Evidence from Empirical Studies: Which Groups of Individuals Experience More Severe Income Hardship Due to COVID-19 Infection?

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Abstract: There is a lack of evidence on whether a pandemic exacerbates economic inequalities among disadvantaged groups. This study examined whether the income of single households was affected by sample adults who were infected with COVID-19. I used NHIS data, compared the average income between infected sample adults and uninfected for each of the sub-groups, and constructed the difference in the difference graph based on the mean value. Also, using a difference-in-difference model to confirm statistically significant differences in mean income between the different groups. The results show that full-time sample adults infected with COVID-19 have significantly lower incomes than those uninfected; the sample adults with hypertension, low education, or non-metropolitan residents' groups, who were not infected with COVID-19 were the most disadvantaged financially. The main reason for these unexpected results may be that the unemployment of infected persons instead qualifies them for high benefits.

Keywords: COVID-19 infection, Unemployment, Income loss, Disadvantage groups

1. Introduction

ILO (International Labour Organization) monitoring shows that COVID-19 has seriously impacted the world labor market by reducing working hours [1]. In April 2020, the U.S. unemployment rate hit a record high of 14.7 percentage points due to the loss of approximately 20.5 million jobs [2]. The unemployment insurance claims report for the week ending March 21, 2020, shows that more than 3.3 million workers filed for unemployment insurance, an unprecedented number even during the deep recession [3]. The occupational risk of COVID-19 exposure also appears to be greater in more precarious categories of workers, including insecure employment, inadequate income, and a lack of rights and protection [4]. Women, younger workers, migrants, Hispanics, lower-skilled workers, and lower-educated workers are at disproportionate risk of working under precarious conditions and suffering poor health outcomes as a result [5-14]. Crucially, precarious work often intersects with other factors of vulnerability. However, there is a lack of evidence on whether a pandemic exacerbates economic inequalities among precarious workers in the face of the dual burden of post-infection negative health outcomes and already vulnerable financial hardship.

This study examined whether the income of single households was affected by the infected with COVID-19. Based on previous studies, we focused our main study target on the part of precarious

workers (part-time workers, young adults, Hispanics, women, urban dwellers, and low-education groups). In addition, it was considered that groups with one or more underlying diseases are also economically vulnerable during the pandemic. This is because they are at higher risk of developing serious diseases because of COVID-19 infection, which implies more time to recover and more medical expenses. Therefore, our target also includes groups with underlying diseases (hypertension, obesity, diabetes, cardiovascular disease, asthma, chronic lung disease). We used a difference-in-difference model to compare the average income gap between individuals infected covid-19 and those uninfected covid-19 within different groups. To demonstrate that individuals in a particular group suffer more severe economic hardship due to infected COVID-19.

I used data from NHIS 2021, which describes how the early stage of the pandemic has increased income inequality between different groups. The results show that full-time sample adults infected with COVID-19 have significantly lower incomes than those uninfected. This is consistent with our assumption 1 that the infected group is relatively disadvantaged in terms of income compared with the uninfected group. This proves that infection with COVID-19 incurs a time cost that is associated with reduced income. In contrast, I did not find an obvious gap in income between infected and uninfected sample adults within the part-time group. This may be due to the average income of part-time workers being much lower than that of full-time workers, and thus their time costs due to COVID-19 infection are also smaller. In several financially vulnerable groups (low-educated, nonmetropolitan dwellers, with hypertension), unexpectedly found that infected individuals had higher incomes than uninfected individuals. In other words, the sample adults with hypertension, low education, or non-metropolitan residents who were not infected with COVID-19 were the most disadvantaged financially. Finally, based on the available evidence, I suggested that the sample adults in the low-education, non-metropolitan, and hypertensive groups became unemployed due to COVID-19 infection. This led to eligibility for unemployment benefits under the CARES Act during the pandemic, which enabled them to overcome the economic shock. This also coincides with a sharp rise in the number of people receiving unemployment benefits.

2. Literature Review

The occupational risk of COVID-19 exposure also appears to be greater in more precarious categories of workers, including younger workers and those in low-income and low-skilled occupations [4]. Crucially, precarious work often intersects with other axes of vulnerability. Women, younger workers, migrants, lower-skilled workers, and lower-educated workers are at disproportionate risk of working under precarious conditions and suffering poor health outcomes [5-14]. Because they have low incomes and limited access to cash and credit, the reduction and loss of income during a pandemic make it difficult to sustain their livelihoods. The health damage caused by the infection also undoubtedly exacerbates this economic hardship. In addition to individuals of lower socioeconomic status like Hispanics, those with less than a bachelor's degree, and those with one or more underlying diseases are disproportionately bearing the negative economic impact of the covid-19 pandemic.

Although, there is ample evidence that the pandemic disproportionately affects the finances of different groups. However, many of the studies are descriptive rather than causal and also use early pandemic data. Therefore, these results should be interpreted with greater caution. However, these studies are useful in helping us to identify which subgroups are experiencing the most severe difficulties. Many studies addressing the risk of COVID-19 transmission in the workplace can lead to an increased risk of poor health status. Precarious workers' pre-existing economic vulnerability, as well as high exposure risk in unstable occupations, both exacerbate negative health effects. However, there is a lack of evidence that facing an adverse health condition such as infected status increases the burden of already fragile economies. Despite the prior studies showing that COVID-19 infection leads to unemployment, they did not involve the loss of income [14]. This leads us to ignore those

special groups who are not unemployed and those who are re-employed come out of economic hardship. Whether income inequality has increased a year after the pandemic remains unclear. Several studies have examined the loss of employment income due to differences in covered insurance, health status, and income level, but have not explicitly analyzed the loss of employment income due to COVID-19 infection as a cause [13]. Individuals' self-reported health status was used as an independent variable to explain changes in income. This may lead to an underestimation of the impact of post-infection ill health on the labor market. Infected persons, even after recovery, may face economic hardship due to unemployment. There is also evidence that there is no statistically significant difference in lost jobs between men and women due to the COVID-19 pandemic in Japan and Korea [15]. However, this was limited to studies between genders and used infection rates as explanatory variables, which were much higher in the United States than in Japan and Korea.

3. Research Methodology

3.1. Study design

This study examined whether the income of single-adult households was affected by sample adults who were infected with COVID-19. Based on previous studies, the primary focus is on whether economically vulnerable groups suffer more severe financial hardship due to infection. Hence, I define all primary objectives of the study as fragile groups (part-time workers, young adults, Hispanics, women, metropolitan dwellers, low education, hypertension, obesity, diabetes, cardiovascular disease, asthma, and chronic lung disease groups). The key fragile - not fragile comparison is captured in the following models, with analyses focused on outcomes reflecting the impact of the pandemic on the income of a single-adult household.

$$INC_i = \alpha + \beta_1 COVID_i * X_i + \beta_2 COVID_i + \beta_3 X_i + \varepsilon_i$$

INC_i is the value of a single family's income; ε_i is an error term, with zero expectation and orthogonal to predictors; $COVID_i$ is a dummy variable for infected status if the sample adults have infected COVID-19 then covid=1, otherwise covid=0. β_2 represents the difference in income between the ever-infected and never-infected groups in not-fragile groups. X_i is a dummy variable. Suppose the sample adults belong to the fragile groups, then $X_i=1$; otherwise, $X_i=0$. β_3 represents the difference in income between the fragile groups and not fragile groups when uninfected by COVID-19. β_1 is the difference-in-differences estimator. The difference in outcome due to group and infection status is captured by a dummy variable cross-term $COVID_i * X_i$, whose parameter estimates the average treatment effect ATE.

$$\beta_1 = E[INC_i \mid COVID_i = 1, X_i=1] - E[INC_i \mid COVID_i= 0, X_i=1] -$$

$$E[INC_i \mid COVID_i= 1, X_i=0] - E[INC_i \mid COVID_i= 0, X_i=0]$$

We propose 2 hypotheses.

1 The infected covid-19 group is relatively disadvantaged in terms of income compared with the uninfected covid-19 group.

2 Part of the precarious workers, including those with underlying disease, who are infected with COVID-19, will lead to a greater reduction in income for their single-adult families than for uninfected single-adult families.

If β_1 is negative and statistically significant, hypotheses 1 and 2 both hold. Compared to the uninfected sample adults, the infected sample adults were economically disadvantaged, and the fragile group experienced a more severe income shock. If positive and statistically significant, it means that hypothesis 1 holds, but hypothesis 2 does not, that the sample adults in the not fragile

group, experienced more severe economic hardship due to covid-19 infection. While if β1 is statistically insignificant, income changes experienced within the fragile group due to infected COVID-19 were the same as in the not fragile group.

3.2. Data Collection

The National Health Interview Survey (NHIS) is a household interview survey data cross-section. The target population is civilian non-institutionalized persons residing in the 50 U.S. states and the District of Columbia at the time of the interview. Using a geographic subgroup sampling technique to select a sample of NHIS dwelling units to make each month's sample nationally representative.

3.3. Data Analysis

A total of 29,482 adults (18 years and older) in the NHIS sample households were interviewed by telephone or at home. Table 2 shows that after constraining the data to single-adult families, 10366 sample data were obtained. This allowed us to assume that the sample follows a normal distribution and satisfies the consistency estimator. Table 1 provides the distribution of single-adult families in terms of demographic characteristics, health factors, and factors of work and income.

The appendix shows the poverty thresholds include a set of money income thresholds that vary by family size and composition but do not vary geographically [17]. The household income of the sample adults is calculated by multiplying the household poverty rate by the threshold.

Table 1: Description of the individual characteristics of single-family

Variable	Description	Code	Number of observations	Percentage
Novaccine	Sample adults (SA) were not vaccinated	nvac=1	4520	44.39%
	Sample adults (SA) were vaccinated	nvac=0	5662	55.61%
Gender	Female	sex=1	4285	41.34%
	Male	sex=0	6080	58.66%
Insurance	Not covered by insurance	insur=1	788	7.60%
	Covered by insurance	insur=0	9578	92.40%
Hispanic	Sample adult (SA) is hispanic	hisp=1	1084	10.46%
	Sample adult (SA) is Nonhispanic	hisp=0	9282	89.54%
Age	<65 years old	age=1	6210	59.91%
	>=65 years old	age=0	4156	40.09%
Education	Non bachelor's degree	edu=1	6616	63.82%
	At least one bachelor's degree	edu=0	3750	36.18%

Table 1: (continued)

Metropolian	Metropolian (metropolitan statistical area population over 50,000)	urb=1	8778	84.68%
	Non metropolian (urban cluster population 49999 to 10,000).	urb=o	1588	15.32%
Prat-time	Single-adult family' SA are working part-time	par=1	6153	59.36
	Single-adult family' SA are working full-time	par=0	4213	40.64%
Hypertension	Had hypertension or hyperlipidemia in the past 12 months	hyp=1	3157	30.58%
	Hadn't hypertension or hyperlipidemia in the past 12 months	hyp=0	7166	69.42%
Asthma	Still have asthma	asthstill=1	1004	9.71%
	not still have asthma & never had asthma	asthstill=0	9340	90.29%
Cancer	Still under treatment for cancer	cancer=1	152	1.47%
	Not under treatment or never had cancer	cancer=0	10191	98.53%
Diabetes	Ever had diabetes	diabe=1	1260	12.17%
	Never had diabetes	diabe=0	9090	87.83%
BMI	Obese, BMI>=30	bmi=1	3305	32.82%
	Not obese, BMI<30	bmi=0	6766	67.18%
COPD,	Ever had been COPD, emphysema, chronic bronchitis	copd=1	814	7.87%
	Neve had been COPD, emphysema, chronic bronchitis	copd=0	9533	92.13%
CardiovascularConditions	Ever had been coronary heart disease, angina pectoris, heart attack, stroke	cvc=1	1366	13.22%
	Never had been coronary heart disease, angina pectoris, heart attack, stroke	cvc=0	8967	86.78%
Covid-19	Infected covid-19	covid=1	1061	10.32%
	Not infected	covid=0	9224	89.68%

Table 2: Describe relate variables of the single-family income

Variable	Description	Code	Number of observations	Mean	Standard deviation	Median
Income	One adult Family Income	Income	10366	49903.89	39013.58	38661.39
Poverty rate	One adult Family poverty rate	Poverty	10366	3.507276	2.735684	2.74

4. Results

For each of the sub-groups, I first compared the average income between the infected sample adults and the uninfected (Table 3). Additionally, based on the mean value, the difference in the difference graph was generated (Figure 1). To ascertain that the fragile and non-fragile groups have different sizes of mean income gaps, we merged the graphs of differences in differences and the average income gap between the infected and uninfected in each subgroup. Filter out independent variables with comparable income gaps between infected and uninfected individuals within the fragile and non-fragile groups. To demonstrate statistically significant variations in the mean income gap between the fragile and non-fragile groups, the remaining subgroups ran linear regressions.

In Figure 3 and Figures 1.1, 1.2, 1.3, and 1.7, we observed that the mean income of the sample adults infected with COVID-19 in both fragile and non-fragile groups was higher than the mean income of the sample adults uninfected with COVID-19. The mean income of sample adults infected with COVID-19 in the unvaccinated group was $1,575 higher than the mean income of sample adults not infected, a smaller gap than in the vaccinated group. The gap in mean income between infected and uninfected sample adults in the females or metropolitan residents' groups is small. However, the gap between the mean income of infected and uninfected sample adults within the male and nonmetropolitan resident groups was large. Also, the income gap between infected and uninfected sample adults was similar in the insurance coverage and non-insurance coverage groups. Of special interest is that in Table 3 and Figures 1.4, 1.5, 1.6, and 1.8, we find that the mean income of infected COVID-19 sample adults in the Hispanic group is lower than that of uninfected ones, whereas the situation is exactly the opposite in the non-Hispanic group. In addition, the average income of infected sample adults in the low-education (no bachelor's degree) group was $4,727 higher than that of the uninfected, while the average income of infected sample adults in the high-education (at least one bachelor's degree) group was $1,132 lower than that of the uninfected. Although we observed that the average income of infected individuals in the low-education group was higher than uninfected individuals, it was still far lower than the average income of the high-education group. No obvious gap in mean income was observed between infected and non-infected sample adults in the part-time group. In contrast, the mean income of infected sample adults in the full-time group was $4,264 lower than that of uninfected sample adults. Importantly, the decline in mean income was greatest among those with the disease who worked full-time. Additionally, we found that the mean income gap for COVID-19 infection was not significant among the sample adults in the younger and older groups. Also, as observed in Table 3 and Figures 1.9-1.15, in a series of underlying disease groups, the mean income of sample adults infected with COVID-19 was higher than that of uninfected ones.

Finally, we excluded the group with similar gaps in mean income between the infected and uninfected sample adults in the corresponding fragile and not-fragile groups. Regressions were run separately for the remaining 13 groups (non-vaccine, gender, Hispanic, education, metropolitan residence, part-time employment; hypertension, diabetes, cancer, obesity, COPD, and cardiovascular

disease). The types of workers, educational levels, and residence groups showed the only statistically significant variations in the findings, which are summarized in Table 4. The results show that the income of the infected sample adults living in non-metropolitan areas was higher than that of the uninfected sample adults. And this gap is larger than the income gap between infected and uninfected living in metropolitan areas. The income of the COVID-19-infected sample adults in the full-time group was lower than that of the uninfected. The gap is also much larger than the income gap between infected and uninfected sample adults in the part-time group. In addition, the income of infected sample adults in the low-education group was higher than that of uninfected ones. In contrast, the income of infected COVID-19 sample adults in the high-education group was slightly below that of uninfected adults. Among the numerous underlying diseases, only the hypertension group showed significant differences. This implies that the direct positive income difference between COVID-19-infected and uninfected hypertensive patients is much greater than the positive income difference within the non-hypertensive group.

Table 3: Descriptive analysis of the difference in the mean one-adult-family income of those with and without COVID-19 infection according to the individual characteristics

|		Non-infected	Median	Infected	Median
Vaccine	Not vaccinated	44835.56(37174.02)	33659.64	46410.76(34319.33)	37029.76
	Vaccinated	53596.32(40208.19)	41868.09	56761.23(41113.09)	47083.98
Gender	Female	45815.01(37089.78)	34492.98	46449.52(36472.92)	36511.23
	Male	55228.82(41114.25)	41868.09	59790(39676.75)	52297.73
Insurance	Not covered	36254.03(31326.03)	29158.45	38612.34(31679.3)	29253.54
	Covered	50804.64(39451.57)	39839.87	53036.86(38682.41)	41868.09
Hispanic	Hispanic	39638.27(35357.16)	27850.75	38388.03(29785.2)	27207.21
	Not hispanic	50830.29(39324.46)	40176.45	54366.07(39244.58)	45981.03
Age	Younger<65	54645.25(42408.79)	41868.09	54665.16(39403.27)	47075.01
	Older>=65	42921.12(32789.62)	32360.04	42990.43(33349.22)	31320.36
Education	No bachelor's degree	36661.47(29288.77)	28201.32	41388.7(32104.13)	32309.88
	At least one bachelor's degree	72527.75(43369.35)	62770.68	71395.76(41332.79)	62770.68
Residence	Metropolitan	52252.33(40091.16)	41847.12	53973.64(39805.87)	41868.09
	Non-metropolitan	35440.21(29011.25)	27161.64	42165.11(28904.21)	35524.44
Part-time	Part-time job	37557.62(32092.31)	26121.96	37886.37(34102.68)	26079.45
	Full-time job	68384.2(41442.2)	57572.28	64120.63(37704.82)	52793.27
Hypertension	Hypertention	40756.22(33578.2)	31295.34	48527.05(38512.9)	36518.76
	No hypertension	53685.42(40693.8)	41868.09	53262.78(38250.13)	41868.09

Table 3: (continued)

Asthma	Still have asthma	41957.56(36591.58)	31218.33	44308.02(38397.27)	31218.33
	Not still have asthma	50505.58(39232.6)	39760.65	52971.26(38265)	41868.09
Cancer	Under treatment for cancer	42356.1(30832.02)	37663.7	55850.24(45663.06)	47900.75
	Not under treatment	49799.94(39170.79)	38598.12	51820.5(38256.51)	41868.09
Diabet	Ever had diabetes	37048.3(32343.96)	25978.89	37567.03(32871.59)	26121.96
	Never had diabetes	51472.22(39615.89)	41836.48	53746.87(38674.29)	41868.09
Bmi	Obese	45447.39(36345.04)	35479.08	49712.79(36233.07)	41836.48
	Not obese	51905.58(40223.36)	41847.12	53740.11(39871.89)	41868.09
Copd	COPD, emphysema, chronic bronchitis	32664.09(28615.21)	22696.17	33174.24(31469.39)	20273.76
	Not COPD, emphysema, chronic bronchitis	51195.59(39518.93)	41697.21	53388.47(38496.88)	41868.09
CardiovascularConditions	Ever had been coronary heart disease	35794.76(31006.06)	25087.47	40195.67(32662.6)	30085.74
	Never had been coronary heart disease	51872.74(39731.07)	41847.12	53152.09(38756.02)	41868.09

Table 4: Preliminary regression results

variables	N	Std.Err.	T	difference in difference effect	P>ItI	95% conf. intrtval	
vaccine*covid	10148	2471.169	-0.64	-1589.705	0.520	-6433.685	3254.275
sex*covid	10,284	2539.053	-1.55	-3926.676	0.122	-8903.714	1050.362
Hispanic*covid	10,285	2935.689	-1.63	-4786.026	0.103	-10540.55	968.4952
Education*covid	10,285	2606.276	2.25	5859.219	0.025	750.4096	10968.03
metropolian*covid	10,285	2654.613	-1.88	-5003.593	0.059	-10207.15	199.9655
part-time*covid	10,285	2347.403	1.96	4592.319	0.050	-9.048202	9193.687
Hypertension*covid	10,244	2753.976	2.98	8193.466	0.003	2795.134	13591.8
cancer*covid	10,268	11433.82	1.00	11473.57	0.316	-10938.96	33886.1
diabete*covid	10,269	3401.887	-0.52	-1755.91	0.606	-8424.272	4912.452
bmi*covid	10,000	2561.84	0.95	2430.877	0.343	-2590.846	7452.599
COPD*covid	10,267	3897.69	-0.43	-1682.733	0.666	-9322.967	5957.5
CVC*covid	10,253	3563.93	0.88	3121.546	0.381	-3864.454	10107.55
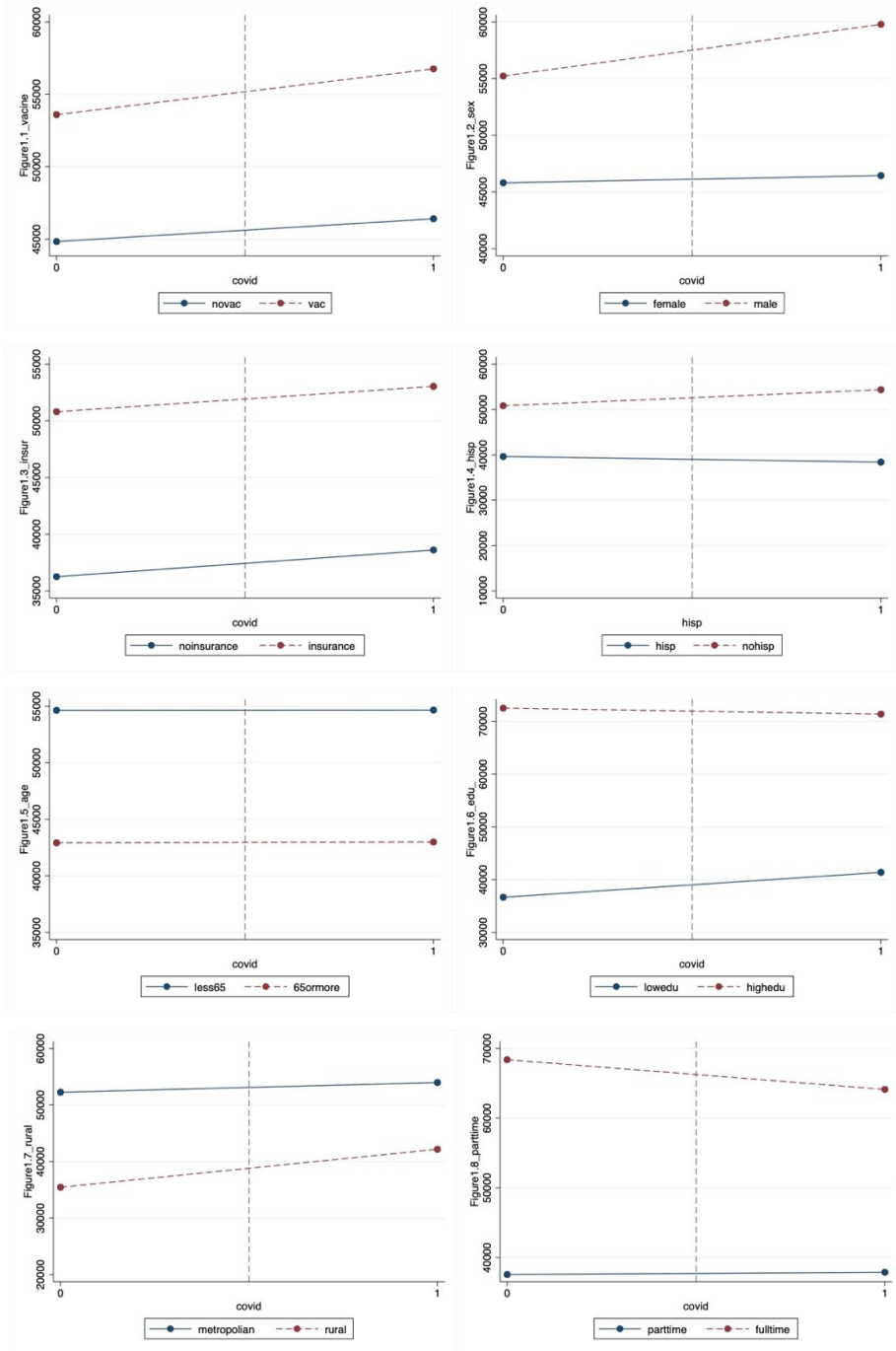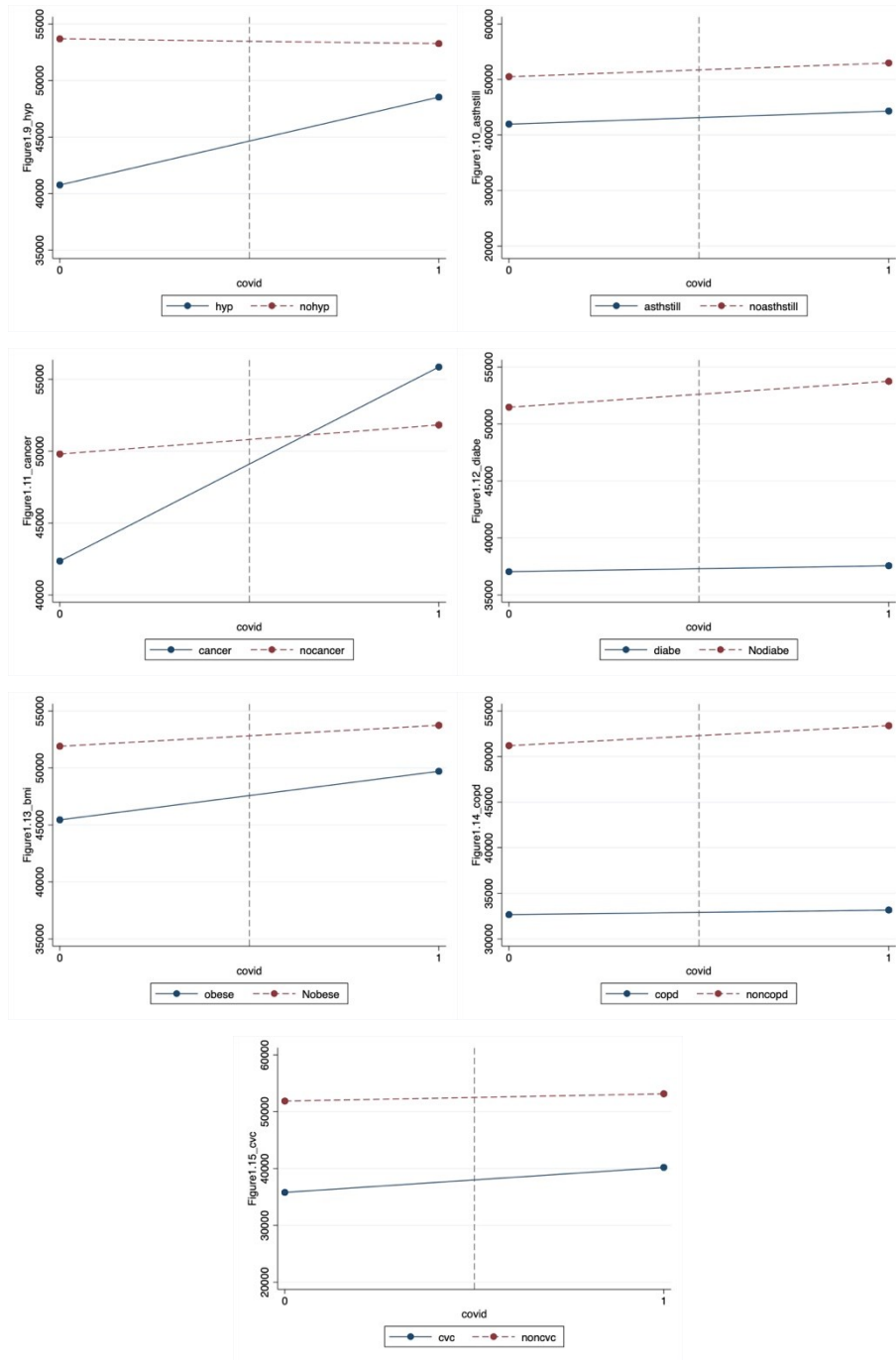
Figures1.1-1.15: The difference in difference graph based on the mean values.

5.   Conclusion and Discussion

Our results show that full-time workers infected with COVID-19 have significantly lower incomes than uninfected full-time workers. This is consistent with our assumption 1 that the infected group is relatively disadvantaged in terms of income compared with the uninfected group. This proves that infection with COVID-19 incurs a time cost that is associated with reduced income. In particular, we observed that the income of full-time workers was much higher than the income of part-time workers. Therefore, the time cost of absenteeism due to infected COVID-19 was also higher for full-time workers. This also explains why the negative mean income gap between infected and uninfected

workers was larger in the full-time worker group. In contrast, no obvious income gap due to infection in the part-time worker group. This can be attributed to the income of part-time workers being lower, and the time cost of health recovery is also lower. The result is inconsistent with assumption 2 and a prior study, that pandemics expose precarious workers to worse financial hardship [4].In addition, the results also showed that the income of the infected COVID-19 sample adults was higher than the uninfected sample adults in the low-education, living non-metropolitan, hypertension group. Inconsistent with previous findings, there was no obvious gap in income between the infected COVID-19 sample adults and the uninfected sample adults in the metropolitan group. To summarize adults in the COVID-19-uninfected sample of low-educated, non-metropolitan residents, part-time workers, or hypertensive patients were the most economically disadvantaged.

To interpret the results, we examined the sample size within each group that was participating in the work. Therefore, we have two possibilities, one being that the sample size in these groups was too small, leading to a bias in the results. Another hypothesis is that individuals in these groups were already economically vulnerable before the pandemic [18-23]. The relatively low average income of low-education and non-urban residents is evidence of the economic vulnerability of these groups. Since low-skilled precarious workers are easily replaced, precarious workers infected covid-19 may lose their jobs. This also explains part of the rise in unemployment. Although the sample adults in the hypertensive, low-education, non-metropolitan population incur the cost of time to recover due to infection, they receive adequate unemployment benefits from the government. This also coincides with a sharp rise in the number of people receiving unemployment benefits. Unemployment led to eligibility for unemployment benefits under the CARES Act during the pandemic, resulting in an unintended effect [24-27]. Also, it can explain why the low-education, non-metropolitan, and hypertension sample adults uninfected with COVID-19 suffered the most severe economic hardship. Since they are not unemployed, they cannot receive unemployment benefits either. We must be aware that those individuals in vulnerable groups who are not infected with COVID-19 are also experiencing economic hardship. These groups, already struggling to provide necessities for themselves and their families before the pandemic, have been faced with reduced opportunities for earning wages and lack sufficient public support to buffer the impact of this public health crisis.

Finally, due to data limitations, our results hold only in the context of single-adult households and do not apply to households with two or more adults. Although we also conducted the same regression for all household income, unlike single-adult households, we found statistical significance in the vaccine, sex, Hispanic, COPD, and cardiovascular disease groups. Although it is difficult to explain the reason for the difference, it may be evidence that the infection status of other household members also had an impact on the household income of the sample adults. Moreover, it is impossible to determine whether this financial hardship is temporary or will increase over time. Unemployment benefits can only improve financial hardship for the period of receiving the benefit. This does not address the root of the problem. The government needs more policies to help individuals through the economic crisis and stimulate labor force recall. Future research should examine the long-term impact of the COVID-19 pandemic on household finances and the extent to which financial difficulties are likely to persist or intensify as unemployment benefits end.

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Appendix

Poverty Thresholds by Single Family and Number of Related Children Under 18 Years Old: 2021

Size of the family unit	None children under 18 years	One children under 18 years	two children under 18 years	3 or more children under 18 years
One person:				
Under age 65	14097			
Aged 65 and older	12996			
Two people:				
Under age 65		18677		
Aged 65 and older		18677		
Three people:			21831	
four or more people:				27575