The Impacts of the COVID-19 Pandemic across Different Genders and Sexualities

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Abstract

Current studies report an increase in psychological distress as a result of the COVID-19 pandemic. This study is interested in examining mental health disparities and how the COVID-19 pandemic has disproportionately impacted marginalized groups—and more specifically, those identified by sex, gender, and sexuality—compared with the general population. This study also considers the effects and ramifications of different policy measures taken during the course of the pandemic. We perform exploratory data modeling and analysis on several important and publicly available datasets taken during the pandemic on mental health and COVID-19 infection data across various identity groups to look for significant disparities, correlations, and causations across different times and identities. This paper uses these analyses to suggest policy measures that could improve public wellness during future public health crises, and in particular across different identities.

1. Introduction

COVID-19 (coronavirus) is an infectious disease which arose in November 2019. As of June 2023, the COVID-19 infection has caused 6,945,714 deaths, along with 768,187,096 cases worldwide [38]. The disease has become one of the most adverse pandemics in recent decades, with variants of the virus with different symptoms capturing distinct time periods, such as the peak of the Omicron variant by November 2021 [20]. As the expiration of the federal COVID-19 Public Health Emergency (PHE) Declaration effectively ended the active monitoring of public health precautions for COVID-19 on May 11, 2023, the recognized infectious and medical damage caused by the pandemic has finally begun to reach a pause [7]. However, the societal consequences have not been resolved right away. COVID-19 has caused enormous distress on existing inequalities, such as between genders, social classes, and races, as well as key social functions such as the economy and education. In addition, aside from physical damage, psychological damage such as panic, anxiety, depression, and PTSD are severe as

well: Around 50% of the U.S. population reported anxiety and depression symptoms. Furthermore, these mental health issues are not just limited to the United States [25]. In a survey taken in China, 54% of participants reported moderate to severe psychological distress such as anxiety and depression from COVID-19 caused by social isolation, certain policies regarding the regulation of COVID-19, economic stress, and fear of COVID-19 [12].

The pandemic also has disproportionately impacted different demographic groups. Researchers Hossain et al. have pointed out that COVID-19 patients, healthcare workers, and the general public have distinct mental health experiences during the pandemic [16]. In general, more vulnerable social groups such as those of lower socioeconomic status face more accessibility difficulties to healthcare services and therefore more adverse mental situations. To better understand and provide appropriate psychological support to these groups, this study looks into the differentiated mental health impacts of COVID-19 on female, male, and sexual and gender minority groups. The Gender Health Paradox reveals that male and female

experienced different physical impacts from COVID-19 due to our social construct: Females have higher infection rates but males have higher death rates [3]. It is plausible that, related to similar societal factors and gender norms, the mental health of different genders is disproportionately influenced by the COVID-19 pandemic. In fact, as pointed out by a few articles, females are more negatively impacted psychologically than their male counterparts due to things such as restricted access to resources and assets, discrimination in the family, social inequalities, and the gender education gap, along with other intersectional factors that contribute to this phenomenon [1][24].

More importantly, the mental aftermath of COVID-19 has been largely under-recognized on a global scale, and in many ways, COVID-19 was not just a health epidemic but a mental health one as well [31]. The physical pandemic has limited access to mental healthcare providers and has given rise to a psychological pandemic alongside a physical one. Negative mental wellness has societal consequences such as social disorders and political polarization [28][23]. In this study, we address the lack of current literature connecting mental health data and the pandemic through performing exploratory data modeling and analysis on several important and available datasets taken during the pandemic on mental health and COVID-19 infection data across different identity groups around identical time intervals. Though focused on COVID-19 data in the U.S., this study is intended to raise awareness on the recognition of mental health as a public health problem, and more importantly, as a notable aftermath of the COVID-19 pandemic that needs to be taken seriously on a global scale through careful cross-analysis of datasets. The recovery of societal death rates and economies might not be sufficient if the public continues to feel negative and uncertain about their future. Moreover, due to the lack of gender-specific research in most countries, by drawing correlations between gender inequality and mental wellness, this study aims to explore the significance of recognizing gender disparity by providing context-specific strategy as society recovers from the COVID-19 pandemic

The purpose of this study is to analyze how and why males and females are disproportionately impacted mentally by the COVID-19 pandemic, and to use the available data on mental health during the COVID-19 pandemic to suggest future healthcare policy adjustments that better support the mental health and wellbeing of marginalized groups. This research would be significant for prior and future studies in pandemic development, geographic, mental health disparity, gender equality, and future applications in public policy and public health. The COVID-19 pandemic has shifted through multiple stages since its start in 2020, yet most of the related data analysis and reports stopped at the earliest stage of the COVID-19 pandemic in 2020, at latest 2021. Factors such as pandemic-prevention-policy went through significant

changes after 2020, and this study can provide a more up-to-date analysis of how these policy changes may have affected the general mental health of different groups in the United States.

2. Methodology

2.1 Data Information

The mental health data used in this study were pulled from the Household Pulse Survey collected by the National Center for Health Statistics (NCHS) and the Census Bureau in the U.S. The survey was put into action on April 23, 2020, in response to the need for monitoring mental health during the pandemic. Responses were collected through a 20-minute questionnaire distributed online. The questionnaire measures mental distress through multidimensional questions regarding symptoms of anxiety and depression over 7 to 14 days periods. Questions are modified from the two-item Patient Health Questionnaire (PHQ-2) and the two-item Generalized Anxiety Disorder (GAD-2) scale [5]. The data includes basic groupings of subjects from age, race, education, state, sex, gender identity, and sexual orientation, enabling further comparison between different identities and groups. As the dataset includes measurements covering all four years of COVID-19, the Household Pulse Survey serves as representative of U.S. mental health data for the use of this study.

The data on COVID-19 used in this study were gathered from the Center for Disease Control and Prevention. The dataset provides measurements of COVID-19 cases, deaths, case rates, and death rates since March 7, 2020. The data also include these variables across basic groupings of sex, age, region, and race. Data is collected through hospitalization data as well as a review of other jurisdiction websites. The statistical analyses we performed were done over a period of April 23, 2020 to March 13, 2023 and are listed below [6].

2.2 Methods

2.2.1 T-test. Student's T-test can be used to compare the means of two sample populations by assuming that the samples are normally distributed but according to possibly different means and variances. To measure differentiated mental health experiences amongst varying identity groups, this study performs T-tests between U.S. male and female depression scores, U.S. male and female anxiety scores, U.S. male and female COVID-19 cases and COVID-19 death numbers, U.S. cisgender and transgender individuals' anxiety scores, U.S. LGBTQIA+ and heterosexual individuals' anxiety scores, and U.S. bisexual and homosexual individuals' anxiety scores. In addition, T-tests on U.S. anxiety and depression scores before and after the first vaccine was released were performed to examine the impact

of vaccination and the first release of a publicly-available COVID-19 vaccine on mental health.

2.2.2 Interpolation. Data interpolation is a process of computing new data points from existing values in a given interval. While COVID-19 infectious data used in this study is collected in a 7-day-interval, Household Pulse Survey data contains intervals varying from seven to fourteen days. In order to perform more complicated correlation tests and modeling techniques between the two datasets with different time intervals, interpolation was carried out to align data points in U.S. male and female anxiety and depression, and U.S. male and female covid cases and deaths. Interpolations were done at intervals of two weeks (14 days), for the purpose of maintaining the volume of data while minimizing error in timesteps. In this study, we use the approx function to perform interpolation [36].

2.2.3 Linear Regression. Linear regression is a modeling technique implemented to predict and measure the strength of a linear relationship between two variables. Though not as sophisticated as nonlinear models, linear regression is still often an effective estimator of the strength of association between input and output variables. For this study, we constructed a linear model between U.S. COVID-19 cases and deaths to measure the correlation between those two variables. In addition, to determine whether a certain variable correlates with mental health more, the study performed and compared linear regressions between both depression and COVID-19 cases, and then between depression and COVID-19 deaths, each separately as functions of time. We are neglecting the effects of non-stationarity of each of the variables for this analysis, but we will try to mitigate these effects in other tests [19]. Furthermore, in order to measure the effects of vaccination and the release of the first publicly-available vaccine on the strength of correlations between COVID-19 deaths and depression, the study builds two linear models between the two variables both before and after the first release of vaccination on April 19, 2021.

2.2.4 Granger Causality Test. Granger causality establishes how well one or multiple variables can be used to predict another variable, which in turn implies said variable causes the other variable, particularly useful when variables in question are time series [32]. To gauge the casual relationship between COVID-19 deaths and depression, this study performed a Granger causality test using grangertest function with COVID-19 deaths as a predictor of depression scores with intervals of years (2020, 2021, 2022, 2023), as well as with intervals of before and after the release of first vaccination.

Variables	p-value for F-test

Female death ~ anxiety before eligibility	**0.03676**
after	0.14301
Female anxiety ~ death before eligibility	0.7328668
after	0.7642135
Female depression ~ death before eligibility	0.1485711
after	0.7743472
Male anxiety ~ death before eligibility	0.1954925
after	0.7264016
Male depression ~ death before eligibility	0.136405
after	0.666757

Figure 1. Granger causality test [pre- and post-vaccination]. This table shows the result of granger causality test between mental distress scores and COVID-19 deaths both before and after when vaccination was eligible.

2.2.5 Spearman's Correlation. Spearman's correlation is a correlation test measuring the strength of a monotonic and potentially nonlinear relationship between two variables. This study performed Spearman's correlation test, again neglecting the effects of non-stationarity on the analysis, on COVID-19 deaths and U.S. depression scores, as well as COVID-19 cases and U.S. depression and anxiety to further examine the strength of correlation proceeding linear modeling by testing for a monotonic relationship that need not be linear

Variables	p-value
Female anxiety ~ death	**0.002928**
Female anxiety ~ case	0.4513
Female depression ~ death	**7.38e-05**
Female depression ~ case	0.4416
Male anxiety ~ death	**0.01139**
Male anxiety ~ case	0.4661
Male depression ~ death	**0.006142**
Male depression ~ case	0.3915

Figure 2. Spearman's correlation test. This table shows the result of Spearman's correlation test between mental distress scores and COVID-19 cases and deaths. Cases and deaths were used as explanatory variables for mental distress.

2.2.6 Engle-Granger Test. The Engle-Granger test tests whether two underlying observed variables are cointegrated, or I(0), against the null hypothesis that no such relationship exists. By I(0), we mean that the two variables satisfy a linear relationship with an error that follows a stationary time

series. This study performed Engle-Granger Tests between COVID-19 deaths and depression, deaths and anxiety, and depression and anxiety.

Variables	p-value	Regression coefficient
Female anxiety ~ death	**3.16e-06**	7.217e-04
Female depression ~ death	**3.02e-07**	5.937e-04
Male anxiety ~ death	**0.00018**	5.092e-04
Male depression ~ death	**0.00028**	3.901e-04
Female anxiety ~ depression	**<2e-16**	1.25018
Male anxiety ~ depression	**<2e-16**	1.23586

Figure 3. Engle-Granger test. This table shows the result of the Engle-Granger test between mental distress scores and COVID-19 deaths, as well as between anxiety scores and depression scores.

3. Results

The tables below show all the results, including p-values, for the statistical tests and models performed in this study. For p-values smaller than 0.05, the number would be bolded.

The statistical analyses suggest several broad conclusions. First off, the general U.S. population has experienced mental health problems during COVID-19 which significantly differ depending on gender and sexuality. That is, it appears that the pandemic generally affects females more than males, and affects the LGBTQ+ population more as well. Next, mental health dilemmas show a greater correlation with the number of deaths due to COVID-19 than merely COVID infection rates. Finally, the eligibility of vaccination and exposure to pandemic knowledge appeared to have had an alleviating effect on the US's population's depression and anxiety level.

To start, the analysis confirms a few claims about the Gender Health Paradox, as well as the correlation with COVID-19 cases and deaths, and anxiety and depression scores. Overall, U.S. males have died more from the pandemic, while U.S. females constitute a larger proportion of the infection cases in the states (p < 0.005, Figure 4). Moreover, as expected, there is a positive correlation between COVID-19 deaths and cases for both sex (p < 0.005, Figure 6). COVID-19 cases are causal to death due to COVID-19 infection in 2020 and 2021 (p < 0.01, Figure 7). For the correlation between anxiety and depression, the two mental distress scores are positively correlated with a regression coefficient close to 1, indicating that the two variables are roughly equivalent in terms of modeling and establishing relationships (p < 0.005, Figure 3).

Variables	p-value	t-value
U.S. male v. female COVID cases	**<2.2e-16**	-9.4787
U.S. male v. female COVID deaths	**<2.2e-16**	11.21
U.S. male v. female depression score	**<2.2e-16**	-25.128
U.S. male v. female anxiety score	**<2.2e-16**	-49.132
U.S. female anxiety score, female depression score	**<2.2e-16**	-42.011
U.S. male anxiety score, male depression score	**<2.2e-16**	-27.071
U.S. LGBTQ+ v. straight depression score	**<2.2e-16**	34.965
U.S. LGBTQ+ v. straight anxiety score	**<2.2e-16**	35.579
U.S. gay v. bisexual depression score	**7.381e-13**	-15.296
U.S. gay v. bisexual anxiety score	**1.895e-13**	-16.403
U.S. transgender v. cisgender depression score	**<2.2e-16**	31.633
U.S. transgender v. cisgender anxiety score	**3.13e-16**	22.629
U.S. cisgender female v. cisgender male depression score	**1.269e-10**	8.8463
U.S. cisgender female v. cisgender male depression score	**<2.2e-16**	17.05

Figure 4. Two sample t-tests. This table shows the results of two sample t-tests between different sex, gender, and sexual orientation on their mental health, COVIDcases, and COVID deaths.

Sex, gender, and sexuality have a notable impact on anxiety and depression scores of the U.S. population. The study confirmed that females have a significantly higher mental distress score than males for both anxiety and depression (p < 0.005, Figure 4), with a greater disparity in anxiety level. In addition, for both sexes, depression scores are higher than anxiety scores (p < 0.005, Figure 4). Furthermore, it appears mental dilemmas, including anxiety and depression, are more significantly correlated with COVID-19 deaths for the female population than the male population (Figure 5, Figure 2).

Variables	p-value for coefficient	Regression coefficient

Female anxiety ~ death before eligibility	**8.58e-05**	7.012e-04
Female anxiety ~ death after eligibility	0.256	-0.0001378
Female depression ~ death before eligibility	**0.000176**	4.730e-04
Female depression ~ death after eligibility	0.892	7.882e-06
Male anxiety ~ death before eligibility	**0.00123**	4.808e-04
Male anxiety ~ death after eligibility	0.0971	-0.0002176
Male depression ~ death before eligibility	**0.0173**	3.168e-04
Male depression ~ death after eligibility	0.188	-0.0001253

Figure 5. Linear regression test [Vaccination]. This table shows the result of linear regression between mental distress scores and COVID-19 deaths. COVID-19 deaths are used as explanatory variables of mental distress for both female and male populations.

When including the grouping of LGBTQ+ population, the study indicates that the LGBTQ+ community generally has greater mental distress during the pandemic than the rest of the population. In terms of gender, transgender groups experience far higher anxiety and depression scores than both cisgender males and females (p < 0.005, Figure 4). On the other hand, in terms of sexuality, the LGBTQ+ community, which, in this case, contains gay, queer, and bisexual individuals, have significantly higher anxiety and depression score than the heterosexual individuals (p < 0.005, Figure 4). In addition, when separating the LGBTQ+ community into gay/queer, and bisexual groups, the bisexual individuals receives greater mental distress than both homosexual and heterosexual individuals (p < 0.005, Figure 4).

Variables	p-value for coefficient	Regression coefficient
Female death ~ case	**4.82e-10**	4.162e-03
Male death ~ case	**4.82e-10**	4.162e-03
Female anxiety ~ death	**3.16e-06**	7.217e-04
Female anxiety ~ case	0.61	5.522e-07
Female depression ~ death	**3.02e-07**	5.937e-04
Female depression ~ case	0.48	5.799e-07
Male anxiety ~ death	**0.00018**	5.092e-04
Male anxiety ~ case	0.945	6.437e-08
Male depression ~ death	**0.00028**	3.901e-04

Male depression ~ case	0.904	8.783e-08

Figure 6. Linear Regression. This table shows the result of linear regression between COVID-19's death and case, and mental distress scores. In these linear models, deaths and cases are used as explanatory variables for mental distress for both female and male.

In addition, as observed from the data analysis, COVID-19 deaths appear to be a better predictor of and are apparently more correlated with mental distress in the U.S. population than COVID-19cases. While deaths related to COVID-19 appear to be causally correlated with COVID-19 cases (as one would expect), anxiety and depression scores appear to correlate with COVID-19 deaths but not as much with COVID-19 cases for both sexes (p < 0.005, Figure 6). The positive correlation between mental distress and deaths remains significant even until 2023. In terms of Granger causality, anxiety and depression level appears to be caused by COVID-19 deaths to a statistically significant extent during 2021, when the pandemic is considerably during its worst, though casualties aren't significant in 2020, or 2022 and 2023. COVID-19 deaths are causal to female anxiety level (p < 0.005, Figure 7) and female depression level (p < 0.05, Figure 7). On the other hand, COVID-19 deaths are roughly causal to male anxiety (p < 0.05, Figure 7), whereas COVID-19 deaths cause anxiety distress for both sexes with a stronger level of statistical significance, both in the sense of Granger causality.

Variables	p-value for F-test
Female death ~ case in 2020	**1.087679e-05**
2021	0.4673115
2022	**0.00540509**
2023	0.1340348
Male death ~ case in 2020	**1.087679e-05**
2021	0.4673115
2022	**0.00540509**
2023	**0.1340348**
Female anxiety ~ death in 2020	0.7528535
2021	**5.754688e-05**
2022	0.5019003
2023	0.3031425
Female depression ~ death in 2020	0.3914924
2021	**0.01647901**
2022	0.4200436

2023	0.1003196
Male anxiety ~ death in 2020	0.7252502
2021	**0.01112981**
2022	0.3260936
2023	0.3283473
Male depression ~ death in 2020	0.2415244
2021	0.09539364
2022	0.3463603
2023	0.2838104

Figure 7. Granger causality test. This table shows the result of Granger causality test between COVID-19 deaths and cases, as well as between mental distress scores and COVID-19 deaths for all four years of the pandemic (from 2020 to 2023).

The availability of the COVID-19 vaccine in April 2021 is correlated with a significant decrease in mental distress for both males and females ($p < 0.005$, Figure 8). When the vaccine was not available, COVID-19 deaths were positively correlated with anxiety and depression scores ($p < 0.005$, Figure 5). On the other hand, after the vaccine became eligible for the public, the correlations became no longer significant (Figure 5). In addition, it is quite surprising that before the availability of the COVID-19 vaccine, in the sense of Granger causality, mental distress caused COVID-19 deaths, while the causal relationships were no longer significant after the vaccine became available ($p < 0.05$, Figure 1).

Variables	p-value	t-value
Female depression score before v. after eligibility	**2.095e-12**	11.685
Female anxiety score before v. after eligibility	**6.113e-11**	9.5024
Male depression score before v. after eligibility	**1.483e-10**	8.8871
Male anxiety score before v. after eligibility	**1.597e-11**	9.3073

Figure 8. Two-sample t-tests [pre- and post-vaccination]. This table shows the result of two-sample t.test between mental distress score before when vaccine was eligible and after when vaccine was eligible for both female and male.

4. Discussion

In summary, the results suggest that COVID-19—or in particular, deaths due to COVID-19 infection—appeared to have caused a rise in the U.S. population's mental distress (Figure 6). In addition, the statistical results suggest that females have been more mentally impacted by the pandemic and that anxiety has been more causally related to COVID-19 deaths than depression. Multiple other studies have also concluded that deaths due to the COVID-19 infection spark fear and uncertainty among the general population, not to mention that high anxiety and depression could also result from COVID-19 patients and their close ones as a result of physical and psychological stress [4][12]. Furthermore, these studies suggest a lack of attention to patients' general care due to the large medical need for servicing COVID-19 patients in particular during the pandemic has also led to an increase in mental distress among the overall population. Thus, preventive strategies for COVID-19 deaths as well as improvement for patient and public care through effective medical and policy strategies could effectively alleviate mental distress in the U.S.

It also appears that the mental dilemmas of female individuals are more significantly correlated, whether due to causality or not, to the number of COVID-related deaths than the mental distresses of male individuals are (Figure 5, Figure 2). Hence, COVID-19 appears to have negatively impacted the female population more than their male counterparts, at least as reported by the mental health survey data available. Social gender norms such as restricted access to resources and assets, discrimination in the family; lack of inclusion of women in familial finances; and gender education gap contribute to such differentiation in pandemic experiences between males and females. In other words, women with less decision-making power in the household are less likely to get access to either adequate COVID-19 treatments or mental health resources. Factors such as intimate violence and increased financial, household, and child burdens during the pandemic also can contribute to an increase in distress levels among females [1]. In addition, researchers have proved that, despite the high infectious rates, females tend to be subject to higher psychiatric disorders and feelings of loneliness than males, possibly as a result of gender norms inducing an increased rate of domestic violence due to increased time during lockdown with potentially abusive partners. As healthcare workers are largely female, the women population is associated with a greater risk of mental disorders as a result of frontier pandemic work and the stress involved with it. Relatedly, it appears that the female population who had or have experienced COVID-19 infection is exposed to a greater risk of mental distress [35]. Gender disparities are not only limited to female norms, however. For example, females and males also may suffer more from different sources of distress [2]. Relative to females, males are less likely to seek help from mental health services, which could be a notable reason for the lower reported mental distress score for men [33].

In addition to the disproportionate mental impact between sexes, our results suggest that the LGBTQ+ community appears to experience greater mental distress

than the rest of the population in the U.S., as shown in reported data which includes information that distinguishes transgender, gay/queer, and bisexual groups from the LGBTQ+ community (Figure 4). Amongst the LGBTQ+ community, transgender individuals tend to have much higher mental distress scores than cisgender individuals. The unexpected high mental risk is associated with historical discrimination as well as a lack of gender-affirming treatments during the pandemic [37]. Often due to already experiencing a more difficult socioeconomic status, the transgender community has experienced a greater lack of pandemic treatment and social support from family during COVID-19, leading to an increase in mental distress relative to other demographic groups [15][22]. With constant lockdowns further worsening social isolation, this group appears to be more vulnerable to impacts caused by lockdowns [29]. Similarly, when comparing the reported mental health of gay and bisexual groups with heterosexual groups, the former two groups experience higher mental distress scores. This could be due to discrimination, loss of support system, and, more importantly, medical discrimination when receiving treatments [30]. While social media may serve as the function of connection and support for the LGBTQ+ community, together with the exposure of cyberbullying risk, it appears that these communities weren't to benefit much from internet use during the pandemic [11]. Moreover, among different sexuality groups, the bisexual group is evidently more vulnerable to the mental health impact of COVID-19. This could be a result of more pervasive identity uncertainty reported by the group in comparison to the gay and queer communities. In addition, the bisexual community tends to experience a weaker sense of belonging and connection with the LGBTQ+ community, which also contributes to higher mental distress along with an already limited social support system during the pandemic [8].

More importantly, our results indicate a correlation between the eligibility of vaccination and decrease in mental distress among the U.S. population. Both anxiety and depression levels significantly decreased after the first vaccine was made eligible after April 19, 2021 (Figure 8, Figure 5). Before eligibility, increases in COVID-19 deaths were positively correlated with mental distress, but then the correlation became no longer significant after April 2021, indicating the public's mental distress was no longer significantly correlated or impacted by COVID-19 deaths. Notably, the U.S. female population experienced a greater decrease in anxiety and depression scores than the U.S. male population, which is inconsistent with claims from a study done in 2022 reporting mental health disparity did not vary when compared to pre-COVID levels [21]. A reasonable explanation is that gender disparity in mental health closed up slightly after the eligibility of the first COVID-19 vaccine.

People were less anxious about COVID-19 after knowing vaccines are available, as the spike in COVID-19 infections caused by the Omicron variants of COVID-19 later in 2021 did not cause a corresponding peak in mental distress, which could also be a result of vast media releases claiming that Omicron was less lethal than earlier variants. Similar results have been observed by other studies which posit that vaccination is correlated with substantial improvements in mental health for the general population, with the public viewing the virus as less detrimental, or associated with death, as a result of vaccination being available [9][4][10]. Moreover, a greater increase in mental wellness was experienced by the female population and the more clinically vulnerable groups [9]. Other studies also indicate that an increase in vaccination rate was associated with a decrease in the negative effect that COVID-19 cases have had on the U.S. public's mental distress during 2021 and 2022 [4]. In addition, vaccination has a positive mental impact on not only those receiving the vaccine but also people who live in areas where vaccination is available. This claim further demonstrates the emotional value of vaccination—knowing that preventive strategies are available has reduced the stress and fear that the public has had for the pandemic [10]. As a result, social support, timely information, and vaccination appear to be effective mediators of mental distress caused by the pandemic. Although vaccination has a positive correlation with mental wellness, the trend observed in the study could also have been caused by more social freedom and interaction, less frequent lockdowns, and better socioeconomic status after vaccines were made available and things returned to a rough sense of normalcy.

On the other hand, when analyzing the evolution of mental health and COVID-19 deaths throughout the four years of the pandemic (2020 to 2023) using the Granger causality test, the causal relationship between COVID-19 deaths and mental distress appears to be only significant during 2021, when COVID-19 deaths sparked anxiety and depression for both biological sexes (Figure 7). However, other studies have suggested that mental distress spiked in 2020 but improved in later years as a result of the aforementioned factors such as exposure to knowledge and vaccination [4]. The two observations could still be valid and tell two sides of a similar story. The causation could be explained as the public's response to the sudden exposure to information about the pandemic, together with frequent transitions between the COVID-19 pandemic lockdown and freedom of movement, caused a surge of anxiety among the public, whereas in 2020, constant quarantine and intransparent pandemic news and reported knowledge on the virus could have shielded the public from mental distress and exposure to COVID-19.

Finally, statistical results from this study signal that the mental health pandemic caused by the virus is no longer too

evident after 2021. That being said, since pre-pandemic anxiety and depression data were beyond the scope of this study, it is unclear whether the mental distress level really goes back to pre-pandemic levels. Different results on this have been observed from distinct studies. Some authors suggest the pandemic did not cause a huge spike in the overall population's mental health [14], and in fact that mental distress levels may have already returned to that of pre-2020 by recent years [34]. On the other hand, other studies suggest that the mental health provider shortages which occurred alongside rises in COVID-19 cases may have had a worse impact than imagined [27]. But overall, it appears that, regardless of if the net increase in cases was significant, mental health symptoms became correlated with COVID-19 over the first two years of the pandemic, and as preventive strategies increased, mental distress decreased accordingly. However, it would be dismissive to announce the end of the COVID-caused mental health pandemic and call an end to mental health supports, as COVID-19 permanently and demonstrably changed a lot of social and ethical attitudes in the U.S. public [18][17][26]. As a result, we suggest that certain policies should still be taken to alleviate pandemic-specific mental distress amongst the general population.

5. Conclusion

In the end, a few main conclusions can be drawn about how and why people with different genders and sexualities were impacted to noticeably different extents by the COVID-19 pandemic. Overall, our study suggests that disparities in mental distress exist across sex, gender, and sexuality, and in summary, females and members of the LGBTQ+ community have been more impacted psychologically by the pandemic. But also, rather than just feelings of depression, fear and anxiety struck by COVID-19 deaths appears to be the main cause of psychological distress for the U.S. population as a whole. However, the availability of the COVID-19 vaccine for the public proved to be evident in improving the general public's mental health, either due to psychological or public health factors. More importantly, the aforementioned vulnerable groups appeared to experience greater improvement in mental distress than the rest once the vaccine was made available. Lastly, although it is unclear and debatable whether the mental pandemic caused by COVID-19 is entirely gone, the public appears to have still undergone significant psychological, ideological, and moral changes that demand further investigation.

From our findings, we suggest a few directions of policymaking for COVID-19 and future global pandemics. To start, it is important for future policy to consider changes in the public's attitude based on their reactions to COVID-19. We should focus on adjusting public policy based on social prioritization, since the aftermath of COVID-19 not only

includes death and infection rates, but also mental health and the public's socioeconomic status. The results of the data analyses suggest that the government should implement public care policies that focus on reverberating and engaging with individuals' and society's socioeconomic situation from the pandemic after COVID-19 and for future pandemics. These policies should also aim to address individual disparities in pandemic experiences, including a more supportive healthcare system that is responsive to gender and sexuality-specific disparities such as gender-affirming care.

In addition, this study revealed a few trends that are significant to policy decisions in the case of future pandemics and natural disasters. Firstly, we should expect a rise in disease or pandemic impacts to spark a rise in public mental distress due to fear and anxiety. In the end, whether caused by the pandemic or not, the disparity in mental health across people of different identities is a long-term issue which the U.S. population continues to face. As a result, resources allocated to psychological care should be increased via public health policies, and in particular, policy should aim to increase, or at the very least maintain, sufficient mental support providers for both patients with prescribed mental disorders and the general public even during the more serious stages of the pandemic. Decreasing anxiety and depression alleviates the public's negative feelings and poor socialization due to the pandemic. Secondly, it should be expected a priori that societally marginalized groups would receive more severe psychological impacts from the pandemic. As a result, future policies should focus on caring for these more vulnerable demographic groups at the beginning of the pandemic in order to minimize possible mental distress, including more inclusive healthcare policy and fostering a supportive social media environment that maximizes the visibility of minority groups to alleviate the impacts brought on by social isolation [11]. Lastly, although exposure to pandemic knowledge would increase public mental distress at first, this study shows information transparency, death preventive strategies, and availability of vaccination could decrease the pandemic's impact on public mental health. Hence, healthcare providers should focus immediately on the aforementioned areas to decrease the public's anxious emotions towards the pandemic.

The following research appears to be significant for prior and future studies in pandemics, mental health, gender equality, and future public health policy. The COVID-19 pandemic has shifted through multiple stages since starting in 2020, yet most of the related data analyses and reports stopped at the earliest stage of the COVID-19 pandemic in 2020, at the latest 2021. Factors such as pandemic prevention policy went through significant changes after 2020, and this study provides a more up-to-date analysis of how these policy changes may have affected the general mental health of different groups in the United States. In the end, this study

analyzes in-depth the major mental health trends during the pandemic in order to generate more robust conclusions that are useful for current and future case studies.

However, since most countries lack effective and complete metrics for mental health, data that cover the full length of time from before the pandemic to 2023, or transparent data that incorporate information about multiple marginalized groups simultaneously, the framework of analysis introduced in this study cannot be applied to most other countries, and therefore, this study is unable to come to effective conclusions on the global impacts of COVID-19 and how these differ across different countries. More generally speaking, most countries seem to lack indicators of mental health and therefore available data for analysis. Thus, we suggest future research and data collection to focus on comparing mental health data across different countries which involves data that features a more diverse sampling of demographic groups, with a specific focus on countries that lack transparent and unbiased data and awareness on mental health.

In the end, the research has a broader purpose than just specific public health policy recommendations. As the world is going through breakthroughs and developments, it is important to adjust and improve social welfare and public health policies accordingly. As shown by our study, the trove of mental health data during the COVID-19 pandemic has been demonstrated to be an effective signal of the need for better mental health policies and interventions. We must build a more resilient healthcare and psychological system that is well-planned to withstand future pandemics like COVID-19. This data-driven study should stand as a call to action for further multidisciplinary studies that address the world and its people's individual and group needs under uncertain times.

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