Beyond the Virus: The Impact of the COVID-19 Pandemic on Mental Health

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The COVID-19 pandemic negatively affected the collective mental health of the population and further worsened it for people with pre-existing mental health and substance abuse problems. A thorough understanding of their impact on the morbidity and mortality in society is imminent to estimate the intensity of the public health challenge we are collectively facing. Using the data collected from multiple sources, from organization web pages to public poll results, we documented the effect of the pandemic on the population on multiple aspects. Our study reveals that there was a 13% increase in the mean depression prevalence rate, especially amongst females which show a rate 30% higher than males, and also on young adults. Both suicide rates and drug overdose increased during the pandemic in varying degrees across the United States, with significant correlation to social isolation and stress. The proposed hypotheses were not rejected based on Wilcoxon non-parametric test and most of the results aligned with the professional input of a domain expert.

Additional Key Words and Phrases: COVID-19, Pandemic, Mental Health, Suicide, Google Search trends, Pearson Correlation, Hypothesis Testing

1 INTRODUCTION

Mental health issues are one of the main concerns in public health. This is of special concern during the COVID-19 pandemic, where restrictive policies in the interest of public health, such as social distancing and domiciliary lockdowns, could make us feel isolated and lonely, leading to anxiety and depression. About 41.1% of adults reported anxiety disorders during the COVID-19 pandemic as compared to the 11% before the onset of the pandemic [9]. This might impact the activity levels, appetite, decision making and even induce suicidal thoughts.

There has been extensive prior analysis done on this topic of discussion. Dsouza et al. [2] analyzes how the fear of contracting the COVID-19 infection had resulted in high suicide rates in India. They scraped data from seven popular English Indian online newspapers by employing purposive sampling method. Sava and Papari [10] performed an interesting comparative analysis of suicide rates based on the criteria of seasons and gender. By employing chi-square test on the dataset, they ranked the season-based suicide rates as summer, spring, autumn and winter. They also observed a significant difference in the rates with respect to the gender. Näher et al. [8] statistically proved that low socioeconomic status and high social isolation are linked to increased suicide rates by modeling data distributions. Holman et al. [6] assessed stress, depression and media-based

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exposures to COVID-19 in the US in three consecutive representative samples. Their study reported that pre-existing mental issues, media exposure and other stressors were strongly associated with acute stress and depression during the pandemic. The twitter analysis study conducted by Zhang et al. [12] noticed a positive correlation between mental health concerns on Twitter posts and the pandemic in the US and that people in the age group of 30-49 were more worried about the mental well-being.

The objective of this work is to study the different factors associated with mental health issues during the COVID-19 pandemic, while also examining the effects of mental health issues, such as suicide rates and substance abuse, on the population during the pandemic across various regions.

2 METHODOLOGY

2.1 Research Hypothesis

This research aims at empirically testing the following hypotheses:

(1) Based on the study of suicide and self-harm in Wetherall [11], four of the indicators for mental health issues can be identified as physical health, relationships, stressful events and financial insecurity. These and other factors that are connected to the pandemic or a consequence of measures taken to preserve public and personal health have contributed to an increase in mental health issues during the COVID-19 pandemic.

(2) There is a correlation between this increase and the increase in the associated consequences (such as suicide and substance abuse).

2.2 Data Collection

The data was collected from various sources from the internet. A few government sources such as the *Centers for Disease Control and Prevention (CDC)* and *World Health Organization (WHO)* provide highly reliable data that is made available to researchers. Suicide data during the pandemic (2020) was also collected from [5]. The public poll data from *KFF - The Implications of COVID-19 for Mental Health and Substance Use* was used for depression during COVID-19 (2020 and 2021) across the US. Survey data for the effect of the pandemic on young adults in 2020 was used from Chaturvedi et al. [1]. Multiple data for mental health, suicide and drug overdose during the pandemic (2020) were collected from the public poll data from KFF - Mental Health Substance Use. Data for depression across the world and unemployment across the world and across the US states during the pandemic (2020) were extracted from World Population Review. Data for gender-wise mental health before (2019) and during the pandemic (2020) and countrywise depression before covid (2019) were extracted from *Our World in Data*. Text Analysis data for the frequency of search queries with keywords as 'depression', 'lonely', 'stress', 'drugs' and 'suicide' during the pandemic (2020) were extracted from *Google Trends*.

All of the above data collected from multiple sources were used both individually and combined to thoroughly test the hypothesis from multiple fronts.

2.3 Methods

This research utilized a vast variety of data from multiple sources, quantitative methods, as well as a qualitative interview with a domain expert. Specifically, it was comprised of the following steps:

(1) Identification, scraping and collection of data for the following categories:
  (a) COVID-19 and mental health.
  (b) COVID-19 and suicide rates.
  (c) COVID-19 and substance abuse.

(2) Visual and quantitative evaluation of the data to observe the overall effect of COVID-19 on public mental health.

(3) Analysis of mental health, suicide rates and substance abuse trends in the United States and linking them to the respective COVID-19 policies applied in each state.

(4) Study of the effect of unemployment on mental health, suicide rates and substance abuse during the pandemic.

(5) Analysis of Google Search queries on depression, suicide and drugs during the pandemic.

(6) Comparison of the effects of the pandemic on mental health of both biological genders.

(7) Study the effect of the closure of schools and universities on the mental health of young adults.

(8) Comparative statistical testing on mental health, suicide rates and substance abuse before and during the COVID-19 pandemic.

(9) Interview of a domain expert for professional insights into the causes of trends observed and possible effective measures to combat mental health issues related to social isolation and other consequences of the pandemic.

3 RESULTS

3.1 COVID-19 Measures vs Public Mental Health

*3.1.1 **Trend Observed**.* As pictured in Figure 1a, the mean depression prevalence rate had a significant increase worldwide in 2020, which was when the pandemic begun. Comparatively, the rates before the pandemic, from 2015 to 2019, were much lesser and remained roughly constant.
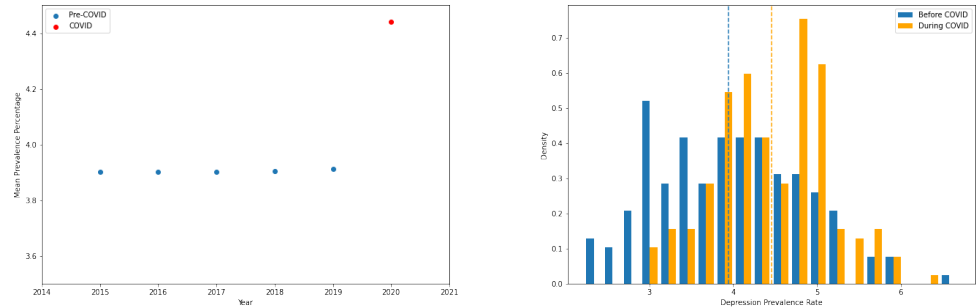
(a) Mean Depression Prevalence Rate worldwide from 2015 to 2020

(b) Histogram Plot of Depression Prevalence Rates before and during the pandemic

Fig. 1. Worldwide Depression Prevalence Rates before and during the pandemic

Figure 1b showed us a histogram plot where the depression rates before the pandemic were left skewed, meaning lower, while after the pandemic they were more right skewed, meaning higher. It can be inferred from Table 1 that the mean depression rate before the pandemic (2019) was inferior to the mean depression rate during the pandemic (2020).

Phase	Mean	Standard Deviation
Before the pandemic (2019)	3.95	0.86
During the pandemic (2020)	4.46	0.67

Table 1. Depression Prevalence Rate statistics before and during the pandemic

The sequential map in Figure 2 allowed a visual overview of depression trends across the world. According to this data, countries such as Australia and the United States, though very well developed economically, suffered from high depression rates, while generally poorer countries in Africa have seen less impact in this area.

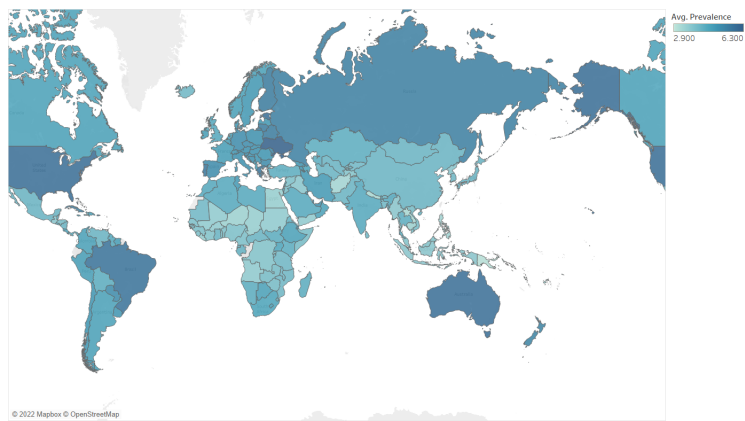Fig. 2. Depression Prevalence Rates across the world during in 2020

3.1.2 ***Country-specific Analysis - US***. Figure 3 showed the depression rates as observed in the different states of the United States. States such as Utah and Minnesota registered higher levels of depression whereas states like Arizona and Colorado registered lower levels of depression.
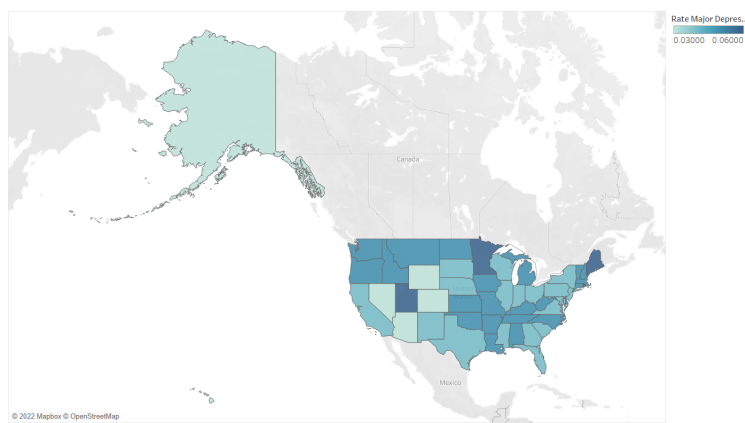

Fig. 3. Map of Depression Rates across the US states in 2020

The scatter plot in Figure 4 compared the depression rates across the different states in the United States between 2020 and 2021. As the pandemic persisted, the depression rates increased overtime in most of the states in the United States, while staying constant in the few that did not register an increase.
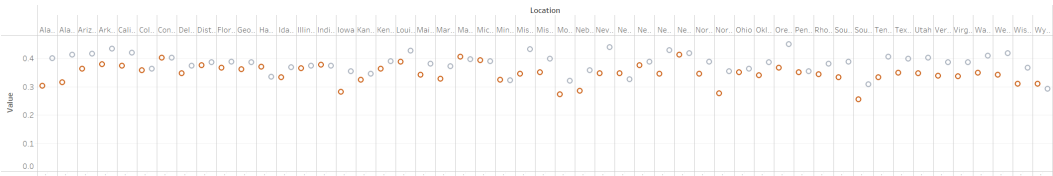

Fig. 4. Depression Rate Change across US states between 2020 (red) and 2021 (grey)

3.1.3 **Unemployment**. The scatter plot in Figure 5a showed there was no clear correlation between unemployment and depression. Table 2 shows the Pearson Correlation result for it.

(a) Scatter Plot between Unemployment Rate and Depression across the world

(b) Scatter Plot between Unemployment Rate and Depression across US states
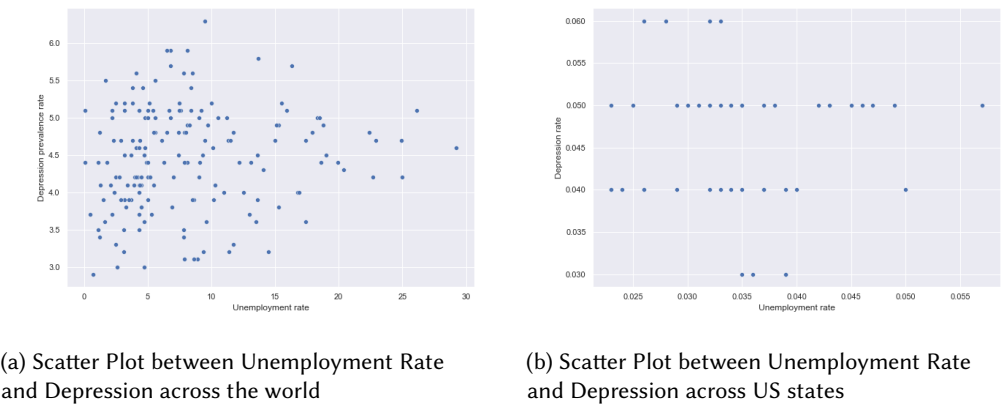
Fig. 5. Correlation between Unemployment Rate and Depression

	r-value	p-value	Inference
World	0.12	0.13	Positive Weak Correlation, Statistically Insignificant
US	0.08	0.96	Positive Weak Correlation, Statistically Insignificant

Table 2. Pearson Correlation Result for unemployment and depression rate across the World and US states

Figure 5b showed the scatter plot between unemployment rate and depression for the United States in specific. Table 2 shows the Pearson Correlation result for it, which meant that depression was also almost independent of unemployment across the United States.

3.1.4   ***Google Search trend***. The packed bubble plot in Figure 6 showed that Philippines has the most searches about depression in 2020, during the pandemic. This was followed by the United States and South Africa (89% and 87% of the amount of searches in the Philippines respectively). Countries like Turkey, Japan and Russia are amongst the set with the least number of such queries, all with only 1% of amount of searches in the Philippines.
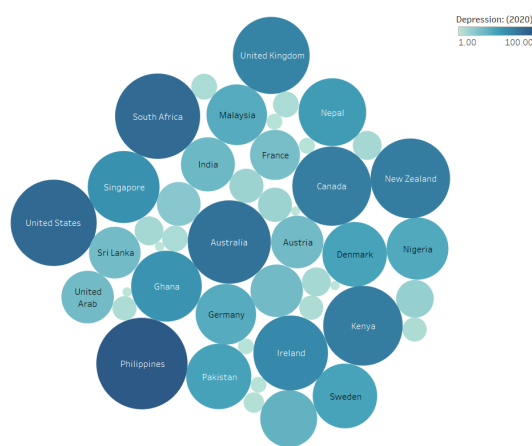
Fig. 6.   Packed Bubble Plot of number of Google Search queries with 'Depression' as the keyword

3.1.5   ***Gender-wise observations***. Figures 7a and 7b allowed us to observe that females were more depressed than males throughout the pandemic period.

(a) Gender-wise comparison of depression rates across countries in 2020

(b) Gender-wise comparison of depression rates across countries in 2021

Fig. 7.   Comparison of depression rates between Male (grey) and Female (red)

3.1.6 ***Young Adults***. Data was extracted from a survey dataset Chaturvedi et al. [1] that contained responses from people in the age group of 21 to 30 in India. This data was cleaned and analyzed to understand the effect of pandemic on young adults at a time when all schools and universities closed.
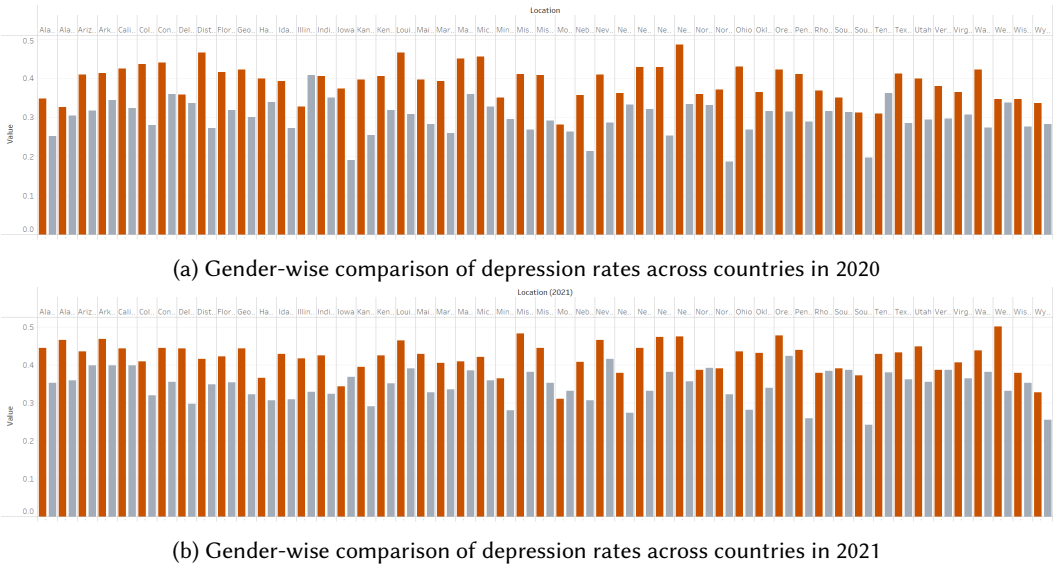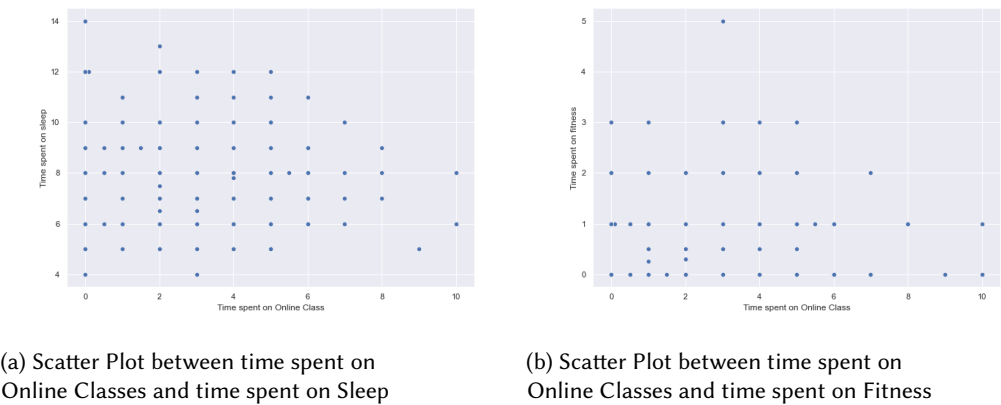

(a) Scatter Plot between time spent on Online Classes and time spent on Sleep

(b) Scatter Plot between time spent on Online Classes and time spent on Fitness

Fig. 8. Correlation between time spent on Online Classes and on other activities during the pandemic

	r-value	p-value	Inference
Sleep	-0.12	0.017	Negative Weak Correlation, Statistically Significant
Fitness	0.06	0.22	Negative Weak Correlation, Statistically Insignificant

Table 3. Pearson Correlation Result for time spent on online class and time spent on sleep

The scatter plot in Figure 8a related the time spent by students on online classes and the time they spent on sleep. Table 3 shows the Pearson Correlation result for the same, which means that online classes had a negligible but statistically significant impact on the time spent on sleep.

Similarly, the scatter plot in Figure 8b related the time spent by students on online classes and the time they spent on fitness and physical activities. Table 3 shows the Pearson Correlation result for the same, which means that online classes had a negligible and insignificant impact on the time spent on everyday fitness.
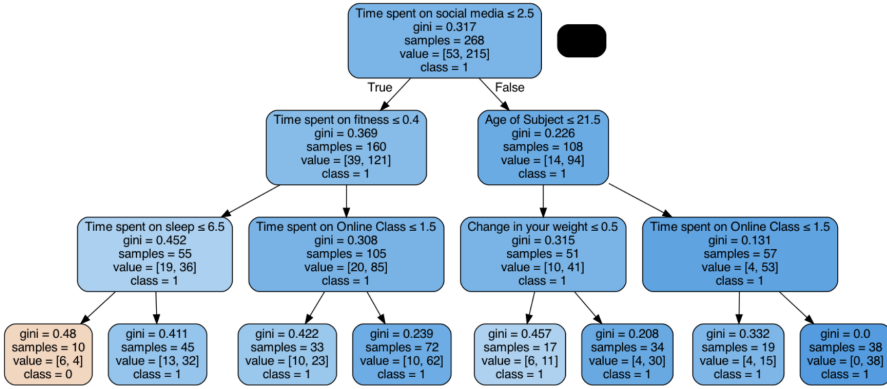
Fig. 9. Decision tree to predict if the health of a student was affected during the pandemic

A decision tree classifier was trained to predict whether the health of a student was affected or not during the pandemic, as shown in Figure 9. With a depth of 3, the decision tree model attained an accuracy of 0.81. The classification report is shown in Table 4.

	Precision	Recall	F1-score	Support
0	0.33	0.16	0.21	19
1	0.85	0.94	0.89	97
accuracy			0.81	116
macro avg	0.59	0.55	0.55	116
weighted avg	0.77	0.81	0.78	116

Table 4. Decision Tree - Classification Report

3.2 COVID-19 Measures vs Suicide Rate

3.2.1 **Trend in the US**. Figure 10 showed the sequential map of the United States with suicide rate trends. States like Wyoming and Alaska registered higher suicide rates than places like California and New York. To note that the number of suicides on the whole might be lower in Wyoming (170 suicides) compared to New York (1705), but when normalized with the respective population, the former has a suicide rate of 29.30 while the latter has a lower rate of 8.30.
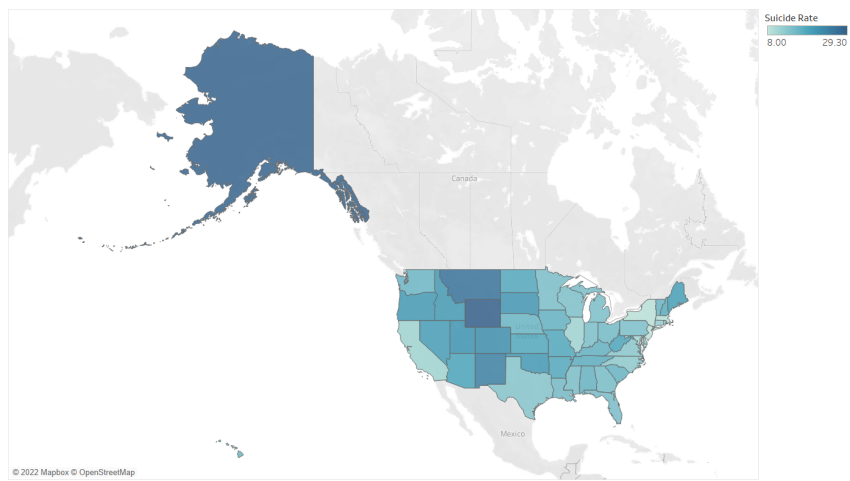
Fig. 10. Map of Suicide Rates across US states

3.2.2 ***Unemployment***. The scatter plot in Figure 11 visually depicted the correlation between the unemployment and suicide rate across the United States. Table 5 shows the Pearson Correlation result for the same.

Fig. 11. Scatter Plot between unemployment and suicide rate across US states during the pandemic

r-value	p-value	Inference
0.11	0.47	Positive Weak Correlation, Statistically Insignificant

Table 5. Pearson Correlation Result for unemployment and suicide rate across the US

3.2.3 ***Google Search trends***. There was a very close relationship between all the search terms in Figures 12 and 13. However, it could be verified from Table 6 that there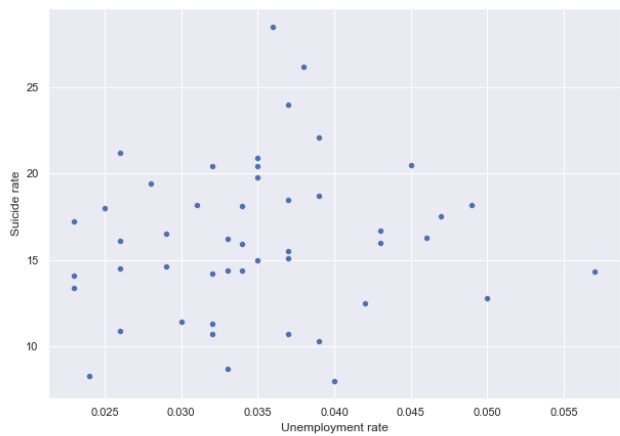 was a higher correlation between the search terms 'Suicide' and 'Depression' as well as 'Lonely' and 'Suicide' during the pandemic as compared to the pre-pandemic period.

(a) Comparison of trends of Google Search of the terms 'Suicide' (grey) and 'Depression' (red) in 2019

(b) Comparison of trends of Google Search of the terms 'Suicide' (grey) and 'Depression' (red) in 2020
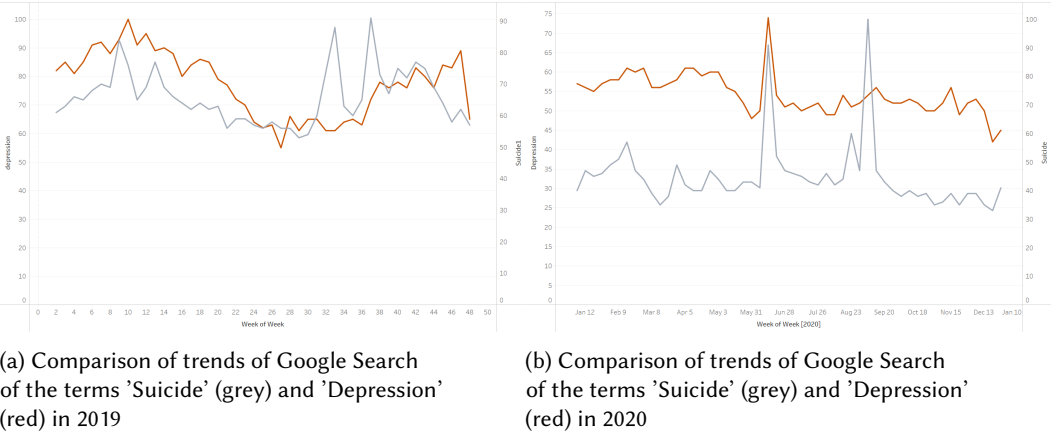
Fig. 12. Google Search trend analysis of the terms 'Suicide' and 'Depression' before and during the pandemic

(a) Comparison of trends of Google Search of the terms 'Suicide' (grey) and 'Lonely' (red) in 2019

(b) Comparison of trends of Google Search of the terms 'Suicide' (grey) and 'Lonely' (red) in 2020
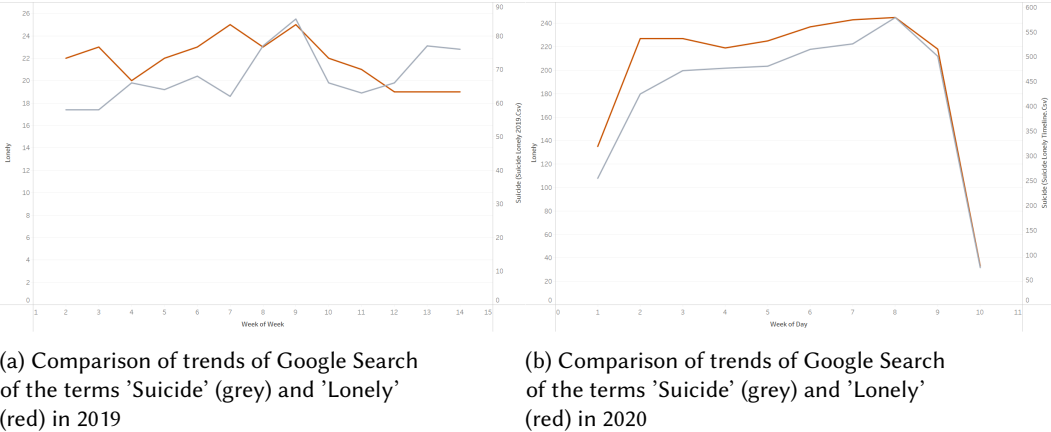
Fig. 13. Google Search trend analysis of the terms 'Suicide' and 'Lonely' before and during the pandemic

Terms	Pearson Correlation (2019)	Pearson Correlation (2020)
'Suicide' and 'Depression'	0.34	0.44
'Suicide' and 'Lonely'	-0.23	0.48

Table 6. Pearson Correlations for suicide search terms
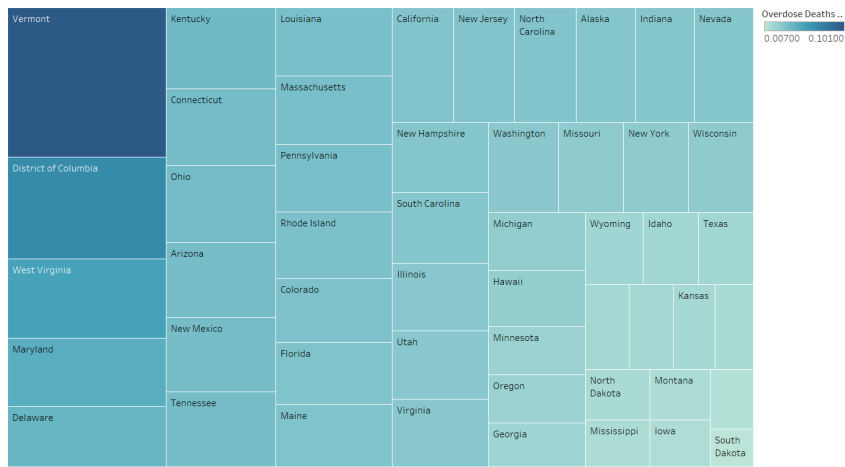
3.3 COVID-19 Measures vs Substance Abuse

Fig. 14. Treemap showing drug overdose issue across US states during the pandemic

*3.3.1 **Trend in the US**.* Figure 14 showed a treemap of the pattern of drug overdose death percentage during the pandemic across US states. Vermont registered the highest drug overdose death percentage of 0.1% of all its deaths, whereas South Dakota, located in the bottom right corner of the treemap, registered the least drug overdose death percentage of 0.007% of all its deaths. Hence, it could be inferred that the drug overdose death percentage in the United States falls roughly in the range of 0.007% to 0.1%.

A scatter plot between the suicide rates and drug overdose death rates observed during the pandemic was plotted in Figure 15a. It could be clearly concluded from the plot that there is a very strong positive correlation between the two. Table 7 shows the Pearson Correlation result for the same.
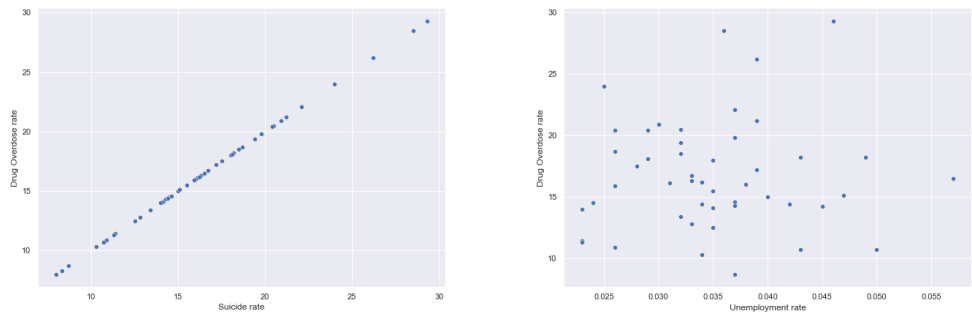
(a) Scatter Plot between suicide and drug overdose rate across US states during the pandemic

(b) Scatter Plot between unemployment and drug overdose rate across US states during the pandemic

Fig. 15. Correlation between drug overdose rates and both suicide and unemployment

	r-value	p-value	Inference
Suicide	0.99	0.0	Positive Strong Correlation, Statistically Significant
Unemployment	0.55	0.71	Positive Moderate Correlation, Statistically Insignificant

Table 7. Correlation between drug overdose rates and both suicide and unemployment

3.3.2 **Unemployment**. Figure 15b shows the scatter plot between the unemployment rate and drug overdose death pattern across US states. Table 7 shows the Pearson Correlation result for the same.

3.3.3 **Google Search trends**. Figure 16 showed the comparison between the search trends for the terms 'Drugs', 'Depression' and 'Stress' during the pandemic. It can be seen that the overall trends are very similar. Around May 8th there is a dip in all three plots, and between August 23rd and October 4th there is a peak in both the 'Stress' and 'Drugs' plots. The 'Depression' plot shows a peak on June 14th that is not present on the other search terms. Table 8 shows the Pearson Correlation result for the same.
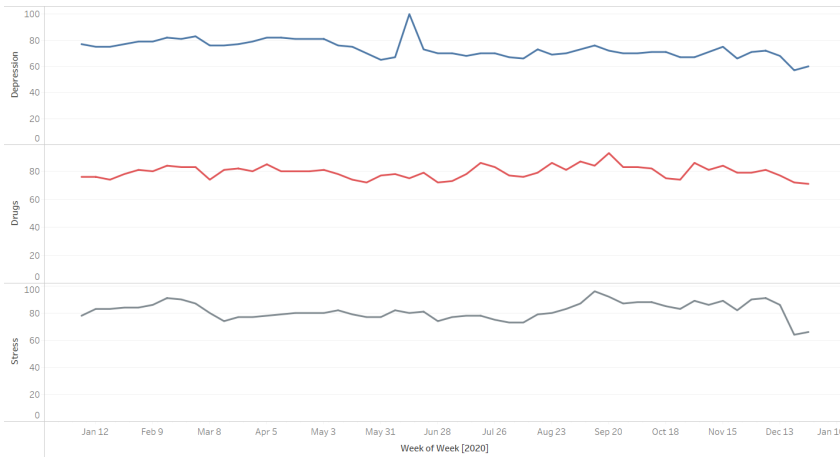
Fig. 16. Google Search Trends for the terms 'Drugs', 'Depression' and 'Stress' during the pandemic

Terms	Pearson Correlation	Inference
'Depression' and 'Drugs'	0.20	Positive Weak Correlation
'Stress' and 'Drugs'	0.57	Positive Moderate Correlation

Table 8. Pearson Correlation Result for Google Search Trends related to 'Drugs'

3.4 Statistical Testing

Since the data used does not follow a normal distribution, the Wilcoxon Signed Rank Test was performed for all comparison data.

3.4.1 **Null Hypothesis**. There is no significant difference between the two categories. The results are in Table 9.

Comparison Topic	Test Statistic	p-value
Depression rates before and during pandemic	-5.771771	7.844266e-09
Depression search text before and during pandemic	-0.495984	0.619906
Suicide rate and drug overdose during pandemic	0.0	1.0
Depression rates between males and females before pandemic	-15.44078	8.704091e-54
Depression rates between males and females during pandemic (2020)	-7.612955	2.678999e-14
Depression rates between males and females during pandemic (2021)	-7.067499	1.577509e-12
Depression rates for males between 2020 and 2021	-4.962642	6.954051e-07
Depression rates for females between 2020 and 2021	-3.466822	0.000527

Table 9. Wilcoxon results for comparison data

3.4.2 Wilcoxon Result Analysis.
(1) Depression rates before and during pandemic:
Since the p-value is less than 0.05, we reject the null hypothesis and state that there is a significant difference. Negative test statistic implies that the rates during pandemic are greater than the rates before the pandemic.
(2) Depression search text before and during pandemic:
Since the p-value is greater than 0.05, we do not reject the null hypothesis and state that there is no significant difference. Negative test statistic implies that the depression text search was more during the pandemic than before.
(3) Suicide rate and drug overdose during pandemic :
Since the p-value is greater than 0.05, we do not reject the null hypothesis and state that there is no significant difference. The test statistic is zero. This implies that they were almost identical.
(4) Depression rates between males and females before pandemic:
Since the p-value is less than 0.05, we reject the null hypothesis and state that there is a significant difference. Negative test statistic implies that the female depression rates were greater than the male depression rates before the pandemic.
(5) Depression rates between males and females during pandemic (2020):
Since the p-value is less than 0.05, we reject the null hypothesis and state that there is a significant difference. Negative test statistic implies that the female depression rates were greater than the male depression rates during 2020.
(6) Depression rates between males and females during pandemic (2021):
Since the p-value is less than 0.05, we reject the null hypothesis and state that there is a significant difference. Negative test statistic implies that the female depression rates are greater than the male depression rates during 2021.
(7) Depression rates for males between 2020 and 2021:
Since the p-value is less than 0.05, we reject the null hypothesis and state that there is a

significant difference. Negative test statistic implies that the male depression rates during 2021 were greater than the male depression rates during 2020.

(8) Depression rates for females between 2020 and 2021:
Since the p-value is less than 0.05, we reject the null hypothesis and state that there is a significant difference. Negative test statistic implies that the female depression rates during 2021 were greater than the female depression rates during 2020.

4 DISCUSSION

4.1 General

The COVID-19 pandemic has had a huge toll not just on physical health but also on the collective mental well-being of the population. With borders closures, travel limitations, domiciliary lockdowns, social isolation and the closure of schools and offices along with the consequent transition to fully remote work, there has been a huge lack of human contact and face to face interactions. In addition, the effects of the pandemic on the economy, such as unemployment, and the excess media negativity has caused huge stress and anxiety across the world [6].

Our study provides evidence to prove the negative effects of the pandemic on the overall mental well-being of the population across the world. We divide the analysis into the effects of the COVID-19 pandemic on three distinct issues – mental health, suicide rates and substance abuse.

The mean depression prevalence rate was significantly higher during 2020 across the world when compared to the rates before the pandemic (2015 to 2019) by 13%. The general trend of depression prevalence rate was analyzed in the form of a map plot, where it could be seen that some economically developed countries suffered from very high depression rates while a few economically less-developed countries have seen a lower impact on public mental health.

The histogram plot showed that that the depression rate across the world was lower through 2019 and the beginning of 2020. But as the pandemic became more severe and longer-lasting, in addition to financial hardships, depression rates increased substantially in 2020, leading to a left-skewed plot.

In the US, different states showed varied levels of depression and suicide rates. The highly differing degrees of effect within the same country could be a result of varying COVID-19 policies followed by each state, such as the amount of time in mandatory lockdown, social distancing policies or even restrictions on public events. In addition, there is an increase in the depression rates across the US states between 2020 and 2021 by 9%. This could be attributed to the longer term effects of isolation, such as being fatigued from stay at home policies. In addition, households with children naturally take a bigger hit with schools turning entirely remote, which results in additional stress and emotional instability. Dsouza et al. [2] also reveals that people get increasingly anxious with the increase in the number of COVID-19 cases, as they fear for their own health and safety as well as of their loved ones. These are all factors that explain the increase in depression rates, not just from the on-set of the pandemic, but also all throughout the pandemic.

A strong and statistically significant correlation was observed between suicide rates and drug overdose in the United States during the pandemic. The overdose death pattern in the US was observed to be high, falling roughly in the range of 0.007-0.1%. Given that this pattern was observed during the pandemic, it is clear that concrete measures on helping people better cope with these kind of problems are long overdue.

A positive weak but statistically insignificant correlation was observed between the unemployment and depression rates across the world. In the United States, the depression rate is almost independent of the unemployment rate while there is a positive weak but statistically insignificant correlation between unemployment and suicide rate. We expected a strong correlation between

unemployment, a natural and logical consequence of personal and corporate financial hardship, and depression and suicide rates. However, this was not the case, most likely because the US economy received multiple financial stimulus, such as a drastic decrease in interest rates, that were rather successful in keeping companies from going bankrupt and/or being forced to layoff their employees.

Google Search trends showed that depression was already concerning before the pandemic as the search figures were already high in 2019, with this part of the population having a higher tendency to have suicidal thoughts due to worsening of their existing depression. It is noteworthy that, from the packed bubble plot, the countries with the highest number of depression-related search queries are a combination of countries in high, middle and low socioeconomic conditions.

The higher similarity in the trend plots of the search terms 'Suicide' and 'Lonely' in 2020 compared to their similarity in 2019 shows that the loneliness felt as a result of social isolation and depression due to multiple negative factors in the surrounding have indirectly affected the suicide rates during the pandemic. In fact, these two search terms were negatively correlated before the pandemic but positively correlated during the pandemic. The average number of searches with the term 'Lonely' increased by 64.5% in 2020. Similarly, there is a higher correlation between the search terms 'Suicide' and 'Depression' in 2020 than in 2019, with the average number of searches with the term 'Depression' increased by 42.5% in 2020. Comparison between the search trends for the terms 'Drugs', 'Depression' and 'Stress' during the pandemic showed that the overall trends were very similar and that there is a significant effect of stress and depression on substance overdose, which, in turn, are both worsened by the pandemic.

The study also observed that females are more affected than males with respect to their mental well-being. *KFF – Implications of COVID-19 for mental health and substance use* also reveals that one in four women in the workplace considered leaving their jobs due to increased household responsibilities. This is understood to be more prevalent amongst women with children due to the closure of schools and universities.

Young adults are the most vulnerable part of the population. The survey data from India revealed that there is a negative weak and statistically significant correlation between the time spent on online classes and sleep. This implies that the shit towards remote learning has a slight negative impact on the hours of sleep students are getting each night. Though it was observed that it had a negligible impact on the time spent on everyday fitness, the excessive use of digital platforms might make young adults more prone to both physical and mental health issues. A decision-tree classifier was also trained to predict if the health of the child would be affected or not, based on a few features such as time spent on online classes, sleep, fitness and change in weight. It attained an accuracy of 81%.

The Wilcoxon Signed Rank Statistical Test performed on various comparison data further strengthened the above visual observations quantitatively.

4.2 Related Works Results Comparison

1. KFF - The Implications of COVID-19 for Mental Health and Substance Use
   Comparison results in Table 10.

Cited Study Inference	Our Study Inference
Depression from 11% (2019) to 41% (2020) (US)	Depression from 3.9% (2019) to 4.5% (2020) (World)
Depression (young adults)	Negative correlation - time on online class and sleep
49% women and 43% men depressed	39% women and 30% men depressed

Table 10. Comparison of results with KFF Journal

2. Citation [3]
Comparison results in Table 11.

Cited Study Inference	Our Study Inference
Difference-in-differences and individual fixed-effects regression show decline of both physical activity and mental health in young adults	Negative correlation between time spent on online class and sleep

Table 11. Comparison of results with [3]

3. Citation [7]
Comparison results in Table 12.

Cited Study Inference	Our Study Inference
A positive association between loneliness and tobacco use	Positive weak correlation between "Depression" and "Drugs" text search
there is strong evidence that both social isolation and loneliness are associated with increased all-cause mortality	Pearson correlation value of 0.48 between "suicide" and "lonely" text search

Table 12. Comparison of results with [7]

4. Citation [4]
Comparison results in Table 13.

Cited Study Inference	Our Study Inference
Average relative search volume for "loneliness" was 24% greater than expected	Average number of google search for "loneliness" was 64.5% times more in 2020 than 2019
Average relative search volume was elevated for "depression" and "panic attack"	Average number of google search for "depression" was 42.5% times more in 2020 than 2019

Table 13. Comparison of results with [4]

4.3 Note from Domain Expert

We interviewed a domain expert, Dr. Maria João Ferro, to relate to the results from the study. She is a psychologist with over 20 years of experience that focuses on Cognitive and Behavioral Therapy for children and young adults, even though she has extensive experience dealing with all age ranges.

The measures adopted to combat COVID-19 have greatly affected collective mental health in several aspects, as our study observed in Figures 1a and 1b. As a psychologist, she observed a significant increase in request for help from children to adults. Young adults seemed to have more easily adapted to working from home and living with technology for the first few months of the pandemic. However, as time passed and domiciliary lockdown continued, they started to show some signs of anxiety due to the excessive use of digital platforms and irregular sleep patterns, as also observed by our study in Figure 8a. A lot of them showed signs of irritability, fear and attention and memory difficulties. Failure in following well-established daily routines and excessive digital socialization led to emotional instability and ultimately a decline in general mental health. The other main concern, especially in young adults, was weight gain.

She also believes that the pandemic did not directly increase the number of people who are depressed, but those who were already depressed before became worse, thus leading to more severe mental health problems and suicidal tendencies. Though not severe enough to be a cause for concern, a significant number of people have resorted to soft drugs like cannabis, alcohol and tobacco as also analysed by our study in Figure 14.

Regarding gender-wise differences in mental health, she noted that, in general, females are more easily affected emotionally and tend to generally display higher levels of anxiety. She noted, however, that both genders sought help equally during the pandemic for a variety of mental health issues. This is in contrast to our study's observations, on 7a and 7b, that adult females were more affected than adult males, although not as significant on the younger population.

As our study observed in Figures 6, 12, 13 and 16, there has been a significant number of cases of people with anxiety, panic disorders and depressions that have consulted mental health professionals due to post-traumatic stress, sleeping disorders, obsessive and compulsive behaviors, as well as addictions, all issues that are made worse by the COVID-19 pandemic.

In her professional opinion, the best way to maintain good mental health during these trying times is to maintain healthy and balanced daily routines and establish daily rules to allocate some time for hygiene, food, work, digital socialization and fitness. Exploration of new activities and interests contributes to positive mental stimulation and outdoor leisure activities, with careful exercise of the COVID-19 safety measures, can also be of great help.

4.4 Significance

This study has the potential for a significant impact on making well-informed decisions and taking better actions in future pandemics, aiming for both the physical and mental well-being of the population.

5 CONCLUSION

This systemic study used data from multiple sources to test and highlight the proposed hypothesis that the COVID-19 pandemic had a significant impact on the mental health of population, in addition to the associated consequences like suicides and substance abuse. Different kinds of numerical data was collected from multiple sources for different countries and US states, for before and during the pandemic, for Google Search trends, for gender-wise differences and for young adults. The analysis was carried out both qualitatively via various data visualization techniques and quantitatively using Wilcoxon non-parametric statistical test. There has been a significant increase in the depression prevalence rate during the pandemic, with females being affected more than males. A positive weak but statistically insignificant correlation was observed between unemployment and depression rate across the world while they are almost non-correlated with respect to the United States. In addition, there is a moderate positive but statistically insignificant correlation between unemployment and drug overdose. There exists a strong correlation between suicide rates and drug overdose in the US and the drug overdose rates fall in the range of 0.007 to 0.1%. Analysis on Google Search Data revealed that there exists a noticeable similarity between the search trends of keywords like 'depression', 'stress', 'suicide', 'drugs', etc. during the pandemic. A negative weak and statistically significant correlation was observed between time spent on online classes and sleep amongst young adults. In the end, a few pointers and opinions were collected from a domain expert most of which aligned with our study results. Overall, both the proposed hypotheses were not rejected.

Given the seriousness of the issue, policy makers and government officials should take our study, as well as others, into consideration and give more thought about the mental well-being of their people, especially on trying times such as a global pandemic. Thus, effective preventive measures should be taken up to better battle the pandemic while securing both physical and mental health of the population.

Some of the limitations were that Google search data is particularly prone to selection bias as access to and inclination to use search engines likely differ substantially between different demographics. Also, this study frequently relied on world wide data, ignoring the fact that countries vary widely in their data collection capabilities and associated infrastructure. Future research should resolve these limitations by incorporating wider ranges of data collection and also, study the comparison of the mental well-being of people between the pre and post-pandemic era, once we successfully survive the ongoing pandemic.

6 ACKNOWLEDGEMENT

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