

# We're a team of epidemiologists from Columbia University's Mailman School of Public Health, who published a recent study linking the wage gap to gender disparities in mood disorders, Ask Us Anything!

MailmanSchool<sub>AMA</sub><sup>1</sup>*andr/ScienceAMAs*<sup>1</sup>

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April 17, 2023

## Abstract

Hi, Reddit – We're a team of epidemiologists from Columbia University's Mailman School of Public Health. In our recent study titled, "Unequal depression for equal work? How the wage gap explains gendered disparities in mood disorders," we used propensity scores to match women and men on age, education, occupation, family composition, years in the workforce, and other factors, and then estimated the effect of income differentials on depression and generalized anxiety disorder. We found that U.S. women whose income was lower than their male matches had nearly 2.5 times the odds of major depression and 4 times the odds of generalized anxiety disorder. Yet when women's income was greater than their male matches, women's odds of generalized anxiety disorder or depression were nearly equivalent to men. This finding, published in the journal *Social Science & Medicine* (<http://www.sciencedirect.com/science/article/pii/S0277953615302616>), may help explain why women are nearly twice as likely to have depression or anxiety than men. We are... Lisa Bates, an assistant professor of Epidemiology and social epidemiologist engaged in research on gender and other axes of inequality as they impact health outcomes; Katherine M. Keyes, an assistant professor of Epidemiology whose research focuses on life-course epidemiology with particular attention to psychiatric disorders; Jonathan Platt, a second-year doctoral student in Epidemiology who studies the incidence and social causes of gender disparities of mood disorders; and Seth Prins, a PhD candidate in Epidemiology who studies the political-economic determinants of mental illness, in addition to mental illness and mass incarceration. We'll be back at 1 pm EST (10 am PST, 6 pm UTC) to answer your questions, Ask Us Anything! \*Edit: Hello! We're online and ready to start answering your questions. We'll be here for about an hour and a half. We're going to answer as many questions as we can, and try to cover a range of issues, from our findings to our methods and theory. \* \*\*\*Edit: We're going to wrap up now – thanks so much for your great questions!\*\*\*

[REDDIT](#)

## We're a team of epidemiologists from Columbia University's Mailman School of Public Health, who published a recent study linking the wage gap to gender disparities in mood disorders, Ask Us Anything!

[R/SCIENCE](#) MAILMANSCHOOL\_AMA

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CORRESPONDENCE:

DATE RECEIVED:  
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January 29, 2016

I'm curious about the apparent causality your summary indicates. You say that the wage gap contributes to the depression incidence, but also that the depression difference exists before adulthood. How are you confident that this isn't instead that depressed people have lower earnings?

[ritchie70](#)

There is a long and ongoing debate about the role of social selection versus social causation regarding social factors and physical and mental illnesses. We acknowledge that selection issues are certainly an issue (as they are in the design and conduct of all observational research). However, the debate between causation and selection mechanisms for mental illness is largely settled: both mechanisms

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are operative, but social causation seems to be a more important factor for anxiety, depression, and personality disorders, and selection seems to be more important for schizophrenia.

In our study we can't definitively determine the respective importance of social causation and selection, but given the large body of evidence suggesting that social causation is predominantly at work for depression and anxiety, we doubt that social selection could entirely explain our findings. We think key next steps in this line of research should include analyses using longitudinal data or alternative identification strategies that would help adjudicate between causation and selection!

Here are some helpful references about the selection/causation debate:

- Dohrenwend, B. P., Levav, I., ShROUT, P. E., Schwartz, S., Naveh, G., Link, B. G., ... Stueve, A. (1992). Socioeconomic status and psychiatric disorders: the causation-selection issue. *Science*, 255(5047), 946–952.
- Ritscher, J. E., Warner, V., Johnson, J. G., & Dohrenwend, B. P. (2001). Inter-generational longitudinal study of social class and depression: a test of social causation and social selection models. *The British Journal of Psychiatry. Supplement*, 40, s84–90
- Johnson, J. G., Cohen, P., Dohrenwend, B. P., Link, B. G., & Brook, J. S. (1999). A longitudinal investigation of social causation and social selection processes involved in the association between socioeconomic status and psychiatric disorders. *Journal of Abnormal Psychology*, 108(3), 490–499.
- Chandola, T., Bartley, M., Sacker, A., Jenkinson, C., Marmot, M., 2003. Health selection in the Whitehall II study, UK. *Soc. Sci. Med.* 56 (10), 2059e2072.

" Yet when women's income was greater than their male matches, women's odds of generalized anxiety disorder or depression were nearly equivalent to men."

Is this to suggest that when women were in income parity with men that they still had increased incidence of depression and generalized anxiety disorder?

[monkeytechx](#)

Thank you for the opportunity to clarify. We found that among the matched pairs where women were in income parity or had incomes that were higher than the matched counterpart, the prevalence of past year depression and anxiety disorders was similar to men. There were no statistically significant differences between men and women in depression and anxiety in this group. Thus, the gender difference in these disorders was not apparent in the group where women were making similar or more than matched male counterpart.

As part of the data collection did you ask women if they know whether a man is making more than her for the same job? I'm curious if being conscious or unconscious of the wage gap made a difference in a person's mental health.

Also, were the mental disorders self reported or evaluated by a psychologist?

[wasp32](#)

See BOKCHOY regarding how we measured the outcomes in the study.

No, we did not have any data in this study regarding participants' perceptions of their wages relative to others. Your comment raises really important questions about the specific mechanisms that might explain the association we observed. While we were not able to test these mechanisms b/c of data limitations, we do discuss several possible pathways by which the existence of the wage gap could explain increased prevalence of mood disorders in women relative to men.

For example, it's possible that women exposed to a gender wage gap DO perceive unfairness in the workplace – as expressed by wage differentials or other dynamics that may be more pervasive in workplace settings WITH gender wage differentials, e.g., sexual or gender harassment, biased devaluation of work performance, etc. – and that this is influencing mental health. As we cite in the paper, many studies have shown evidence of an association between perceived discrimination and health outcomes, include depression and anxiety. But we also note that the wage gap is a potential marker of gender inequality that may manifest in numerous other ways, with negative effects on health – e.g., lower incomes, greater role overload as women who are secondary household earners may face more burdensome “second shifts” on the domestic front, etc.

Admittedly I haven't read your study with a fine-tooth comb, but it would seem that your data hasn't controlled for women and men with highly similar backgrounds, experience, hours worked, etc, but rather focuses on stats in aggregate. I have heard that when you control for all of those factors, incl. the same job, same experience level, hours worked per week, etc, the wage gap almost completely disappears. How thoroughly has your data done that control?

[briendownie](#)

As far as what we controlled for, Frankenhitler quoted the relevant paragraph. After we controlled for those factors, the wage gap was reduced 25%, but not eliminated.

We noticed a bunch of questions about the existence of the wage gap and wanted to respond to that as well.

There is a vast amount of empirical evidence demonstrating gendered wage differences among women and men with equal productivity-related, individual characteristics. Much of this research has attempted to deal with the selection issues you and other commenters have raised (and other commenters have provided great links to references). That said, we're not economists or wage gap experts -- we were convinced by the overwhelming evidence of a wage gap (and importantly, found the gap in our data) and wanted to use this construct to test hypotheses about structural inequality and mood disorders.

Here are some other references on the gender wage gap:

- Goldin, Claudia, (2014). A Grand Gender Convergence: Its Last Chapter, 104 American Economic Review 1091, 1093-1103
- Blau, Francine D. & Kahn, Lawrence M. (2007). The Gender Pay Gap: Have Women Gone As Far As They Can?, 21 Academy of Management Perspectives. 7
- Weichselbaumer, D., & Winter-Ebmer, R. (2005). A Meta-Analysis of the International Gender Wage Gap. Journal of Economic Surveys , 19 (3), 479-511.
- Blau, F. D., & Kahn, L. M. (2000). Gender differences in pay (No. w7732). National bureau of economic research.
- Petersen, Trond & Morgan, Laurie A. (1995). Separate and Unequal: Occupation-Establishment Sex Segregation and the Gender Wage Gap Author(s): The American Journal of Sociology, Vol. 101, No. 2, pp. 329-365
- Blau, F. D., & Kahn, L. M. (1994). Rising wage inequality and the US gender gap. The American Economic Review, 23-28.

As per section 2.3.1. Propensity score estimation and matching, "Men were resampled with replacement, while women were sampled with no replacement. The purpose of this was to preserve

the sample distribution of covariates among women, avoiding the bias that would be introduced by resampling women with the highest propensity scores."

Why did you not do this both ways and compare the results, to have a clear estimate of what kind of difference this male vs female selection does?

[eek04](#)

Thanks for raising this issue. We did not match our sample in the opposite way, as suggested in the comment, because we were interested in investigating the predicted salary among women with the same workplace characteristics as men, and not among men with the same workplace characteristics as women. As we explained in the paper, as thoughtfully raised by the commenter, matching using the latter approach (i.e., sampling women with replacement) would likely skew our sample with an over-representation of women who were outliers in their individual-level characteristics. The comment raises a valid point that research methods and analyses can be strengthened through the use of sensitivity analyses such as this.

How does a study like this account for the fact that many jobs that are held exclusively by men, like infantrymen, air force pilots, oil-rig workers, etc could be dominated by men with depressive and anxiety disorders?

How does your study cope with the fact that many men with depression kill themselves and are not able to self-report as it were? The word suicide is not even mentioned in your report.

How would you respond to the criticism that your study was looking for this result because you knew it would already be there?

[whoizz](#)

1. Our propensity-score matching design allows us to take into account issues of industry gender segregation such as this.
2. Theoretically, this could be an artefactual explanation for gender differences in depression. However, the literature also shows gender disparities in depression incidence which can't as easily be explained by the phenomenon you describe.
3. About the criticism you mention (and other comments elsewhere regarding our motivations or a priori expectations in doing this study) -- As a team of scientists interested in social determinants of health we naturally look for novel and robust opportunities to estimate the effects of structural factors on health outcomes and/or explain the observed social patterning in health by evaluating the role of the kinds of structural factors that often are not accounted for in much epidemiologic research. In the case of gender disparities in mood disorders, the prevailing "risk factors" that have been tested as potential causal factors – e.g., sex hormones, stress coping styles, care-seeking – have not yet been able to fully explain this persistent finding. Efforts to test the role of gender inequality in explaining these disparities are limited by the kinds of data available in epi studies. The gender wage gap is a novel approach to operationalizing structural gender inequality in a very concrete way that does not depend on individual reports of perceived discrimination. (Discrimination may not be perceptible, or not be interpreted as discrimination by an individual and therefore not reported at all or as such.)

It's safe to say we each have a political and moral stance that inequality along any axis (e.g., sex, race, class, sexual orientation, etc.) is wrong and should be reduced on ethical grounds. But this project was not an advocacy exercise whereby we sought to substantiate the negative effects of gender inequality in order to make a case that it should be reduced. Our enterprise is to develop a theoretically-informed hypothesis (e.g., gender inequality may help explain gender disparities in mood disorders) and then

subject that hypothesis to a robust "risky test" that has the potential to fail, meaning disconfirm our hypothesis. We think our operationalization of the gender wage gap, and our use of multiple sensitivity analyses to in effect see if we can make our results "go away," meet this standard of scientific inquiry.

So we distinguish between concerns regarding ethical issues and what we would argue is a scientific interest in the causes of mental disorders and ultimately an empirical question -- does the gender wage gap help explain mental health disparities? In other words, if we had found that the answer was "no" we'd still feel like this study contributed to our understanding of depression and anxiety, AND we'd still be against gender discrimination in pay.

What first led you to conducting this study?

[RichardTheQuail](#)

Attempts have long been made to explain gender differences in depression and anxiety disorders. However, no one theory has completely explained these gender differences, so it is likely that the reasons are complex and to some extent the result of social experiences. In that vein, it has been shown that overt gender bias can have negative mental health consequences for women in the workplace. For example, sexual harassment or being monitored more closely on the job than others may do harm when the experience is perceived as discriminatory. In addition to overt discrimination, structural and institutional discrimination, which may or may not be perceptible, has long been hypothesized and documented empirically. We sought to operationalize these less visible forms of discrimination with the gender wage gap, and test the degree to which they explained the disparity in gender mood and anxiety disorders.

Great article!

A few questions for you. Prior research shows that gender differences in MDD and GAD emerge in adolescence. Your study creatively demonstrates how the gender difference in MDD/GAD as observed in adulthood may be related to gender differences in income, after adjusting for individual factors that may impact productivity and thus earning potential. However, it seems that you're suggesting that wage discrepancies play a causal role in the gender differences in MDD/GAD observed in adults. How can you reconcile this with the evidence that the MDD/GAD gender difference emerges in adolescence, prior to entry into the workforce?

I do see that you suggest in the discussion that it could be useful to examine the impact of structural discrimination on adolescent girls before they enter the workplace "to investigate the causes of gender disparities in MDD and GAD incidence in adolescence." I suppose that, in order to maintain that wage differences play a causal role in the gender differences seen in MDD/GAD, you would need to show that there was structural discrimination in adolescence as well, and could perhaps thus conclude that workplace discrimination is just the "adult version" of the structural discrimination present in adolescence. Or, if there was no structural discrimination observed in adolescence, then I suppose one could argue that other factors contribute to the emergence of the MDD/GAD gender gap in adolescence, but workplace discrimination plays a key role in maintaining the gap in adulthood. Do these ideas fit with your thinking on the causality of wage differences in higher rates of MDD/GAD in women?

I have one final question. How would you propose measuring structural discrimination in adolescence? I'd be curious to hear your ideas for measuring it in an ideal world (i.e., assuming you could readily develop the "perfect" measure, that you could collect data longitudinally, gather information from multiple reporters, use a large sample, etc.), and also your practical recommendations (i.e., are there measures of structural discrimination in adolescence currently available? what variables might be used

to construct such a measure? perhaps grades, involvement in leadership activities, access to transportation?)

Thank you for sharing your work!

[kermumfulence](#)

Your comments about the emergence of gender differences of MDD/GAD in adolescence raise valid and important methodological issues. See our above discussion about selection vs. causation.

Your question about measuring structural discrimination in adolescence is also a great one! We know of one compelling example: one of us was involved in a study looking at the effects of structural discrimination on outcomes among adolescents, specifically, the impact of inclusive, anti-bullying school policies and suicide among LGBT youth:

<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3696185/>

If we were to speculate about something analogous with respect to gender, we might look for other ways that structural gender discrimination could operate in adolescence (you're right that it probably wouldn't be through wages). For example, we might look for things that happen in schools, such as gender norms and expectations about outmoded ideas like "girls are bad at math." If there were schools that implemented programs to encourage girls to study traditionally "male" subjects, we could compare them to schools where such an effort was lacking. This is an area ripe for innovative measurement development!

We found that U.S. women whose income was lower than their male matches had nearly 2.5 times the odds of major depression

What about men whose income is lower than their matches? What are the odds of them having major depression?

[lulzoiaf](#)

Good question! There is over a century of research documenting an inverse relationship between socioeconomic status and physical and mental illnesses. For example, and generally speaking, individuals with lower incomes tend to have a higher risks of many major mental disorders. Of course these findings are subject to concerns about the direction of causation, but research has shown that social causation is a powerful phenomenon. There are also numerous theories about the mechanisms that bring socioeconomic status "under the skin." In general these explanations focus on material and psychosocial factors, such as money, knowledge, power, prestige, access to beneficial social connections, etc., and both rely on notions of stress and stressors. But comparing men who earn less than other men in the same job wouldn't necessarily get at discriminatory mechanisms.

Here are some classic and more recent references about socioeconomic status and mental illness:

- Dohrenwend, B.P. (1990) Socioeconomic status (SES) and psychiatric disorders. Are the issues still compelling?, *Social Psychiatry and Psychiatric Epidemiology*, 25, 1, 41–7.
- Dohrenwend, B.P. and Dohrenwend, B.S. (1969) *Social Status and Psychological Disorder: a Causal Inquiry*. New York: John Wiley.
- Dohrenwend, B.P., Levav, I., Shrout, P.E., Schwartz, S. et al. (1992) Socioeconomic status and psychiatric disorders: the causation-selection issue, *Science*, 255, 5047, 946–52.
- Faris, R.E.L. and Dunham, H.W. (1988) *Mental Disorders in Urban Areas: An Ecological Study of Schizophrenia and other Psychoses*. Chicago: University of Chicago Press.

- Hollingshead, A.B. and Redlich, F.C. (1953) Social stratification and psychiatric disorders, *American Sociological Review*, 18, 2, 163–9.
- Muntaner, C., Ng, E., Vanroelen, C., Christ, S., et al. (2013) Social stratification, social closure, and social class as determinants of mental health disparities. In Aneshensel, C.S., Phelan, J.C. and Bierman, A. (eds) *Handbook of the Sociology of Mental Health*. Dordrecht: Springer.
- Muntaner C, Eaton WW, Miech R, O'Campo P. Socioeconomic position and major mental disorders. *Epidemiol Rev*. 2004;26:53-62. doi:10.1093/epirev/mxh001.

What kind of analytical software do you use?

[structuralbiology](#)

All analyses were completed in Stata SE version 13 using weighted analysis to account for nonresponse and sample attrition. Propensity scores were calculated using the psmatch2 module (developed by Leuven & Sianesi, 2014).

Why did you choose to use a 2002 set of data? Do you think that the data might be misrepresenting the current population of American men and Women? It seems that the 54% wage gap calculated in your study is oddly much lower than most estimates for women. Maybe this was due to the ages of the individuals and the fact that they lived in a more sexually divided society as children and young adults. A 30 yr old (lowest age in the study) from 2002 would be 44 now and the oldest would be nearing 80 years old today. It seems these individuals do not represent the millennial population and the wages associated with them.

[Yo5yoman2](#)

To clarify, our unmatched wage gap in our study was 54%. That is, before accounting for the individual differences in workplace characteristics. After matching on these characteristics, the wage gap decreased to 68%, which is still higher than other studies, but certainly in the range of what has been reported in the literature. To test the robustness of the wage gap in our study, we:

\*Restricted the sample to those with income < \$1,000,000 to test if study results were due only to those with the largest incomes, and thus the greatest matched pair income differences.

\*Restricted our sample to exclude imputed income, to test if imputed data could explain our findings.

\*Restricted our sample to those in executive, administrative, managerial occupations as a way to test a more narrowly defined workforce population.

\*Included spousal income in the propensity score estimation and matching to test the explanation that high earning women were more likely to be married and/or live in a two-income household, and therefore generally less likely to develop mood disorders.

\*Also, because broadly defined occupation and industry categories might be driving some of the heterogeneity in income differences, despite matching, we performed an additional sensitivity analysis, excluding education level from the propensity score estimation, and then stratifying by three levels of education (some high school, high school diploma/GED through some college, and a college degree or more).

The results were consistent in all analyses. We saw a clear signal emerge in these data which reflects real health consequences of structural and institutional gender discrimination in the the workforce.

Good timing on your AMA! President Obama just announced an executive action to crack down on firms that pay women less for doing the same work as men. It will require companies to report to the government what they pay employees by race, gender, and ethnicity. What's your take on this news? Will it close the wage gap?

[tim\\_edit](#)

As we note in our paper, we think an important first step in addressing this issue is simply transparency. So it's definitely encouraging!