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The Effect of Americans' Confidence in Medicine and the Scientific Community on Health Outcomes Before and During the COVID-19 Pandemic Assessed using Ordered Logistic Regression and Heterogenous Choice Models

Abstract

Americans' confidence in the medical and scientific communities have dwindled over the last several decades. With data from the 2018 and 2021 General Social Survey, I examine the effect of (lack of) confidence in these communities on individuals' health outcomes before and during the COVID-19 pandemic using ordered logistic regression and heterogeneous choice models. The results show that counterintuitively, COVID-19 did not have a significant impact on the confidence in these communities and none of the research hypotheses were accepted, which indicates the need to assess the larger societal landscape from the past 50 years.

Background

The American public's confidence in one of its major social institutions—the scientific community—and their confidence in medicine's ability to diagnose, treat, and cure health conditions have dwindled over the last five decades (Pescosolido, Tuch, & Martin, 2001). Between 1910 and 1970, the American healthcare system, "aided after World War II by federal support for research and development as well as infrastructure," flourished in its "Golden Age of Doctoring" (McKinlay and Marceau, 1998) and "Era of Professional Dominance" (Pescosolido and Boyer 2001). Physicians determined "the nature of medical care and the arrangements under which it was provided": patients could choose their physicians, but physicians set prices and worked out of single offices rather than hospitals (Pescosolido, Tuch, & Martin, 2001).

Since the 1970s, the American healthcare system has seen an increasing number of uninsured Americans, exorbitant and rapidly increasing costs, limitations on insurance reimbursements, as well as an increase in the politicization of medicine with the introduction of Medicaid, Medicare, and the Affordable Care Act (Pescosolido, Tuch, & Martin, 2001). Compounding these difficulties with the healthcare system, the American public became concerned about vaccine safety (Goldenberg, 2021). The uneasy terrain of the American medical landscape has given rise to Americans who—for better or worse—assertively question the authority and credibility of physicians and who are becoming less confident in medicine and the scientific community.

Since the 1990s, the American public has begun to lose the generational memory of the world before vaccines and therefore, challenges the need for vaccines, further bulldozing confidence in the American scientific and medical landscape (Goldenberg, 2021).

This erosion of confidence in the medical system and scientific community, particularly with vaccines, provides an almost perfect situation for a global pandemic to wreak havoc on Americans' health and on their confidence in institutions. The rapid advancements in our understanding of COVID-19 and the U.S.'s frequently changing safety recommendations has emboldened Americans to question the medical and scientific community even more (Baker 2020). The pandemic has been politicized and downplayed, particularly by the Trump Administration. For example, the Trump Administration blocked the head of the National Institute of Allergy and Infectious Diseases, Dr. Anthony Fauci, from testifying before Congress about the United States' pandemic response, while touting untested COVID-19 treatments, such as hydroxychloroquine and convalescent plasma, which later proved to be ineffective (Viglione, 2020). Conversely, the Biden Administration has attempted to restore Americans' trust in the credibility and

accountability of the U.S. government through consistent communication on the case count and death rate, vaccine campaigns, and the like (Source 8 stay-at-home orders). While the current administration's effort has been valiant, the lack of trust in the healthcare system and the damage done by the previous administration is already etched into our cultural landscape.

The politicization of the pandemic has fueled distrust in the medical and scientific communities and concern regarding the credibility of information, resulting in Americans who are unsure whether to wear masks, social distance, or get vaccinated.

The public does not have an intimate relationship with scientific language and therefore, misinterprets acknowledgement of limitations as a lack of credibility, while those in popular media speak with enough authority and fervor to suggest they are more reliable than the scientific community (Baker 2020, Guilbeault, Becker, & Centola, 2018).This tension between the medical and scientific community and popular political media can force people to draw their own conclusions about guidelines, treatment, and prevention of COVID-19. When people are forced to draw medical conclusions for themselves, they frequently seek out information from those in their communities (Zhang & Centola, 2019). Therefore, those who already had access to health information gain additional access and those who had limited access are unable to access accurate and credible health information (Zhang & Centola, 2019). It's crucial to note that health information does not spread independently from personal and political opinions; as a result, medical beliefs—whether factual or not—are reinforced and perpetuated in social 'echo chambers' (Eastin 2006, Guilbeault, Becker, & Centola, 2018).

This gap in health literacy exacerbates health inequities; for example, those of higher socioeconomic status are likely to have more "personal ties, organizational memberships, and professional resources" that expose them to health information than those of lower socioeconomic

status (Zhang & Centola, 2019, p. 97). COVID-19 has exacerbated these health inequities, which are exemplified by the disproportionately high rates of cases, deaths, and adverse outcomes for people of color, the elderly, and the queer community (Zhang & Centola 2019; Baker 2020). For instance, the elderly (85 years and older) die of COVID-19 at 370 times higher rates than their 18- to 29-year-old counterparts (CDC, 2021).

Given the tumultuous history of Americans' confidence in medicine and the scientific community coupled with the introduction of the COVID-19 pandemic, it is vital to assess the effect of confidence in medicine and the scientific community on health outcomes before and during the COVID-19 pandemic. Therefore, my hypotheses are:

H1a: *The odds of reporting excellent health—rather than good, fair, or poor health—will be higher for respondents who have more confidence in medicine, holding age, sex, sexual orientation, political affiliation, mental health status, physical ability, and pain constant.*

H1b: *The odds of reporting excellent health—rather than good, fair, or poor health—will be higher for respondents who have more confidence in the scientific community, net all other variables.*

H2a: *The odds of reporting excellent health —rather than good, fair, or poor health—will be higher in 2018 for those who have more confidence in medicine than for those who have more confidence in medicine in 2021 due to the COVID-19 pandemic, net all other variables.*

H2b: *The odds of reporting excellent health —rather than good, fair, or poor health—will be higher in 2018 for those who have more confidence in the scientific community than for those who have more confidence in the scientific community in 2021 due to the COVID-19 pandemic, net all other variables.*

Data, Measures, and Methods

I evaluate my hypotheses using two waves of data from the General Social Survey (GSS 2018 and GSS 2021). The GSS is a nationally representative survey that has been collected since 1972. The sample from two waves have approximately 630 respondents for 2018 and 2000 respondents for 2021 (Table 1). The survey contains questions about concerns, beliefs, experiences, and actions of residents across the United States.

Measures

Health Outcomes. The dependent variable is an ordered measure of self-reported health outcomes: poor, fair, good, and excellent health. Since very few respondents reported "poor" health, running an ordered logistic regression resulted in perfect prediction. Therefore, I combined poor and fair health, and adjusted the hypotheses from the odds of reporting poor health to the odds of reporting excellent health. As many as 779 respondents failed to report their health in 2018, so roughly 33% of the data were missing for the dependent variable. Given that it is not couth to alter the dependent variable, I determined that it was best to exclude the data with listwise deletion. For 2021, only nine respondents failed to report their health, so only a minute amount of data were excluded.

Confidence in Medicine. The first independent variable is an ordered measure of confidence in the institution of medicine as well as the individuals who run the healthcare system in the United States.

Confidence in the Scientific Community. The second independent variable is an ordered measure of confidence in the scientific community and the individuals who run that community in the United States. Confidence in the scientific community differs from confidence in medicine, particularly as it relates to the COVID-19 pandemic, because, for example, someone may believe

in evolution, but be opposed to vaccinations, therefore their view of the scientific community may have nothing to do with the medical community.

Health Control Variables. Since overall health outcomes are impacted by mental and physical health, I included mental health, ability to carry out everyday physical activities, and pain ratings in the last seven days to control for the role they may play in how confidence in medicine and the scientific community effect health outcomes. I am operating under the assumption that the combination of mental health, physical ability, and pain rating may have a larger impact on health outcomes than confidence in medicine and the scientific community, which is why I am controlling for them.

Demographic Control variables. I include various demographic characteristics as controls, such as sex, sexual orientation, age, years of education, family income, and political party affiliation. Previous research suggests that heterosexual men are less likely to receive routine annual examinations and are more likely to report poorer health than their female and non-heterosexual counterparts. As previously mentioned, the queer community and the elderly experience disproportionately high rates of COVID-19 cases, death, and poor health outcomes, so I control for these demographics as well (CDC, 2021). Moreover, the politicization of the COVID-19 pandemic warrants controlling for political party affiliation as there is a substantial divide between American Democrats and Republicans regarding safety protocols, prevention, and treatment (Goldenberg, 2021).

Analytic Approach

The purpose of this analysis is to determine the relationship between confidence in medicine and the scientific community and the odds of reporting excellent health before (2018) and during the COVID-19 pandemic (2021). The data did not have changes in variable names,

definitions, or question wording from one wave to the next. Additionally, each variable that was adjusted in one wave was adjusted in the other.[1]

I appended the two waves of data and created a dummy variable that labeled all 2018 data as "0" and all 2021 data as "1." To ensure that the relationship between health outcomes and confidence in medicine were statistically different ($p < 0.05$), I fitted a Heterogenous Choice Model (HCM) using Ordinal Generalized Linear Model (OGLM) with an interaction term between the confidence in medicine variable and the dummy variable that differentiated the 2018 wave from the 2021 wave (HCM1). I also fitted a HCM using OGLM to ensure that the relationship between health outcomes and confidence in the scientific community were statistically different from 2018 to 2021 (HCM2) ($p < 0.05$) (Table 2).

After confirming that the two waves were comparable, I used ordered logistic regression models for 2018, then 2021 (Table 3). Due to perfect prediction, the dependent ordered variable (health) was recoded into three categories, instead of four: excellent health, good health, and fair or poor health. To avoid perfect prediction with the independent and control variables, age, sexual orientation, political party affiliation, pain rating, and mental health were recoded in both waves.[1]

After the OLR models, I ran a Brant test to confirm that the assumptions necessary to use an ordered logistic regression model were not violated. For 2018, the Brant test was insignificant

[1] The age variable in 2018 was modified so that the maximum value was 85 and older instead of 89 and older, so the age variable was changed for 2021, too. Sexual orientation was recoded from a categorical variable (heterosexual, bisexual, and gay or lesbian) to binary (heterosexual or LGBTQ+). Political party affiliation was coded as very Democrat, mildly Democrat, moderate, Independent, and so on, therefore I binned that variable to only include Democrat, Republican, and Independent or Other political party affiliation. Too few respondents reported no pain and the most severe pain, so I recoded the variable to include those who reported less than or equal to a four out of ten rating, those who reported greater than or equal to an eight out of ten rating, and then the ratings in-between. Similarly, too few respondents reported enough variation in mental health, so the categorical variable was recoded as a binary variable: excellent mental health or good, fair, or poor mental health.

for the entire model as well as the independent variables; however, the Brant test for 2021 was significant for the entire model, but not significant for the independent variables (confidence in medicine: $p = 0.672$, confidence in the scientific community: $p = 0.736$), which allows me to draw conclusions about the independent variables, rather than the entire model.

Results

Table 1: Summary Statistics for the 2018 and 2021 waves of the General Social Survey after variables were recoded to fit Ordered Logistic Regression Models.

	OLRM1: 2018 (n = 627)	OLRM2: 2021 (n=2,020)
DV: Health Outcomes		
Excellent	22.88%	20.76%
Good	49.14%	56.28%
Fair or Poor	27.98%	22.97%
IV1: Confidence in the Medical Community		
A Great Deal	35.59%	40.20%
Only Some	50.84%	50.56%
Hardly Any	13.58%	9.24%
IV2: Confidence in the Scientific Community		
A Great Deal	45.22%	50.38%
Only Some	48.14%	42.99%
Hardly Any	6.64%	6.63%
Demographics		
Age (years)	49 (17.99)	52.16 (17.23)
Education (years)	13.73 (2.97)	14.76 (2.80)
Sex		
Male	44.80%	44.06%
Female	55.20%	55.94%
Sexual Orientation		
Lesbian, Gay, Bisexual (LGB)	5.97%	7.61%
Heterosexual	94.03%	92.39%
Family Income	$49,973.96 ($42,407.21)	$55,956.23 ($47,369.69)
Political Affiliation		
Democrat	31.58%	34.08%
Republican	22.76%	22.70%
Other or Independent	45.66%	43.23%
Mental & Physical Health Characteristics		
Pain Rating in Past 7 Days	3.97 (1.57)	2.69 (2.48)
Ability to do Physical Activity		
Completely	64.36%	60.45%
Mostly	17.48%	18.41%
Moderately	11.85%	13.99%
A Little	5.54%	6.04%
Not At All	0.77%	1.10%
Mental Health		
Excellent	20.52%	15.92%
Very Good, Good, Fair, or Poor	79.48%	84.08%

Note: standard errors in parentheses.

Table 2: Heterogenous Choice Models that examine 1. if the relationship between health outcomes and c*onfidence in medicine* are different between 2018 and 2021 and 2. if relationship between health outcomes and *confidence in the scientific community* are different between 2018 and 2021 ($p < 0.05$*, $p < 0.01$**, $p < 0.001$***).

	HCM1: health outcomes and *confidence in medicine* (n = 3,437)*	HCM2: health outcomes and *confidence in the scientific community* (n = 3,406)**
Likelihood Ratio	χ^2 (1) = 6.54	χ^2 (1) = 8.89
Log Likelihood	-3458.093	-3418.195
Interaction term for combined waves of data and *confidence in medicine* variables	0.105* [0.0246, 0.186]	
Interaction term for combined waves of data and *confidence in the scientific community* variables		0.139** [0.478, 0.231]

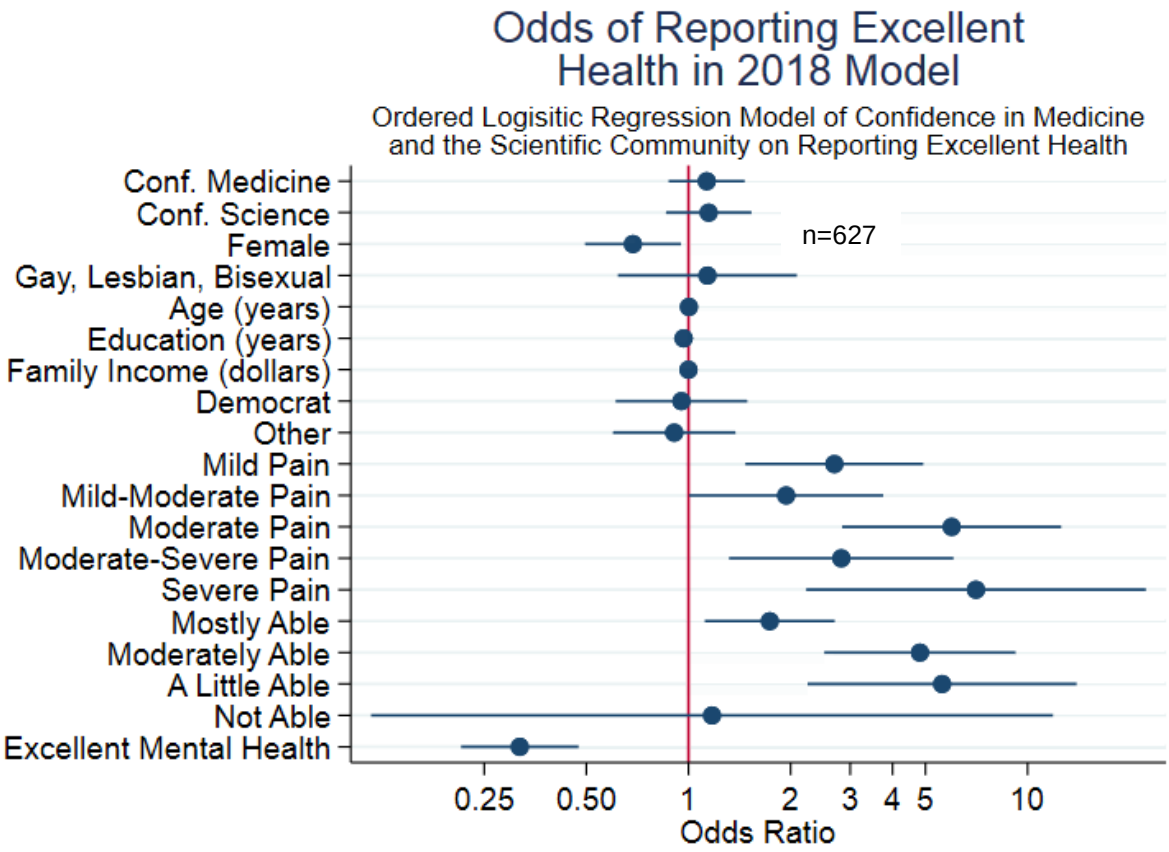
The Heterogenous Choice Models for 2018 and 2021 confirm that the two waves of data are significantly different, indicating that comparisons can be drawn between them (Table 2). Using Akaike's information criterion, the model that examines the effect of confidence in medicine on the odds of reporting excellent health (HCM1) is better fitting than the model that examines the effect of confidence in the scientific community (HCM2) (Table 2). It is unsurprising that a respondent's confidence in medicine is better at predicting the odds of reporting excellent health than a respondent's confidence in the scientific community.

Table 3: Ordered Logistic Regression Models for the Effects of Confidence in Medicine and Confidence in the Scientific Community on the Odds Ratio of Reporting Excellent Health before the COVID-19 pandemic (2018) and during the COVID-19 pandemic (2021) ($p < 0.05$*, $p < 0.01$**, $p < 0.001$***).

	2018 Ordered Logistic Model*** (n=627)	2021 Ordered Logistic Model*** (n=2,020)
Confidence in Medicine	1.132	1.183*
	[0.874, 1.465]	[1.001, 1.398]
Confidence in the Scientific Community	1.146	1.060
	[0.857, 1.533]	[0.882, 1.273]
Demographics		
Female	0.685*	0.873
	[0.495, 0.950]	[0.724, 1.053]
Sexual Orientation		
Gay, Lesbian, or Bisexual	1.137	1.944*
	[0.619, 2.087]	[1.000, 3.780]
Age (years)	1.003	1.001
	[0.993, 1.013]	[0.995, 1.006]
Education (years)	0.967	0.923***
	[0.906, 1.032]	[0.888, 0.960]
Family Income	0.999***	0.999***
	[0.999, 0.999]	[0.999, 0.999]
Political Affiliation (reference: Republican)		
Democrat	0.953	1.046
	[0.609, 1.490]	[0.806, 1.357]
Independent or Other	0.907	1.211
	[0.598, 1.376]	[0.950, 1.543]
Physical and Mental Health Characteristics		
Pain Rating (0-10)		
$\leq$ 4 (mild)	2.692***	2.340***
	[1.471, 4.927]	[1.594, 3.436]
5	1.940*	2.109***
	[1.003, 3.752]	[1.498, 2.968]
6 (moderate)	5.970***	2.826***
	[2.836, 12.565]	[1.899, 4.204]
7	2.822**	2.752***
	[1.318, 6.043]	[1.688, 4.485]
$\geq$ 8 (severe)	7.041***	2.971***
	[2.222, 22.309]	[1.890, 4.670]
Ability to accomplish everyday physical activities (reference: completely able)		
Mostly Able	1.736**	2.323***
	[1.117, 2.699]	[1.794, 3.007]
Moderately Able	4.811***	3.397***
	[2.512, 9.216]	[2.496, 4.624]
Mildly Able	5.594**	8.194***
	[2.245, 13.393]	[4.974, 13.500]
Not Able	1.173	6.622***
	[0.115, 11.883]	[2.348, 18.669]
Excellent Mental Health	0.318***	0.211***
	[0.213, 0.474]	[0.163, 0.274]
Log-Likelihood	-540.207	745.32
Likelihood Ratio	χ^2 (20) = 224.31	χ^2 (20) = -1623.53

Note: standard errors in parentheses.

Figure 1: Odds Ratio Plot with Confidence Intervals and Indication of Significance (red line at zero) on the Odds of Reporting Excellent Health in the 2018 OLRM on Confidence in Medicine and the Scientific Community



2018 OLRM1 Results

The overall 2018 ordered logistic regression model (n = 627) that estimates the impact of confidence in medicine and the scientific community on the odds of reporting excellent health is significant ($p < 0.0001$); however, the independent variables—confidence in medicine or confidence in the scientific community—are insignificant ($p = 0.361$, $p = 0.582$ respectively). Some controls were also insignificant: sexual orientation, age, political affiliation, inability to accomplish everyday physical activities, and excellent mental health.

Being female decreases the odds of reporting excellent health in 2018—rather than good, fair, or poor health—by 31.5% (95% CI [0.495, 0.950]), holding all other variables constant ($p <$

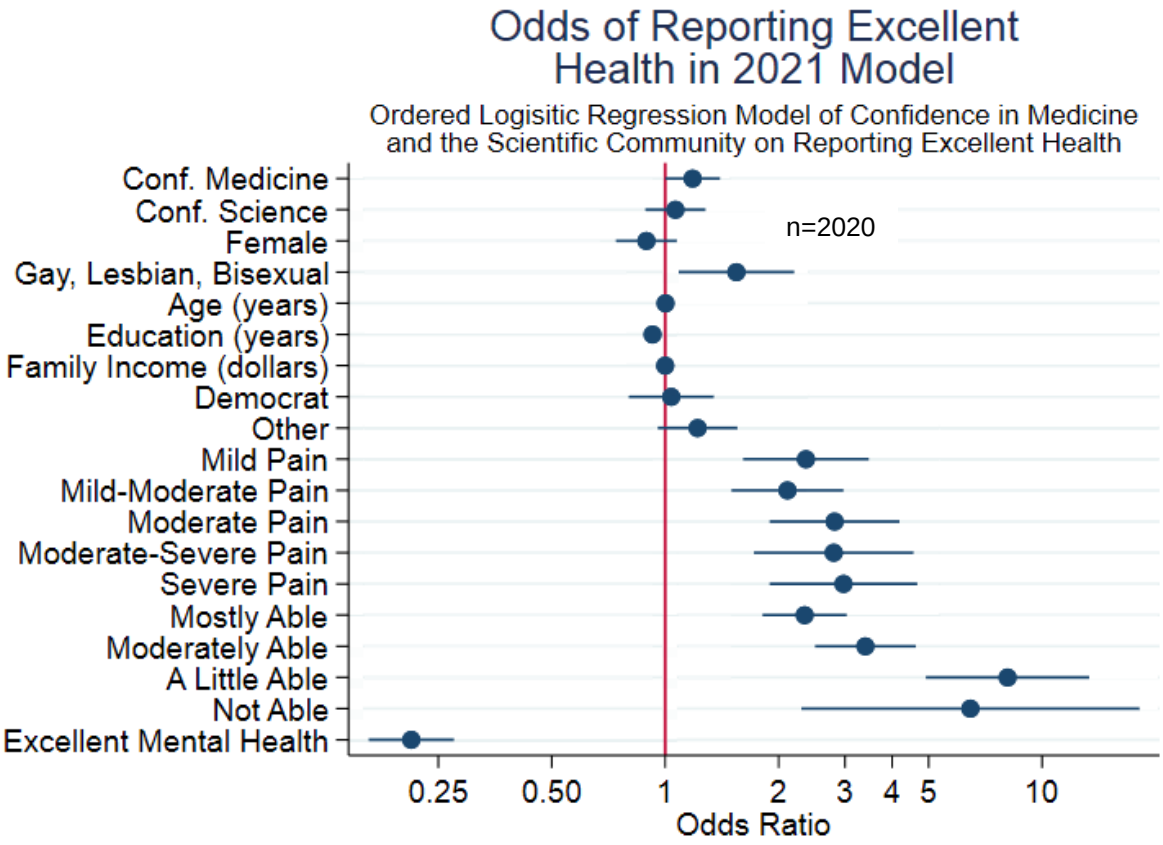
0.05). For every dollar added to a respondent's family income, the odds of reporting excellent health in 2018—rather than good, fair, or poor health—decrease by less than 0.01% (95% CI [0.999, 0.999]), holding all other variables constant ($p < 0.001$).

The control, respondents' average pain rating for the past seven days, was significant for each level of pain. Understandably, having a pain rating of four or less (mild pain) increases the odds of reporting excellent health in 2018—rather than good, fair, or poor health—by 169% (95% CI [1.471, 4.927]), net all other variables ($p < 0.001$). As the average pain rating increases, the odds of reporting excellent health approximately increase, too. Having a pain rating of five (moderate pain) increases the odds of reporting excellent health in 2018—rather than good, fair, or poor health—by 94% (95% CI [1.003, 3.752]), holding all other variables constant ($p < 0.05$). Having a pain rating of six (moderate pain) increases the odds of reporting excellent health in 2018—rather than good, fair, or poor health—by 497% (95% CI [2.836, 12.565]), holding all other variables constant ($p < 0.001$). Having a pain rating of seven (moderate to severe pain) increases the odds of reporting excellent health in 2018—rather than good, fair, or poor health—by 182% (95% CI [1.318, 6.043]), net all other variables ($p < 0.01$). Having a pain rating of eight or greater (severe pain) increases the odds of reporting excellent health in 2018—rather than good, fair, or poor health—by 604% (95% CI [2.222, 22.309]), holding all other variables constant ($p < 0.001$). Perhaps those who reported having severe pain in the past seven days experienced a one-time event, such as childbirth or an appendectomy, rather than a chronic illness; this, paired with the fact that only eight respondents reported excellent overall health and severe pain, may explain why those who reported severe pain in 2018 still had high odds of reporting excellent health.

Being mostly able to accomplish everyday physical activities—compared to being completely able—increases the odds of reporting excellent health in 2018—rather than good, fair,

or poor health—by 73.6% (95% CI [1.117, 2.699]), holding all other variables constant ($p < 0.01$). Being moderately able to accomplish everyday physical activities—compared to being completely able—increases the odds of reporting excellent health in 2018—rather than good, fair, or poor health—by 381% (95% CI [2.512, 9.216]), holding all other variables constant ($p < 0.001$). Being mildly able to accomplish everyday physical activities—compared to being completely able—increases the odds of reporting excellent health in 2018—rather than good, fair, or poor health—by 459% (95% CI [2.245, 13.393]), holding all other variables constant ($p < 0.01$). Having excellent mental health—rather than very good, good, fair, or poor mental health—decrease the odds of reporting excellent overall health in 2018—rather than good, fair, or poor health—by 68.2% (95% CI [0.213, 0.474)], net all variables ($p < 0.001$).

Plot 2: Odds Ratio Plot with Confidence Intervals and Indication of Significance (red line at zero) on the Odds of Reporting Excellent Health in the 2021 OLRM on Confidence in Medicine and the Scientific Community



2021 ORLM2 Results. The overall 2021 ordered logistic regression model (n = 2020) that estimates the impact of confidence in medicine and the scientific community on the odds of reporting excellent health is significant ($p < 0.001$). The first independent variable—confidence in medicine—is also significant ($p < 0.05$), meaning that being confident in medicine increases the odds of reporting excellent health in 2021—rather than good, fair, or poor health—by 18.3% (95% CI [1.001, 1.398]), net all other variables. However, confidence in the scientific community is insignificant ($p = 0.533$). Some demographic controls were also insignificant: sex, age, and political affiliation.

Being lesbian, gay, or bisexual increases the odds of reporting excellent health in 2021—rather than good, fair, or poor health—by 94.4% (95% CI [1.000, 3.780]), holding all other variables constant ($p < 0.05$). Each additional year of education decreases the odds of reporting excellent health in 2021—rather than good, fair, or poor health—by 7.7% (95% CI [0.888, 0.960]), net all other variables ($p < 0.001$). For every dollar added to a respondent's family income, the odds of reporting excellent health—rather than good, fair, or poor health—in 2021 decreases by 0.001% (95% CI [0.999, 0.999]), holding all other variables constant ($p < 0.001$).

Like the results for 2018, the control, respondents' average pain rating over the previous seven days, was significant for each level of pain. Having a pain rating of four or less (mild pain) increases the odds of reporting excellent health in 2021—rather than good, fair, or poor health—by 134% (95% CI [1.594, 3.436]), net all other variables ($p < 0.001$). Having a pain rating of five (moderate pain) increases the odds of reporting excellent health in 2021—rather than good, fair, or poor health—by 111% (95% CI [1.498, 2.968]), net all other variables ($p < 0.001$). Having a pain rating of six (moderate pain) increases the odds of reporting excellent health in 2021—rather than good, fair, or poor health—by 182% (95% CI [1.899, 4.204]), holding all other variables

constant ($p < 0.001$). Having a pain rating of seven (moderate to severe pain) increases the odds of reporting excellent health in 2021—rather than good, fair, or poor health—by 175% (95% CI [1.688, 4.485]), holding all other variables constant ($p < 0.001$). Having a pain rating of eight or greater (severe pain) increases the odds of reporting excellent health in 2021—rather than good, fair, or poor health—by 197% (95% [1.890, 4.670]), net other variables ($p < 0.001$). Similar to the 2018 model, perhaps those who reported severe pain experienced a one-time illness, even though the odds are lower for 2021 than 2018 (197% and 604%, respectively). Having excellent mental health—rather than very good, good, fair, or poor mental health—decrease the odds of reporting excellent overall health in 2021—rather than good, fair, or poor health—by 78.9% (95% CI [0.163, 0.274]), holding all other variables constant ($p < 0.001$).

Conclusion and Future Research

The effects of confidence in medicine on the odds of reporting excellent health in 2021 was significant: being confident in medicine increases the odds of excellent health by 18.3%. That being said, confidence in medicine was insignificant for the 2018 wave, so I reject my hypotheses 1a and 2a: *The odds of reporting excellent health—rather than good, fair, or poor health—will be higher for respondents who have more confidence in medicine, holding age, sex, sexual orientation, political affiliation, mental health status, physical ability, and pain constant and will be higher in 2018 than in 2021 due to the COVID-19 pandemic.*

Confidence in the scientific community was insignificant for both waves of data, so I also reject my hypotheses 1b and 2b: *The odds of reporting excellent health —rather than good, fair, or poor health—will be higher for respondents who have more confidence in the scientific community, net other variables, and will be higher in 2018 than 2021 due to COVID-19.* However, it proves to be more interesting that COVID-19 did not have a significant impact on Americans'

confidence in medicine or the scientific community, suggesting that the erosion of confidence that we have seen in the last 50 years may be more influential than a global pandemic spanning three years. Perhaps the societal unease with vaccines, the worsening gap in health literacy, and the distrust regarding the credibility and accuracy of scientific information is more pervasive and long-lasting than I feared. It would be far easier to blame the COVID-19 pandemic for diminishing confidence in the scientific community, but these results indicate the need to look back at the larger social backdrop. Future research may consider examining GSS results starting from 1972, the first year of survey, until present to quantitatively track the shift in confidence in the medical and scientific community throughout the last five decades.

Limitations

Failing to include race in a discussion about the COVID-19 pandemic and confidence in the medical and scientific community is a drastic limitation that future research should include.

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