Aging, Depression, and Gender:
Do Older Adult and Elderly Women Report Higher Rates of Depression?

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Introduction

Depression is a common mental illness in the United States. In 2019 alone, an estimated 7.8% of Americans experienced a major depressive episode.[1] While depression is most prevalent in young adults, it also affects many older Americans. According to the Centers for Disease Control (CDC), in 2019, 18.4% of both adults aged 45-64 and 65 and over experienced symptoms of depression within the last two weeks.[2] In addition to the suffering caused by the condition's symptoms, its presence in older and elderly adults is associated with higher rates of medical care utilization, suicide, and negative health outcomes broadly.[3] Given these impacts, it is important for public health officials and policymakers to understand demographic patterns in the incidence of depression in this population to design effective interventions. This paper explores the role of gender in the self-reporting of symptoms of depression among older adults. We theorize that women report higher rates of depression than men due to American cultural conceptions of masculinity. These attitudes, which emphasize male stoicism and discourage expressions of emotion or vulnerability, potentially result in older men underreporting their experience of depression compared to women.[4]

[1] Substance Abuse and Mental Health Services Administration. *Key substance use and mental health indicators in the United States: Results from the 2019 National Survey on Drug Use and Health*, 2020. https://www.samhsa.gov/data/report/2019-nsduh-annual-national-report.

[2] Villarroel MA, Terlizzi EP. "Symptoms of depression among adults: United States, 2019." *NCHS Data Brief*, no 379, 2020. https://www.cdc.gov/nchs/products/databriefs/db379.htm#ref4.

[3] Scogin, Forrest. "Depression and Suicide in Older Adults." *American Psychological Association*. Resource Guide," 2009. https://www.apa.org/pi/aging/resources/guides/depression.

[4] Papas, Stephanie. "APA issues first-ever guidelines for practice with men and boys." *Monitor on Psychology*, 2019. Vol 50, No. 1, https://www.apa.org/monitor/2019/01/ce-corner.

Data

Our analysis uses data from RAND's Health and Retirement Study (HRS).[5] The HRS is a national panel survey of individuals over 50 years old and their spouses intended to inform research and policymaking related to aging populations. The survey collects information on participant's demographic characteristics, health, finances, work experience, and familial relationships. Our data includes individuals who participated in each biannual interview from 2008 to 2016.

The Center for Epidemiologic Studies Depression Scale (CES-D), a mental health index administered as part of the HRS, is used to help determine an appropriate measurement of depression. Survey participants are to respond "yes" or "no" when asked if they experience eight distinct feelings and behaviors associated with depression "all or most of the time." Eight feelings and behaviors are specified including six negative indicators (*feeling depressed, everything is an effort*, *sleep is restless*, *feeling alone*, *feeling sad,* and *could not get going*), and two positive indicators (*was happy* and *enjoyed life*). A score of 1 is assigned when a negative indicator is present or when a positive indicator is absent, for a maximum score of 8.[6]

We use the CES-D scale to create our dependent variable, *depressed*. This dummy variable separates respondents into those who scored a CES-D score of 6 or above, an indicator of moderate to severe depression, and those who scored 5 or lower, an indicator of mild or no depression. A CES-D score of 6 is used as a cutoff as the percentage of HRS respondents with

[5] Stiefel, Leanna, "Data Set: RAND Health and Retirement Study (HRS)." PADM-GP 2902, NYU Wagner Graduate School of Public Service. Posted August 24, 2020. Class Document.
[6] Stiefel, "Data Set."

this score reflects the CDC's estimates of individuals aged 45 and older who experience moderate to severe depression.[7] We chose the dummy variable *gender* as our principal independent variable, which is 0 if an individual identifies as male and 1 if they identify as female. After removing HRS respondents younger than 50 or missing CES-D data, our total dataset consists of 47,554 observations of individuals, with 5.91% suffering from moderate to severe depression and 61.8% identified as female (see Appendix A, Table 1).

The theoretically significant variables we use as controls fall into four categories. The first contains demographic information including level of educational attainment (*educ*), veteran status (*vetrn*), marital status (*partnered*), hispanic identified (*hispan*), and non-white identified (*race*). Our sample population has a mean educational experience of less than high school, 18.7% identified as veterans, and 63.1% were married or with a partner. In terms of racial and ethnic makeup, 9.99% identify as Hispanic and 19.6% non-white. The second category of control variables concern individuals' financial status and work experience. These include respondents' income earnings from the last calendar year in thousands of dollars (*income*), indicators of whether the respondent received pension income (*pension*), and whether they were currently working for pay (*work*). We found that the average income earned in the previous year was $12,350, 29.4% of the respondents earned pension income, and 32.4% reported they were currently working. The third consists of health-related variables and includes a self-reported health scale (*genhealth*), whether they had ever smoked cigarettes (*smokev*), indicators if an individual has ever experienced a cardiac disease (*heatprob*), arthritis (*arthritis*), diabetes (*diabetes*), cancer (*cancer*), and body mass index (*bmi)*. On average, respondents described

[7] Villarroel, "Symptoms of Depression."

themselves as in "good" health and 54.4% reported they had smoked in their life. 25.1% of surveyed individuals experienced heart disease, 64% arthritis, 23.4% diabetes, and 16.4% cancer. The samples averaged a BMI of 28.43. The final category of variables relates to family background and indicates if the respondent lives alone (*livealone*), their number of living siblings (*numsiblings*) and their total number of children (*numchildren*). 25% of individuals surveyed reported living alone, having an average of 2.84 siblings, and 3.24 children. Two points of interest to note on our data set is that many reported BMIs that were significantly above what is considered obese (30.0+) and that most of the respondents earned $1000 or less in income in the year prior to participation (see Appendix A, Table 1).[8]

Model and Empirical Strategy

Our base model includes only our dependent variable, *depressed*, and our independent variable of interest, *gender* (see Appendix C, Table 3, Column 1).

$$depressed_{it} = \beta_0 + \beta_1 gender_{it} + YEAR_t + \varepsilon_{it}$$

This model indicates whether there is any preliminary statistical evidence to support our hypothesis that women report higher rates of depression than men. It also serves as a point of comparison for subsequent models.

Due to our dependent variable being binary, each of our models are linear probability models. This model is best suited to determine the viability of our hypothesis compared to a linear regression model with a scalar dependent variable. The linear probability model allows us to

[8] Centers for Disease Control and Prevention. "All About Adult BMI." *Centers for Disease Control and Prevention*, 17 Sept. 2020, www.cdc.gov/healthyweight/assessing/bmi/adult_bmi/index.html#trends.

examine the likelihood an individual reports experiencing depression rather than the severity of depression that they experience.

$$\begin{aligned} depressed_{it} = {} & \beta_0 + \beta_1 gender_{it} + \beta_2 educ_{it} + \beta_3 vetrn_{it} + \beta_4 partnered_{it} + \beta_5 hispan_{it} \\ & + \beta_6 race_{it} + \beta_7 income_{it} + \beta_8 pension_{it} + \beta_9 work_{it} + \beta_{10} genhealth_{it} \\ & + \beta_{11} smokev_{it} + \beta_{12} heartprob_{it} + \beta_{13} arthritis_{it} + \beta_{14} diabetes_{it} \\ & + \beta_{15} cancer_{it} + \beta_{16} bmi_{it} + \beta_{17} livalone_{it} + \beta_{18} numchildren_{it} \\ & + \beta_{19} numsiblings_{it} + YEAR_t + \varepsilon_{it} \end{aligned}$$

Our second model adds control variables to account for additional contributors toward depression (see Appendix C, Table 3, Column 2). These statistics were described in the Data section and can be viewed in Appendix X. Additionally, adding controls will help account and correct for omitted variable bias that is likely present in our base model. However, we acknowledge that there are likely additional omitted variables which are correlated with both depression and at least one independent variable (e.g., stress levels, history of substance abuse, level of social isolation, familial history of mental illness, etc.) which were not captured in our dataset.

Our third model adjusts the form of the *income* variable and adds interactions between variables we feel will provide theoretically relevant and significant insight into the subject area (see Appendix C, Table 3, Column 3).

$$\begin{aligned} depressed_{it} = {} & \beta_0 + \beta_1 gender_{it} + \beta_2 geninc_{it} + \beta_3 genincsq_{it} + \beta_4 educ_{it} + \beta_5 vetrn_{it} \\ & + \beta_6 partnered_{it} + \beta_7 support_{it} + \beta_8 hispan_{it} + \beta_9 race_{it} + \beta_{10} nwhispan_{it} \\ & + \beta_{11} income_{it} + \beta_{12} incsq_{it} + \beta_{13} pension_{it} + \beta_{14} work_{it} + \beta_{15} workeduc_{it} \\ & + \beta_{16} genhealth_{it} + \beta_{17} smokev_{it} + \beta_{18} heartprob_{it} + \beta_{19} arthritis_{it} \\ & + \beta_{20} diabetes_{it} + \beta_{21} cancer_{it} + \beta_{22} bmi_{it} + \beta_{23} livalone_{it} \\ & + \beta_{24} numchildren_{it} + \beta_{25} numsiblings_{it} + YEAR_t + \varepsilon_{it} \end{aligned}$$

Income is squared in this model to represent the diminishing returns of income on a reduction of depression, meaning that as income increases the magnitude of the reduction in likelihood an

individual reports being depressed gradually decreases. In addition to this change in form, we add the following interactions: *geninc* and *genincsq*, which interact *gender* and *income* and *gender* and *incsq*, respectively; nwhispan, which interacts *race* and *hispan*; *support*, which interacts *partnered* with *numchildren* and *workeduc*, which interacts *work* with *educ*. Each of these interactions are included to highlight specific socioeconomic statuses or key relationships between variables in order to provide further insight and nuance to our examination of what induces symptoms of depression.

Our last model is a Fixed Effects model which allows us to account for time invariant omitted variables, particularly differences between individuals (see Appendix C, Table 3, Column 4).

$$\begin{aligned} depressed_{it} = {} & \beta_0 + \beta_1 geninc_{it} + \beta_2 genincsq_{it} + \beta_3 partnered_{it} + \beta_4 support_{it} \\ & + \beta_5 income_{it} + \beta_6 incsq_{it} + \beta_7 pension_{it} + \beta_8 work_{it} + \beta_9 workeduc_{it} \\ & + \beta_{10} genhealth_{it} + \beta_{11} bmi_{it} + \beta_{12} livalone_{it} + \beta_{13} numsiblings_{it} + YEAR_t \\ & + a_i + \varepsilon_{it} \end{aligned}$$

Although this model is helpful to account for time invariant omitted variables not captured by our dataset, it does not best explain the relationship between our independent variable of interest and our dependent variable, as *gender* itself is time invariant and cannot be included in a Fixed Effects equation. Furthermore, our previous regression features variables we feel are amongst the most significant time invariant variables which may affect depression. For this reason, the Fixed Effects model may not add much value in accounting for additional time invariant variables. Therefore, we find the Functional Form model to be most useful and relevant in judging our hypothesis.

Each of our models use robust standard errors to account for heteroskedasticity, which is likely present in our equations due to our data being cross-sectional and longitudinal. White tests

performed on each model support this, rejecting the null hypothesis of homoskedasticity at the 1% level of significance. We must also acknowledge that autocorrelation is likely also present in our models because they use time series data. This cannot be confirmed, as the Durbin Watson test is not compatible with panel data and our binary dependent variable makes it difficult to interpret residual graphs. Of our four models, only the Fixed Effects model accounts for autocorrelation using xtreg. Lastly, we find it unlikely that multicollinearity is present in our data due to a low average VIF score of 2.5. The only variable with a score well above the standard of 5 is *workeduc*, with a score of 10.23. This is not necessarily cause for concern as it is an interaction, and its high score is likely a result of its 93% correlation with *work*, one of its interacted variables.

Results

We find *gender* to be significant at the 1% level in the first three models. The coefficient on *gender* drops by about half from our Base Model to our Control Model, likely due to omitted variable bias. Notably, the coefficient on *gender* actually increases by a tenth of a percent from the Control Model to the Functional Form Model. Other variables that are found to be significant in the Functional Form model are: *educ*, *partnered*, *hispan*, *pension*, *work*, *workeduc*, *genhealth*, *smokev*, *heartprob*, *arthritis* and *cancer* at the 1% level of significance; *support* at the 5% level of significance and vetrn, income, and *numchildren* at the 10% level of significance. With the exception of the bivariate model, where it is about 3%, the magnitude of the gender coefficient is quite small: about 1.5% (see Appendix C, Table 3).

These results are unsurprising. Physical health clearly has an impact on one's mental health, as medical conditions are associated with a higher likelihood of depression. Additionally, continuing to work is shown to decrease the likelihood of depression, as keeping with routine and having purpose are likely key contributors to one's mental health, especially as one ages. Similarly, variables that indicate the support system an individual has (i.e.: *partnered*, *livealone*, *numsib* etc.) reduce depression.[9] Higher education levels are also associated with such a reduction, which may be related to the relative social status or type of employment associated with higher levels of education.

The two significant variables where the directions of their coefficients differed from what we hypothesized are *income* and *numchildren*. We had thought that higher levels of income and a greater number of children would reduce depression, as wealth and a larger support system generally have such an effect. However, the results show the opposite: higher income and number of children increase likelihood of reporting depression. It is possible that those with higher income report depression more often because they are less likely to be affected by social stigma, perhaps more comfortable with doctors, and could have greater access to education surrounding mental health. This reason is identical to what we hypothesize for women. While the number of children one has could result in greater financial or emotional strain, it is ultimately unclear based on our results.

[9] American Psychological Association. "Growing Mental and Behavioral Health Concerns Facing Older Americans." *American Psychological Association*, Aug. 2018, www.apa.org/advocacy/health/older-americans-mental-behavioral-health.

In our interactions, we find *workeduc* and *support* significant alone and with both their respective interacted variables. *Nwhispan* is jointly significant with *hispan* but not *race* and *geninc* and *genincsq* are jointly significant with *gender* but not their respective income variables (to see a full list of the F-tests conducted, see Appendix D).

The coefficients on *geninc* and *genincsq* suggest income plays a moderating role on gender, decreasing the increase in likelihood of reporting depression caused by gender at higher income levels (see Appendix C, Table 3, Column 3). The positive coefficient on *workeduc* suggests those that are still working and have more advanced degrees see an increase in reports of depression. We theorize that higher-educated workers might have different expectations of retirement compared to lower-educated workers. The decision of maintaining routine by continuing to work would have negative impacts on their mental health that could outweigh the financial benefits of additional income. Finally, non-white Hispanics show to be more likely to report depression than white Hispanics, who reported symptoms more often than non-Hispanics. This could be for a variety of reasons and warrants further analysis.

In the Fixed Effects model, fewer variables are included due to many being time invariant. Most variables retain their significance, such as *work*, *pension*, and *partnered*. While *workeduc* and *support* are no longer significant, but are jointly significant with *work* and *partnered*, respectively. These results do not differ significantly than expectations. Without the inclusion of our independent variable of interest it is hard to analyze them further.

Conclusions

The results of this study support our theory that women are more likely to report moderate to severe depression than men. While this relationship is statistically significant in our models, the magnitude of gender's effect on reported depression is relatively low. We also discovered that variables related to one's potential ability to save, such as receiving a pension, educational attainment and partnership status, had significant negative relationships with depression. This may indicate the importance of savings for one's mental health within this age group. However, the magnitude of all the variables in our model were not extremely high. This suggests depression is a complex subject and there is not just one indicator that can define it.

Furthermore, the results of our study presented some insight into what physical health factors might lead to depression in this age group. Pre-existing conditions such as arthritis, diabetes, and heart issues showed a positive relationship with those who identified with mild to severe depression. While this is not a surprising outcome, the concentration and similar magnitude of these variables is meaningful. The causes of ailments such as diabetes, smoking, and heart issues, often take root at a time much before a person turns 50. Therefore, we could conclude that some causes of depression in people aged 50+ are preventable in youth.

To further investigate *gender* and depression, we suggest adding additional questions to the HRS survey around the relationship of vulnerability and stigma in expressing depressive symptoms. If this is not possible, then we suggest a new study devoted entirely to this topic. Our team is emboldened by this option due to our results and the literature documenting the lack of confidence that men and lower-income people have when needing to discuss emotional stresses

in their life to medical professionals[10]. We also propose investigating to see if low-income individuals are as reactive to expressions of vulnerability as our hypothesis of men suggests, as our results surprisingly showed that lower-income individuals were less likely to report depression.

Additionally, a study around mental and physical health across the ages might prove beneficial. Certain health crises like diabetes, severe effects from smoking, heart disease figured prominently in our study. Utilizing the mental health aspects of managing these major health struggles when older might help the younger age groups make healthier choices. Policymakers can then take the findings from these studies to refine the current mental and physical health programs found in Medicare and other insurance programs.

[10] Williams, David R. "The Health of Men: Structured Inequalities and Opportunities." *American Journal of Public Health*, vol. 93, no. 5, 2003, pp. 724–31. *Crossref*, doi:10.2105/ajph.93.5.724.

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Appendix A (Table 1)

Descriptive statistics on health and demographic characteristics of individuals surveyed by the RAND Health and Retirement Study from 2008-2016.

VARIABLES	(1) mean	(2) sd	(3) min	(4) max
depressed*	0.0591	-	0	1
gender	0.618	-	0	1
educ	3.341	1.35	1	5
vetrn	0.187	-	0	1
partnered	0.631	-	0	1
hispan	0.0996	-	0	1
race	0.196	-	0	1
income	12.35	35.86	0	1,425
pension	0.294	-	0	1
work	0.324	-	0	1
genhealth	3.208	1.03	1	5
smokev	0.544	-	0	1
heartprob	0.251	-	0	1
arthritis	0.640	-	0	1
diabetes	0.234	-	0	1
cancer	0.164	-	0	1
bmi	28.43	5.83	8.9	92.80
livalone	0.250	-	0	1
numchildren	3.234	2.09	0	20
numsiblings	2.835	2.45	0	20

N=47,554

Note: There were missing values for the following variables: hispan, vetrn, smokev, work, pension, educ, genhealth, numchildren, bmi, diabetes, cancer, heartprob, numsiblings, arthritis, partnered. A detailed explanation of the methods used to complete the dataset for this study is located in Appendix A.

*depressed is a 0-1 dummy variable based on individual's score on the Center for Epidemiologic Studies Depression Scale (CES-D). The cutoff utilized is 6 out of a possible 10, which results in the sample percentage of individuals experiencing mild to severe to depression mimicking a proxy of the population percentage as found by the CDC. For more detail see Appendix B.

Appendix B (Table 2)

	Descriptions of health and demographic variables for individuals surveyed by the RAND Health and Retirement Study from 2008-2016.
depressed	A dummy variable which is 1 if an individual scores a 6 or higher out of 10 on the Center for Epidemiologic Studies Depression Scale (CES-D).
gender	A dummy variable which is 0 if male, 1 if female.
educ	A categorical variable indicating an individual's level of education, ranging from 1 (little high school) to 5 (college and above).
vetrn	A dummy variable which is 1 if a veteran.
partnered	A dummy variable which is 1 if married or with a partner.
hispan	A dummy variable which is 1 if Hispanic.
race	A dummy variable which is 0 if white, 1 if the non-white.
income	Income earnings from the last calendar year in thousands of dollars.
pension	A dummy variable which is 1 if currently receiving any pension income.
work	A dummy variable which is 1 if currently working for pay.
genhealth	A categorical variable of self-reported health ranging from 1 (Poor) to 5 (Excellent).
smokev	A dummy variable which is 1 if the individual ever smoked cigarettes.
heartprob	A dummy variable which is 1 if the individual has ever had a heart attack, coronary heart disease, angina, congestive heart failure or other heart problems.
arthritis	A dummy variable which is 1 if the individual has ever reported having arthritis or rheumatism.
diabetes	A dummy variable which is 1 if the individual has ever reported having diabetes or high blood sugar.
cancer	A dummy variable which is 1 if the individual has ever reported having cancer or a malignant tumor of any kind besides skin cancer.
bmi	Body mass index (BMI) calculated from self-reported height and weight.
livalone	A dummy variable which is 1 if the individual lives alone based on the reported number of individuals in their household.
numsiblings	Number of the individual's living siblings.
numchildren	Number of children ever born to the individual.

Appendix C (Table 3)

Regression models predicting mild to severe depression by gender in individuals 50 years of age and older.

VARIABLES	(1) Bivariate	(2) Controls	(3) Functional Form	(4) Fixed Effects
gender	0.0305***	0.0140***	0.0152***	
	(0.00209)	(0.00271)	(0.00300)	
geninc			-8.45e-05	-0.000168
			(6.50e-05)	(0.000107)
genincsq			1.18e-07	2.31e-07
			(1.12e-07)	(1.66e-07)
educ		-0.00214**	-0.00396***	
		(0.000946)	(0.00114)	
vetrn		-0.00553*	-0.00506*	
		(0.00291)	(0.00293)	
partnered		-0.0375***	-0.0276***	-0.0415***
		(0.00395)	(0.00547)	(0.0116)
support			-0.00284**	-0.000553
			(0.00118)	(0.00219)
hispan		0.0418***	0.0370***	
		(0.00499)	(0.00595)	
race		-0.00262	-0.00501	
		(0.00316)	(0.00325)	
nwhispan			0.0159	
			(0.0104)	
income		4.84e-05**	6.71e-05*	1.90e-05
		(1.92e-05)	(3.55e-05)	(4.54e-05)
incsq			-5.67e-08	-1.24e-08
			(4.06e-08)	(4.18e-08)
pension		-0.0222***	-0.0218***	-0.00550*
		(0.00218)	(0.00218)	(0.00311)
work		-0.0102***	-0.0327***	-0.0175
		(0.00224)	(0.00708)	(0.0107)
workeduc			0.00653***	0.000785
			(0.00177)	(0.00273)
genhealth		-0.0499***	-0.0500***	-0.0263***
		(0.00143)	(0.00143)	(0.00187)
smokev		0.00942***	0.00970***	
		(0.00211)	(0.00211)	
heartprob		0.00903***	0.00879***	
		(0.00280)	(0.00280)	
arthritis		0.0118***	0.0115***	
		(0.00205)	(0.00205)	
diabetes		-0.00231	-0.00226	
		(0.00284)	(0.00285)	
cancer		-0.00810***	-0.00806***	

		(0.00286)	(0.00286)	
bmi		0.000290	0.000296	-0.000547
		(0.000227)	(0.000227)	(0.000630)
livalone		-0.00651	-0.00505	0.00948
		(0.00434)	(0.00439)	(0.00668)
numchildren		0.000229	0.00201*	
		(0.000553)	(0.00103)	
numsiblings		3.34e-06	0.000115	0.00449
		(0.000491)	(0.000491)	(0.00321)
Constant	0.0405***	0.234***	0.233***	0.185***
	(0.00263)	(0.0107)	(0.0113)	(0.0222)
Observations	47,554	47,554	47,554	47,554
Year FE	YES	YES	YES	YES
Individual FE	NO	NO	NO	YES
Number of individuals	9,865	9,865	9,865	9,865

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Appendix D

F-tests for Functional Form Model

. test gender geninc
F(2, 47524) = 13.58
Prob > F = 0.0000

. test gender genincsq
F(2, 47524) = 13.19
Prob > F = 0.0000

. test hispan nwhispan
F(2, 47524) = 36.42
Prob > F = 0.0000

. test numchildren support
F(2, 47524) = 2.95
Prob > F = 0.0525

. test work workeduc
F(2, 47524) = 12.87
Prob > F = 0.0000

. test geninc income
F(2, 47524) = 1.95
Prob > F = 0.1421

. test genincsq incsq
F(2, 47524) = 1.21
Prob > F = 0.2988

. test nwhispan race
F(2, 47524) = 1.79
Prob > F = 0.1671

. test support partnered
F(2, 47524) = 46.35
Prob > F = 0.0000

. test workeduc educ
F(2, 47524) = 8.21
Prob > F = 0.0003

F-tests for Fixed Effects Model

. test geninc income
F(2, 9864) = 1.25
Prob > F = 0.2872

. test geninc genincsq
F(2, 9864) = 1.26
Prob > F = 0.2845

. test support partnered
F(2, 9864) = 15.00
Prob > F = 0.0000

. test genincsq incsq
F(2, 9864) = 0.96
Prob > F = 0.3815

. test work workeduc
F(2, 9864) = 8.95
Prob > F = 0.0001