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Association Between Long COVID-19 and Insurance Status Using the Behavioral Risk Factor Surveillance System (2022)

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Abstract

Objective

To determine if insurance status can directly predict self-diagnosed Long COVID and what sociodemographic factors are significantly associated with a self-diagnosis of Long COVID among those who tested positive for COVID-19.

Methods

This cross-sectional study uses data from the 2022 Behavioral Risk Factor Surveillance System to conduct a multivariate logistic regression model analysis. Out of 445,132 participants, 110,402 participants were identified to be used in this study.

Results

After testing positive for COVID-19, 21.7% of individuals were self-diagnosed with Long COVID. After controlling for confounders, insurance status wasn't significant (p-value: 0.8458). However, in crude analysis, individuals with Medicaid (cPOR:1.44; 95%CI:[1.30-1.58]) and no health insurance (cPOR:1.37; 95%CI:[1.22-1.54]) were associated with increased odds of self-diagnosed Long COVID. Females had a 61% greater adjusted odds (95% CI: [1.44-1.80]) of self-diagnosing Long COVID than males. Individuals aged 45 to 64 had 37% greater adjusted odds (95% CI: [1.15-1.63]) of self-diagnosed Long COVID compared to those aged 65 and over.

Conclusions

Insurance status alone shouldn't be used as a direct predictor of self-diagnosed Long COVID but should be considered alongside other sociodemographic factors.

Introduction

Health insurance coverage is critical in impacting the social determinants of health (SDOH) by influencing accessibility, affordability, utilization, and quality of care for certain individuals. Inequalities found within populations before the COVID-19 pandemic have only aggravated pre-existing health conditions of diseases such as respiratory conditions, cardiovascular diseases, diabetes, immunocompromised conditions, and obesity, thus magnifying the disease burden.[1] Research has shown that Black and minority groups have oftentimes been more affected by COVID-19 compared to White groups, and it has also been known that health insurance coverage varies substantially between ethnic and racial groups in the United States.[2,3]

In 2022, White and Asian individuals were the largest portion of those with private insurance, followed by Black and Hispanic individuals.[3] Medicare primarily covers individuals 65 and older, individuals with a disability status, or End-Stage Renal Disease, and was mainly used by Non-Latino Whites in 2019.[4,5] Medicaid covers low-income individuals and families (e.g., children, pregnant women, elderly adults, and people with disabilities) and was utilized mainly by nonelderly American Indian/Alaska Native (AIAN), Black, Native Hawaiian/Other Pacific Islander (NHOPI), Hispanic, and White individuals in 2022.[6] Those without insurance coverage in 2022 were typically nonelderly Hispanic, Black, Asian, AIAN, and NHOPI individuals compared to White individuals.[6]

COVID-19 has had a substantial and profound impact on the United States, with an estimated 1.2 million deaths and about 6.7 million COVID-19-related hospitalizations since 2020.[7,8] According to the Johns Hopkins University of Medicine Coronavirus

Resource Center, there have been about 103 million confirmed cases of COVID-19 in the United States since the start of the pandemic in 2020.[9]

It has also come to fruition that some individuals may struggle with extended or new manifestations of COVID-19 symptoms, known as Long COVID.[10] Long COVID, also known as Post-acute sequelae of SARS-CoV-2 infection (PASC), is defined as having a wide range of ongoing respiratory, neurological, cardiovascular, and other symptoms that can last weeks to years.[10] In 2022, an estimated 6.9% of U.S. adults were affected by Long COVID at some point, and an estimated 3.4% of adults are currently affected by Long COVID.[10] This means that roughly out of the estimated 43 million confirmed cases of COVID-19 in 2022, about 3 million of those cases had Long COVID.[9]

Prior research has examined the impact of insurance type on COVID-19 mortality amongst race and ethnicity groups and concluded that when comparing those who relied on Medicare, patients with commercial insurance or out-of-pocket insurance had lower odds of mortality.[11] In 2022, a study examined the healthcare system's role in exacerbating COVID-19 mortality rates in the United States, finding that people with lower health insurance coverage had significantly higher mortality, case counts, and hospitalizations.[12] Recent studies have discovered associated risk factors of COVID-19, like healthcare access, race/ethnicity, socioeconomic status, prior chronic conditions, but much still remains unknown about the determinants of Long COVID.[1,13]

Although research on Long COVID and its association with insurance coverage is limited, this study will look to expand this relatively new and evolving field by looking at this relationship directly and assessing contributing sociodemographic factors that might influence a self-diagnosis of Long COVID. This study is vital because it can potentially help us better understand healthcare access, identify any disparities in the study population, inform policy decisions based on results, and ultimately look to improve patient care in regards to Long COVID.

The overall aims of this study were to (1) identify how certain insurance statuses contributed to a potential increase or decrease in the chance of getting self-diagnosed Long COVID-19 and (2) to determine what attributing sociodemographic factors, such as sex, gender, age, race/ethnicity, income level, education level, etc., were most associated with self-diagnosis Long COVID-19. The general hypothesis of this study was that there would be higher odds of self-diagnosed Long COVID in those with no insurance coverage compared to those with all other insurance types (e.g., Medicare, Medicaid, military, commercial, or private insurance).

Methods

Study Design

This cross-sectional study used data from the 2022 Behavioral Risk Factor Surveillance System (BRFSS) questionnaire. The research question of this study was to determine if insurance status (e.g., Medicare, Medicaid, military, private insurance, and no insurance) can directly predict a self-diagnosis of Long COVID and what sociodemographic factors are significantly associated with a self-diagnosis of Long COVID among those who tested positive for COVID-19.

Data Collection and Sample

The 2022 BRFSS data uses telephone survey responses from both landline and cellphone numbers to collect data on self-reported individual-level data on health-related risk behaviors, chronic health conditions, health-care access, and the use of preventive services from the noninstitutionalized adult population (≥ 18 years) residing in the United States and participating areas.[14]

The BRFSS questionnaire uses a multi-stage stratified random-digit-dialing (RDD) sampling method that targets both landlines using disproportionate stratified sampling and cellular telephone lines using random sampling. Since RDD can be susceptible to specific demographic and non-response factors/bias, BRFSS applied statistical weighing and stratification to combat those factors.

Inclusion criteria were based on the following: (1) Individuals who reported having been told by a doctor, nurse, or health professional that they tested positive for COVID-19. (2) Individuals who tested positive using an at-home testing kit without a health professional. (3) Any individual who reports having symptoms lasting three months or longer that they did not have before COVID-19. (4) Individuals with Medicare, Medicaid, military, private, or no insurance. Individuals with missing information or who didn’t meet all four criteria were excluded, leaving a final analytical sample size of 110,402 participants out of an overall sample size of 445,132 participants. This criterion excludes about 75% of the overall sample size.

Outcome and Exposure Measures

The outcome variable of self-diagnosis Long COVID-19 was measured by answering the following question: “Did you have any symptoms lasting 3 months or longer that you did not have prior to having coronavirus or COVID-19? (Yes or No).”[15] The exposure variable of insurance status was measured by answering the following question: “What is the current primary source of your insurance status?

(‘Private/Commercial,’ ‘Medicare,’ ‘Medicaid,’ ‘Military Healthcare,’ or ‘No Health Insurance’)”.[15]

Covariate Measures

A total of fifteen covariates were selected due to their association with self-diagnosis of Long COVID-19 and COVID-19 diagnosis, which included age group (‘18 to 44,’ ‘45 to 64,’ and ‘65+’), sex (‘Male or Female’), health status (Excellent, Very Good, Good, Fair, or Poor), Body Mass Index (BMI) (‘Underweight’, ‘Normal’, ‘Overweight’, and ‘Obese’), educational level (‘Less than High School,’ ‘Graduated High School,’ ‘Attended College/Technical School,’ and ‘Graduated College/Technical School’), veteran status (‘Yes’ or ‘No’), employment status (‘Yes’ or ‘No’), income level (‘Less than $50,000’, ‘$50,000 to less than $100,000’, ‘$100,000 plus’, and ‘Missing’), smoking status (‘Yes’ or ‘No’), heavy alcohol consumption (‘Yes’ or ‘No’), past immunizations of influenza and pneumonia (‘Yes’ or ‘No’), race/ethnicity group (‘White, Non-Hispanic,’ ‘Black, Non-Hispanic,’ ‘Hispanic,’ and ‘Other Race’), exposure to stress (‘Yes’ or ‘No’), and healthcare unaffordability (‘Yes’ or ‘No’). These sociodemographic and exposure variables have been known to show associations related to COVID-19, so including them in this analysis is important despite the little-to-unknown determinants of Long COVID.[13,16]

A total of nine chronic health conditions (angina/coronary heart disease, stroke, heart attack, asthma, cancer, COPD/chronic bronchitis, depressive order, kidney disease, and diabetes) that have been known to increase the risk of acquiring COVID-19 was recategorized to if an individual had a pre-existing chronic condition (‘Yes’ or ‘No’). The recategorization of participants with pre-existing chronic conditions and participants without pre-existing chronic conditions was supported by recent findings that the abovementioned conditions can increase the risk and severity of COVID-19.[17,18] This recategorization generates a better analysis of how pre-existing chronic conditions can influence COVID-19 and in return self-diagnosis of Long COVID.

Data Analysis

A univariate logistic analysis was conducted on all 17 variables included in this study in the form of frequencies (n) and weighted percentages (%) to provide demographic characteristics of the study's variables. Survey weights were also applied to this analysis to account for the complex survey design utilized by the BRFSS survey to ensure that the results were representative of the population from which the sample was taken.

Next, a bivariate logistic analysis was conducted to determine if there was an association between the outcome of self-diagnosed Long COVID by insurance status and other sociodemographic factors by comparing two variables at a time (e.g., outcome versus covariate). This analysis gave frequencies (n), weighted percentages (%), 95% Confidence Intervals (95% CI), crude prevalence odds ratios (cPOR), and p-values. A p-value that was ≤ 0.05 was considered statistically significant.

Subsequently, an adjusted multivariate logistic regression analysis was conducted to show the association of self-diagnosed Long COVID by insurance status and other sociodemographic factors. This analysis simultaneously compared the independent and dependent variables while controlling for confounders, providing an adjusted prevalence odds ratio (aPOR) and 95% CI.

The unadjusted multivariate logistic regression model included all variables with the addition of an interaction term between ‘Age Group’ and ‘Insurance Status’ to assess possible effect modification. Age has been shown to influence the type of insurance an individual has, preventive care they receive, chronic disease management, healthcare needs, and utilization patterns, so it’s essential to take that into consideration with this study.[19]

A “10% Change Rule” guideline was used when assessing confounding. Initially, the association between the exposure and outcome, without any potential confounding variables, was evaluated to determine a baseline estimate. Next, the potential confounder was introduced, and a re-estimation of the association between the exposure and outcome was noted. Lastly, a comparison between the unadjusted and adjusted estimate was taken, and if the adjusted estimate changed by ≥10% compared to the unadjusted variable, that variable was considered a confounder.

The adjusted multivariate logistic regression model selection process was conducted in a backward selection manner, resulting in three models. The final model adjusted for all possible confounders except for ‘Veteran Status,’ ‘Heavy Alcohol Consumption,’ and the interaction term of ‘Age Group’ and ‘Insurance Status’ since they were considered not statistically significant.

The model fit was assessed by using an R-square. An R-square value of ≥ 0.2 was considered suitable for explaining sufficient variation in the final adjusted model. Model assumptions were checked to ensure all assumptions were met. Reference groups were determined based on epidemiologic and clinical significance of past published studies. All statistical analyses were carried out using SAS OnDemand 9.4.[20]

Potential concerns or limitations of this study concerning the data analysis stage were missing data or other possible variables associated with the exposure and outcome not covered by the BFRSS survey. If a variable had significant missingness (>10%) associated with it and had support from recently published literature, that missingness was accounted for by having its own category.

Ethical Approval

This study used publicly available de-identified public health surveillance data and was therefore not subjected to IRB oversight.

Results

When examining the univariate analysis, 62.6% of individuals had private or commercial insurance, while 21.7% of people diagnosed with COVID-19 reported a self-diagnosis of Long COVID. **(Table 1)** Regarding BMI and heavy alcohol consumption, the majority of the study population reported being “Obese” (36.8%), while 93.0% of the study population reported heavy alcohol consumption. Approximately 60.0% of the study population was ‘White, Non-Hispanic,’ while about 52.3% of the study population were aged 18 to 44 years old. The largest income level group was individuals earning ‘Less than $50,000’ (30.0%), and around 33.5% of the study population had graduated from college or technical school.

When assessing the bivariate analysis, individuals who had Medicaid (cPOR:1.44; 95%CI:[1.30-1.58]) and no health insurance (cPOR:1.37; 95%CI:[1.22-1.54]) were significantly associated with increased odds of self-diagnosed Long COVID compared to individuals with private/commercial insurance. **(Table 2)** Those who reported a ‘Poor’ health status had 1.85 (95% CI: [1.62-2.12]) times the odds of being self-diagnosed with Long COVID compared to those who reported a ‘Good’ health status. It was also found that individuals with an ‘Obese’ BMI had 1.60 times the odds (95% CI: [1.48-1.72]) of self-diagnosed Long COVID compared to those with a ‘Normal Weight’ BMI. Those who had pre-existing chronic conditions had 1.37 times the odds (95% CI: [1.25-1.45]) of self-diagnosed Long COVID than those without pre-existing chronic conditions. Participants who did not have the influenza vaccine had 17% greater odds (cPOR: 1.17; 95% CI: [1.10-1.24]) of self-diagnosed Long COVID compared to those with the influenza vaccine. Individuals who did not have the pneumonia vaccine had 15% lower odds (cPOR: 0.85; 95% CI: [0.80-0.91]) of self-diagnosed Long COVID compared to those with the pneumonia vaccine. ‘Current Smokers’ had 1.57 times the odds (95% CI: [1.38-1.79]) of self-diagnosed Long COVID compared to someone who has never smoked. While examining age group, individuals aged 18 to 44 had a 29% greater odds (cPOR: 1.29; 95% CI: [1.19-1.40]) of self-diagnosed Long COVID compared to ages 65 and over. This bivariate analysis found that females had 69% greater odds (cPOR: 1.69; 95% CI: [1.59-1.80]) of self-diagnosed Long COVID compared to males. The bivariate analysis also showed that those who reported not going to the doctors due to financial cost had 2.17 times the odds (95% CI: [1.99-2.37]) of being self-diagnosed with Long COVID compared to those who did not report any healthcare unaffordability. Lastly, individuals who reported some form of stress in the past month had 85% greater odds of being self-diagnosed with Long COVID compared to those who didn’t report any exposure to stress in the last month (95% CI: [1.69-2.02]).

After controlling for potential confounders, the results from the multivariate analysis showed that compared to private/commercial insurance, Medicare (aPOR:1.07; 95% CI: [0.88-1.30]), Medicaid (aPOR:1.06; 95% CI: [0.87-1.29]), military healthcare (aPOR:1.14; 95% CI: [0.83-1.55]), and no insurance (aPOR:1.10; 95% CI: [0.86-1.40]) was not significantly associated with an increased odds of self-diagnosed Long COVID. **(Table 3)** Previously, only Medicaid (cPOR:1.44; 95%CI:[1.30-1.58]) and no health insurance (cPOR:1.37; 95%CI:[1.22-1.54]) were significantly associated with self-diagnosed Long COVID, but that association was no longer observed. Individuals who claim to have 'Poor' health had 1.64 times the adjusted odds of having self-diagnosed Long COVID compared to those who claim to have 'Good' health (95% CI: [1.26-2.12]). After adjustments were made to the model, individuals with pre-existing chronic conditions (aPOR:0.95; 95% CI: [0.82-1.10]) were now found not to be statistically associated with self-diagnosed Long COVID.

When analyzing BMI, the aPOR for 'Obese' individuals decreased to 1.44 (95% CI: [1.25-1.66]), but still showed significance. Those who didn't have the pneumonia vaccine had 16% lower odds (aPOR: 0.84; 95% CI: [0.74-0.95]) of self-diagnosed Long COVID compared to those with the pneumonia vaccine. Individuals who didn't have the influenza shot had 20% greater odds (aPOR: 1.20; 95% CI: [1.08-1.34]) of self-diagnosed Long COVID compared to those who had the influenza vaccine.

Current smokers had 30% greater odds (aPOR: 1.30; 95% CI: [1.08-1.57]) of self-diagnosing Long COVID compared to those who didn't smoke. Females had a 61% greater odds (aPOR: 1.61; 95% CI: [1.44-1.80]) of self-diagnosed Long COVID compared to males. Age group aPOR remained significant, with now 45 to 64-year-old individuals having higher odds (aPOR: 1.37; 95% CI: [1.15-1.63]) of self-diagnosed Long COVID compared to the 65 and over age group.

Individuals who couldn't see a doctor due to cost had 80% greater odds (aPOR=1.80; 95% CI: [1.52-2.13]) of self-diagnosed Long COVID compared to individuals who could afford to see a doctor. Individuals exposed to stress had 46% higher odds (aPOR: 1.46; 95% CI: [1.29-1.65]) of being self-diagnosed with Long COVID compared to individuals not exposed to stress.

Overall results of the "Goodness of Fit" for the final multivariable analysis showed an R-Square value of only 5.5%, which indicates the variance in the dependent variable (self-diagnosis of Long COVID) is explained by the independent variable (Insurance Status) in the final multivariable analysis model.

Discussion

In this cross-sectional study involving 110,402 participants that used the 2022 BRFSS survey, our initial research question, which proposed that insurance type would be associated with self-diagnosed Long COVID, was not supported by this analysis. When assessing the crude analysis, 'Medicaid' and 'No Health Insurance' were significantly associated with higher odds of self-diagnosed Long COVID. Although these findings were interesting, all insurance types were not statistically significant after adjusting for potential confounders. Possible reasons for seeing this change can be due to the addition of variables in the adjusted analysis that were shown to be more influential than health insurance on the outcome of self-diagnosed Long COVID.

The statistically significant sociodemographic status factors that influenced a self-diagnosis of Long COVID were ‘Healthcare Unaffordability,’ ‘Stress Level,’ ‘Overall Health Status,’ ‘BMI,’ ‘Past Vaccinations,’ ‘Smoking Status,’ ‘Age Group,’ ‘Sex,’ and ‘Income Group.’ It was also determined that ‘Other Chronic Health Conditions,’ ‘Race/Ethnicity Group,’ ‘Employment Status,’ and ‘Education Level’ were not statistically significant when assessing these sociodemographic status factors that could influence a self-diagnosis of Long COVID. These findings were unexpected as recent studies looking at the previously stated sociodemographic factors were all associated in some way with the outcome of a Long COVID or COVID-19 diagnosis.[21,22,23,24] Potential reasons for differences in previous studies compared to this one are differences in study designs and population demographics.

Findings in this study will help to further support how certain sociodemographic factors can influence the outcome of a self-diagnosed Long COVID, such as looking at sex. Females in this study had higher odds of a self-diagnosed Long COVID compared to males, and in recent studies, sex was found to be an essential determinant in Long COVID.[25,26] Individuals who neglected medical attention due to cost in this study showed an increased risk of self-diagnosed COVID, which aligns with existing literature that many people forgo treatment due to healthcare access and affordability.[27] Furthermore, findings associated with BMI and overall health status in this study are further back by numerous studies, underscoring the crucial role these two factors have on increased severity of morbidity and mortality related to Long COVID and COVID-19.[28,29]

Overall, health insurance type had no statistical significance in this study, and a past study has shown similar results that insurance status alone can't predict an individual's outcome of self-diagnosed Long COVID or COVID-19 because certain sociodemographics, access to services, geographical region, and day-to-day exposures can also influence the outcome of acquiring the disease.[30] These findings suggest that the outcome of being self-diagnosed with Long COVID doesn't depend solely on the type of insurance an individual has but should be assessed alongside other sociodemographic factors.

There are several strengths to this study. First, the cross-sectional manner of this study allows for a timely and inexpensive way to assess the relationship between Long COVID and insurance status. While this study's data doesn't cover the entirety of the US population, it does offer a considerable representation of the population, enabling a wide-ranging analysis of how insurance type and sociodemographic factors influence the likelihood of self-diagnosed Long COVID. Since much remains to be learned about Long COVID, this study can contribute to this growing field in the hopes of better understanding it. This study also had a reasonably large sample size, making it more generalizable, reliable, and precise from which to draw conclusions from in the hopes of diminishing present gaps in the literature.

There were also limitations in this study. One of the most important is that this is a cross-sectional study; therefore, temporal changes, changes over time, and causality can't be accurately determined. Additionally, it is also possible that the BRFSS questionnaire doesn't cover all the associated risk factors for Long COVID since it is an emergent public health concern, so not all possible covariates can be accounted for to explain the association between the exposure and outcome in this study (e.g., early testing and treatment of COVID-19). Lastly, all BRFSS data is self-reported, which can lead to issues with accuracy, validity, and reliability in a participant's responses to questions. Biases regarding recall and sampling bias can also be present within the study.

In conclusion, the findings in this secondary BRFSS analysis showed that insurance status wasn't predictive of the outcome of self-diagnosed Long COVID, and only certain sociodemographic factors were associated with a Long COVID diagnosis. This is a relatively new and complex field of study, and more longitudinal studies must be conducted in the future to understand better what factors drive Long COVID diagnoses. This study is important because it provides a stepping stone to better understanding the complexities related to Long COVID.

In the meantime, this study can give public health officials an insight or snapshot at what constitutes a high-risk population and where proactive support should be provided to prevent and combat the effects of Long COVID. Support can be in the form of developing education and awareness campaigns to advocate for policies to protect susceptible populations. Also, public health officials can ensure guidelines and protocols for Long COVID management are established within healthcare systems to support susceptible populations and individuals with Long COVID.

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Appendix

Table 1. Distribution of the insurance status variable, Long COVID related variables, and sociodemographic variables on individuals who tested positive for COVID-19 using the Behavioral Risk Factor Surveillance System (BRFSS) data from 2022. (Univariate Analysis) (N= 110,402) *

	Frequency (n) ‡	Weighted Percent (%) §
Insurance Status		
Private/Commercial Insurance	64,812	62.6
Medicare	27,235	16.8
Medicaid	8,569	9.6
Military Healthcare†	4,085	3.7
No Health Insurance	5,701	7.4
Long COVID		
Yes	24,115	21.7
No	86,287	78.3
Health Status		
Excellent	17,537	16.9
Very Good	38,501	34.2
Good	35,726	32.2
Fair	14,199	13.0
Poor	4,251	3.7
Pre-existing Chronic Conditions		
Yes	18,370	14.5
No	92,025	85.5
BMI		
Underweight	1,338	1.6
Normal Weight	27,563	27.6
Overweight	36,164	34.0
Obese	38,833	36.8
Immunization History		
Influenza Vaccination	53,529	42.7
Pneumonia Vaccination	36,665	29.5
Heavy Alcohol Consumption		
Yes	100,994	93.0
No	7,633	7.0
Smoking Status		
Current Smoker	3,890	4.3
Former Smoker	3,605	3.7
Never Smoker	69,188	92.0
Race/Ethnicity Group		
White, Non-Hispanic	82,370	60.0
Black, Non-Hispanic	7,963	10.6
Hispanic	12,403	19.2
Other Race	7,666	10.2
Age Group (years)		
18 to 44	42,138	52.3
45 to 64	39,225	31.5
65+	29,039	16.1
Sex		
Male	50,746	46.7
Female	59,656	53.3
Income Level		
Less than $50,000	32,261	30.0
$50,000 to less than $100,000	30,759	26.1
$100,000+	31,468	28.6
Missing	15,914	15.3
Healthcare Unaffordability		
Yes	10,222	11.8
No	99,942	88.2
Employment Status		
Yes	69,301	67.2
No	40,392	32.8
Education Level		
Less than High School	4,913	8.5
Graduated High School	24,619	25.7
Attended College/Technical School	31,084	32.3
Graduated from College/Technical School	49,497	33.5
Exposure to Stress		
Yes	46,165	68.0
No	23,415	32.0
Veteran Status		
Yes	12,109	9.3
No	98,142	90.7

*N= Total Population Size
† This insurance includes: TRICARE (CHAMPUS) / VA Healthcare / CHAMP-VA
‡ n= Total Sample Size
§ Percentages are weighted to account for complex survey data
|| N/A= not applicable

Table 2. Bivariate analysis of the association of self-reported Long COVID by insurance status and other sociodemographic factors on individuals who tested positive for COVID-19 using the Behavioral Risk Factor Surveillance System (BRFSS) data from 2022. (Bivariate Analysis) (Outcome) (N=110,402) *

	Reported Long COVID N † (Weighted %) ‡	Did Not Report Long COVID n (Weighted %)	Crude Prevalence Odds Ratio (95% CI) §	P-Value
Insurance Status				
Private/Commercial Insurance	13,517 (59.3)	51,295 (63.5)	REFERENCE	<. 0001
Medicare	5,693 (16.5)	21,542 (16.9)	1.05 (0.97-1.13)	
Medicaid	2,450 (11.9)	6,119 (8.9)	1.44 (1.30-1.58)	
Military Healthcare ‖	881 (3.4)	3,204 (3.8)	0.98 (0.84-1.15)	
No Health Insurance	1,574 (8.9)	4,127 (6.9)	1.37 (1.22-1.54)	
Health Status				
Excellent	2,474 (11.0)	15,063 (18.6)	0.53 (0.48-0.58)	<.0001
Very Good	6,938 (29.0)	31,563 (35.7)	0.72 (0.67-0.77)	
Good	8,516 (35.3)	27,210 (31.3)	REFERENCE	
Fair	4,527 (18.5)	9,672 (11.5)	1.43 (1.31-1.56)	
Poor	1,612 (6.2)	2,639 (3.0)	1.85 (1.62-2.12)	
Pre-existing Chronic Conditions				
Yes	4,888 (17.5)	13,482 (13.6)	1.35 (1.25-1.45)	<.0001
No	19,226 (82.5)	72,799 (86.4)	REFERENCE	
BMI				
Underweight	286 (1.5)	1,052 (1.6)	1.19 (0.88-1.60)	<.0001
Normal Weight	5,047 (23.1)	22,516 (28.9)	REFERENCE	
Overweight	7,161 (31.0)	29,003 (34.8)	1.12 (1.03-1.21)	
Obese	10,089 (44.4)	28,744 (34.7)	1.60 (1.48-1.72)	
Immunization History				
Influenza Vaccination				
Yes	10,938 (39.7)	42,591 (43.6)	REFERENCE	<.0001
No	13,059 (60.3)	43,175 (56.4)	1.17 (1.10-1.24)	
Pneumonia Vaccination				
Yes	8,510 (32.2)	28,155 (28.8)	REFERENCE	<.0001
No	13,758 (67.8)	50,618 (71.2)	0.85 (0.80-0.91)	
Heavy Alcohol Consumption				
Yes	22,142 (92.8)	78,852 (93.1)	0.96 (0.87-1.07)	0.4813
No	1,611 (7.2)	6,022 (6.9)	REFERENCE	
Smoking Status				
Current Smoker	1,124 (5.9)	2,766 (3.9)	1.57 (1.38-1.79)	<.0001
Former Smoker	986 (4.8)	2,619 (3.5)	1.43 (1.23-1.65)	
Never Smoker	13,928 (89.4)	55,260 (92.7)	REFERENCE	
Race/Ethnicity Group				
White, Non-Hispanic	18,070 (61.3)	64,300 (59.8)	REFERENCE	0.0025
Black, Non-Hispanic	1,586 (9.9)	6,377 (10.7)	0.90 (0.81-0.99)	
Hispanic	2,842 (19.8)	9,561 (19.0)	1.02 (1.93-1.11)	
Other Race	1,617 (8.9)	6,049 (10.6)	0.82 (0.72-0.93)	
Age Group (years)				
18 to 44	9,069 (51.9)	33,069 (52.4)	1.29 (1.19-1.40)	<.0001
45 to 64	9,431 (33.9)	29,794 (30.9)	1.16 (1.07-1.26)	
65+	5,615 (14.2)	23,424 (16.7)	REFERENCE	
Sex				
Male	8,694 (36.7)	42,052 (49.5)	REFERENCE	<.0001
Female	15,421 (63.3)	44,235 (50.5)	1.69 (1.59-1.80)	
Income Level				
Less than $50,000	8,450 (35.1)	23,811 (28.5)	REFERENCE	<.0001
$50,000 to less than $100,000	6,824 (27.7)	23,935 (25.6)	0.88 (0.82-0.95)	
$100,000+	5,645 (23.6)	25,823 (30.0)	0.67 (0.59-0.69)	
Missing	3,196 (13.7)	12,718 (15.8)	0.70 (0.64-0.77)	
Healthcare Unaffordability				
Yes	3,734 (19.1)	6,488 (9.8)	2.17 (1.99-2.37)	<.0001
No	20,326 (80.9)	79,616 (90.2)	REFERENCE	
Employment Status				
Yes	14,751 (65.3)	54,550 (67.8)	REFERENCE	0.0004
No	9,214 (34.7)	31,178 (32.2)	1.12 (1.05-1.19)	
Education Level				
Less than High School	1,180 (9.6)	3,733 (8.1)	1.19 (1.03-1.38)	<.0001
Graduated High School	5,659 (25.5)	18,960 (25.7)	REFERENCE	
Attended College/Technical School	7,953 (36.7)	23,131 (31.1)	1.19 (1.10-1.28)	
Graduated from College/Technical School	9,258 (28.2)	40,239 (35.0)	0.81 (0.76-0.87)	
Exposure to Stress				
Yes	11,569 (77.6)	34,596 (65.3)	1.85 (1.69-2.02)	<.0001
No	3,700 (22.4)	19,715 (34.7)	REFERENCE	
Veteran Status				
Yes	2,313 (8.4)	9,796 (9.5)	REFERENCE	0.0047
No	21,762 (91.6)	76,380 (90.5)	1.15 (1.04-1.26)	

*N= Total Population Size
† This insurance includes: TRICARE (CHAMPUS) / VA Healthcare / CHAMP-VA
‡ n= Total Sample Size
§ Percentages are weighted to account for complex survey data
‖ N/A= not applicable

Table 3. Multivariate analysis of the association of self-reported Long COVID by insurance type and other sociodemographic factors on individuals who tested positive for COVID-19 using the Behavioral Risk Factor Surveillance System (BRFSS) data from 2022. (N=110,402) *		
	Crude Prevalence Odds Ratio (95% CI) †	Adjusted Prevalence Odds Ratio (95% CI)
Insurance Status		
Private/Commercial Insurance	REFERENCE	REFERENCE
Medicare	1.05 (0.97-1.13)	1.07 (0.88-1.30)
Medicaid	1.44 (1.30-1.58)	1.06 (0.87-1.29)
Military Healthcare ‡	0.98 (0.84-1.15)	1.14 (0.83-1.55)
No Health Insurance	1.37 (1.22-1.54)	1.10 (0.86-1.40)
Health Status		
Excellent	0.53 (0.48-0.58)	0.64 (0.54-0.77)
Very Good	0.72 (0.67-0.77)	0.76 (0.67-0.87)
Good	REFERENCE	REFERENCE
Fair	1.43 (1.31-1.56)	1.28 (1.09-1.51)
Poor	1.85 (1.62-2.12)	1.64 (1.26-2.12)
Pre-existing Chronic Conditions		
Yes	1.35 (1.25-1.45)	0.95 (0.82-1.10)
No	REFERENCE	REFERENCE
BMI		
Underweight	1.19 (0.88-1.60)	0.97 (0.53-1.78)
Normal Weight	REFERENCE	REFERENCE
Overweight	1.12 (1.03-1.21)	1.24 (1.08-1.43)
Obese	1.60 (1.48-1.72)	1.44 (1.25-1.66)
Immunization History		
Influenza Vaccination		
Yes	REFERENCE	REFERENCE
No	1.17 (1.10-1.24)	1.20 (1.08-1.34)
Pneumonia Vaccination		
Yes	REFERENCE	REFERENCE
No	0.85 (0.80-0.91)	0.84 (0.74-0.95)
Smoking Status		
Current Smoker	1.57 (1.38-1.79)	1.30 (1.08-1.57)
Former Smoker	1.43 (1.23-1.65)	1.24 (0.99-1.54)
Never Smoker	REFERENCE	REFERENCE
Race/Ethnicity Group		
White, Non-Hispanic	REFERENCE	REFERENCE
Black, Non-Hispanic	0.90 (0.81-0.99)	0.85 (0.71-1.01)
Hispanic	1.02 (1.93-1.11)	1.02 (0.88-1.20)
Other Race	0.82 (0.72-0.93)	0.81 (0.64-1.01)
Sex		
Male	REFERENCE	REFERENCE
Female	1.69 (1.59-1.80)	1.61 (1.44-1.80)
Age Group (years)		
18 to 44	1.16 (1.07-1.26)	1.29 (1.07-1.55)
45 to 64	1.29 (1.19-1.40)	1.37 (1.15-1.63)
65+	REFERENCE	REFERENCE
Income Level		
Less than $50,000	REFERENCE	REFERENCE
$50,000 to less than $100,000	0.88 (0.82-0.95)	1.16 (1.01-1.34)
$100,000+	0.67 (0.59-0.69)	1.07 (0.90-1.27)
Missing	0.70 (0.64-0.77)	0.80 (0.68-0.96)
Healthcare Unaffordability		
Yes	2.17 (1.99-2.37)	1.80 (1.52-2.13)
No	REFERENCE	REFERENCE
Employment Status		
Yes	REFERENCE	REFERENCE
No	1.12 (1.05-1.19)	1.02 (0.89-1.18)
Education Level		
Less than High School	1.19 (1.03-1.38)	1.11 (0.85-1.44)
Graduated High School	REFERENCE	REFERENCE
Attended College/Technical School	1.19 (1.10-1.28)	1.19 (1.04-1.37)
Graduated from College/Technical School	0.81 (0.76-0.87)	1.04 (0.90-1.21)
Exposure to Stress		
Yes	1.85 (1.69-2.02)	1.46 (1.29-1.65)
No	REFERENCE	REFERENCE

** N = total population size*
† 95% CI = 95% Confidence Interval
‡ This insurance includes: TRICARE(CAMPUS)/VA healthcare/CHAMP-VA
§ = The R-Square "Goodness of Fit" = 0.0548

Biography

Hi everyone!

My name is Elizabeth Osbourn, and I am currently living in Wayne, Nebraska, and I'm originally from California. I came to Nebraska on a basketball scholarship and have since stayed here. It really is the "Good Life" here!

My journey to getting my MPH has really been a roundabout way. I recently worked for the USDA-FSIS as a food inspector of swine. Before that, I was a lab technician for a chemistry, process, and microbiology lab testing mainly egg products. Let's say I no longer crave boiled eggs or bacon/pork chops like I used to since I had to work with them on the daily.

When I worked for the USDA, my coworkers actually talked me into going back to school to get my master’s and figured why not. I actually wasn't sure what I should get my masters in since I'm honestly interested in about everything, so I ended up "Googling" master programs online, and UNMC COPH was the first one to pop up and I thought to myself, "Hey, this sounds cool!"

So, in a little over a year and a half, I hope to obtain the MPH with a concentration in epidemiology pretty soon. My future plans are to either return to the USDA-FSIS or jump on board a local public health department. My interests have definitely expanded since my academic career here at UNMC, so if I can get a career path related to outbreak investigations or implementation, I'll be happier than a peach!

Resume

ELIZABETH OSBOURN

Address: 422 Lincoln Street Apt. E • Wayne, NE 68787 • Phone: (530) 370-6068

• Email: osbourn_elizabeth@yahoo.com

OBJECTIVE

To learn and gain hands on experience in the hopes of broadening my horizons and gaining more knowledge in a variety of biological fields and public health/food sciences.

EDUCATION

AS in Science
Concentration: Biological Science
Degree Received: May 2017
Yuba College-Marysville, California

BS in Biology
Concentration: Life Sciences/Biology
Degree Received: May 2020
Wayne State College-Wayne, NE
Cumulative GPA: 3.473

Pursuing Master's in Public Health (cMPH)
Concentration: Epidemiology
Degree Received: May 2024
University of Nebraska Medical College (UNMC-COPH)-Omaha, NE
Cumulative GPA: 3.879

QUALIFICATIONS

- Worked for a Reclamation District which helped me gain knowledge in invasive weed species management and troubleshooting any other possible problems that may arise.
- Took extensive courses that were available at university level pertaining to Ecology, Plant Science, Flora, and other classes as well.
- Adult CPR/AED, Child CPR, and First Aid Certified
- Dedicated to fine details, hard work, and not being afraid of getting dirt underneath my nails.
- Some experience working with special-needs wildlife and exotic animals. (Internship at Barry R. Kirshner Wildlife Foundation and Educational Center)

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EMPLOYMENT

Sales Associate May 2017 – August 2017, May 2018-August 2018

Fallas, Gridley, California

- Served as on-floor associate in charge of organization, interacting with customers on a positive basis, and was in charge of dressing room duties.
- Promoted to work as the cashier after showing hard work and dedication as an on-floor associate.
- Effectively kept records of transactions, returns or exchanges, and was also put in charge of phone directory if a customer were to call and have questions.
- Delegated in association with on-floor associate duties was also shoplifter prevention and doing security scans of store.
- Strived to accomplish company and branch goals of completing task in a timely fashion and personally tried to go above and beyond what was required of task(s) Incorporated onto the truck delivery and processing team, where packages were offloaded and processed to be on floor products.

Laborer May 2018-August 2018, May 2019-July 2019

City of Gridley Reclamation District, Gridley, California

- Implemented weed control on a variety of different drainage canals and/or ditches.
- Interacted with local farmers and effectively communicated our objectives of providing proper drainage.
- Formalized complex problem-solving solutions when issues arise and could potentially institute a large problem if not fixed properly and in a timely fashion.
- Incorporated detailed records of how much solution was used, location of where it was sprayed, and date of being sprayed.
- Operated with potentially hazardous chemicals successfully by following all safety protocols associated with every substance.
- Achieved in a successful spraying season and the successful repair of a bridge that got blown out during a flood.
- Furthered gain skills and knowledge in operating large equipment and maintenance of equipment.
- Improved on verbal directions of where to spray and maintain issues when they arose. Also had to utilized maps and pay close attention to wind direction.

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Crew Supervisor July 2019-August 2019
J's Detasseling

- Duties consisted of supervising between 8-12 detasselers (most were underaged adults) at a time to make sure tassels weren't missed.

- Give demonstrations of proper tassel removal of the female corn and to make sure the detasselers stayed on the correct rows.
- Safety and close supervision of each individual detasselers was a must.
- Another must was, to make sure breaks were implemented, but during these breaks I would really try to make sure moral was always boosted because detasseling can be a very emotionally and physically draining job.

QA-Lab Technician May 2020-April 2021
Michael's Food

- Duties of this job consisted of working in two overall QA Lab areas in the plant: Process Lab, Chemistry Lab, and Microbiology Lab.
- In the Process Lab and Chemistry Lab duties consisted of running tests to determine pH, solids, fats, moisture, and salt.
  - Specialty tests include:
    - Fat determination through Free Fatty Acid (FFA), Acid Hydrolysis, Gravimetric Fats
    - Whips, weeps, and density of dried whites
    - Viscosity and heat stability testing
    - Data Entry
- In the Microbiology Lab duties consisted based of which room you were placed in.
  - Setting Room:
    - Finished Food products are set up for pathogen and bacteria testing.
    - Bacteria testing consisted of handling finished and raw products, so they could be plated according to test requested and/or required.
  - Media Prep:
    - Make media used throughout the day and/or week
    - Remove and dispose of autoclave waste
    - Receive incoming supplies and put them away in designated area(s)
  - Pathogen Room:
    - Read out plate results and test Finished Product for Salmonella and Listeria

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- Report out any out of spec results and notify management accordingly
- Also run out swabs for Salmonella and Listeria

USDA FSIS Food Inspector-Intermittent May 2021-August 2022
Smithfield-Crete, NE

- Duties of this job consist of working as an on-line food inspector at a swine slaughtering process plant.
  - There are three areas of rotation: Heads, Viscera Table, and Final Rail.
    - The head station is in charge of dissecting the mandibular lymph nodes, examining the back of carcass, and the general head/neck region.
    - The viscera table is in charge of palpating the mesentery lymph nodes, intestines, heart, lungs, esophagus, liver, spleen, and tail.
      - Also, examining the internal carcass as well.
    - The final rail is in charge of re-examining the carcass too, before giving the all clear for processing. Kidneys are palpated and a visual inspection of the carcass front, back, and head are carried out.
- The main duties of the food inspector are to analyze each carcass for possible pathology and/or contamination. If this is found it then becomes the duty of the inspector to tag the carcass for the veterinarian to later inspect it.
- Another duty is that if an NR (Noncompliance Record) is found, it then becomes the duty of the online inspector to call down the off-line inspectors or their supervisors.
  - So, this ranges from finding direct contact contamination (via insects or chemicals) or other possible contamination scenarios.

Janitorial Custodian September 2022-Present
Wayne Community School (Elementary)

- Responsibilities include maintain cleanliness of the building and the surrounding grounds.
- Duties include:
  - Vacuuming floors, restocking, dusting, sweeping, disposal collection of trash and/or recycling, and the occasional minor repairs to equipment or to the facility.

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HONORS & ACTIVITIES

Holy Names University Women's Basketball Aug. 2015- May 2016
Yuba College Women's Basketball Aug. 2016- May 2017
Yuba College Women's Track & Field Feb. 2017
Wayne State College Women's Basketball Aug. 2017- May 2019
Dean's List Aug. 2015- December 2019
WSC Science Fair Volunteer Mar. 2019
Head Start Volunteer Aug. 2018- Dec. 2018
Barry R. Kirshner Wildlife Foundation Internship May 2019-July 2019
WSC Science Bowl Volunteer Feb. 2020
Introduction to Quality Improvement in Public Health (1059243) (TRAIN) April 2023
Winnebago Public Health Department APEX Internship Summer 2023
Graduation with Honors from College of Public Health-University of Nebraska Medical College May 2024

I did omit references for privacy reasons.