



# Factors associated with adverse mental health outcomes during the COVID-19 pandemic

S.H. Choi, S. Kim\*

College of Liberal Arts and Sciences, Azusa Pacific University, USA

## ARTICLE INFO

### Keywords:

Mental health  
COVID-19 pandemic  
Health inequities  
Healthcare access  
Missing data

## ABSTRACT

**Objectives:** Even with significant advances to advance the health status of the general American population, the increased prevalence of mental health conditions and re-emergence of highly infectious diseases across all levels of society present a significant threat. This study aimed to quantify the effects of pandemic-, healthcare-related, and sociodemographic variables on adverse mental health outcomes, and determine their relative magnitudes. **Study design:** This study employed publicly available data from the Household Pulse Survey, conducted by the United States Census Bureau to examine the social and economic impacts of the COVID-19 pandemic on American households.

**Methods:** A multiple regression model formed the basis of analysis, with adverse mental health as the outcome and various pandemic-, healthcare-related, and sociodemographic variables as predictors. Missing data was handled using multiple imputation.

**Results:** The factors with significant contributions to adverse mental health outcomes were those associated with mental health services and prescriptions. General healthcare-related variables followed those specific to mental health, along with sociodemographic variables contributing smaller changes. There were differential outcomes in mental health that were in part attributable to sociodemographic factors, but also a lack of access to both mental and physical healthcare due to factors both related and unrelated to the ongoing pandemic.

**Conclusions:** There is a need for policymakers and other stakeholders to work towards a mental health system that is more robust to restrictions brought on by events like the COVID-19 pandemic, and to address inequities in health care that have been exacerbated.

## 1. Introduction

Over the last century, significant advances in medicine, biotechnology, and public health have ameliorated the health status of the general American population. At the same time, the increased prevalence of mental health conditions and re-emergence of highly infectious diseases across all levels of society present a significant threat to quality of life and increased mortality risk. With previous research showing that various sociodemographic factors may play a role in both mental health and infectious disease, it is of interest to explore the effects of such factors on mental health during the COVID-19 pandemic.

The contribution of common demographic variables such as age and gender to the onset of psychiatric disorders seems to be complex, but some general patterns can be ascertained. It is clear, for instance, that there are differential impacts of different disorders according to age and gender, to the point where it has become standard practice to

disaggregate data according to these two variables [1]. Physiological differences, such as those of the reproductive system or gut-brain axis [2, 3], may explain such differences; the differences in gender experience (e.g., gender roles, gender-based violence) and how gender may affect the perception of mental well-being also seem to be involved. [2].

The increasing proportion of racial and ethnic minority groups in the United States, which has become a central focus in population health, seems particularly vulnerable to both psychiatric and infectious disease events: previous research has shown disparities in mental health treatment among minority populations [4]; disproportionate impacts of the COVID-19 pandemic on racial and ethnic minorities [5,6]; and experts have expressed concern regarding the potential relationship these two events may have on these groups [7].

The relationship between health and income is well-established. In the field of international development, it is traditionally thought that as income *per capita* increases, so do positive health outcomes (e.g., life

\* Corresponding author. Azusa Pacific University, 675 E Foothill Blvd, Azusa, CA, 91702, USA.

E-mail address: [soeunkim@apu.edu](mailto:soeunkim@apu.edu) (S. Kim).

<https://doi.org/10.1016/j.puhip.2023.100360>

Received 27 July 2022; Received in revised form 13 December 2022; Accepted 10 January 2023

Available online 26 January 2023

2666-5352/© 2023 The Authors. Published by Elsevier Ltd on behalf of The Royal Society for Public Health. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

expectancy); this is not only because more capital allows for increased access to health services, but also as healthier individuals are more productive and contribute to their society, being valued and hence, generating income [8]. Higher education (e.g., higher life expectancy can be associated with greater incentive to invest in schooling and skill development) and job loss (tied to income) also fit into this picture. Studies from various international environments have shown the link between increased health and income to be valid, even specifically relating to mental health and income [9].

It is evident that these variables, in addition to other pandemic-, healthcare-related, and sociodemographic factors that are not as well-studied, may be importantly associated with mental health outcomes during the COVID-19 pandemic. This study informs stakeholders about factors (both known and novel) that are contributing to mental health issues, particularly among vulnerable and marginalized populations, during an infectious disease pandemic. This study aimed to quantify the factors associated with adverse mental health outcomes, and determine their relative magnitudes.

## 2. Methods

### 2.1. Data

This study employed publicly available data from Week 27 (Phase 3) of the Household Pulse Survey (HPS), conducted by the United States Census Bureau to examine the social and economic impacts of the COVID-19 pandemic on American households [10]. Households selected to participate in the survey were contacted by email and/or text, depending on what information was available in the Census Bureau's Master Address File (MAF; the source of sampled units), with the survey being conducted on the online platform Qualtrics. For Week 27, the data source for this study, 1,040,111 housing units were contacted between March 17 and 29, 2021, of which 77,104 unique responses were recorded [11].

### 2.2. Outcome

An amalgamation of 4 self-reported indices suggestive of adverse mental health outcomes from the past week were treated as the outcome.

- anxiety ("feeling nervous, anxious, or on edge"),
- worry ("not being able to stop or control worrying"),
- little interest ("having little interest or pleasure in doing things"), and
- depression ("feeling down, depressed, or hopeless").

Each of these variables was reported on a scale of 0 ("Not at all") to 3 ("Nearly every day"). Therefore, 'adverse mental health outcomes' was measured as a single response variable calculated by adding the 4 self-reported indices together, with possible values ranging from 0 to 12.0 indicated the lowest severity, and 12 indicated the highest.

### 2.3. Exposures

Demographic, COVID-19-, mental health- and overall health-related variables were examined as part of this study. These include: age (continuous), gender (male/female), race/ethnicity (Hispanic, any race/non-Hispanic White/non-Hispanic Black/non-Hispanic Asian/non-Hispanic other, where other is defined as "any other race alone, or race in combination"), household income (above or below \$75,000), marital status (currently married/other), education level (bachelor's degree and higher/below), job loss in household during pandemic (yes/no), received a diagnosis of COVID-19 (yes/no), received COVID-19 vaccine (yes/no), prescription for mental health condition in the last month (yes/no), mental health services (e.g., counseling, therapy) received in

the last month (yes/no), mental health services needed, but not received for any reason in the last month (yes/no), public or private health insurance (yes/no), delayed medical care in the last month (yes/no), and medical care not received due to COVID-19 pandemic (yes/no).

### 2.4. Statistical analysis

A multiple linear regression model formed the basis of analysis conducted in this study. The dependent variable was 'adverse mental health outcomes,' and all variables listed under the Exposures section were included as independent, binary variables, with the exception of age which was continuous. The regression equation below summarizes the model:

$$Y_i = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_m x_m + \varepsilon_i,$$

where  $Y_i$  is the dependent variable,  $\beta_0$  is the intercept, all other  $\beta$  values are coefficients for each of the independent variables such as age, and  $\varepsilon_i$  is the random error component.

As is common in survey data, some observations contained missing responses. Multiple imputation entails imputing missing values with several plausible values [12,13], conducting separate analyses, and compiling the results while accounting for variations to provide valid results. Multiple imputation avoids the potential bias that may arise from omitting incomplete observations, or using a single imputation for each variable which underestimates variability; thus, this was the method of choice for dealing with missing values.

Markov chain Monte Carlo (MCMC) method was employed for multiple imputation, using the MI procedure in SAS 9.0. All variables in the model were used to impute and obtain 10 imputed datasets, which were analyzed separately using the REG procedure to produce 10 multiple regression results. To obtain the combined parameter estimates, the MIANALYZE procedure was used; two-sided tests were conducted for each of the parameters, with the significance level set at  $p < 0.05$ .

## 3. Results

The average age of respondents in the sample was 54.6 years, with a range of 70 years (18–88 years). There were fewer respondents in the youngest and most elderly age groups (18–29 years and 80–89 years), with those groups corresponding to only 6.5% and 3.8% of the total respondents, respectively. There was an overrepresentation of females in this study (59.4% of total) as well as non-Hispanic White participants (74.9% of total) when compared to the general American population. On average, it also seemed that respondents were of higher socioeconomic status and education level, which is reflective of response patterns observed in other studies [14].

Among those who responded to questions relating to their anxiety, worry, little interest and depression in the past week, defined collectively in this study as 'adverse mental health outcomes', 55.4%, 46.4%, 46.9%, and 44.1% of participants experienced such feelings for at least 'several days', respectively (Table 1). When it came to the most extreme severity, 'nearly every day', 14.2%, 9.8%, 8.4%, and 8.1% of participants reported experiencing anxiety, worry, little interest and depression at that level, respectively.

According to the results of the multiple regression model (Table 2), the factors with significant and large contributions to adverse mental health outcomes were those associated with mental health services and prescriptions. Having needed mental health services, but not received them for any reason in the last month contributed an approximately 3-unit increase ( $\beta = 3.08$ ) to adverse mental health outcomes, which corresponds to a quarter of the 12-unit scale. This was followed by having a prescription for a mental health condition in the last month (1.55) and receiving mental health services in the last month (1.20), all of which were positively associated with adverse mental health outcomes.

**Table 1**  
Characteristics of sample, Household Pulse Survey, March 17–29, 2021.

Characteristic	n (%)
Age, in years	77,104 (100.0%)
18-29	4983 (6.5%)
30-39	10,804 (14.0%)
40-49	13,335 (17.3%)
50-59	14,982 (19.4%)
60-69	18,184 (23.6%)
70-79	11,901 (15.4%)
80-89	2915 (3.8%)
Gender	77,104 (100.0%)
Female	45,768 (59.4%)
Male	31,336 (40.6%)
Race/Ethnicity	77,104 (100.0%)
Hispanic, any race	7391 (9.6%)
non-Hispanic White	57,715 (74.9%)
non-Hispanic Black	5600 (7.3%)
non-Hispanic Asian	3813 (5.0%)
non-Hispanic other	2585 (3.4%)
Household income	58,680 (100.0%)
Less than \$25,000	5663 (9.7%)
\$25,000-\$34,999	4899 (8.4%)
\$35,000-\$49,999	6310 (10.8%)
\$50,000-\$74,999	10,448 (17.8%)
\$75,000-\$99,999	8473 (14.4%)
\$100,000-\$149,999	11,005 (18.8%)
\$150,000-\$199,999	5458 (9.3%)
\$200,000 and above	6424 (11.0%)
Marital status	76,289 (100.0%)
Now married	45,350 (59.5%)
Widowed	4566 (6.0%)
Divorced	11,719 (15.4%)
Separated	1314 (1.7%)
Never married	13,340 (17.5%)
Education level	77,104 (100.0%)
Less than high school	551 (0.7%)
Some high school	1139 (1.5%)
High school graduate or equivalent (e.g., GED)	8851 (11.5%)
Some college, but degree not received or is in progress	16,501 (21.4%)
Associate's degree (e.g., AA, AS)	8091 (10.5%)
Bachelor's degree (e.g., BA, BS, AB)	22,267 (28.9%)
Graduate degree (e.g., master's, professional, doctorate)	19,704 (25.6%)
Job loss in household during pandemic	76,626 (100.0%)
Yes	27,518 (35.9%)
No	49,108 (64.1%)
Received COVID-19 diagnosis	76,165 (100.0%)
Yes	8425 (11.1%)
No	67,740 (88.9%)
Received COVID-19 vaccine	76,698 (100.0%)
Yes	45,626 (59.5%)
No	31,072 (40.5%)
Prescription for mental health condition in last month	62,718 (100.0%)
Yes	13,862 (22.1%)
No	48,856 (77.9%)
Mental health (MH) services received in last month	62,703 (100.0%)
Yes	6745 (10.8%)
No	55,958 (89.2%)
MH services not received for any reason in the last month	62,770 (100.0%)
Yes	6152 (9.8%)
No	56,618 (90.2%)
Public or private health insurance	63,089 (100.0%)
Yes	60,106 (95.3%)
No	2983 (4.7%)
Delayed medical care in the last month	62,728 (100.0%)
Yes	15,396 (24.5%)
No	47,332 (75.5%)
Medical care not received due to COVID-19 pandemic	62,758 (100.0%)
Yes	11,191 (17.8%)
No	51,567 (82.2%)
Anxiety in the past week	63,944 (100.0%)
Not at all	28,490 (44.6%)
Several days	19,443 (30.4%)
More than half the days	6909 (10.8%)
Nearly every day	9102 (14.2%)
Worry in the past week	63,840 (100.0%)
Not at all	34,263 (53.7%)

**Table 1 (continued)**

Characteristic	n (%)
Several days	17,802 (27.9%)
More than half the days	5535 (8.7%)
Nearly every day	6240 (9.8%)
Little interest in the past week	63,841 (100.0%)
Not at all	33,942 (53.2%)
Several days	18,620 (29.2%)
More than half the days	5943 (9.3%)
Nearly every day	5336 (8.4%)
Depression in the past week	63,889 (100.0%)
Not at all	35,682 (55.9%)
Several days	18,025 (28.2%)
More than half the days	4992 (7.8%)
Nearly every day	5190 (8.1%)

**Table 2**  
Parameter estimates for multiple regression model predicting mental ill-being (10 imputations).

Parameter	Estimate	Std Error	p
Age, in years	-0.022	0.001	<.0001
Female	0.116	0.025	<.0001
Ethnicity/Race (non-Hispanic, White as reference)			
Hispanic, any race	0.131	0.056	0.0042
non-Hispanic, Black	0.045	0.043	0.3060
non-Hispanic, Asian	0.208	0.054	0.0001
non-Hispanic, other	0.267	0.062	<.0001
Household income of \$75,000 and above	-0.456	0.030	<.0001
Married	-0.358	0.027	<.0001
Bachelor's degree and above	-0.354	0.026	<.0001
Job loss in household during pandemic	0.794	0.025	<.0001
Received COVID-19 diagnosis	-0.082	0.036	0.0217
Received COVID-19 vaccine	-0.198	0.026	<.0001
Prescription for mental health condition in last month	1.553	0.030	<.0001
Mental health (MH) services received in last month	1.203	0.042	<.0001
MH services needed, but not received for any reason in the last month	3.076	0.040	<.0001
Public or private health insurance	-0.627	0.056	<.0001
Delayed medical care in the last month	1.043	0.038	<.0001
Medical care not received due to COVID-19 pandemic	0.806	0.038	<.0001

General healthcare-related variables followed those specific to mental health: delayed medical care in the last month because of the pandemic was associated with an approximately 1-unit increase (1.043) to adverse mental health outcomes, while not receiving needed medical care in the last month for something unrelated to the pandemic showed a slightly smaller increase (0.806). Contrary to the variables discussed thus far, holding either public or private health insurance was negatively associated with adverse mental health outcomes (-0.627) indicating an association with better mental health.

COVID-19 diagnosis (-0.082) and receiving a COVID-19 vaccine (-0.198) were both statistically significant, but had minimal contributions to adverse mental health outcomes, according to the model. Among sociodemographic variables, increasing age (-0.022), a household income of \$75,000 and above (-0.456), being married (-0.358), and possessing a bachelor's degree or above (-0.354) were associated with better mental health outcomes, while being female (0.116), and job loss in household during the pandemic (0.794) were associated with worse mental health outcomes. Most of these contributions were relatively small, with the exception of job loss.

Compared to the non-Hispanic, White reference group, all ethnicity/race groups showed minor increases in mean adverse mental health outcomes. That being said, the non-Hispanic, Black group was not significant (p = 0.3060).

#### 4. Discussion

COVID-19 has had a series of wide-ranging effects on American households, including increases in indicators of adverse mental health [15]. It is also thought that sociodemographic factors could contribute to differential outcomes in mental health. Therefore, a more in-depth examination of the factors behind this increase in adverse mental health outcomes could be helpful when developing future preventative and interventional measures.

The multiple regression model on multiply imputed data, which serves as the primary focus of this study, clearly shows that variables related to mental health services and prescriptions were associated with large increases in adverse mental health outcomes, even after accounting for various sociodemographic variables. Though it is difficult to completely delineate the pandemic's contribution to lack of access to mental health services in contrast to a heightened baseline of participants with pre-existing disorders (i.e., before the pandemic), it is possible to observe the importance of accessing professional services like counselling and therapy. As with limitations to physical healthcare treatment (e.g., postponement of elective surgeries and in-person appointments), mental healthcare has suffered from similar challenges due to COVID-19, which likely contributes to this increase. The increase associated with having a prescription for a mental health condition and receiving mental health services is likely a heightened baseline for individuals with a psychiatric disorder that is not necessarily attributable to the pandemic.

General healthcare-related variables, though not intrinsically mental health-related, are associated with more adverse mental health outcomes. This may be due to the limitations to physical healthcare treatment described above: as is commonly known, there is a strong relationship between physical and mental health which seems to be at play in this case [16,17]. The slight decrease in adverse mental health outcomes brought by holding some form of health insurance could be related to reduced anxiety regarding healthcare costs and some assurance that one would have access to healthcare when needed, particularly during a time when access to healthcare is more restricted.

In contrast to the mental health difficulties brought on by the pandemic, receiving the COVID-19 vaccine or a COVID-19 diagnosis were associated with minor, yet significant contributions to mental well-being. Receiving a COVID-19 vaccination, particularly when first released, was a logistical challenge for many; therefore, a slight decrease in adverse mental health outcomes seems appropriate for this variable. In regards to receiving a COVID-19 diagnosis, the mechanism is less clear: that said, this may be a case of slight survivorship bias, where participants are more likely to have experienced mild symptoms, as they were able to respond to the survey. This, in turn, would result in a more favorable view of the virus than potentially anticipated, leading to a slight drop in adverse mental health outcomes. Yet, this is pure conjecture that should be examined with further studies.

Among the sociodemographic predictors, a household income of \$75,000 and above, being married and possessing a bachelor's degree were all associated with more favorable mental health outcomes. This corroborates the findings of researchers like Kose and the theorization of the relationship between income and health by Bloom and Canning [8, 9], where being married (associated with an increase in household income) and pursuing higher education fit into the picture. The same applies to health insurance, which may be more accessible to individuals with higher household income, and who are employed. Unsurprisingly, then, job loss during the pandemic contributed to adverse mental health outcomes, which may have been exacerbated by the instability of the job market due to various pandemic-related concerns. Considering that employment, health insurance, and income often are tied together, particularly in the American context, the negative effect of job loss and positive effects of health insurance and household income according to the model underscore the importance of job security, particularly during the pandemic.

Race/ethnicity seems to be a poor predictor for adverse mental health outcomes once more pertinent variables are accounted for, with a small effect and the non-Hispanic Black dummy variable being statistically insignificant. As the model contains other sociodemographic variables discussed below, which remain significant contributors, this may suggest the disparities due to race/ethnicity are not intrinsic, but attributable to the interplay between multiple sociodemographic variables; further investigation would be needed.

Lastly, age and gender showed significant, yet minor contributions to our scale of adverse mental health outcomes: increasing age was associated a decrease in adverse mental health outcomes, while being female was associated with an increase. This is in line with Czeisler et al.'s finding that young adults (ages 18–24) were more likely to have reported considering suicide during the pandemic [18] and that among young children and adolescents, a demographic with lower COVID-19 risk, there were increases in anxiety-related behaviors, especially due to lockdown restrictions [19]. In addition, Afifi notes that depressive and anxiety disorders are more common in women in certain countries, which is in part attributable to the difference in gender experience. He also notes that mental morbidity is higher in women compared to men. [1] Finally, as the measured outcome in this study is an amalgamation of anxiety, worry, little interest and depression, it is possible that mental health conditions more commonly experienced by women are overrepresented.

The general patterns of the pandemic's effect on mental health according to this model seems to agree with the findings of other researchers [15,18]. There are clearly differential outcomes in adverse mental health outcomes that are in part attributable to sociodemographic factors, but also a lack of access to both mental and physical healthcare due to factors both related and unrelated to the ongoing pandemic. It seems that although there is a heightened mental health concern due to the pandemic, the disparities in mental health that existed prior to the pandemic remain, and have perhaps been exacerbated.

As this study focused on a general trend of mental health during a critical period of the COVID-19 pandemic, further investigation into the effects of both pandemic-related and unrelated factors on specific mental health outcomes is needed. Yet, the findings emphasize the need for policymakers and other stakeholders to work towards a mental health system that is more robust to restrictions brought on by events like the COVID-19 pandemic. In addition, digital tools for professional mental health services, like counselling and therapy, should be designed with accessibility in mind. For example, cross-platform services for households with no computer, and improved text-based services for those without a place to receive services in a solitary setting or with patchy Internet access should be considered. Qualitative and mixed-methods research into significant variables from these findings should also be considered, in order to encapsulate the effect of COVID-19 on mental health in a more holistic manner. In sum, this data investigates mental health in the era of COVID-19, and shows that there is a continuation of inequities that requires issues to be tackled at the source.

#### Funding

This work was supported by the Richter Scholars Research Fellowship Program, generously funded by the Paul K. Richter Memorial Fund, Bank of America, N.A., Trustee.

#### Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Acknowledgements

*Statement of ethical approval:* Due to the deidentified nature of the dataset, this study was exempt from IRB review.

## References

- [1] M. Afifi, Gender differences in mental health, *Singap. Med. J.* 48 (5) (2007) 385–391.
- [2] World Health Organization, Gender and mental health. [https://www.who.int/gender/other\\_health/genderMH.pdf](https://www.who.int/gender/other_health/genderMH.pdf), 2002. (Accessed 9 February 2022).
- [3] C. Holingue, A.C. Budavari, K.M. Rodriguez, C.R. Zisman, G. Windhelm, M. D. Fallin, Sex differences in the gut-brain axis: implications for mental health, *Curr. Psychiatr. Rep.* 22 (12) (2020) 83, <https://doi.org/10.1007/s11920-020-01202-y>.
- [4] A.M. de Haan, A.E. Boon, J.T.V.M. de Jong, R.R.J.M. Vermeiren, A review of mental health treatment dropout by ethnic minority youth, *Transcult. Psychiatr.* 55 (1) (2018) 3–30, <https://doi.org/10.1177/1363461517731702>.
- [5] K. Khunti, A.K. Singh, M. Pareek, W. Hanif, Is ethnicity linked to incidence or outcomes of covid-19? *BMJ* 369 (2020) 1548, <https://doi.org/10.1136/bmj.m1548>.
- [6] D.B.G. Tai, A. Shah, C.A. Doubeni, I.G. Sia, M.L. Wieland, The disproportionate impact of COVID-19 on racial and ethnic minorities in the United States, *Clin. Infect. Dis.* 72 (4) (2021) 703–706, <https://doi.org/10.1093/cid/ciaa815>.
- [7] K. Smith, K. Bhui, A. Cipriani, COVID-19, mental health and ethnic minorities, *Evid. Base Ment. Health* 23 (3) (2020) 89–90, <https://doi.org/10.1136/ebmental-2020-300174>, 2020.
- [8] D.E. Bloom, D. Canning, The health and wealth of nations, *Science* 287 (2000) 1207–1209, <https://doi.org/10.1126/science.287.5456.1207>, 2000.
- [9] T. Kose, Gender, income and mental health: the Turkish case, *PLoS One* 15 (4) (2020), e0232344, <https://doi.org/10.1371/journal.pone.0232344>.
- [10] United States Census Bureau, Household Pulse Survey Technical Documentation, 2022. <https://www.census.gov/programs-surveys/household-pulse-survey/technical-documentation.html>. (Accessed 8 March 2022).
- [11] United States Census Bureau, Source of the Data and Accuracy of the Estimates for the Household Pulse Survey – Phase 3, 2021. [https://www2.census.gov/programs-surveys/demo/technical-documentation/hhp/Phase3\\_Source\\_and\\_Accuracy\\_Week\\_27.pdf](https://www2.census.gov/programs-surveys/demo/technical-documentation/hhp/Phase3_Source_and_Accuracy_Week_27.pdf). (Accessed 8 March 2022).
- [12] D.B. Rubin, *Multiple Imputation for Nonresponse in Surveys*, John Wiley & Sons, New York, 1987.
- [13] J.L. Schafer, Multiple imputation: a primer, *Stat. Methods Med. Res.* 8 (1999) 3–15, <https://doi.org/10.1177/096228029900800102>.
- [14] T. Lallukka, O. Pietiläinen, S. Jäppinen, M. Laaksonen, J. Lahti, O. Rahkonen, Factors associated with health survey response among young employees: a register-based study using online, mailed and telephone interview data collection methods, *BMC Publ. Health* 20 (2020) 184, <https://doi.org/10.1186/s12889-020-8241-8>.
- [15] R.L. Coley, C.F. Baum, Trends in mental health symptoms, service use, and unmet need for services among U.S. adults through the first 9 months of the COVID-19 pandemic, *Transl Behav Med* 11 (10) (2021) 1963, <https://doi.org/10.1093/tbm/ibab082>.
- [16] J. Ohrnberger, E. Fichera, M. Sutton, The relationship between physical and mental health: a mediation analysis, *Soc. Sci. Med.* 195 (2017) 42–49, <https://doi.org/10.1016/j.socscimed.2017.11.008>.
- [17] A.H. Kemp, D.S. Quintana, The relationship between mental and physical health: insights from the study of heart rate variability, *Int. J. Psychophysiol.* 89 (3) (2013) 288–296, <https://doi.org/10.1016/j.ijpsycho.2013.06.018>.
- [18] M.É. Czeisler, R.I. Lane, E. Petrosky, J.F. Wiley, A. Christensen, R. Njai, et al., Mental health, substance use, and suicidal ideation during the COVID-19 pandemic – United States, June 24–30, 2020, *MMWR-Morbid Mortal W* 69 (32) (2020) 1049–1057, <https://doi.org/10.15585/mmwr.mm6932a1>.
- [19] S. Singh, D. Roy, K. Sinha, S. Parveen, G. Sharma, G. Joshi, Impact of COVID-19 and lockdown on mental health of children and adolescents: a narrative review with recommendations, *Psychiatr. Res.* 293 (2020), 113429, <https://doi.org/10.1016/j.psychres.2020.113429>.