because the goal of this paper is to examine historical change, I focus on the ability of social factors to explain the sex gap in depression. Although the other types of explanations may still be relevant to this topic, it is likely that the dramatic changes in social demographic characteristics over the past forty years are related to any change in the sex difference in depression.

Socio-demographic characteristics associated with depression

Age. Putting gender aside, the relationship between age and depression is complex and often contradictory (Jorm 2000). Empirical research has found evidence for all possible relationships between age and depression: some find that age is associated with an increased risk of depression (Luppa et al.; Newmann 1989; Sonnenberg et al. 2000); others find that depression 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); research has found that the relationship between age and depression is nonlinear, and that it follows either a U-shaped (Ronald C. Kessler et al. 1992; John Mirowsky 1996; John Mirowsky and Catherine E. Ross 1992) or inverse U-shaped (Newmann 1989) pattern; and finally, studies have concluded

that there is no real trend in the 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).

In terms of the relationship between gender, age and depression, the story is just as unclear. One theoretical explanation for the sex gap in depression is that it is attributable to both the social and biological implications of the reproductive years. A few studies have 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 possibility is that women are significantly more likely to experience depression than men at all ages (Case and Paxson 2005), and that the sex gap is constant over age (Cairney and Wade 2002; Hopcroft and Bradley 2007; Glaesmer et al. 2011; Ronald C. Kessler et al. 1992; Ronald C. Kessler and McRae 1981; McGuire et al. 2009; Sonnenberg et al. 2000; van Grootheest et al. 1999). However, other research suggests that the sex gap in depression increases as people age (Moen 1996; Luppa et al.).

Thus, there are many inconsistencies in the literature with respect to age and depression, and to sex gaps in depression as people age. Some of the reasons for these inconsistencies include how age is measured, the age range considered, and the depression outcome examined. One study concluded that the nonlinear age pattern in depression needs to be taken into account when examining sex gaps in depression, particularly at the oldest ages (Medalia 2012). In this study, the sample population is between the ages of 25 and 74, and I control for age and age-squared to account for the non-linear association between age and depression.

Race. Depression is also associated with race, though findings are mixed. One study found that while whites are more likely to experience major depression than blacks, blacks are more likely to have depressive symptoms (Jackson and Williams 2006). Whites having greater

rates of major depression than blacks is a consistent finding in the literature, and whites also appear to be at greater risk for major depression than Mexicans as well (Riolo et al. 2005). In terms of sex differences in depression, previous research has shown mixed findings by race. For example, a cross-national study found that the sex gap in depression was larger among Danes and American whites than among the Japanese (Oksuzyan et al. 2010). Another study found that while the sex gap in depression was present for whites, it was not statistically significant for blacks (Mezuk et al. 2010). In this study, I attempt to mitigate variation by race or ethnicity by controlling for a dummy variable indicating that the respondent is white. Unfortunately, race was measured as white/not white in the NHANES I, so this is the only possible race variable for historical comparison.

Poverty. Poverty has a strong positive association with depression. One study found that being in poverty doubles the risk of recurrent depressive episodes for both sexes, but that there were no significant gender differences in the effect of poverty on depression (Bruce, Takeuchi, and Leaf 1991). Other research focusing on women, find that women in poverty, and especially mothers, are more likely to be depressed than those not in poverty (Belle 1990; Belle and Doucet 2003; Kahn et al. 2000). However, yet another study found that the positive association between poverty and depression was true only for whites, and not for Blacks or Mexicans (Riolo et al. 2005). I control for whether the respondent's family income falls below the poverty line in this study.

Marital status. There is a complex relationship between marital status and depression. Marital satisfaction reduces distress and improves well-being for both men and women (Coverman 1989). Typically, being married also protects both sexes from depression, but the effect may be particularly strong for men (Whisman, Weinstock, and Tolejko 2006). The sex

difference in depression is also larger for married than unmarried people (Ronald C. Kessler 2006). There may be a more nuanced relationship for other categories of marital status, like divorce and widowhood. Unfortunately, I am unable to address this possibility in this study. There are too few widowed, separated, never-married and divorced individuals in NHANES I to treat them as separate categories. Therefore, I control for marital status as whether or not the respondent is married.

In addition to marital status affecting depression outcomes, another possibility is that depression affects marital status. There could be a selection effect of non-depressed people into marriage. For example, depressed people could be less likely to marry and more likely to divorce than non-depressed people. One way to rule out the possibility of reverse causation is to use longitudinal data as opposed to cross-sectional data (the latter is used in this study). Another way to reduce the implications of reverse causality is to focus on historical changes in depression. In this study, I examine the association between depression and marital status in 1971 and again in 2008. I also observe whether or not the association between depression and marital status has changed over this period. If there has been no change in the association between marital status and depression, but marital status differences between 1971 and 2008 explain some of the change in the sex gap in depression, then it is likely that compositional changes in marital status are responsible. If this is the case, I can conclude that changes in the sex gap in depression that are attributable to marital status are due to marital status affecting depression and not the reversal.

Parental status. Most recent studies show that there is little difference in depression between parents and non-parents (Evenson and Simon 2005; Bures, Koropeckyj-Cox, and Loree 2009). However, in the past, there was a stronger relationship between parental status and

depression. Radloff (1975; 1980) found that parents of both sexes, especially those with children younger than 6, had higher depression scores than non-parents. Another study found that being a parent is more emotionally disturbing than not being a parent in 1976 (Veroff et al. 1981). In this study, the measure of parental status that I include is whether or not the respondent has children under 18 living in the home. More detailed age measures of children are not available.

Education. Most studies find evidence that education is negatively associated with depression (Adler et al. 1994; Chen et al. 2005; Dohrenwend et al. 1992; Ronald C. Kessler, Katherine A. McGonagle, et al. 1994). The effect of education on depression may also be amplified over age. One study found that the education gradient in depression increased with age, explained by physical health problems among the low educated (Miech and Shanahan 2000). In this study, I control for age by using a dummy variable for having a Bachelor's Degree (BA).

Employment. At the individual level, there is a negative relationship between employment and depression – both men and women who work are less depressed than those who do not. In a meta-analysis of 91 studies on work and women's well-being conducted in the 1980s and 1990s, Klumb and Lampert (2004) calculated that the average benefit of employment was a 60 percent reduction in women's depression. In an earlier study, using data from 1976, married women who worked outside the home were significantly less depressed than housewives. However, for their husbands, the effect was in the other direction – men whose wives worked were more likely to be depressed than those with housewives (Ronald C. Kessler and McRae 1982). The relationship between work and depression is most strongly supported by two explanations that describe unemployment as both cause and consequence of depression (Lennon 2006). First, depression acts as a barrier to employment; depressed people who do

work are also more likely to take sick days. Second, there is strong evidence supporting the explanation that unemployment can cause depression.

This study does not specifically address the possibility of reverse causation in terms of employment. However, like the explanation provided for reverse causation and marital status, the design of this study, which examines historical trends, mitigates that possibility. Previous research has demonstrated that changes in the sex gap in labor force participation are related to changes in the sex gap in depression. For example, one study examined the trend in the relationship between sex and depression between 1957 and 1976 (Ronald C. Kessler and McRae 1981). They found that while women had higher levels of symptoms in both years, the sex gap was larger in the 1950s then in the 1970s. The authors attributed this change in the sex gap in distress to the increase in women's labor force participation over that period, which explains 20 percent of the changing relationship between gender and distress.

OBJECTIVES

This paper will attempt to answer three primary questions.

1. What was the relationship between sex and depression forty years ago, and what is it today? Has the sex gap in depression changed?

The second and third questions address the change in the sex gap in depression.

2. Has the relationship between socio-demographic characteristics and depression changed for men and/or women over the past forty years? What factors protected people from depression, and what factors augment the risk for depression? Are there the same factors associated with depression for men and women? At both points in time?
3. How do compositional changes affect the sex difference in depression?

DATA AND METHODS

The data used for this study come from multiple waves of the National Health and Examination Survey (NHANES). The NHANES is a large nationally representative survey that contains interview and examination components at the individual level, as well as household-level information. I use data from NHANES I (1971 to 1975) and the Continuous NHANES (2005 to 2008). The sample is restricted to those ages 25 to 74 for whom depression measures could be calculated.

Measuring Depression

Survey research on depression generally uses one of two types of depression instruments. On the one hand are surveys which ask respondents a relatively small number of questions (between 5 and 30) to determine depression severity and probable Major Depression. Depression severity instruments include questions about the respondent's mood (including sadness and depression), somatic symptoms or "malaise" (such as energy level), social isolation (nobody likes me), and positive affect (enjoying life). These instruments are often used to understand the relationship between social factors and differences in depression between subgroups (Newmann 1989). On the other hand are diagnostics tools, which involve a much longer battery of specific questions pertaining to specific occurrences of depression throughout one's life. These instruments are often used to diagnose people with a specific disorder, such as Major Depressive Episode (MDE), according to the criteria established by the Diagnostic and Statistical Manual of Mental Disorders (DSM). Depending on which type of depression instrument is used, studies come to very different conclusions regarding the prevalence of depression in the population (Newmann 1989).

In performing this historical analysis, it is crucial that the indicators of depression I use are comparable to one another and belong to the same type of depression instruments. In this study, I use the former type of depression instrument described, which are based on questions to determine depressive severity and probable depression. NHANES I uses the Center for Epidemiologic Studies Depression Scale (CES-D), and the Continuous NHANES uses the Patient Health Questionnaire (PHQ-9). Both of these instruments have been demonstrated to perform as valid and reliable indicators of depression severity and are both highly predictive of medically diagnosed Major Depression. Studies that have compared the CES-D to the PHQ-9 found that the measures are highly correlated and when used in regressions on a variety of socio-demographic characteristics and other clinical depression measures, and that both instruments produce similar and not statistically significantly different scores (Milette et al.). Another study also concluded that the PHQ-9 and CES-D measure the same concept, and that they are highly correlated (r=.83) (Dbouk, Arguedas, and Sheikh 2007).

While each wave uses a different survey instrument, they share many of the same questions as well as overall indicators of major depression. In this paper, I analyze two sets of outcome variables. First, I create a dichotomous variable that indicates probable major depression by using a cut-point on each scale. From this point forward, I will refer to this measure as "depression." Clinicians and other researchers typically use a cut-point on the scale to determine who is depressed and who is not. The cut-points used in this study are described below. Second, I examine each survey instrument as a complete, continuous variable (CES-D for NHANES I and the PHQ-9 for the Continuous NHANES). I will refer to this measures as "depressive severity," since it indicates the preponderance of depressive symptoms.

Survey Waves and Depression Outcomes.

NHANES I was collected between 1971 and 1975. A subset of 3,059 adults between the ages of 25 and 74 received the Center for Epidemiologic Studies Depression Scale (CES-D), created by the National Institute for Mental Health (NIMH). The CES-D consists of 20 items that ask the respondent how frequently during the past week he experienced a particular feeling or symptom associated with depression. Responses range 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 total instrument is therefore scored from 0 to 60, with 60 indicating the most severe depression. The scale is reliable, and has high internal consistency between the items (Chronbach's alpha usually around .85) (McDowell 2006). It 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).

Four of the items on the CES-D are worded positively (e.g., "I enjoyed life"), while the remaining sixteen questions are worded in a negative direction (e.g., "I felt depressed"). Documentation for NHANES I urged caution when using the four positively worded items in the CES-D, because they were not always consistent with the negatively worded items. However, this is a common feature of the CES-D, and is part of its design. "Empirical evidence suggests that the positive items on the CES-D form a separate dimension, rather than being the inverse of the negative items" (McDowell 2006:350). While non-depressed individuals may experience some of the negative symptoms, it is thought that the depressed people would not experience the corresponding positive feelings. Therefore, I use the entire CES-D score for both the continuous and dichotomous outcome measures.

Various cut-points on the CES-D have been recommended to determine depression, ranging from 16 to 25 (Dbouk et al. 2007; Haringsma et al. 2004; Myers and Weissman 1980; Turk and Okifuji 1994; Watnick et al. 2005; Zonderman, Costa, and McCrae 1989). The selection of a cut-point is important for estimating the prevalence of depression in a population. Sixteen is the most commonly used cut-point, especially in clinical settings, "although a higher point may be beneficial in primary care settings to reduce the number of false positives" (McDowell 2006:352). This is true for a couple of reasons. In clinical settings, patients have already self-selected into seeing a mental health professional, so lower scores may still indicate depression. Secondly, the primary goal of using the CES-D in a clinical setting is to diagnose and potentially treat a patient. False positives would be preferable to false negatives, because misdiagnosing people who actually have major depression could be detrimental to their health. For the purposes of this study, however, a low cut-point would lead to an overestimation of depression, which could affect the conclusions I make with regard to historical changes in the sex gap in depression. I considered using several different cut-points, but after examining the cumulative distribution of each possible score, I selected 20 as the cut-point, which corresponded to 9.9 percent having depression. If I had used a cut-point of 16, 15.9 percent would have depression, which is much too high for a nationally representative population.

The Continuous NHANES was fielded between 2005 and 2008. The mental health module, the Patient Health Questionnaire (PHQ-9), was administered to 10,214 individuals between 18 and 85 years old. To facilitate comparison between survey waves, the sample was limited to the 7,622 people between ages 25 and 74. The PHQ-9 consists of 9 questions that ask the respondent how frequently they have been bothered by problems such as "little interest in doing things", "feeling down, depressed, or hopeless", or "feeling bad about yourself".

Responses to these 9 questions are scored from 0 to 3, where 0 is not at all, 1 is several days, 2 is more than half the days, and 3 is nearly every day. The score for each question is summed to create a total scale of 0 to 27, where 27 is the highest level of depression. The PHQ-9 includes a tenth question that asks about the difficulty these problems have caused, which, like in most non-clinical studies that use the measure, is not included in the scale. The questions on the PHQ-9 derive from the DSM-IV criteria for major depressive disorder (MDD); the instrument is therefore a valid indicator of major depression (Dbouk et al. 2007).

In this study, the cut-point selected for depression on the PHQ-9 was 10 on the scale from 0 to 27. This cut-point was selected because it is commonly used and a standard cut-point (Milette et al.). Previous research has found that when comparing the PHQ-9 and CES-D, the cut-point used to determine depression may matter for the prevalence of depression in the study (Dbouk et al. 2007; Milette et al.). Using higher cut-points on the PHQ-9 may lead to more agreement between the two measures (Dbouk et al. 2007).

Analysis

To recap, in this paper, I analyze two sets of outcome variables, both of which derive from the mental health instrument in the NHANES surveys: the CES-D and the PHQ-9. First, I analyze a dichotomous variable that indicates depression, based on a cut-point of the original score. The cut-points chosen were selected based on their applicability for the general population. For the CES-D, the cut-point was 20 on the original scale of 0 to 60, and for the PHQ-9, the cut-point chosen was 10 on the scale from 0 to 27. To analyze these dichotomous variables, I use logistic regression for survey analysis. Second, I examine both the CES-D and the PHQ-9 as a continuous variable. Although the response categories for both instruments are comparable and range from 0 to 3, the CES-D contains 20 questions while the PHQ-9 contains 9 questions. I

rescale the CES-D so that both scales range between 0 and 27 so that the results can be interpreted. Because the NHANES has a complex survey design, I use survey specific procedures to account for weights, and nesting within cluster and strata (National Health and Nutrition Examination Survey 1982, 2006, 2011b, 2011a).

Independent Variables

To examine sex differences in depression between 1971 and 2008, it is important to account for socio-demographic changes which may underlie any changes in the sex gap. In addition to the models that control for sex and survey year, the other independent variables include age and age-squared (to account for non-linear relationship between age and depression), race (measured as white or not white due to the limited race questions in the NHANES I), poverty (below 100 percent of the poverty threshold for each year), marital status (married or not), parental status (having children under the age of 18 in the home), educational attainment (BA or not), and employment status (currently has a job or not).

Most of these variables are measured the same way in each survey. However, an explicit indicator for parental status was not available in NHANES I. To generate parental status, I used the household roster (unfortunately, the ages of household members was not provided), and the relationship of the respondent to the head of household. A respondent was coded as being a parent if they were married and either the head of household or the spouse of the head and if the household contained more than 2 people, or if the respondent was the head, unmarried, and the household contained more than 1 person. They are coded as not being a parent when they live alone or with non-relatives, if they are the child or other relative. Additionally, a married adult who is the head or spouse of head in a household with two members was considered not a parent.

Methods

The results section is broken down into three parts to answer the three questions posed at the beginning of the paper. To recap, the first objective asks, *What was the relationship between sex and depression forty years ago, and what is it today? Has the sex gap in depression changed?* These questions are answered looking descriptively at the mean levels of depression and depressive symptoms by sex and year. The second objective is to examine the relationship between various social demographic characteristics and depression for men and women at both points in time. *Has the relationship between socio-demographic characteristics and depression changed for men and/or women over the past forty years? What factors protected people from depression, and what factors augment the risk for depression? Are there the same factors associated with depression for men and women? At both points in time?* To address this question, I separately examine depression and depressive symptoms for men and women by year (four groups). Socio-demographic characteristics are added individually, and then all at once. The third objective is: *How do compositional changes affect the sex difference in depression?* To study compositional changes, I pool together both sexes and both years of data. I include female and survey year in the model, as well as the interaction between female and year. By adding in control variables individually and then all together, I can examine what demographic shifts are responsible for the convergence in the sex gap I observe.

RESULTS

In this paper, I examine the association between gender and depression in light of social changes that have occurred between 1971 and 2008. Figures 1 and 2 illustrate these demographic shifts for men and women. The average age of the population has increased by about 1 year for both sexes, but this difference is not statistically significant as the confidence intervals overlap. The

percentage of the population that is white has decreased from about 89 percent to 72 percent for both sexes. In 1971, men ages 25 to 74 were more likely to have a BA than women, 17.8 percent versus 12.6 percent. In 2008, the percentage of the population with a BA has increased to 28.3 percent for males and 29.1 percent for females, resulting in a convergence and reversal in the sex gap in education. The percentage of the population that is currently married has decreased for both sexes over this period. In 1971, 85.0 percent of males were married, as were 72.3 percent of females. By 2008, 74.1 percent of males and only 67.0 percent of females were married. Thus, there was a decrease for both sexes, but a larger decrease in the proportion married among men than among women. Like being married, being a parent of children in the home is also less common in 2008 than 1971. In 1971, 57 percent of both sexes had children living at home. By 2008, 42.9 percent of men and 45.3 percent of women were still parents. Having a job decreased slightly for men over this time period. In 1971, 82.9 percent of men had a job, and by 2008, 77.9 did. For women, there has been a massive increase in the percentage of women with a job. In 1971, among women ages 25 to 74, 47.4 percent had a job. In 2008, 64.4 percent of women had a job. This shift decreased the sex gap in employment, but did not eliminate it, as men are still more likely to have a job. Finally, being in poverty has increased significantly for men, from 6.9 to 10.8 percent, but has not significantly increased for women. In summary, the largest socio-demographic shifts observed over this period are female employment status, parental status and marital status for both sexes, and the racial composition of the population.

Objective 1

The first question this paper asks, *what were the levels of depression for men and women in 1971, and what are those levels in 2008? What about the sex gap in depression? T*o answer these questions, I compare the mean levels of major depression for men and women at both

points in time. Figure 3 shows the means and 95 percent confidence intervals for the percentage of the population with major depression. A striking finding is that depression has become less prevalent among women, but has remained unchanged for men. In 1971, 13.7 percent of women had depression. In 2008, 8.9 percent of women were currently depressed. This is an absolute decrease of 4.8 percent, which translates into a 35.0 percent reduction in depression over these years. During the same period, men's average levels of depression decreased from 5.6 percent in 1971 to 5.1 percent in 2008. However, the confidence intervals overlap, so the decrease of 0.5 percent in the percent of depression among men is not statistically significant.

Change in the sex gap in depression is measured by combining the trends observed for men and women. Between 1971 and 2008, the sex gap in depression decreased from 8.1 percent to 3.8 percent. This is an absolute decrease of 4.3 percent, which means that over this 35 year period, the sex gap in depression was cut by more than half, specifically by 53.1 percent.

Figure 4 illustrates another way to examine change in the sex gap in depression. Here, logistic regressions were performed separately by year. In the null model, the only predictor variable is female. In the full model, all socio-demographic characteristics are included as covariates. In 1971, females were 2.7 times more likely to be currently depressed without controls, and 1.8 times more likely with controls. In 2008, women are 1.8 times more likely than men to have depression in the null model and 1.5 times more likely in the full model. In both the null and full models, women are more likely to have depression than men, and in both models, the sex gap decreases over time. However, the cumulative effect of socio-demographic controls had a larger impact in explaining the relationship between sex and depression in 1971 than in 2008. In 1971, the control variables explained 32.6 percent of the variation in the sex gap in

depression. By 2008, the same socio-demographic controls explained only 14.1 percent of the variation in the sex gap in depression.

In addition to examining cut-points to represent having depression, I look at the sex gap in depressive severity, measured by the gap in the total depression scores seen in Figure 5. Depression severity scores range from 0 to 27. Men in 1971 had an average depression severity of 3.2, while in 2008, men's average severity score decreased to 2.3. This decrease of 0.8 points is statistically significant. For women, the average depression severity score in 1971 was 4.4, and by 2008, their depression severity score significantly decreased to 3.4 points. The sex gap in depressive symptoms in 1971 was 1.3 points, and was 1.0 in 2008. Therefore, there was a slight decrease in the sex gap in depressive severity over this period, due to a decrease in depressive severity for both sexes but a larger decrease for women than men. As Figure 6 illustrates, however, the time trend in the sex gap in depressive severity appears to be completely explained by the inclusion of socio-demographic control variables in the model.

The answer to the question posed in the first objective is that while both sexes report lower levels of depressive severity now, only women are less likely to have depression. Furthermore, there is a significant decrease in the sex gap in depression, but there does not appear to be a decrease in the sex gap in depressive severity.

Objective 2

The second part of this paper is about the sex difference in the relationship between social characteristics and depression over time. *What was the relationship between sex, social factors and depression forty years ago, and what do those relationships look like today? Have these relationships changed over the past forty years?* In other words, this question tries to address the change in the sex gap in depression by asking if there have been changes in the 'causes' of

depression over this period. Have certain social factors become either less or more important in predicting depression? To answer these questions, I look at the effects of social characteristics separately by sex and year, as illustrated in Figures 7 and 8 and in Table 1 (major depression), and in Figures 9 and 10 and in Table 2 (depressive symptoms).

Figures 7 and 8 show the odds ratios and 95 percent confidence intervals for the primary socio-demographic characteristics, calculated from separate models. In each model, age, age-squared, and the dummy variable for 'white' were also included in the model. Poverty increases the likelihood of being depressed by about three-fold for both sexes and at both points in time. There is no statistically significant sex gap at either point in time, and the change over time within each sex is also not significant. Being married decreases the likelihood of having major depression by about half for both sexes and at both points in time. Being a parent to children in the home is not significantly associated with major depression for men in either 1971 or 2008. There is a slight increase in major depression for fathers compared to non-fathers in 1971, but the confidence interval overlaps with 0. For women, mothers in 1971 are no more depressed than non-mothers. However, in 2008, being a mother decreases the likelihood of having major depression by 30 percent.

Having a BA is also protective against major depression. For males in 1971 and 2008, having a BA decreased the likelihood of having major depression by 65 percent and 72 percent, respectively. However, the slight decrease in the odds ratio over the time period is not statistically significant. For women, a bachelor's degree did not significantly relate to major depression in 1971. In 2008, a BA decreased the likelihood of depression by about 76 percent. This decrease in the odds ratio is substantial, but because the confidence intervals overlap, I cannot conclude that the change over time is statistically significant.

Finally, having a job is protective against depression. In 1971, men with a job were 29 percent less likely to be depressed than men without a job. By 2008, having a job was even more protective against depression, with employed men 73 percent less likely to be depressed than unemployed men. Because the confidence intervals do not overlap (by a narrow margin), I conclude that the effect of having a job on depression has become more protective over this period for men. For women, having a job reduced the odds of being depressed by 72 percent in 1971, and by 78 percent in 2008. Unlike for men, however, the decrease in the odds ratio is not statistically significant.

These figures illustrate that there has been little change in the effect of socio-demographic characteristics on having major depression for either men or women over time. The only statistically significant change observed for either sex is that having a job is more protective against depression for men in 2008 than it was in 1971.

In Figures 9 and 10, the same trend observed for major depression is observed for depressive symptoms. The relationship between social factors and depressive symptoms has remained constant over time for both sexes. The one exception is that the relationship between having a job and depression for males has increased, as found for major depression. In the model where all covariates are included simultaneously, it is again employment status for males is the only one where the relationship has changed.

In Table 1, all of the socio-demographic characteristics are included in the four models simultaneously. The direction of the relationship between the socio-demographic characteristics and major depression are the same as reported in Figures 7 and 8. However, when controlling for all variables, a different time trend emerges. In 1971, fathers are 48.9 percent more likely to be depressed than non-fathers. In 2008, there is no relationship between parenthood and major

depression for men. The change over time is statistically significant, meaning that parenthood no longer increases depression for men. The decrease in the odds ratio observed in the models where job was the only characteristic (besides age, age-squared and white), is no longer statistically significant.

Table 2 shows the results for depressive symptoms when all covariates are included in the model. The only variable that changed significantly over time was employment status for males.

Based on these models, I conclude that there has been little change in the relationship between socio-demographic characteristics and the likelihood of having major depression for men, and that there has been no change for women. The same is true for the relationship between social factors and depressive symptoms for both sexes. What, therefore, explains the decrease in the sex gap in major depression and depressive symptoms? In the next section, I answer that question by examining compositional changes in the population.

Objective 3

The third question asks, *How do compositional changes affect the sex difference in depression?* For example, have women's greater educational attainment and increased labor force participation reduced the sex difference in depression? To answer this question, I pool data for both sexes and survey years. I perform logistic regression for survey analysis where the outcome is major depression and regression where the outcome is depressive symptoms; the predictors include a dummy variable for female, survey year, and the interaction between female and year. By adding in the same socio-demographic characteristics described in the previous section, I examine whether or not there are changes in the level and significance of the interaction. In doing so, I am able to isolate the compositional changes that are responsible for the decrease in the sex gap in depression between 1971 and 2008.

Table 3 shows the beta coefficient, statistical significance, and standard error for each model for the outcome major depression. In Model 1, female, year, and the interaction between female and year are included. Model 2 additionally controls for age, age-squared, and the dummy for 'white'. Models 3 through 7 add one of the socio-demographic characteristics at a time, and Model 8 includes all variables. The coefficient for being female is positive and statistically significant at the $p<.001$ level for all of the models. Because of the interaction between female and year, this means that the effect of being female on having major depression in 1971 cannot be explained by the covariates included in any of the models. The survey coefficient can be interpreted as the change in the likelihood of a male being depressed over time. The negative coefficient across all eight models implies that men are less likely to be depressed in 2008 than they are in 1971. However, only models 1 through 5 show a difference that is statistically significant at the $p<.05$ level. In Models 6, 7 and 8, the survey coefficient is significant at the $p<.10$ level. Therefore, controlling for compositional changes in men who have a BA and a job explains away the decrease in the proportion of males with major depression between 1971 and 2008. The interaction between female and survey year can be used to identify if there are changes in the sex gap in depression over time. In Models 1 through 6, the coefficient for the interaction is significant. In Models 7 and 8, however, the interaction is very small and no longer significant. This means that compositional changes in having a job can explain the decrease in the sex gap between 1971 and 2008.

In Table 4, I examine depressive symptoms. Results indicate that depressive symptoms have decreased for both sexes and that the sex gap in depressive symptoms has not changed significantly. Model 1 shows that in 1971, females' average depressive symptoms scores were 1.3 points higher than males'. In 2008, females' scores were 1.0 higher than males' on average.

Between 1971 and 2008, male's average depressive symptoms scores decreased by 0.8 points. Therefore, although there was a 0.3 decrease in the sex gap between 1971 and 2008, it is not statistically significant. It is worth noting, however, that controlling for employment status (Model 7) in 2008 reduced the sex gap in depressive symptoms to 0.8 points. None of the other socio-demographic characteristics have this large of an effect on the sex gap. Therefore, while there has not been a statistically significant decline in the sex gap in depressive symptoms between 1971 and 2008, the observable decline is primarily attributable to compositional changes in employment.

DISCUSSION

Over the past forty years, there have been dramatic changes in the social demographic composition of the United States. Educational attainment has improved for both sexes, and now men and women between the ages of 25 and 74 are equally likely to have a BA. The percentage of the population who is currently married and has children under the age of 18 living in the home has declined for both sexes. Many more women today are currently employed than they were in 1971: the percentage of women who have a job increased from 47.4 percent to 64.4 percent over the past forty years. During the same period, men's employment rates have not changed, thus narrowing the sex gap in employment.

The literature on depression has consistently shown that women are more likely to be depressed than men. The findings from this study are no exception: women are between 1.5 to 3 times more likely to be depressed as men, depending on the year and the covariates included in the model. However, this study contributes to our knowledge about the sex gap in depression by focusing on historical change. The first objective was to determine the rates of depression for both sexes in 1971 and in 2008, and to determine if the sex gap in depression changed over that

period. I found that 13.7 percent of women and 5.6 percent of men had major depression in 1971. By 2008, 8.9 percent of women and 5.1 percent of men had major depression. Therefore, the sex gap in major depression is smaller today than it was forty years ago. As illustrated in Figure 4, this means that women were 2.7 times more likely to have major depression than men. Controlling for socio-demographic characteristics reduced this gap to 1.8, indicating that 32.6 percent of the sex gap in depression in 1971 was explained by sex differences in factors such as education and employment status. In 2008, women were 1.8 times more likely to be depressed as men without controls, and 1.5 times more likely with controls. Therefore, the socio-demographic controls explained only 14.1 percent of the variation in the sex gap in depression in 2008.

When I look at depressive symptoms, on the other hand, a slightly different story emerges. Both men and women showed a decrease in depressive symptoms over this time period, although the reduction in symptoms was slightly greater for women than men. However, the entire time trend in sex differences appears to be driven by sex differences in socio-demographic characteristics.

The change in the sex gap in depression could be due to one or both of the following factors. First, the relationship between socio-demographic characteristics and depression could have changed. This explanation was not supported by the data. Surprisingly, there has been little to no change in these relationships over time. Despite the massive shifts in employment for women, having a job has the same protective effect on women's depression in 1971 and in 2008. None of the other factors considered in this paper changed over time for women, either. For men, I observed a slight change in the effect of having a job on depression, but although statistically significant the change is very small.

The other explanation is that compositional factors led to a decrease in the sex gap in depression. Since there was little to no change in the magnitude of the relationships between social characteristics and major depression over time, the explanation for the decrease in the sex gap must rest on compositional changes. The results from this study strongly support the role that female employment has played in decreasing women's depression and in diminishing the sex gap in depression. Having a job is the only socio-demographic characteristic to explain the change in the sex gap in depression.

This paper used two survey instruments, the CES-D and PHQ-9 to estimate the prevalence of major depressive and severity of depressive symptoms. While these surveys are similar, they are not the same. To improve our understanding of the historical trend in the sex gap in depression, it would be beneficial to have nationally representative data for the same mental health instrument. At the time being, such data are not available. If new data becomes available that uses the CES-D, it would facilitate comparison to the data collected in the NHANES I.

This paper shows that the sex gap in depression has decreased between 1971 and 2008. Over this period, female labor force participation dramatically increased, which led to a subsequent decrease in the prevalence of depression for women. This is an important finding, and suggests that if women continue to increase their levels of employment, that the sex gap may be further diminished. However, there remains a sex gap in depression as well as a sex gap in employment. If the sex gap in employment was eliminated and an equal percentage of men and women were employed, what would happen to the sex gap in depression? Future research should address this question.

The sex gap in depression is smaller now than it once was, but it remains. Could any other socio-demographic factors not examined in this paper help to further reduce the gap? In addition to social explanations for sex differences in depression, biological factors and comorbidities with other diseases explain part of the gap. Ideally, research would be able to look at all of these explanations together, and to examine interactions between social factors and other types of explanations.

TABLES AND FIGURES

Figure 1.Means and 95% confidence intervals for socio-demographic characteristics by year, females.

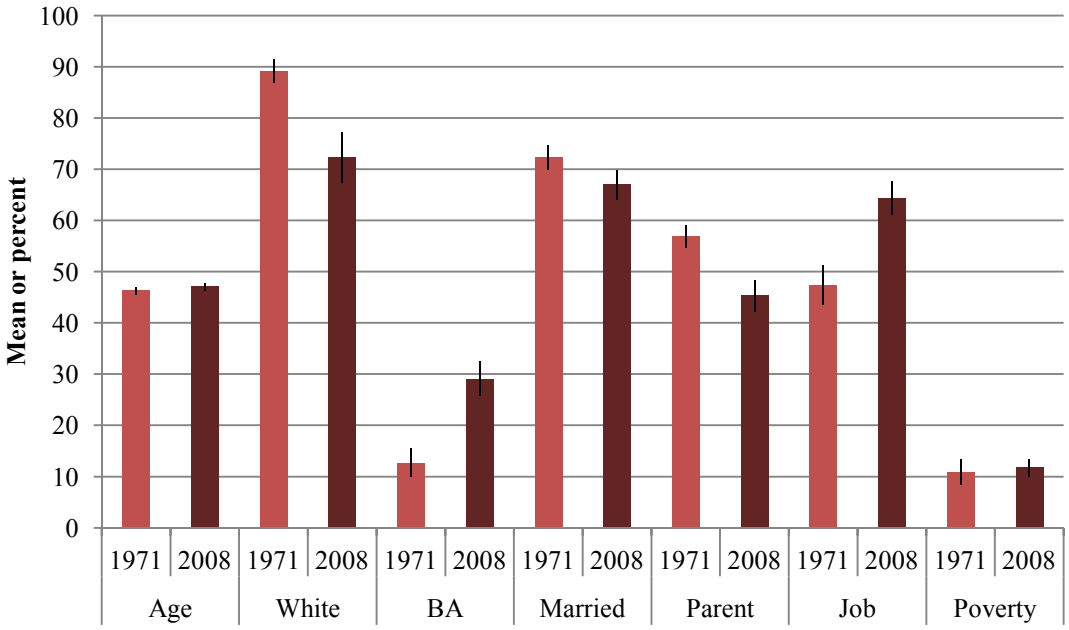

Figure 2. Means and 95% confidence intervals for socio-demographic characteristics by year, males.

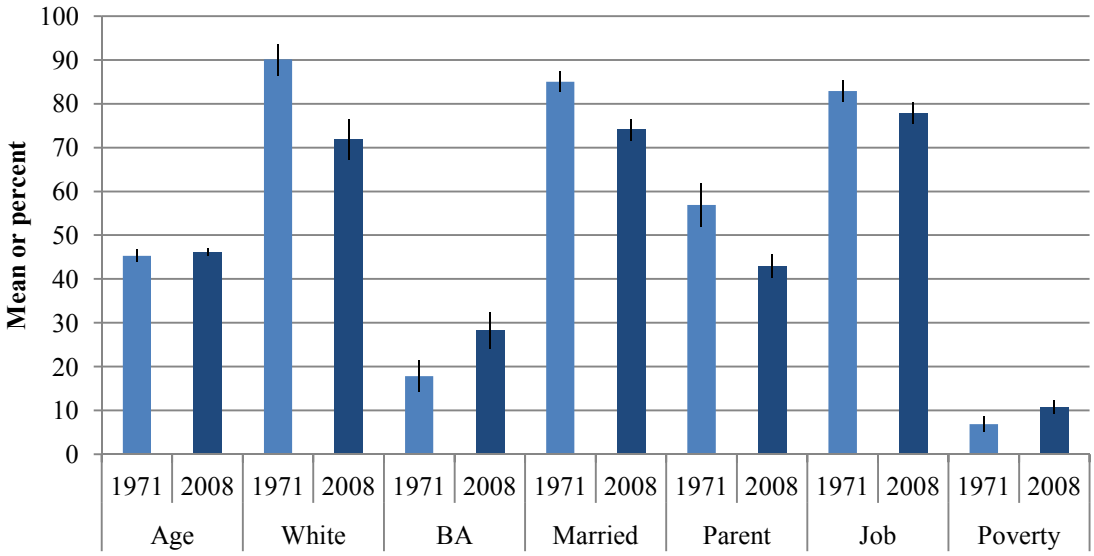

Figure 3. Objective 1: Percent with depression (and 95 % confidence intervals) by sex and year

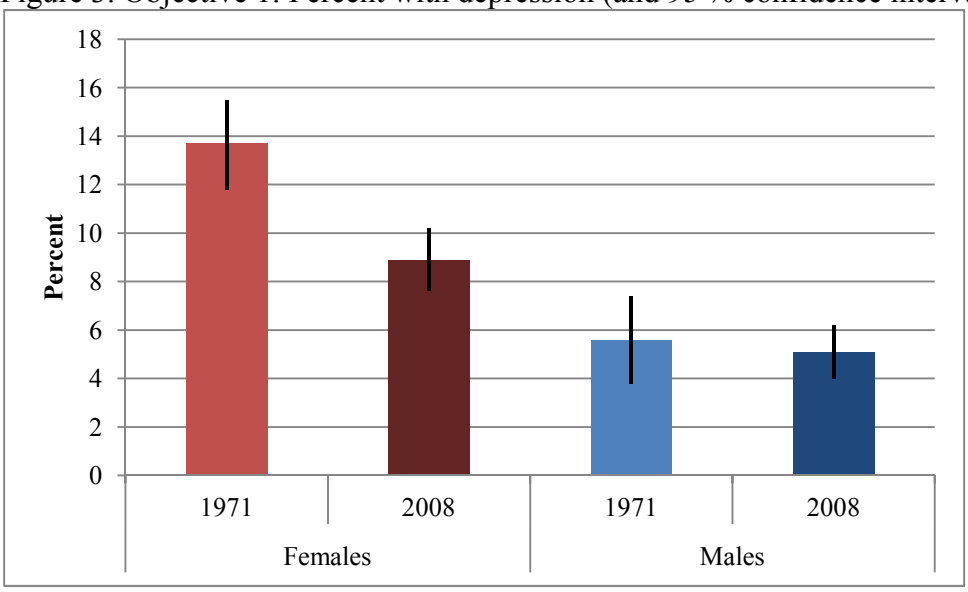

Figure 4. Female odds ratios for logistic regression of depression, in models with and without control variables, by year

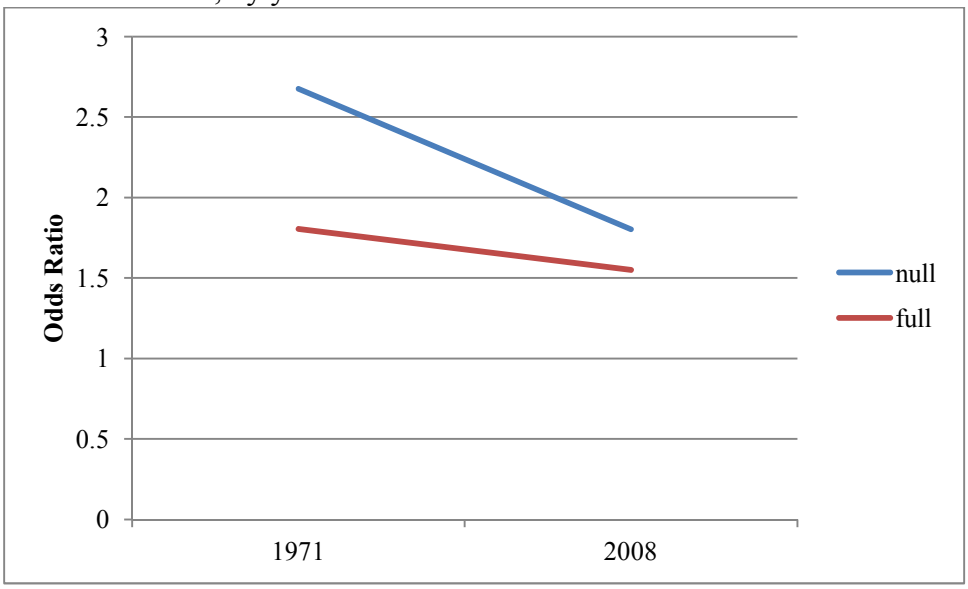

Figure 5. Objective 1: Mean levels of depressive severity (and 95 % confidence intervals) by sex and year

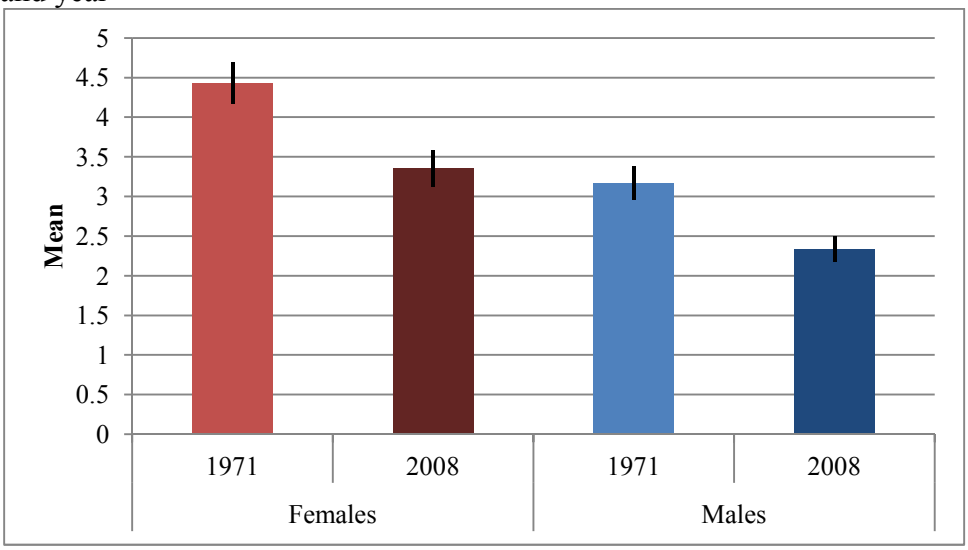

Figure 6. Female beta coefficients for regression of depressive severity, in models with and without control variables, by year

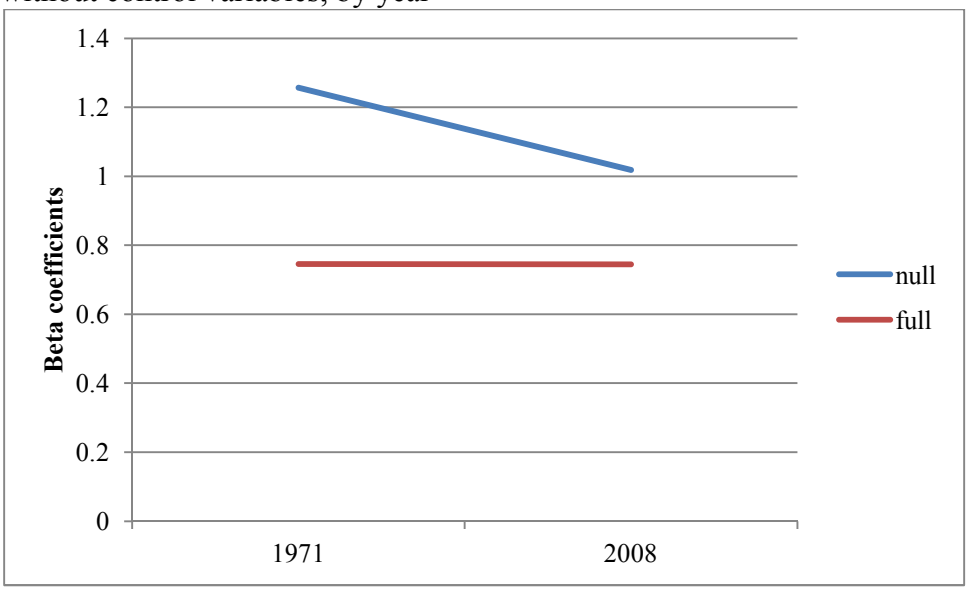

Figure 7. Objective 2: Odds ratios (and 95% confidence intervals) for logistic regression of depression on socio-demographic characteristics, females

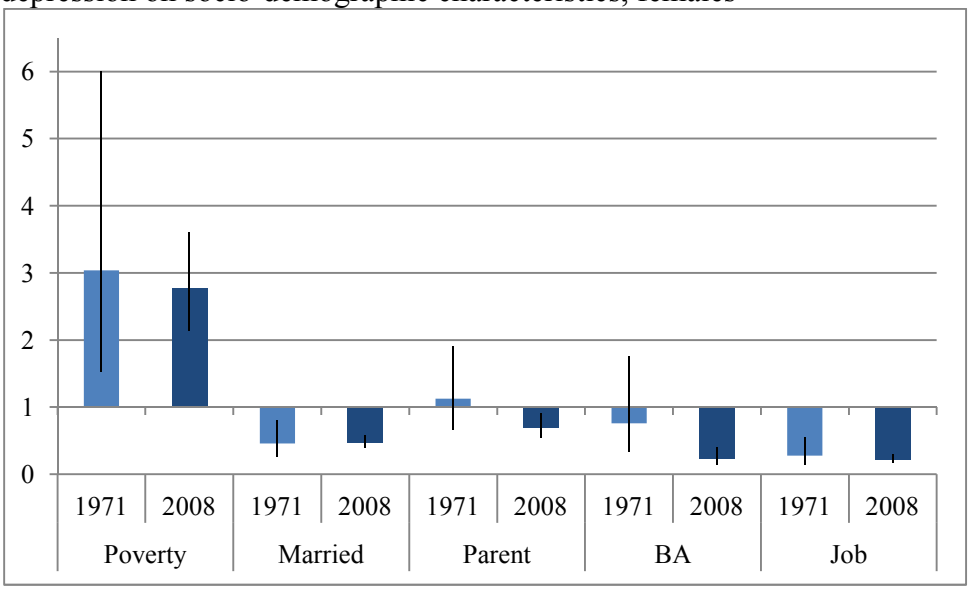

Figure 8. Objective 2: Odds ratios (and 95% confidence intervals) for logistic regression of depression on socio-demographic characteristics, males

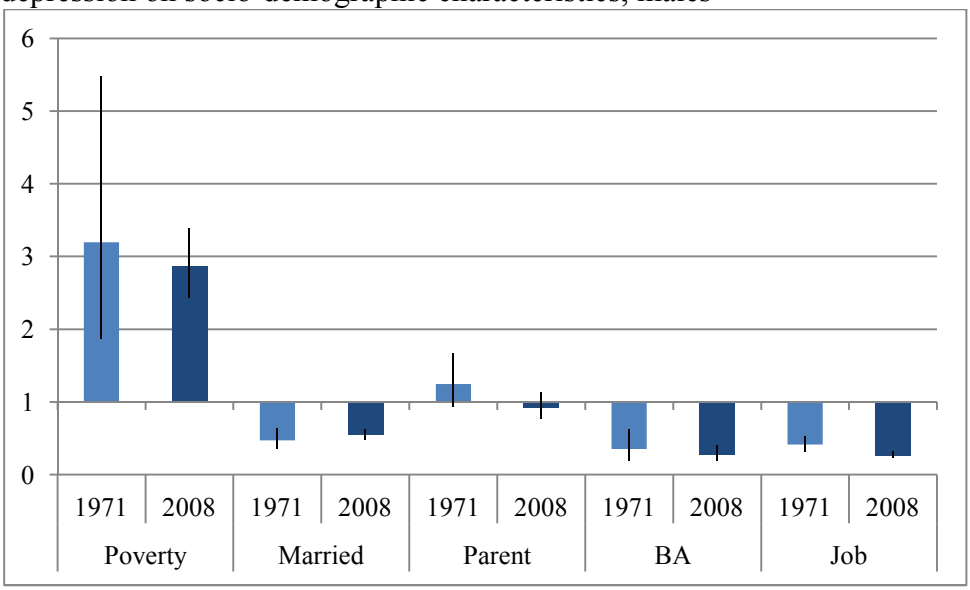

Figure 9. Objective 2: Beta coefficients (and 95% confidence intervals) for regression of depressive severity on socio-demographic characteristics, females

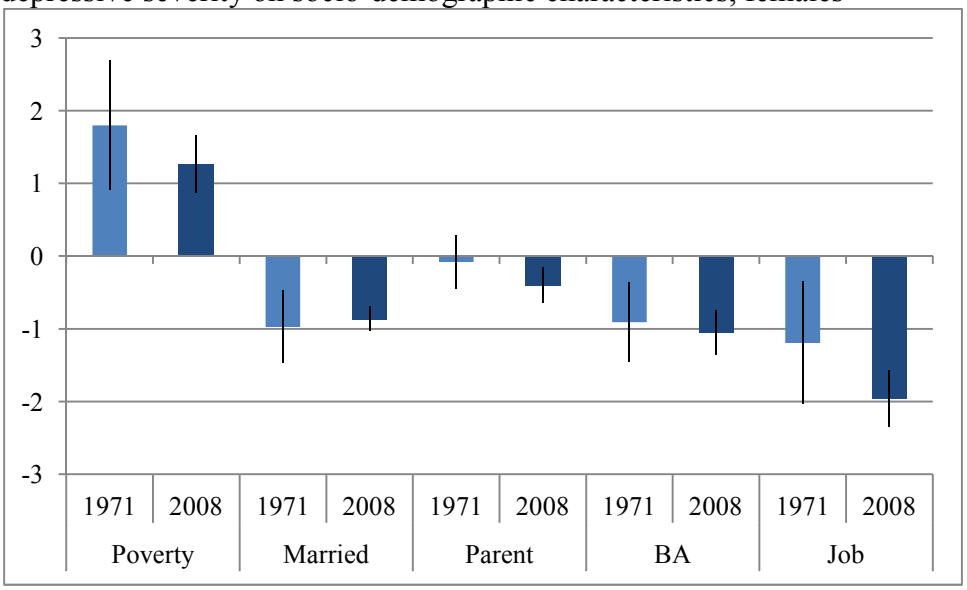

Figure 10. Objective 2: Objective 2: Beta coefficients (and 95% confidence intervals) for regression of depressive severity on socio-demographic characteristics, males

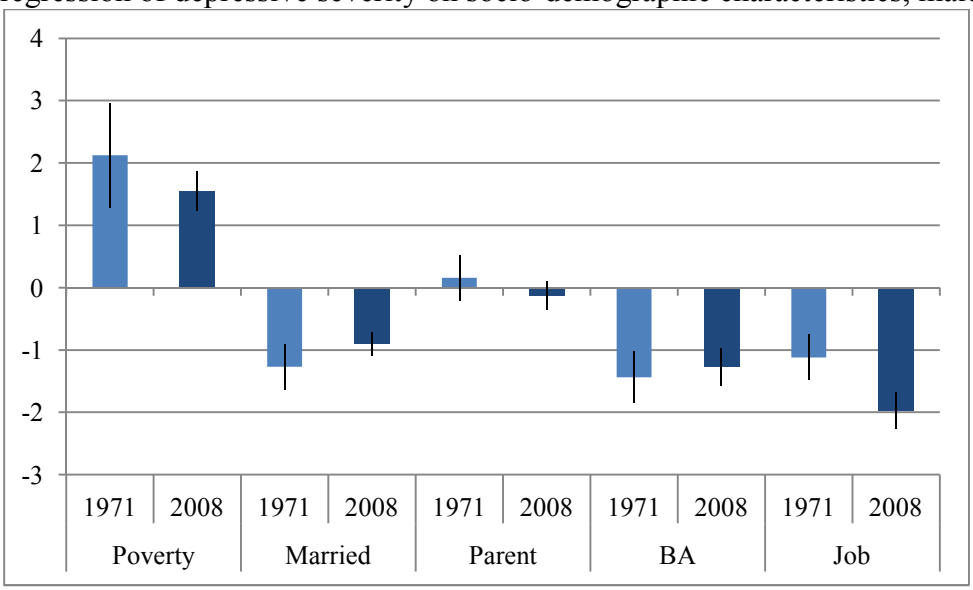

Table 1. Objective 2: Odds ratios and 95% confidence intervals for logistic regression of socio-demographic characteristics on major depression, separately by year and sex

	Females						Males					
	1971			2008			1971			2008		
	OR	**Low**	**High**	**OR**	**Low**	**High**	**OR**	**Low**	**High**	**OR**	**Low**	**High**
Age	1.22	1.02	1.47	1.13	1.08	1.19	1.08	0.99	1.16	1.16	1.12	1.20
Age*Age	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
White	0.60	0.35	1.01	1.13	0.84	1.50	0.80	0.59	1.09	1.13	0.92	1.40
Poverty	2.24	1.06	4.70	1.92	1.51	2.44	2.14	1.16	3.98	1.86	1.57	2.21
Married	0.45	0.27	0.77	0.65	0.51	0.84	0.46	0.33	0.62	0.59	0.51	0.68
Parent	1.58	0.93	2.69	0.81	0.64	1.04	1.49	1.15	1.93	0.95	0.79	1.14
BA	0.90	0.39	2.08	0.36	0.21	0.62	0.44	0.23	0.84	0.40	0.27	0.59
Job	0.34	0.18	0.66	0.26	0.18	0.37	0.49	0.37	0.67	0.31	0.25	0.39

Table 2. Objective 2: Beta coefficients, significance levels and standard errors for regression of socio-demographic characteristics on depressive symptoms, separately by year and sex

	Females						Males					
	1971			2008			1971			2008		
	β	**sig**	**SE**	**β**	**sig**	**SE**	**β**	**sig**	**SE**	**β**	**sig**	**SE**
Intercept	3.51	***	(0.70)	2.41	***	(0.43)	4.62	***	(0.67)	1.94	***	(0.32)
Age	0.08	+	(0.04)	0.12	***	(0.02)	0.05	*	(0.03)	0.17	***	(0.02)
Age*Age	0.00	*	(0.00)	0.00	***	(0.00)	0.00	*	(0.00)	0.00	***	(0.00)
White	-0.41	*	(0.19)	0.43	**	(0.15)	-0.47	*	(0.20)	0.39	**	(0.12)
Poverty	1.47	**	(0.43)	0.89	***	(0.19)	1.55	***	(0.41)	1.05	***	(0.15)
Married	-0.87	***	(0.23)	-0.55	***	(0.11)	-1.23	***	(0.17)	-0.85	***	(0.09)
Parent	0.21		(0.18)	-0.25	+	(0.12)	0.37	*	(0.16)	-0.14		(0.10)
BA	-0.80	**	(0.27)	-0.66	***	(0.12)	-1.14	***	(0.22)	-0.85	***	(0.13)
Job	-0.92	*	(0.38)	-1.97	***	(0.19)	-0.87	***	(0.16)	-1.83	***	(0.14)

+ p<.10, * p<.05, ** p<.01, *** p<.001

Table 3. Objective 3: Beta coefficients for logistic regression for predicting depression, pooled years and sexes

	1		2		3		4		5		6		7		8	
	β	**sig.**	**β**	**sig.**	**β**	**sig.**	**β**	**sig.**	**β**	**sig.**	**β**	**sig.**	**β**	**sig.**	**β**	**sig.**
Intercept	-2.47	***	-4.15	***	-4.73	***	-4.14	***	-4.17	***	-4.01	***	-4.02	***	-4.15	***
Female	0.40	***	0.41	***	0.38	***	0.37	***	0.40	***	0.40	***	0.26	***	0.24	***
Survey year	-0.14	*	-0.19	**	-0.20	**	-0.22	**	-0.20	**	-0.13	+	-0.13	+	-0.13	+
Female*Year	-0.11	**	-0.11	**	-0.09	*	-0.10	*	-0.11	**	-0.10	*	-0.04		-0.01	
Age			0.09	**	0.10	**	0.11	***	0.10	**	0.09	**	0.13	***	0.14	***
Age*Age			0.00	**	0.00	**	0.00	***	0.00	**	0.00	**	0.00	***	0.00	***
White			-0.42	***	-0.22	*	-0.33	**	-0.42	***	-0.33	***	-0.41	***	-0.11	
Poverty					1.18	***									0.73	***
Married							-0.68	***							-0.67	***
Parent									-0.05						0.03	
BA											-1.18	***			-0.91	***
Job													-1.10	***	-0.96	***

+ p<.10, * p<.05, ** p<.01, *** p<.001

Table 4. Objective 3: Beta coefficients and significance levels for regression for predicting depressive severity, pooled years and sexes

	1		2		3		4		5		6		7		8	
	β	**sig.**	**β**	**sig.**	**β**	**sig.**	**β**	**sig.**	**β**	**sig.**	**β**	**sig.**	**β**	**sig.**	**β**	**sig.**
Intercept	3.168	***	2.206	***	1.512	**	2.478	***	2.207	***	2.364	***	2.574	***	2.389	***
Female	1.272	***	1.275	***	1.176	***	1.149	***	1.278	***	1.208	***	0.746	***	0.597	***
Survey year	-0.8	***	-0.91	***	-0.97	***	-1.01	***	-0.93	***	-0.75	***	-0.91	***	-0.94	***
Female*Year	-0.28		-0.27		-0.18		-0.22		-0.28	+	-0.2		0.081		0.214	
Age			0.065	**	0.079	***	0.091	***	0.072	***	0.066	**	0.123	***	0.15	***
Age*Age			-0	**	-0	***	-0	***	-0	***	-0	***	-0	***	-0	***
White			-0.5	***	-0.24	*	-0.37	**	-0.51	***	-0.36	**	-0.46	***	-0.05	
Poverty					2.103	***									1.498	***
Married							-1.09	***							-1.01	***
Parent									-0.16	0					-0.05	
BA											-1.27	***			-0.96	***
Job													-1.53	***	-1.29	***

+ p<.10, * p<.05, ** p<.01, *** p<.001

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