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For Young Adults, COVID-19 Restrictions Significantly Reduced Health-Related Quality of Life

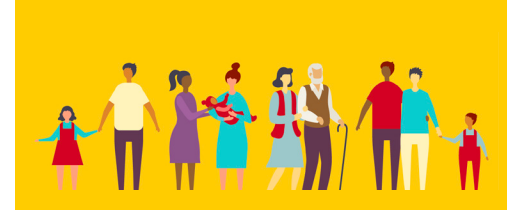
Future policy responses must consider widespread health impacts

Overview

We surveyed nearly 3,000 adults across the United States during the early stages of the pandemic in April 2020 and compared their health-related quality-of-life to pre-pandemic quality-of-life. Young people (<35 years) showed the greatest drop in health-related quality-of-life, whereas older adults (65+) did not show the same decreases as other age groups. Based on average life expectancy, these decreases are equivalent to a significant number of lives lost among those under 35 years of age.

Anxiety and depression are the primary drivers, suggesting that the mental health impact of COVID-19 is significant and falls primarily on younger adults whose health outcomes may have been overlooked based on policy initiatives to date. Future public health responses must consider balanced policy approaches that comprehensively account for downstream consequences on physical and mental health well-being.

“...these decreases [in health-related quality-of-life] are equivalent to a significant number of lives lost among those under 35 years of age.”



Introduction

There is no doubt that the global pandemic has devastated the lives of many, but to what extent and how has it specifically impacted health-related quality-of-life (HRQoL)? Since the pandemic began, countries around the world have demonstrated worsened HRQoL with significantly more anxiety and depression.

We assess the impact of COVID-19 on HRQoL in the United States using the EQ-5D-5L, a widely used survey instrument which measures HRQoL in terms of mobility, self-care, usual activities, pain/discomfort, and anxiety/ depression to compute a utility score scaled from 0 (death) to 1 (perfect health). It also includes a self-rating of health on a scale of 0-100 known as the Visual Analog Scale (VAS).

These results are translated into total lives lost by adjusting the US population life expectancy for the estimated HRQoL by age group, with the hope of informing nuanced policy and public health responses when the next pandemic occurs.

Methods

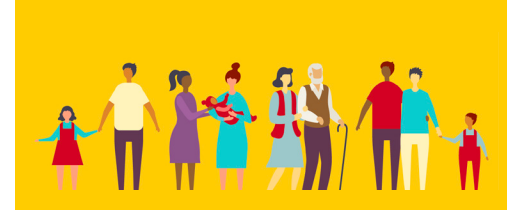
From April 1st to May 6th 2020, we surveyed 2,776 participants across the United States from an online crowd-sourced platform (Amazon Mturk) to complete the EQ-5D-5L, as well as demographics, COVID-19 status, and COVID-19-related behavior and employment changes. Respondents rated their level of fear of the impact of COVID-19 on health and finances, whether they were under mandatory social distancing, and their level of support for social distancing policies.

We calculated utility scores from the responses and compared these to previously collected pre-pandemic (n=40), online (n=2,018), and face-to-face (n=1,134) US population norms. We extrapolated total lives lost resulting from changes in HRQoL by multiplying the losses in HRQoL by the US population size of each age group, then dividing that value by the average remaining life expectancy of that age group.

We also evaluated how demographics, personal COVID-19 experiences, and fear of health and financial consequences affected HRQoL score. We accounted for history of chronic diseases (e.g. diabetes, heart problems, smoking), BMI category, and US state of residence.

These were estimated with a simple model and followed by a sophisticated machine-learning model to refine our predictions. We tested our models to see if anything not captured in the survey could affect HRQoL responses.

“Since the pandemic began, countries around the world have demonstrated worsened HRQoL with significantly more anxiety and depression”



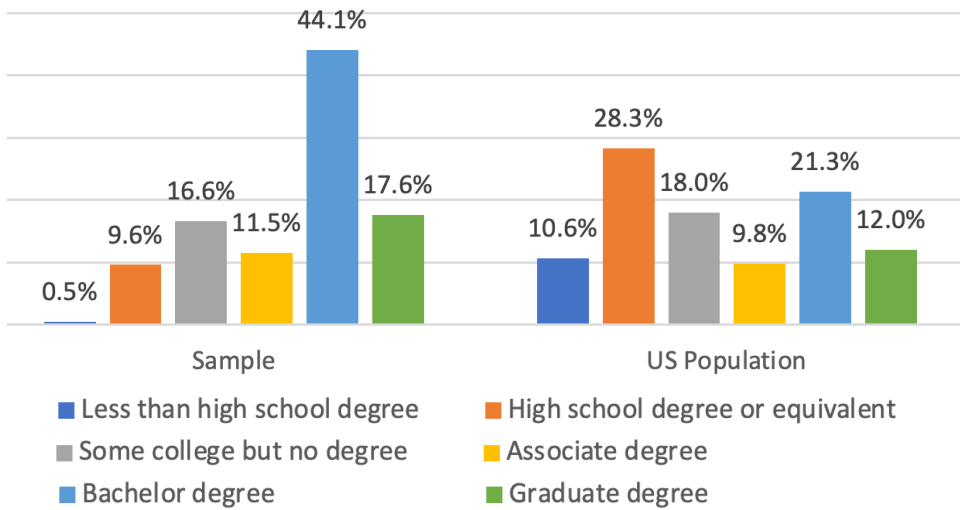
Results

Sample

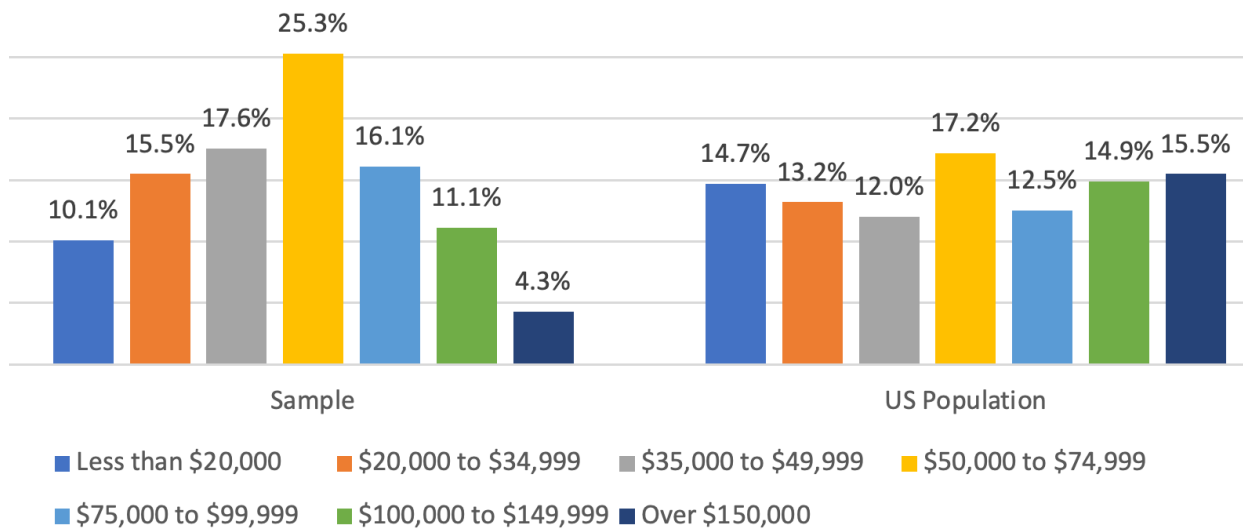
We received 2,746 complete responses to the EQ-5D-5L. Compared with the US general population, our sample was slightly older, with higher education and income levels; more Democrats; less Hispanic and Black respondents, but more individuals identifying as multi-race. There was also less chronic blood pressure, diabetes, arthritis, and migraine problems; but more problems with cholesterol, depression, asthma, and bronchitis. Full-time employment, gender, age, marital status, and BMI >30 were similar to the general US population (Figures 1a-d).

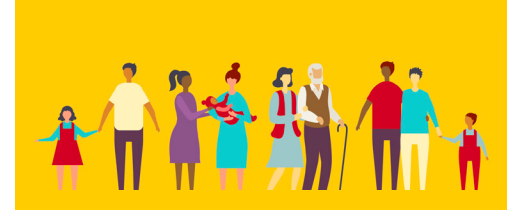
Figure 1: Select Sample Characteristics vs. the US Population

Education

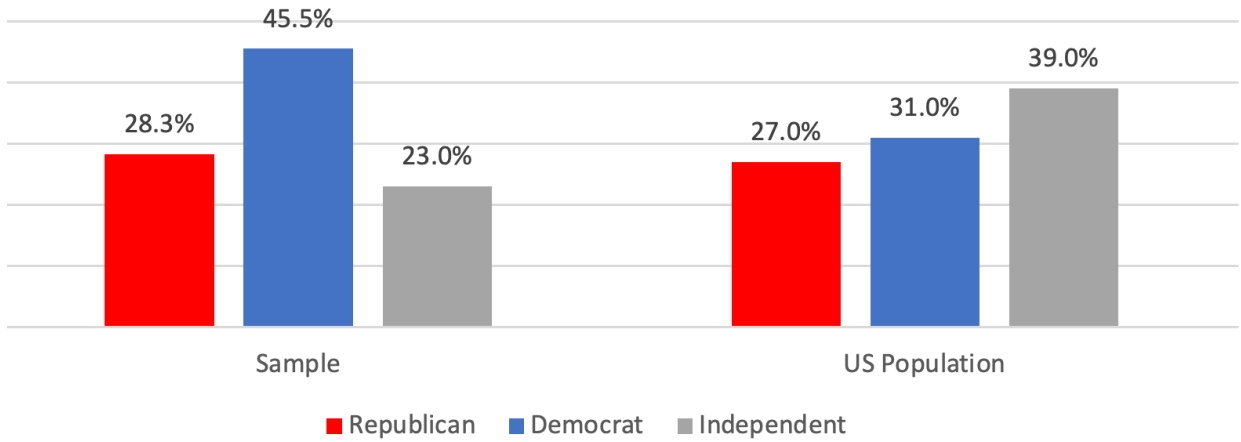


Income

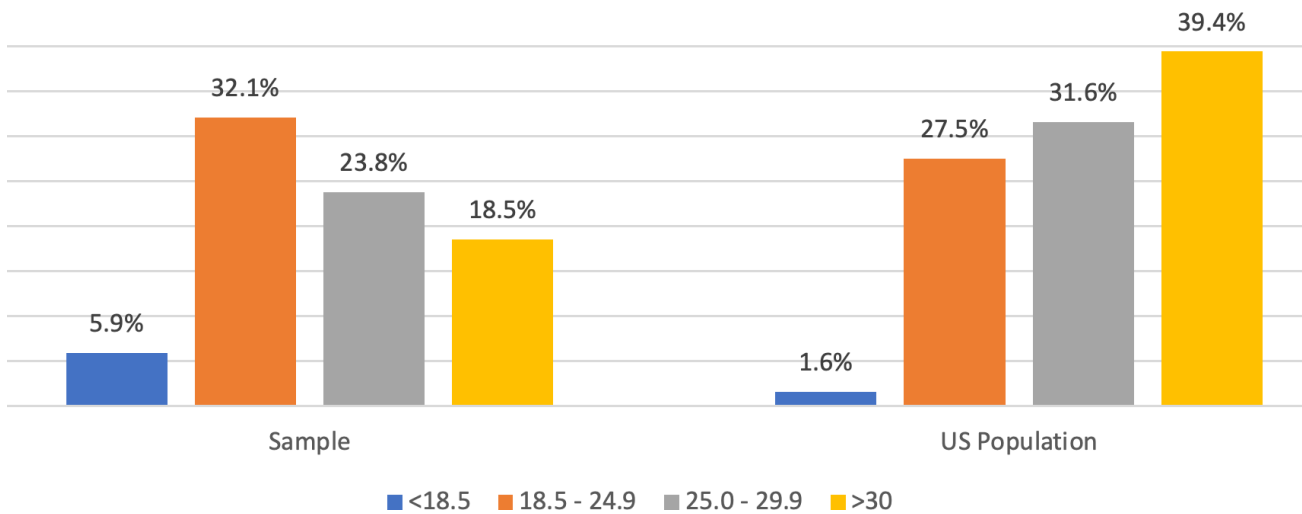




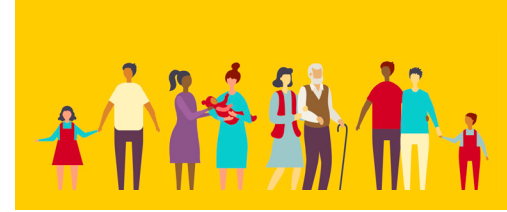
■ Political Affiliation



■ BMI Category

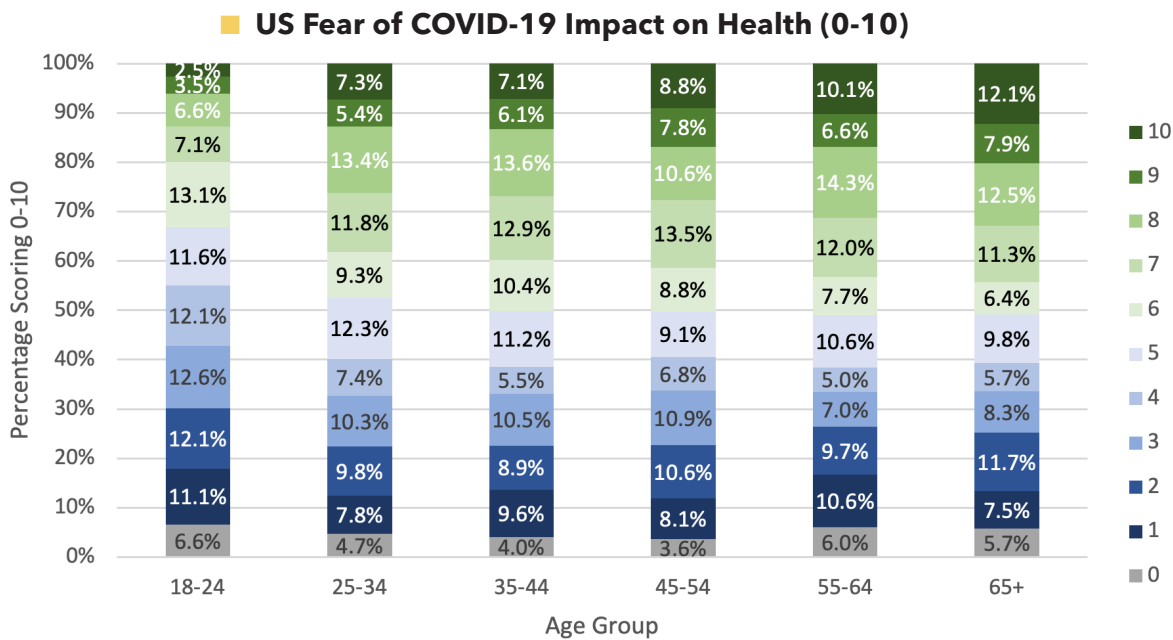


Most respondents worked in business/finance, computer and mathematical industries, office/administrative support, and management. Most respondents (52.5%) reported no change in number of hours worked per week, while 5.8% lost their job and 9.7% were temporarily laid off; 32.1% began working from home.



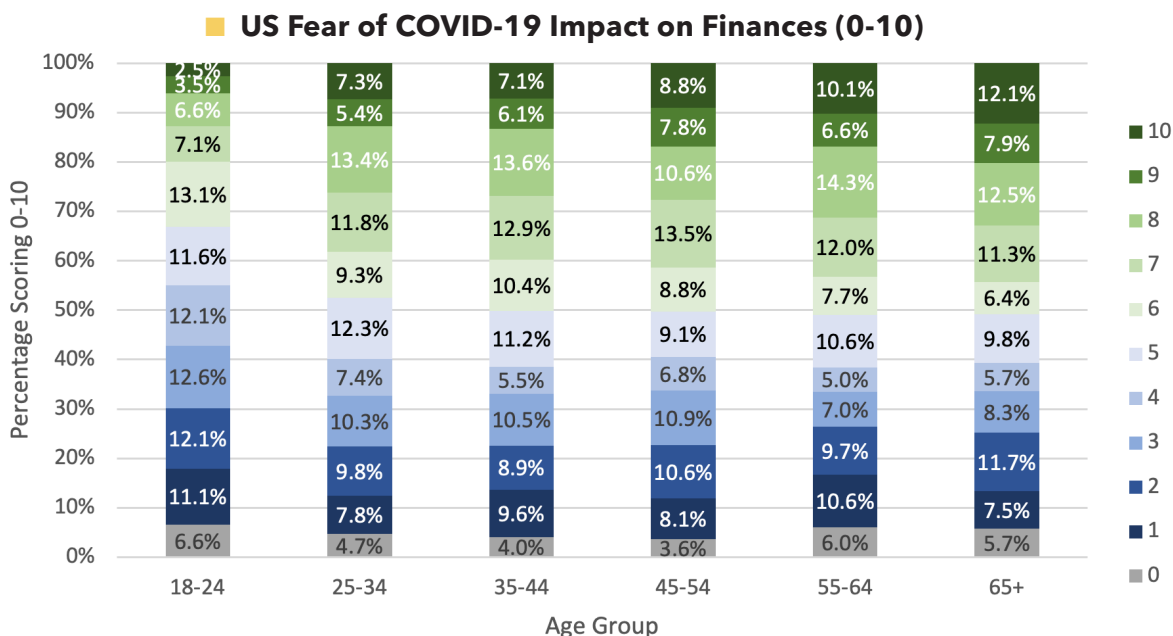
When rating fear of COVID-19's impact on their health, 59.5% of the sample reported a score of >5 on a scale of 0-10 (mean 5.20, SD 2.95) (Figure 2).

Figure 2: Fear of COVID-19 Impact on Health

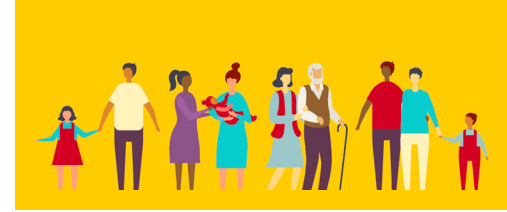


For fear of COVID-19's impact on economic/financial well-being, 67.6% reported a score of >5 (mean 5.79, SD 3.01) (Figure 3).

Figure 3: Fear of COVID-19 Impact on Finances



90.8% of respondents were under mandatory social distancing, and 90.6% scored >5 (mean 8.37, SD 2.5) in support of social distancing policies to prevent the spread of COVID-19.



Health-Related Quality of Life (HRQoL)

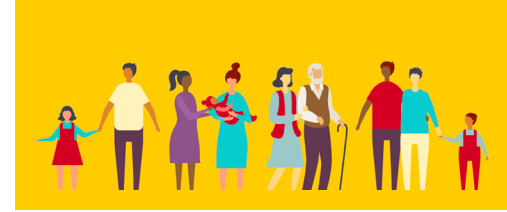
HRQoL utility score is significantly lower especially among those ages 18-24 (n=198) and ages 25-34 (n=817) compared to pre-pandemic norms. Among ages 35-64 (n=1,488), utility values are higher during-pandemic but only compared to online norms; there are no significant differences compared to pre-pandemic and face-to-face samples. At age 65+ (n=248), utility values are nearly identical across all samples.

All age groups except age 45-54 have significantly worse VAS scores compared to face-to-face norms. Only ages 18-24 also report significantly worse VAS scores compared to online norms, while ages 25-34 report significantly better scores compared to pre-pandemic. All HRQoL comparisons between our sample and online and face-to-face samples are stratified by age group in Table 1.

Table 1. Comparison of EQ-5D-5L Utility Values and VAS Scores to Norms

| EQ-5D-5L MEAN UTILITY VALUES | | | | | | | |
|------------------------------|---------------------|---------------|--------------|---------------------|--------------|-------------------|--------------|
| Age | DURING (n=2,746) | PRE (n=40) | p-value | ONLINE (n=2,018) | p-value | F2F* (n=1,134) | p-value |
| 18-24 | 0.752 | 0.921 | 0.010 | 0.844 | 0.000 | 0.919 | 0.000 |
| 25-34 | 0.825 | 0.860 | 0.490 | 0.811 | 0.305 | 0.911 | 0.000 |
| 35-44 | 0.845 | 0.867 | 0.393 | 0.794 | 0.001 | 0.841 | 0.806 |
| 45-54 | 0.818 | 0.736 | 0.452 | 0.760 | 0.001 | 0.816 | 0.969 |
| 55-64 | 0.817 | 0.766 | 0.543 | 0.781 | 0.022 | 0.815 | 0.996 |
| >=65 | 0.827 | 0.831 | 0.957 | 0.831 | 0.815 | 0.819 | 0.707 |
| EQ-5D-5L MEAN VAS SCORES | | | | | | | |
| Age | DURING (n=2,746) | PRE (n=40) | p-value | ONLINE (n=2,018) | p-value | F2F (n=1,134) | p-value |
| 18-24 | 73.1 | 72.3 | 0.950 | 79.9 | 0.001 | 84.9 | 0.000 |
| 25-34 | 76.6 | 60.8 | 0.008 | 77.7 | 0.261 | 84.4 | 0.000 |
| 35-44 | 74.2 | 74.9 | 0.894 | 74.7 | 0.686 | 78.1 | 0.004 |
| 45-54 | 73.2 | 70.5 | 0.709 | 71.1 | 0.172 | 75.9 | 0.101 |
| 55-64 | 73.4 | 71.0 | 0.827 | 71.5 | 0.194 | 78.8 | 0.002 |
| >=65 | 74.4 | 67.3 | 0.073 | 75.1 | 0.696 | 80.9 | 0.000 |

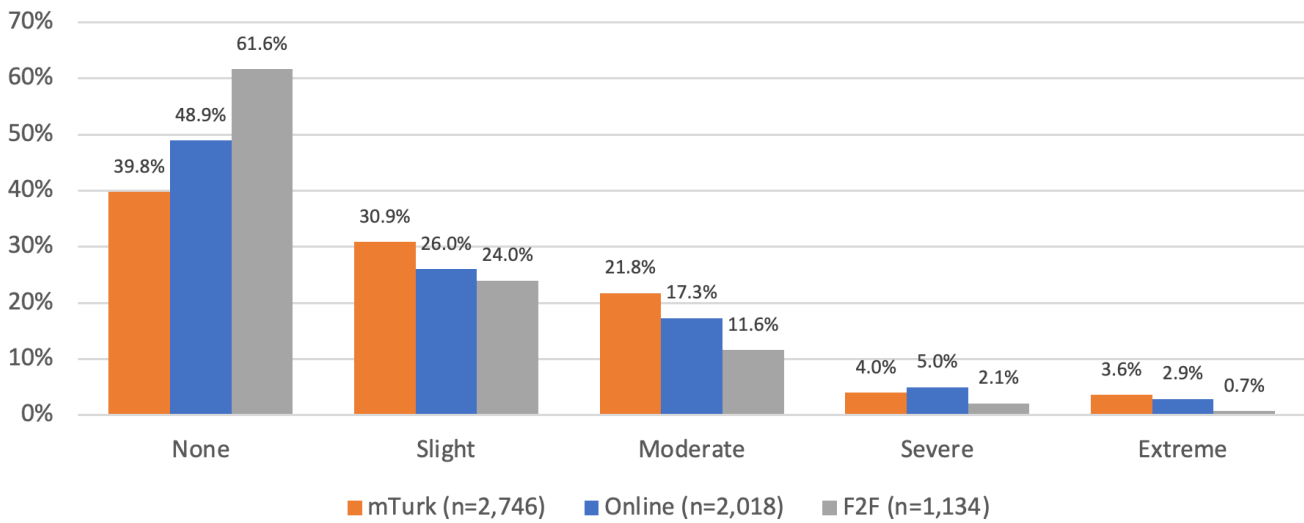
Utility values represent societal preference scores for the health states as rated by respondents and can be used to calculate quality-adjusted life years (QALYs), which adjusts life expectancy based on quality-of-life as measured by the EQ-5D-5L. VAS scores directly reflect the respondents' valuation of his/her own health status. Bolded values indicate statistical significance ($p < 0.05$).



Differences appear to be driven by the anxiety/depression dimension of the EQ-5D-5L, which is worse during the pandemic compared to pre-pandemic norms (Figure 4). This data is based on the percentage reporting none, slight, moderate, severe, and extreme problems with anxiety and depression.

Figure 4: Anxiety and Depression Dimension by Sample

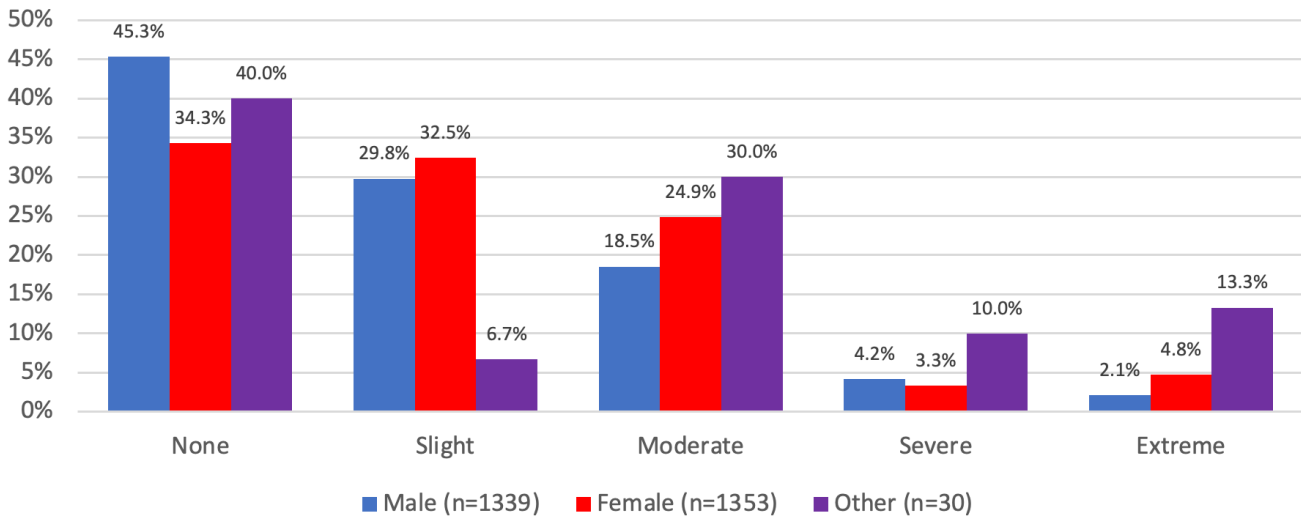
■ **Anxiety and Depression Dimension (%)**

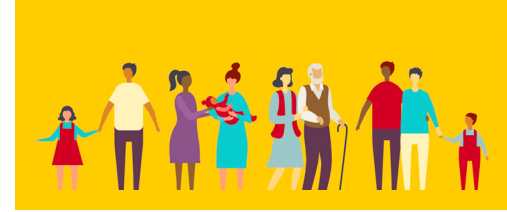


Anxiety and depression is especially pronounced among females and “other” gendered persons (Figure 5).

Figure 5: Anxiety and Depression Dimension by Gender

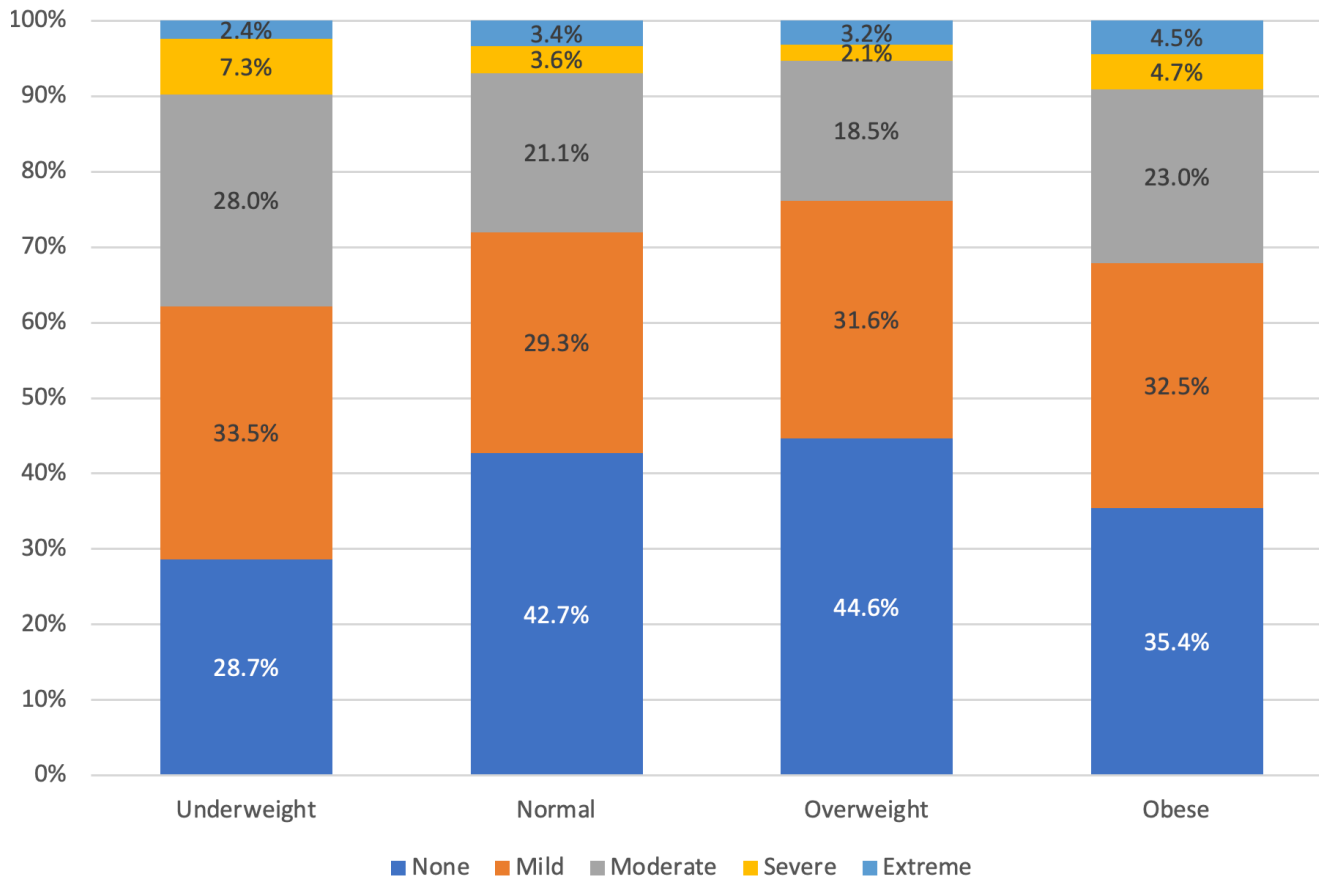
■ **Anxiety and Depression by Gender (%)**





When stratified by BMI, those who are underweight or obese experience the most severe/extreme anxiety/depression (Figure 6).

Figure 6: Anxiety and Depression by BMI



Those who are classified as underweight or obese tend to have worse anxiety and depression.

Predictors of EQ-5D-5L Utility Scores

Compared to males, “other” gendered persons have significantly worse HRQoL scores, whereas females and “prefer not to say” gendered persons differ non-significantly from males. Being 25+ years old is significantly associated with better HRQoL scores relative to ages 18-24. Asian, American Indian or Alaska Native race is significantly associated with worse scores compared to being white; other race groups differ non-significantly from whites. Hispanic ethnicity is also significantly associated with worse scores, as is being married, compared to being single.

Annual income levels >\$35,000 are associated with significantly better HRQoL scores compared to annual incomes less than \$20,000. Living alone, experiencing COVID-19-like symptoms, and having a family member diagnosed with COVID-19 (n=187) are significantly associated with worse HRQoL scores. Self-reported fear of COVID-19’s impact on personal health is also significantly correlated with poor HRQoL.



With advanced modeling, we find that arthritis (n=244), diabetes (n=181), self-reported depression (n=541), and stroke (n=28) combined with fear of COVID-19's impact on health, and underweight BMI (n=120) while residing in California (n=274) predict worse HRQoL scores. The results are driven by a self-reported diagnosis of anxiety/depression. These results are robust even after accounting for characteristics that may not have been captured in our survey.

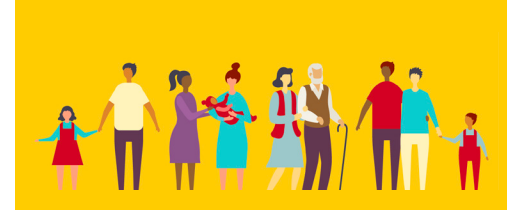
Population Lives Loss

When extrapolated to the US population, we calculate average lives lost of 77,343 and 32,449 for those aged 18-24 and 25-34, respectively, per month. This translates to 1,317,504 lives lost over one year for those <35 years of age. Below we show the number of lives lost for all other age groups.

Table 2. Change in Quality-Adjusted Life Years and Lives Affected Per Month

| TOTAL CHANGE IN QALYs | | | | | |
|-----------------------------|-----------------------------------|-------------------|------------------|-------------------|-------------------|
| Age | US Population | PRE | ONLINE | F2F | AVERAGE |
| 18-24 | 31,678,500 | -5,340,457 | -2,917,051 | -5,292,939 | -4,516,816 |
| 25-34 | 45,209,000 | -1,548,922 | 649,879 | -3,871,021 | -1,590,021 |
| 35-44 | 41,027,000 | -920,509 | 2,081,300 | 153,031 | 437,940 |
| 45-54 | 40,700,000 | 3,353,599 | 2,366,624 | 87,424 | 1,935,882 |
| 55-64 | 41,755,000 | 2,130,799 | 1,483,597 | 63,927 | 1,226,108 |
| >=65 | 52,787,000 | -225,999 | -208,403 | 425,041 | -3,120 |
| TOTAL QALY CHANGE | | -2,551,488 | 3,455,945 | -8,434,537 | -2,510,027 |
| TOTAL CHANGE IN LIVES | | | | | |
| Age | Life Expectancy (years remaining) | PRE | ONLINE | F2F | AVERAGE |
| 18-24 | 58.40 | -91,446 | -49,950 | -90,633 | -77,343 |
| 25-34 | 49.00 | -31,611 | 13,263 | -79,000 | -32,449 |
| 35-44 | 39.80 | -23,128 | 52,294 | 3,845 | 11,004 |
| 45-54 | 30.8 | 108,883 | 76,838 | 2,838 | 62,853 |
| 55-64 | 22.50 | 94,702 | 65,938 | 2,841 | 54,494 |
| >=65 | 18 | -12,555 | -11,578 | 23,613 | -173 |
| TOTAL LIVES AFFECTED | | 44,845 | 146,805 | -136,495 | 18,385 |

*F2F: face-to-face. To estimate lives lost, for example, among those aged 18-24, HRQoL decreased from 0.919 (F2F) to 0.752, a decrease of 0.167. On a population level, $-0.167 * 31,678,500$ lives = $-5,292,939$ QALYs. This value divided by an estimated remaining life expectancy of 58.4 life-years yields $-90,633$ lives lost.



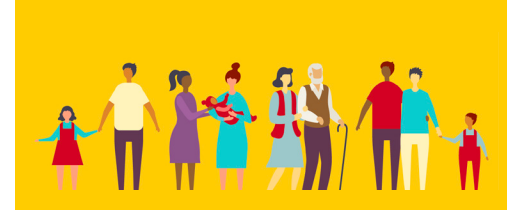
Discussion

Health-related quality of life decreased during the first months of the COVID-19 pandemic especially for those aged 18-24. This is unsurprising as the younger generation is likely more anxious about the future (education, career) and less firmly established in a set employment/career path. It is also likely a time when young adults typically are “leaving the nest”; staying home may significantly increase stress and anxiety. In addition, younger adults are at a critical life stage in developing and solidifying social relationships and networks, and social distancing/lockdowns due to COVID-19 disproportionately impacts them, particularly as this age group is far less susceptible to mortality from COVID-19. Finally, young adults may be starting families or have very young children and are not interacting with elderly family members who would normally participate in childcare, thus contributing a significant source of stress/anxiety.

We found HRQoL to be higher than population norms among those >35 years, although this may reflect a healthier, more highly educated sample compared to the US population due to the ability to work from home without loss of pay, spending more time with immediate family or friends, and more flexibility allowing time for non-job-related tasks. Those >35 are more likely to have established routines and families, thus the ability to be at home has provided improved flexibility to balance family and work life. Nonetheless, results suggest that the mental health impact of COVID-19 is significant. It is difficult if not impossible to disentangle the positive and negative impact of these elements, and it is also important to acknowledge that relationship between these factors and HRQoL may change over time.

We believe our study overestimates HRQoL as online survey respondents are more likely to have the flexibility to complete online tasks, and thus less likely to live and work in situations that would be heavily impacted by COVID-19, such as job loss or furlough. Nationally, reported unemployment rates reached a high of nearly 15% in April 2020 with some metropolitan areas reporting numbers >30%, far higher than the 5.8% who reported job loss and the 9.6% who reported being temporarily laid off in our sample. Respondents in our study were more likely to work in jobs that can be done remotely. Most likely those who experience significant job loss and/or loss income, and thus more likely to report worse HRQoL, are not being adequately captured in our sample.

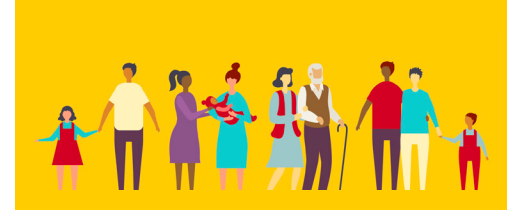
“lockdowns due to COVID-19 disproportionately impact [younger adults], particularly as this age group is far less susceptible to mortality from COVID-19”



Conclusion

COVID-19's impact on American HRQoL varies by age group, with the largest negative impact on young adults aged 18-24 years. Our results suggest that universal lockdowns without risk-assessment by age or demographic characteristics, have been implemented at the expense of the mental health of younger adults whose health outcomes have been discounted based on policy initiatives to date. We must consider the long-term implications of policies implemented during epidemics that may disproportionately impact the health and well-being of subgroups of the population, and continue to encourage health-promoting behaviors that improve the health of the population overall.

"...universal lockdowns...have been implemented at the expense of the mental health of younger adults..."



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AUTHORS

1. Joel W. Hay, PhD¹
2. Cynthia L. Gong, PharmD, PhD^{2,3,7}
3. Xiayu Jiao, PhD¹
4. Nadine K. Zawadzki, MPH, PhD¹
5. Roy S. Zawadzki⁴
6. A. Simon Pickard, PhD,⁵
7. Feng Xie, PhD,^{6,7}
8. Samuel A. Crawford, MS, PhD,¹
9. Ning Yan Gu, PhD,^{6,8,9}

AFFILIATIONS

1. Schaeffer Center for Health Policy & Economics, School of Pharmacy, University of Southern California, Los Angeles, CA, USA
2. Fetal & Neonatal Institute, Children's Hospital Los Angeles, Los Angeles, CA, USA
3. Department of Pediatrics, Keck School of Medicine, University of Southern California, Los Angeles, CA, USA
4. Department of Statistics, Donald Bren School of Information and Computer Sciences, University of California, Irvine, Irvine, CA, USA
5. Pharmacy Systems, Outcomes and Policy, University of Illinois at Chicago, Chicago, IL, USA
6. EuroQol Research Foundation, Rotterdam, the Netherlands
7. Department of Health Research Methods, Evidence and Impact (HEI), McMaster University, Hamilton, ON, CAN
8. University of San Francisco, Sacramento, CA, USA
9. NYG Technologies, CA, USA

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CONFLICT OF INTEREST STATEMENT

ASP reports that he is a member of the EuroQol group and a partner in a health care consulting company, Second City Outcomes Research LLC, but that work has no bearing on the content of this manuscript. FX and NYG are also members of the EuroQol group. NKZ and SAC report grants from EuroQol Foundation during the conduct of the study. All other authors report no other conflicts of interest.



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