How Income and Population Density Correlate to Symptoms (Runny Nose and Chills) of COVID-19 Positive Patients Either Symptomatic or Asymptomatic.

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INTRODUCTION/ LITERATURE REVIEW:

The main question we approached this assignment with to test two variables was; *Does income and population density correlate to symptoms felt by COVID-19 positive patients, either symptomatic or asymptomatic?*

COVID- 19 is a virus that has affected the world by storm in 2020, this topic is important to study because little is known about the virus.

Since COVID-19 is so new there is still a world of things to discover about this fast spreading and deadly virus. What we do know is that population density does increase the number of COVID cases. Densely populated cities and cities in poverty have a higher chance of people being COVID-19 positive and showing symptoms.

Countries and cities with limited medical and hospital access are advised to stay home and or wear a face shield at since they are in the higher risk category.

What we do know about COVID-19 is that the virus is very easily spread especially to individual's with weakened immune systems as well as individual's living in poverty or overly populated places.

Since the disease so new many things aren't discovered yet but everyday new information is coming out about the virus and hopefully a vaccine will be distributed soon to slow the spread of COVID-19.

Proportions of Symptom Occurrences in Urban Populations By Income

	P_DENSE	INC_BANNER	factor(SYM_TOT)	count	prop
49	(3) Urban	(1) Less than $30,000	1	300	0.0399733511
50	(3) Urban	(1) Less than $30,000	2	154	0.0205196536
51	(3) Urban	(1) Less than $30,000	3	61	0.0081279147
52	(3) Urban	(1) Less than $30,000	4	22	0.0029313791
53	(3) Urban	(1) Less than $30,000	5	3	0.0003997335
54	(3) Urban	(1) Less than $30,000	NA	760	0.1012658228
55	(3) Urban	(2) $30k to less than $60k	1	358	0.0477015323
56	(3) Urban	(2) $30k to less than $60k	2	161	0.0214523651
57	(3) Urban	(2) $30k to less than $60k	3	63	0.0083944037
58	(3) Urban	(2) $30k to less than $60k	4	16	0.0021319121
59	(3) Urban	(2) $30k to less than $60k	5	1	0.0001332445
60	(3) Urban	(2) $30k to less than $60k	NA	798	0.1063291139
61	(3) Urban	(3) $60k to less than $125k	1	434	0.0578281146
62	(3) Urban	(3) $60k to less than $125k	2	187	0.0249167222
63	(3) Urban	(3) $60k to less than $125k	3	61	0.0081279147
64	(3) Urban	(3) $60k to less than $125k	4	20	0.0026648901
65	(3) Urban	(3) $60k to less than $125k	5	3	0.0003997335
66	(3) Urban	(3) $60k to less than $125k	NA	1273	0.1696202532
67	(3) Urban	(4) More than $125k	1	229	0.0305129913
68	(3) Urban	(4) More than $125k	2	94	0.0125249833
69	(3) Urban	(4) More than $125k	3	29	0.0038640906
70	(3) Urban	(4) More than $125k	4	4	0.0005329780
71	(3) Urban	(4) More than $125k	5	1	0.0001332445
72	(3) Urban	(4) More than $125k	NA	706	0.0940706196
73	(3) Urban	NA	1	21	0.0027981346
74	(3) Urban	NA	2	11	0.0014656895
75	(3) Urban	NA	3	4	0.0005329780
76	(3) Urban	NA	4	1	0.0001332445
77	(3) Urban	NA	NA	94	0.0125249833

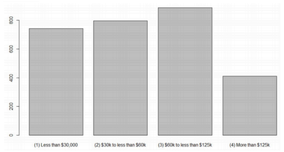
uency Tables: Symptom by Population Density & Income

```
req(rqdata$P_DENSE[rqdata$SYM_TOT>=1])
ata$P_DENSE[rqdata$SYM_TOT >= 1]
          Frequency Percent
 Rural          170   5.893
 Suburban       477  16.534
 Urban         2238  77.574
al             2885 100.000
req(rqdata$INC_BANNER[rqdata$SYM_TOT>=1])
ata$INC_BANNER[rqdata$SYM_TOT >= 1]
                          Frequency Percent Valid Percent
 Less than $30,000              743  25.754         26.18
 $30k to less than $60k         796  27.591         28.05
 $60k to less than $125k        887  30.745         31.25
 More than $125k                412  14.281         14.52
s                                47   1.629
al                             2885 100.000        100.00
```

METHODS

We began our research by creating the codebook and separating the data into succinct excel pages per COVID-19 related symptom with population density and income included. To begin learning how COVID-19 spread may relate to population density and income levels, we used keywords such as COVID AND "population density," COVID AND income, and COVID AND "disease transmission." Since COVID-19 is a new health crisis, we expected to have difficulty finding research, but scientists have been working hard to catch up. New studies, combined with existing research on earlier, global respiratory infections, offer promising information about a possible correlation of virus spread rates between densely populated and lower-income areas instead of rural or more affluent communities. We conducted peer review and researched various articles that speak to research done on both current and former widespread respiratory-related infections, pandemic or otherwise. We then managed the data and conducted various frequency tests to find answers to our narrowed down questions.

Income:

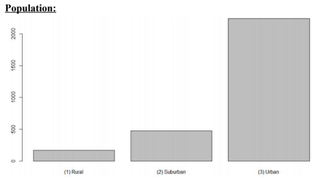


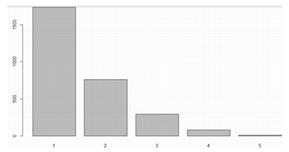
Frequency of having 1-5 symptoms:

NA represents (2) No Symptoms, (77) Not Sure, (98) Skipped on Web

```
> freq(rqdata$SYM_TOT)
rqdata$SYM_TOT
      Frequency  Percent Valid Percent
1          1734 23.1046        60.1040
2           762 10.1532        26.4125
3           295  3.9307        10.2253
4            81  1.0793         2.8076
5            13  0.1732         0.4506
NA's       4620 61.5590
Total      7505 100.0000       100.0000
```

Population:





RESULTS

Over the course of our study this semester, we have examined the correlation between typical COVID-19 symptoms (runny nose and chills) and their relationship to those in various socioeconomic groups and populous areas in the United States. Obviously, the novel coronavirus is experienced by positive patients in different ways. Patients are either symptomatic or asymptomatic which can skew the statistics. The specific statistical test we decided to run is the chi-square test to compare observed frequencies to expected frequencies. We used the same Chi-square test for both variables.

Of the individuals sampled who experienced between 1-5 of the COVID symptoms we examined, 60.10% had only one symptom; those with two symptoms totaled 26.41%. The mean number of symptoms experienced was 1.57. Individuals in the $60K-$125K income group had the most symptoms: 31.25% of the total sample. Individuals living urban areas made up 77.52% of the sample who experienced symptoms. The second test revealed that the p-value was less than 0.05 therefore we do not reject our null hypothesis which says there is no significant difference in people who experienced fever and had an income of between 30k and 125k. The larger difference to note, occurs in the bracket of household income of more than 125k USD. Overall, utilizing the chi-square test we observed that our initial predictions were virtually correct. The symptoms were more likely to be felt in relatively lower income and populous areas.

RESULTS (CONT.)

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Overall, we found that income and population density did, in fact, correlate with COVID-19 symptoms. The higher percentage in inner city patients is proof that population density and income do play a factor in strain and severity of the impact COVID-19 has on a patient.

CONCLUSIONS/ DISCUSSION:

The main question we approached this assignment with to test two variables was *Does income and population density correlate to symptoms felt by COVID-19 positive patients, either symptomatic or asymptomatic?*

We can see that the income and population density correlate to symptoms felt by COVID-19 positive patients, either symptomatic or asymptomatic. We assumed from the beginning that there would be an influx of positive COVID-19 patients in inner cities with lower income or HHINCOME rates.

The biggest discovery we found is that symptoms felt by patients were generally the same from high income to low-income places however the difference is in the population density. This questions what other factors are present in determining which patients present symptoms or are asymptomatic.

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