**Preliminary Analysis**

The original data set includes 2,109 survey respondents from April 24 to September 8, 2020. We only consider individuals that are at least 18 years old, so 10 data points were deleted from the survey, leading to a final data set of size 2,099.

We define five racial categories: (1) American Indian or Alaska Native; (2) Asian/Pacific Islander: Chamorro, Chinese, Filipino, Japanese, Korean, Native Hawaiian, Samoan, Vietnamese; (3) Black or African American; (4) White or Caucasian American; and (5) Bi-racial or multi-racial. We also consider two ethnic groups: Hispanic and non-Hispanic.

We categorize individuals’ education level into three groups: (1) Some high school & high school graduates or GED; (2) Some college, associate’s degree or technical school, and Bachelor's degree; and (3) Postgraduate degree.

Table 1. Characteristics of survey respondents

|  |  |  |
| --- | --- | --- |
| Characteristic | Categories | Number (%) |
| Age (mean ± standard deviation) |  | 33.6 ± 14.7 |
| Gender | Female  Male | 1,559 (74.3)  540 (25.7) |
| Race | American Indian or Alaska Native  Asian/Pacific Islander  Black or African American  White or Caucasian American  Multi-racial or Not Specified | 77 (3.7)  76 (3.6)  527 (25.1)  615 (29.3)  804 (38.3) |
| Ethnicity | Hispanic, Latino, or Spanish Origin  Not Hispanic, Latino, or Spanish Origin | 1,202 (57.3)  897 (42.7) |
| Education level | Some high school, high school graduate, GED  Some college, associate’s degree/technical school, Bachelor’s degree  postgraduate degree | 955 (45.5)  854 (40.7)  290 (13.8) |
| Household income | Less than 12,999 per year  $13,000–$24,999 per year  $25,000–$49,999 per year  $50,000–$74,999 per year  $75,000–$99,999 per year  $100,000–$124,999 per year  $125,000–$149,999 per year  More than $150,000 per year  Not Specified | 254 (12.1)  251 (12.0)  275 (13.1)  202 (9.6)  178 (8.5)  129 (6.1)  78 (3.7)  179 (8.5)  553 (26.4) |

We utilized a revised version of the United States Department of Agriculture six-item validated food security module to measure food insecurity before COVID-19 and since COVID-19. We sum up the total affirmative responses (often and sometimes) of questions 11-1, 11-2, 12-1, 12-2, and 12-3. A score of 0-1 indicates a high or marginal food security, 2-4 indicates low food security (low food insecurity), and 5-6 indicates very low food security (high food insecurity). In this study, we categorize individuals into groups of food secure (0-1) and food insecure (2-6).

Table 2. Number of food insecure individuals before and after COVID-19 by race and ethnicity

|  |  |  |  |
| --- | --- | --- | --- |
| Race | Total Number | Before Covid-19 (%) | Since Covid-19 (%) |
| American Indian or Alaska Native | 77 | 41 (53.2) | 44 (57.1) |
| Asian/Pacific Islander | 76 | 14 (18.4) | 29 (38.2) |
| Black or African American | 527 | 217 (41.2) | 237 (45.0) |
| White or Caucasian American | 615 | 208 (33.8) | 232 (37.7) |
| Others or Not Specified | 804 | 108 (13.4) | 119 (14.8) |
| Hispanic, Latino, or Spanish | 1,202 | 302 (25.1) | 325 (27.0) |
| Total | 2,099 | 588 (28.0) | 661 (31.5) |

We found an increase in food insecurity in all races and ethnicities. The total percentage of food insecurity among respondents increase from 28% to 31.5%. The highest increase belongs to Asian/Pacific Islanders. However, our analysis includes those who left some questions blank. In the following, we only take into account individuals who answered at least one of the five food insecurity questions for both before and after COVID-19.

Table 3. Number of food insecure individuals before and after COVID-19 by race and ethnicity

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Race | Total Number | Before Covid-19 (%) | Since Covid-19 (%) | P-value |
| American Indian or Alaska Native | 60 | 39 (65.0) | 44 (73.3) | 0.4291 |
| Asian/Pacific Islander | 65 | 11 (16.9) | 29 (44.6) | \*0.001236 |
| Black or African American | 370 | 207 (55.9) | 237 (64.0) | \*0.02955 |
| White or Caucasian American | 466 | 168 (36.0) | 232 (49.8) | \*3.05e-5 |
| Others or Not Specified | 204 | 80 (39.2) | 119 (58.3) | \*0.0001674 |
| Hispanic, Latino, or Spanish | 496 | 270 (54.4) | 325 (65.5) | \*0.0004663 |
| Total | 1,165 | 505 (43.3) | 661 (56.7) | \*1.34e-10 |

We check the statistical significance of the increase in food insecurity rates by using Pearson Chi-square test with Yates’ continuity correction. We consider a significance level of 0.05, and show statistically significant differences by asterisks (\*). In Table 3, we can see that for all the racial/ethnic groups, the food insecurity rate increased since COVID-19, except for American Indians or Alaska Native, for which the change is not considered statistically significant due to the small sample size for this group.

We define health security by summing up the total affirmative responses (usually and always) of two items in question 19, “access to healthcare” and “medical expenses” concerns. A score of 0 indicates health security, and a score of 1 or 2 indicates health insecurity. Table 4 shows the number of health insecure individuals since COVID-19 by race and ethnicity.

Table 4. Number of health insecure individuals since COVID-19 by race and ethnicity

|  |  |  |
| --- | --- | --- |
| Race | Total Number | Since COVID-19 (%) |
| American Indian or Alaska Native | 77 | 47 (61.0) |
| Asian/Pacific Islander | 76 | 40 (52.6) |
| Black or African American | 527 | 243 (46.1) |
| White or Caucasian American | 615 | 326 (53.0) |
| Others or Not Specified | 804 | 146 (18.2) |
| Hispanic, Latino, or Spanish | 1,202 | 351 (29.2) |
| Total | 2,099 | 803 (38.2) |

The total number of people suffering from health insecurity since COVID-19 exceeds those experiencing food insecurity, and this is true for all races and ethnicities. Overall, 52.4% of food secure people, 71.5% of consistently food insecure people, and 72.5% of newly food insecure people are experiencing health insecurity.

In this study, we discriminate between individuals who had been food insecure prior to COVID-19 and those who became food insecure since the pandemic. We refer to them as “consistently food insecure” and “newly food insecure,” and believe that there are significant differences between these two groups. In our data set, we have a total number of 456 food secure, 460 consistently food insecure, and 201 newly food insecure individuals among the respondents who answered the food insecurity related questions for both before and after COVID-19.

**Multivariate Logistic Regression Model**

We use a multivariate logistic regression model to find factors contributing to higher odds of health insecurity, and to identify the connection between food, job, and health insecurity. Job security is defined based on the affirmative response of question 19 item “employment and job security.”

We consider the following independent variables in our logistic regression model: age (young (less than 30 years old), adult (between 30 and 65), and senior (more than 65 years old)), gender, race, ethnicity, education level, income level, employment change (job loss, reduced hours, and furloughed, versus no employment change), having disability, being retired, student, unemployed, or essential worker, having a high risk member in the household, health insurance status, having cancer or chronic diseases, being consistently food insecure, being newly food insecure, and job security status.

We first perform a backward stepwise variable selection based on the Akaike Information Criterion (AIC) to select the best-fit model, and then, perform a logistic regression analysis on the selected model. The results are shown in Table 5 (only the statistically significant variables are included).

Table 5. Result of the logistic regression analysis

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Independent Variables | Coefficients | Standard Error | P-value | Odds ratio |
| Intercept | -2.37887 | 0.10227 | < 2e-16 | 0.09 |
| Being Consistently Insecure | 0.96846 | 0.16408 | 3.58e-09 | 2.63 |
| Being Newly Insecure | 0.96172 | 0.21261 | 6.08e-06 | 2.62 |
| Being a Senior | 1.01741 | 0.32269 | 0.001616 | 2.77 |
| Change in job status (losing job, reduced hours, or being furloughed) | 0.41957 | 0.14378 | 0.003521 | 1.52 |
| Having disability | 1.17321 | 0.40864 | 0.004091 | 3.23 |
| Retired | 1.12371 | 0.39415 | 0.004359 | 3.08 |
| Unemployed | 0.64305 | 0.17933 | 0.000336 | 1.90 |
| Essential worker | 0.22176 | 0.03072 | 5.27e-13 | 1.25 |
| No Health Insurance | 0.63039 | 0.25192 | 0.012336 | 1.88 |
| Being Job Insecure | 2.40742 | 0.13701 | < 2e-16 | 11.10 |

Table 5 indicates that there is a strong association between food insecurity (both consistently and newly insecurity), job insecurity, and health insecurity. Indeed, people with job insecurity have more than 11 times higher odds of being health insecure, and individuals experiencing food insecurity have more than 2.6 times higher odds of having health insecurity. Our analysis also shows that age plays an important role in health insecurity. Seniors and retired individuals have more than 3 times higher odds of being health insecure; and the same is true for people with disabilities. People without any type of health insurance have 88% higher odds. People with job loss, reduced hours, or furlough also have 52% higher odds. Finally, unemployed people and essential workers have respectively 90% and 25% higher odds of being health insecure.

**Healthcare Providers Status**

Among 1,203 people who replied to this question, 708 (58.8%) mentioned that their healthcare provider changed or canceled their plan. However, there is a significant difference between food secure and food insecure people. Among the food secure people, 205 (48.7%) reported change or cancelation of their healthcare provider, while this number is 503 (64.3%) for food insecure people, which indicates that food insecure people are at a much higher risk of not getting the healthcare accommodations they need.

**Health Insurance, Smoking, and Chronic Diseases**

Table 6 compares health secure and insecure individuals in terms of health insurance status, smoking status, and having any types of cancer or chronic diseases. Based on the results, health insecure people are significantly more likely to be a smoker and have chronic conditions, and yet, they have a significantly higher chance of not having any type of health insurance.

Table 6. Household status

|  |  |  |
| --- | --- | --- |
|  | Health Secure | Health Insecure |
| No Insurance | 38 (2.9) | 95 (11.8) |
| Smoker | 54 (4.2) | 143 (17.8) |
| Chronic condition | 56 (4.3) | 103 (12.8) |

**Current and Future Healthcare-seeking Behaviors**

Table 7. Current and future healthcare-seeking behaviors

|  |  |  |
| --- | --- | --- |
|  | Health Secure  Before COVID-19 (%) – Since COVID-19 (%) | Health Insecure  Before COVID-19 (%) – Since COVID-19 (%) |
| Going for an annual flu shot | 266 (20.5)-286 (22.0) | 460 (57.3)-419 (52.2) |
| Going to a healthcare provider’s office for a checkup examination | 246 (19.0)-331 (25.5) | 432 (53.8)-511 (63.6) |
| Going to a clinic for a  diagnostic test, or  treatment | 188 (14.5)-288 (22.2) | 394 (49.1)-472 (58.8) |
| Going to a hospital for  a medically necessary procedure | 160 (12.3)-276 (21.3) | 341 (42.5)-489 (60.9) |
| Going for telehealth  appointments | 176 (13.6)-229 (17.6) | 386 (48.1)-414 (51.6) |
| Delaying or canceling  an appointment | 253 (19.5)-174 (13.4) | 445 (55.4)-370 (46.1) |
| Total | 1297 | 803 |

Table 7 shows that the changes in healthcare-seeking behaviors since COVID-19 is similar for health secure and insecure people. The only exception is that health insecure individuals are less likely to go for an annual flu shot in contrast to health secure ones. However, it would be much harder for health insecure people to receive the health care they seek, since a high proportion of them do not have any health insurance. Moreover, they are at higher risks of needing healthcare services because they have a higher chance of being a smoker and having chronic diseases.

**Mental Health**

In this analysis, our goal is to check if there is any significant differences between mental health status of health secure and insecure, and between food secure, consistently insecure, and newly insecure individuals.

**Analysis based on Food Insecurity**

We first run a Kruskal Wallis test to see if there is any statistically significant differences among the three groups, and if there is, we run a pairwise Wilcoxon Rank Sum test to identify differences between each pair. The scoring system is as follows: Not at all = 1, Several days = 2, More than half the days = 3, Nearly every day = 4. Our analysis shows that there is statistically significant differences between food secure and food insecure people (both consistently and newly), with food secure people having a better mental health condition. However, the difference between consistently food insecure and newly food insecure people is not statistically significant.

Table 8. Mental health since COVID-19

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Secure | Consistently Insecure | Newly Insecure | P value | Pairwise P-value |
| Feeling nervous, anxious or on edge | 2.020690 | 2.250000 | 2.415842 | \*0.003195 | \*0.02224  \*0.00402  0.1921 |
| Not being able to stop or control worrying | 1.903448 | 2.289157 | 2.425743 | \*9.34e-6 | \*3.36e-6  \*5.9e-5  0.2763 |
| Little interest or pleasure in doing things | 1.986207 | 2.436747 | 2.504950 | \*5.97e-6 | \*1.18e-6  \*9.3e-5  0.5633 |
| Feeling down, depressed or hopeless | 1.882759 | 2.433735 | 2.445545 | \*6.8e-8 | \*6.38e-8  \*6.02e-5  0.9749 |

**Analysis based on Health Insecurity**

We performed a similar analysis on health secure versus health insecure individuals and found out that health secure people have a statistically significantly better mental health condition.

Table 9. Mental health since COVID-19

|  |  |  |  |
| --- | --- | --- | --- |
|  | Health Secure | Health Insecure | P value |
| Feeling nervous, anxious or on edge | 2.022 | 2.34 | \*<2.2e-16 |
| Not being able to stop or control worrying | 2.02 | 2.31 | \*<2.2e-16 |
| Little interest or pleasure in doing things | 2.03 | 2.48 | \*<2.2e-16 |
| Feeling down, depressed or hopeless | 2.08 | 2.43 | \*<2.2e-16 |