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Mental health, substance use, and suicidal ideation during a prolonged COVID-19-related lockdown in a region with low SARS-CoV-2 prevalence

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ABSTRACT

The coronavirus disease 2019 (COVID-19) pandemic has been associated with mental health consequences due to direct (i.e., SARS-CoV-2 infection, potentially due to neuronal or astrocytic infection, microvascular, or inflammatory mechanisms) and indirect (i.e., social and economic impacts of COVID-19 prevention measures) effects. Investigation of mental health in a region with one of the longest lockdowns and lowest COVID-19 prevalence globally (Victoria, Australia) allowed for evaluation of mental health in the absence of substantial direct pandemic mental health consequences. Surveys were administered during 15–24 September 2020 to Victorian residents aged ≥18 years for The COVID-19 Outbreak Public Evaluation (COPE) Initiative. Responses were compared cross-sectionally with April-2020 data, and longitudinally among respondents who completed both surveys. Multivariable Poisson regressions were used to estimate prevalence ratios for adverse mental health symptoms, substance use, and suicidal ideation adjusted for demographics, sleep, and behaviours (e.g., screen-time, outdoor-time). In September-2020, among 1157 Victorians, one-third reported anxiety or depressive health symptoms, substance use, and suicidal ideation for diagnostics, sleep, and behaviours (e.g., screen-time, outdoor-time). In September-2020, among 1157 Victorians, one-third reported anxiety or depressive disorder symptoms, one-fifth reported suicidal ideation, and one-tenth reported having seriously considered suicide in the prior 30 days. Young adults, unpaid caregivers, people with disabilities, and people with diagnosed psychiatric or sleep conditions showed increased prevalence of adverse mental health symptoms. Prevalence estimates of symptoms of burnout, anxiety, and depressive disorder were unchanged between April-2020 and September-2020. Persistently common experiences of adverse mental health symptoms despite low SARS-CoV-2 prevalence during prolonged lockdown highlight the urgent need for mental health support services.

1. Introduction

The coronavirus disease 2019 (COVID-19) pandemic, caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), has been associated with adverse mental health consequences directly through SARS-CoV-2 infection and COVID-19 (i.e., through neuronal or astrocytic infection, microvascular, or inflammatory mechanisms), and indirectly through disruption of socio-behavioural health and socio-economic factors (i.e., from stay-at-home orders, nonessential business closures, school closures, gathering bans, etc.). While such sequelae may seem specific to the Great Pandemic of 2019-2021, observations of both direct and indirect mental health consequences of infectious disease outbreaks date back more than six centuries (Czeisler et al., 2021). Evidence of direct mental health effects of COVID-19 is emerging (Boldrini et al., 2021; Meinhardt et al., 2021; Perlis et al., 2021; Taquet et al., 2021a, 2021b; Woo et al., 2020). Analysis of U.S. electronic health records reveals that 18.1% of COVID-19 survivors were diagnosed with a neuropsychiatric condition within 90 days of diagnosis, including

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5.8% among individuals with no psychiatric history (Taquet et al., 2021a, 2021b), consistent with evidence of neuropsychiatric symptoms following infection with other coronaviruses (Rogers et al., 2020).

Indirect mental health effects of the COVID-19 pandemic were also anticipated (Brooks et al., 2020; Galea et al., 2020). Non-pharmaceutical interventions to contain COVID-19 have necessitated considerable social and economic disruption. Simultaneously, with 3.75 million COVID-19 deaths globally (Dong et al., 2020), and considerable morbidity, many may face prolonged grief (Verdery et al., 2020). There is evidence of widespread adverse mental health symptoms (Amerman et al., 2021), including increased prevalence of anxiety and depression symptoms, substance use, and suicidal ideation, compared with previous years (Czeisler et al., 2020, 2021a, 2021b; Ettman et al., 2020; Pierce et al., 2020; Pollard et al., 2020). Mental health disparities are apparent, with younger adults, people with pre-existing psychiatric conditions, unpaid caregivers, and essential workers disproportionately affected (Czeisler et al., 2020, 2021c; Ettman et al., 2020; Toh et al., 2021).

While evidence of adverse mental health symptoms is abundant, distinguishing between direct effects (i.e., of the disease COVID-19) and indirect effects (i.e., of SARS-CoV-2 and COVID-19 mitigation policies, COVID-19-related medical care delay or avoidance) of the pandemic is challenging, as many regions have inconsistently instituted or enforced mitigation policies alongside relatively high SARS-CoV-2 caseloads. Moreover, the U.S. Centers for Disease Control and Prevention (CDC) estimates that nearly 80% of SARS-CoV-2 infections in the U.S. in 2020 were undetected (C.D.C., 2020; Reese et al., 2020), which could complicate approaches seeking to distinguish between direct and indirect mental health effects by comparing individuals with and without histories of laboratory-confirmed SARS-CoV-2 infection. Victoria, Australia therefore presents a unique opportunity to assess robustly in contemporary community SARS-CoV-2 transmission. Victoria reported 20, 112 total SARS-CoV-2 cases (<1% positivity rate) between 25 January and 24 September 2020 with widespread testing, suggesting that approximately 0.32% of the population of 16.2 million Victorians contracted SARS-CoV-2 (Australian Government Department of Health, 2020). Even if the true infection prevalence were manifold higher, it would likely remain below 2% of the population.

The low SARS-CoV-2 prevalence may be related to stringent mitigation policies (Fig. 1), including sustained border closures, enforced physical distancing, work-from-home directives, stay-at-home orders, education and industry closures, and both visitor and public gathering bans. After restrictions briefly began to ease in late May 2020, Victoria reimposed intensive restrictions following acute increases in SARS-CoV-2 cases. In August, Victoria escalated restrictions to include an 8:00pm to 5:00am curfew, 5-km distance-from-residence travel restriction, and 1-h outdoor-exercise limit. These lockdowns were maintained through the September-2020 survey interval, before stage reopening began in October.

Evidence about mental health during the COVID-19 pandemic in Victoria is sparse, though surveys have been conducted during the COVID-19 pandemic in Australia, including several that used versions of the Patient Health Questionnaire (Lowe et al., 2004, 2010) to screen for symptoms of anxiety and depression. Across Australia, in late March 2020 near the onset of the pandemic, a survey study reported prevalence estimates of anxiety and depression symptoms were 16.4% and 20.3%, respectively, with worse mental health among Australians of younger age and female gender, as well as people living with mental health disorders (Dawel et al., 2020) or employed as essential workers (Toh et al., 2021). In a survey of 1531 Australians in early April 2020, prevalence estimates of anxiety and depression symptoms were 22.1% and 21.9%, respectively, with 28.6% of respondents screening positive for symptoms of either condition (Czeisler et al., 2021a). A month-long survey study from April to May 2020 across Australia reported similar prevalence estimates, with 21.0% and 27.6% screening positive for symptoms of anxiety and depression.

![Fig. 1. Timeline of SARS-CoV-2 active cases and related restrictions in Victoria (Regional and Metropolitan Melbourne) Legend: The number of days since the first identified active case in Victoria is plotted on the horizontal axis and number of active cases per day on the vertical axis. Publicly available data were obtained from the Victorian State Government, Department of Health and Human Services. Stage 2 lockdown requirements are indicated by yellow shaded area, Stage 3 by orange and Stage 4 by red shaded area. Dotted line indicates when Stage 3 local lockdowns were imposed across Metro Melbourne. Symbols represent the type of restrictions in place as follows (only the most relevant restrictions are shown): Stage 2 lockdown: five visitors to the household, 10 people outdoors, no over-night stays, some retail industry open, hospitality is restricted to takeaway only (31 May: 20 patrons, 21 June: 50 patrons). Key: #Social distancing in place (1.5 m apart and 4 m² per person) × Work from home directive #Four reasons to leave home are shopping for essential supplies, care/caregiving, exercise and essential work (Step 1 = 1 h of daily exercise, Step 2 = 2 h, Steps 3 and 4 = no time limit).](image-url)
April-2020 surveys were re-contacted and invited to complete September-2020 surveys. Demographic quota sampling was used to maintain by the Monash University Human Research Ethics Committee. Respondents provided electronic informed consent. Monte Carlo simulation power analyses showed that for $\alpha = 0.05$, base prevalence of adverse mental health symptoms between 15% and 40% in April 2020, and $\geq 9\%$ absolute difference in the September-2020 sample compared to the April-2020 sample, 300 participants in the April-2020 sample and 1200 in the September-2020 sample provided $\geq 78\%$–93% power, depending on the assumed prevalence in April and whether September had an absolute difference that was 9% higher or lower. Further details about the power analysis are provided in the appendix (p 2).

2.3. Outcome measures

Mental and behavioural health variables in both waves included anxiety or depressive disorder symptoms and burnout symptoms. In September-2020, additional variables included COVID-19-related trauma- and stressor-related disorder (COVID-19 TSRD) symptoms, psychological well-being, new or increase of substance use (e.g., alcohol, legal or illegal drugs, or prescriptions drugs) to cope with stress or emotions, past-month passive suicidal ideation (i.e., wished to be dead), and past-month serious suicidal ideation. Details are provided in the appendix (pp 3).

2.4. Explanatory measures

Demographic variables in both waves included sex, age, ancestry, educational attainment, employment status, political ideology, COVID-19 risk perception, diurnal preference, and previous medical history of psychiatric (anxiety, depression, post-traumatic stress disorder) and sleep (insomnia, narcolepsy, obstructive sleep apnoea, restless leg syndrome, shift work disorder, periodic limb movement disorder) conditions. In September-2020, sexual orientation, disability status, essential worker status, unpaid caregiver (caregiver) status, regional vs metropolitan postal code (corresponding to jurisdictional COVID-19 restrictions), and history of substance use disorder were also assessed. Sleep and behavioural variables in both waves included self-reported sleep duration per 24 h, insomnia symptoms, comparisons for several sleep-related variables (time in bed, trouble falling asleep, sleep regularity) during vs before the pandemic (October–December 2019), comparisons for time spent on screens and time spent outdoors during daylight hours during vs before the pandemic, and daily hours spent consuming information about COVID-19 (i.e., discussing, attending meetings, following news and announcements). Daytime sleepiness was also assessed in September 2020. Details are provided in the appendix (pp 3–6).

2.5. Statistical methods

Analyses were conducted on three samples: Victorian-April (the subset of the cross-sectional April sample from Victoria); Victorian-September (the cross-sectional September sample from Victoria); and Victorian-Longitudinal (the subset of the Victorian-September sample that completed April-2020 surveys). Iterative proportional fitting (raking) and weight trimming were employed using the R survey package (version 3.29) and R software (version 4.0.2; The R Foundation) to improve representativeness of cross-sectional samples by sex, age, and ancestry. The study was reviewed and approved by the Monash University Human Research Ethics Committee. Respondents provided electronic informed consent.
these respondents were included in the April samples only for cross-sectional comparisons (i.e., excluded from the Victorian-September sample) to eliminate survivorship bias. Bonferroni adjustments were applied to account for the 13 outcome comparisons (i.e., statistical significance was assessed as $p \times 13 < 0.05$).

With anxiety or depressive disorders symptoms, COVID-19 TSRD symptoms, having started or increased substance use, suicidal ideation (passive or active), and a composite outcome (i.e., one or more of these symptoms) as dependent variables for separate models, adjusted prevalence ratios (aPRs) and 95% confidence intervals (CIs) were estimated in the Victorian-September sample using weighted multivariable Poisson regressions. Models were adjusted for sex, age group, sexual orientation, ancestry, disability status, combined employment status, caregiver status, regional vs metropolitan postcode classification, political ideology, and COVID-19 risk perception. Additional models including all demographic explanatory variables plus one sleep- or behavioural-change variable each (to avoid collinearity) were used to estimate aPRs and 95% CIs for dependent variables. Crosstab, bivariate Rao-Scott Pearson Chi-squared tests, and unadjusted prevalence ratios for adverse mental and behavioural health symptoms were also conducted for each explanatory variable. Exploratory longitudinal analyses are described in the appendix (p 6). Statistical significance was set at two-sided $p < 0.05$. Rounded, weighted numbers and percentages are reported unless otherwise specified.

3. Results

Overall, 1531 eligible invited adults completed surveys during April 2–8, 2020, including 334 (21.8%) Victorians, and 1269 eligible invited adults completed surveys during September 15–24, 2020, including 93 recontacted respondents. After supplementary cleaning (appendix p 1), 1580 of 1603 (98.6%) unique respondents were included in the final analysis (Victorian-April $n = 331$ [99.1%]; Victorian-September $n = 1249$ [98.4%]; Victorian-Longitudinal $n = 92$ [98.9%]). Demographics are summarized in Table 1 and in the appendix (pp 8–11).

Among 1157 Victorian-September adults (excluding recontacts), 387 (33.4%) reported anxiety or depressive disorder symptoms, 354 (30.6%) reported COVID-19 TSRD symptoms, and 305 (26.3%) reported burnout symptoms (Table 2). Additionally, 143 (12.3%) respondents reported having started or increased substance use to cope with the pandemic, 196 (16.9%) reported having wished they were dead in the prior 30 days, and 110 (9.5%) reported past-month serious suicidal ideation. Regarding sleep during the COVID-19 pandemic compared to before the pandemic, Victorian-September adults more commonly reported having spent more ($n = 353$ [30.5%]) versus less ($n = 66$ [5.7%]) time in bed and having more ($n = 277$ [23.9%]) versus less ($n = 67$ [5.8%]) trouble falling asleep. Insomnia symptoms were reported by 239 (20.6%) respondents, and excessive daytime sleepiness by 166 (14.3%). Regarding other behavioural changes during COVID-19 compared to before, >1-h increased screen time and >1-h reduced time spent outdoors during daylight hours were reported by 525 (45.4%) and 586 (50.7%) respondents, respectively, and 853 (73.7%) reported not consuming information about COVID-19, compared to 43 (3.8%) who reported spending ≥4 h doing so daily.

There were no significant differences in the prevalence of adverse mental health symptoms assessed in both April-2020 and September-2020 (anxiety or depressive disorder symptoms, burnout symptoms) or sleep measures between the Victorian-April and Victorian-September samples. There were, however, significant differences in behavioural outcomes between April-2020 and September-2020. Compared with the Victorian-April sample, significantly greater percentages of respondents in the Victorian-September sample reported >1-h increased screen time ($\geq 12.0\%$ vs Victorian-April, $p = 0.013$) and not consuming COVID-19 information ($\geq 18.4\%$ vs Victorian-April, $p < 0.0001$).

Multivariable Poisson regression models with demographic variables only in the Victorian-September sample ($n = 1249$) revealed differences

| Table 1 | Respondent characteristics by sample. |
|--------|-------------------------------------|
|        | Victorian- April | Victorian- September | Victorian- Longitudinal |
|        | $n^a$ (%)$^b$ | $n^a$ (%)$^b$ | $n^a$ (%)$^b$ |
| Demographics | | | |
| Sex | | | |
| Male | 171 (51.7) | 544 (47.0) | 46 (49.5) |
| Female | 160 (48.3) | 613 (53.0) | 46 (50.5) |
| Age group, years | | | |
| 18-24 | 42 (12.8) | 123 (10.6) | 11 (12.3) |
| 25-44 | 123 (37.2) | 436 (37.6) | 34 (36.5) |
| 45-64 | 105 (31.7) | 379 (32.8) | 29 (31.1) |
| 65 | 61 (18.4) | 219 (18.9) | 19 (20.2) |
| Sexual Orientation | | | |
| Sexual | – | 1031 (89.1) | 82 (88.9) |
| Lesbian or gay | – | 45 (3.9) | 3 (3.3) |
| Bisexual | – | 44 (3.8) | 2 (1.9) |
| Something else | – | 6 (0.5) | 3 (2.7) |
| I don’t know the answer | – | 11 (1.0) | 3 (3.2) |
| Prefer not to say | – | 20 (1.8) | 0 (0.0) |
| Ancestry | | | |
| Oceanian | 86 (26.1) | 289 (25.0) | 29 (32.0) |
| North-West European | 82 (24.8) | 386 (33.4) | 22 (23.7) |
| South-East European | 32 (9.6) | 106 (9.2) | 12 (12.9) |
| North-East Asian | 19 (5.8) | 49 (4.3) | 8 (8.5) |
| South-East Asian | 16 (4.8) | 42 (3.6) | 5 (5.0) |
| South and Central Asian | 22 (6.7) | 71 (6.1) | 6 (6.2) |
| North African and Middle Eastern | 9 (2.8) | 14 (1.2) | 1 (0.9) |
| Sub-Saharan African | 0 (0.1) | 2 (0.2) | 0 (0.0) |
| Peoples of the Americas | 4 (1.1) | 10 (0.9) | 2 (1.7) |
| North-West European, Oceanian | 34 (10.4) | 100 (8.7) | 6 (6.5) |
| Educational attainment | | | |
| Secondary diploma or less | 147 (44.4) | 503 (43.4) | 40 (43.6) |
| More than secondary diploma, less than Bachelor’s degree | 90 (27.2) | 311 (26.9) | 25 (27.0) |
| Bachelor’s degree | 14 (4.1) | 37 (3.2) | 1 (1.2) |
| Bachelor’s degree or more | 94 (28.4) | 344 (29.7) | 27 (29.5) |
| Regional vs metropolitan postal code | | | |
| Regional | – | 255 (22.0) | 23 (25.1) |
| Metropolitan | – | 902 (78.0) | 69 (74.9) |
| Employment status | | | |
| Employed | 183 (55.4) | 651 (56.3) | 46 (50.3) |
| Unemployed | 47 (14.2) | 210 (18.2) | 17 (18.4) |
| Retired | 70 (21.2) | 251 (21.7) | 22 (23.5) |
| Student | 31 (9.2) | 45 (3.9) | 7 (7.8) |
| Essential worker status | | | |
| (among employed respondents) | | | |
| Essential | – | 360 (55.4) | 24 (51.1) |
| Essential | – | 291 (44.6) | 23 (48.9) |
| Unpaid caregiver status | | | |
| None | – | 725 (62.7) | 56 (51.1) |
| Unpaid caregiver of adults | – | 156 (13.5) | 8 (8.9) |
| Unpaid caregiver of children or adolescents | – | 125 (10.8) | 17 (18.1) |
| Multigenerational unpaid caregiver | – | 151 (13.0) | 11 (11.8) |
| Political ideology | | | |
| Far left | 14 (4.4) | 64 (5.5) | 8 (9.2) |
| Left | 69 (20.8) | 221 (19.1) | 15 (16.0) |
| Centre | 106 (32.0) | 399 (34.5) | 33 (36.1) |
| Right | 70 (21.2) | 173 (14.9) | 16 (17.7) |
| Far right | 19 (5.7) | 112 (9.7) | 5 (5.9) |
| Other | 53 (16.0) | 189 (16.3) | 14 (15.2) |

COVID-19 risk perception

| | Victorian- April | Victorian- September | Victorian- Longitudinal |
| | $n^a$ | $n^a$ | $n^a$ |
| | (continued on next page) | (continued on next page) | (continued on next page) |
in mental health by age, disability status, caregiver status, political ideology, and COVID-19 risk perception (Table 3, Fig. 2). Younger adults reported significantly higher adjusted prevalence of adverse mental or behavioural health conditions than older adults (e.g., aged 18–24 vs ≥65 years, suicidal ideation, aPR 5.59, 95% CI 2.62–11.95, p < 0.0001), as did people with vs without disabilities (e.g., individuals supported by the NDIS, suicidal ideation, 2.47, 1.70–3.58, p < 0.0001) and both multigenerational caregivers and caregivers of adults only vs non-caregivers (e.g., multigenerational caregivers, suicidal ideation, 2.95, 2.06–4.20, p < 0.0001). Victorians who identified as having Far Right political ideology had higher adjusted prevalence of all four adverse symptoms vs those who identified as Centre, including nearly twice the prevalence of suicidal ideation (1.88, 1.29–2.74, p = 0.0010). Finally, those who believed they were vs not at high risk for severe COVID-19 also had higher prevalence of symptoms of anxiety or depressive disorder (1.28, 1.02–1.61, p = 0.034).

Multivariable Poisson regression models with demographic and additional variables in the Victorian-September sample revealed differences in mental and behavioural health by medical history, sleep, and behavioural changes (Table 4, Fig. 2). For example, suicidal ideation was nearly three times as prevalent among respondents with vs without previously diagnosed psychiatric conditions (2.88, 2.07–4.01, p < 0.0001), and nearly two times as prevalent among those with diagnosed sleep conditions (1.94, 1.46–2.57, p = 0.0007) and insomnia symptoms (1.86, 1.38–2.51, p = 0.0001). Adverse mental health symptoms were also significantly more prevalent among those with a self-reported sleep duration <6 h (e.g., suicidal ideation, 1.46, 1.02–2.08, p = 0.039, vs >7 h), and those who reported spending more time in bed (1.47, 1.12–1.92, p = 0.0054, vs no change) and having more trouble falling asleep (1.66, 1.25–2.20, p = 0.0055, vs no change). Those who reported maintaining a less regular sleep-wake schedule also more supported by the NDIS, suicidal ideation, 2.47, 1.70–3.58, p < 0.0001) and insomnia (1.88, 1.29–2.74, p = 0.0010).

**Table 2**

Estimated prevalence of adverse mental and behavioural health conditions, sleep, and beneficial changes during the pandemic during April 2020 and September 2020.

| Sample           | Victorian April | Victorian September (excluding recontacts) | September vs April 2020 |
|------------------|-----------------|--------------------------------------------|-------------------------|
|                  | n                  | % (95% CI)                             | Δ % (95% CI)                  | P |
| Total Respondents | 331                | 1157                                    |                          |    |
| Mental or Behavioural Health Condition |                       |                                        |                          |    |
| Symptoms of anxiety or depressive disorder | 104 (31.3) (26.0, 37.3) | 387 (33.4) (30.3, 36.7) | 2.1 (–6.3 to 10.5) | >0.99 |
| Symptoms of a COVID-19 TSRD | – – | 354 (30.6) (27.6, 33.8) | – – | >0.99 |
| Symptoms of burnout | 74 (22.4) (17.8, 27.9) | 305 (26.3) (23.4, 29.5) | 3.9 (–3.7 to 11.5) | >0.99 |
| Started or increased suicide or wish to die in the previous 30 days | – – | 143 (12.3) (10.6, 14.9) | – – | – |
| Psychological well-being |                       |                                        |                          |    |
| 0–25% | – – | 220 (19.1) (16.4, 22.0) | – – | – |
| 26–50% | – – | 304 (26.3) (23.5, 29.4) | – – | – |
| 51–75% | – – | 375 (32.4) (29.4, 35.7) | – – | – |
| 76–100% | – – | 257 (22.2) (19.7, 24.9) | – – | – |
| Sleep Duration |                       |                                        |                          |    |
| <6 h | 48 (14.6) (10.8, 19.6) | 204 (17.6) (15.1, 20.5) | 3.0 (–3.5 to 9.5) | >0.99 |
| 6–7 h | 87 (26.4) (21.5, 32.0) | 285 (24.7) (22.0, 27.5) | –1.7 (–6.9 to 3.4) | >0.99 |
| >7 h | 195 (59.0) (52.8, 64.9) | 668 (57.7) (54.4, 61.0) | –1.3 (–10.1 to 7.6) | >0.99 |

Comparison of sleep to before the pandemic

| Spend more time in bed | 99 (29.9) (24.9, 35.4) | 353 (30.5) (27.7, 33.5) | 0.6 (–7.6 to 9.9) | >0.99 |
| Spend less time in bed | 31 (9.3) (6.2, 13.7) | 66 (5.7) (4.4, 7.4) | –3.6 (–8.6 to 1.5) | 0.28 |
| More trouble sleeping | 69 (20.7) (16.3, 25.9) | 277 (23.9) (21.2, 26.9) | 3.2 (–4.2 to 10.6) | >0.99 |
| Less trouble sleeping | 11 (67) (69) | – | – | >0.99 |

(continued on next page)
### Table 2 (continued)

| Sample                          | Victorian April | Victorian September (excluding recontacts) | September vs April 2020 |
|--------------------------------|-----------------|--------------------------------------------|-------------------------|
|                                | n\(^a\) | %                    (95% CI) | n\(^a\) | %                    (95% CI) | Δ % (95% CI) | P\(^b\) |
| Time spent on screens compared with before the pandemic... |                |                                        |                         |                        |                |        |
| Reduced by more than 1 h       | 25    | 7.5                   (4.9, 11.3) | 92    | 7.9                   (6.2, 10.1) | 0.4               >0.99 |
| Reduced by less than 1 h        | 11    | 3.4                   (1.8, 6.3) | 46    | 4.0                   (2.8, 5.7) | 0.6               >0.99 |
| About the same                 | 162   | 49.1                  (33.9, 54.7) | 404   | 34.9                  (28.8, 41.5) | −14.2             <0.0001 |
| Increased by less than 1 h      | 22    | 6.6                   (4.1, 10.3) | 90    | 7.8                   (6.1, 9.7) | 1.2               >0.99 |
| Increased by more than 1 h      | 111   | 33.4                  (28.2, 39.0) | 525   | 45.4                  (42.1, 48.7) | 12.0(3.4)         0.0013 |
| Time spent outside during daylight hours compared with before the pandemic... |                |                                        |                         |                        |                |        |
| Reduced by more than 1 h        | 144   | 43.5                  (37.6, 49.6) | 586   | 56.7                  (47.3, 64.0) | 7.2               0.27 |
| Reduced by less than 1 h         | 26    | 7.8                   (5.2, 11.6) | 78    | 6.7                   (5.2, 8.7) | −1.1              >0.99 |
| About the same                  | 118   | 35.6                  (30.1, 41.5) | 357   | 30.9                  (28.0, 34.0) | −4.7              >0.99 |
| Increased by less than 1 h       | 5     | 1.7                   (0.7, 3.6) | 49    | 4.2                   (3.0, 6.0) | 2.5               0.36 |
| Increased by more than 1 h       | 38    | 11.4                  (8.0, 16.2) | 87    | 7.5                   (5.9, 9.4) | −3.9              0.29 |
| Daily hours spent following COVID-19 0 | 183   | 55.3                  (49.6, 61.2) | 853   | 73.7                  (70.8, 76.7) | 18.4(9.7)        <0.0001 |
|                                | 1     | 56.9                  (41.2, 72.6) | 185   | 15.9                  (13.7, 18.6) | −1.0              >0.99 |
|                                | 2     | 17.8                  (13.7, 23.1) | 73    | 6.3                   (4.8, 8.3) | −11.5             <0.0001 |
|                                | 4     | 9.6                   (6.7, 13.8) | 43    | 3.8                   (2.8, 5.0) | −5.8              0.0002 |

**Note:** Weighted rounded counts and percentages may not sum to expected values. CI and P-values are Bonferroni-adjusted to account for multiplicity (13 comparisons).

VIC = Victoria, AUS = Australia, TSRD = trauma- and stressor-related disorder, NDIS = National Disability Insurance Scheme, COVID-19 = coronavirus disease 2019.

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### 4. Discussion

In September 2020, during one of the longest global COVID-19 lockdowns in a region with low SARS-CoV-2 prevalence, approximately one-third of surveyed Victorian adults reported anxiety or depressive symptoms and COVID-19 TSRD symptoms, and about one-tenth reported new or increased substance use to cope. Most concerning, about one-tenth of adults reported serious past-month suicidal ideation. Prevalence estimates of poor mental health were similar to those in Victorians in April 2020, near the start of the lockdown, in the U.S. in April, June, and August 2020 through February 2021 (Czeisler et al., 2021a, 2021b, 2020; Ettman et al., 2020; Vahratian et al., 2020), and estimates from meta-analyses during the COVID-19 pandemic (Salari et al., 2020). Stability in rates of poor mental health across time and region stands in stark contrast to variation in SARS-CoV-2 infections and COVID-19 hospitalisations and deaths, suggesting that the indirect adverse mental health impact during the pandemic may be insensitive to objective COVID-19 risk. Given that high prevalences of adverse mental health symptoms were observed in a region with comparatively low SARS-CoV-2 prevalence, these findings may largely reflect indirect mental health effects of the pandemic and its mitigation.

Our findings demonstrate that poor mental health symptoms among adults in Victoria during the COVID-19 pandemic were not transient. Investment in mental health treatment, particularly for depression and anxiety, is cost-effective, with benefit-cost ratios of 2.3–3.0 for economic benefits (Chisholm et al., 2016) in addition to ross benefits from ameliorating human misery and suffering. Australia has responded through reimbursement for telehealth delivery of mental health services, increased publicly funded mental health benefit allowances, and funding for community mental health telephone support services. Victorians have substantially increased mental health services utilization (Australian Government, 2020), which may reflect greater need for and access to these resources, and represent one reason that the prevalence of poor mental health in Victoria did not increase from April to September, despite one of the world’s longest COVID-19 lockdowns.

Our findings also highlight mental health disparities. Adults aged <6 years, people with disabilities, and multigenerational unpaid caregivers experienced disproportionate burdens of almost all forms of adverse mental and behavioural health symptoms, consistent with results from U.S. studies of mental health during the COVID-19 pandemic (Czeisler et al., 2020, 2021b, 2021c). Moreover, diagnosed psychiatric or sleep disorders and insomnia symptoms were robustly associated with higher prevalence of poor outcomes, consistent with prior evidence during the pandemic (Czeisler et al., 2021b; Meaklin et al., 2021; Varma et al., 2021; Xiong et al., 2020). Examining behaviours, compared to April 2020, Victorians in September 2020 spent more time on screens...
and less time following COVID-19 media coverage. There was a trend, albeit not statistically significant after Bonferroni correction, for reduced outdoor time among Victorians during September compared to Victorians in April. Reduced outdoor time was associated with higher prevalence ratios for all assessed adverse mental health symptoms, and increased time on screens was associated with higher prevalence ratios for anxiety or depression symptoms. More regular sleep times and spending less time following COVID-19 were associated with lower prevalence ratios for anxiety or depression symptoms.

These results, which are consistent with findings related to mental health during the COVID-19 pandemic among Victorian athletes (Facer-Childs et al., 2021), show that a sustained lockdown does not have a unitary effect on behaviours, with some behaviour changes associated with better and others with worse mental health symptoms. Although our cross-sectional results do not demonstrate causality, they do suggest that in addition to interventions directly aimed at mental health, research should investigate whether interventions that target behaviour or the environment are associated with improved mental health. As an alternative to targeting behaviours, given the disproportionate experience of adverse mental health symptoms among younger adults, caregivers, and individuals with pre-existing psychiatric conditions, prevention and intervention resources designed for these populations could be prioritized. For younger adults, programs that promote early engagement in mental health services may be particularly beneficial, as adolescents are the least likely age group to seek professional mental health care despite a high prevalence of mental health challenges (Burns and Birrell, 2014). For caregivers, effective interventions may include cognitive behavioural approaches (Wiegelmann et al., 2021) or those with caregiving-related information and education with or without professional psychological support (Sherifali et al., 2018).

Table 3
Estimated adjusted prevalence ratios for adverse mental and behavioural health conditions among Victorian adults in September 2020, by respondent characteristics.

| Demographic | Mental or Behavioural Health Condition | Symptoms of Anxiety or Depressive Disorder | Symptoms of a COVID-19 TSRD | Started or Increased Substance Use | Suicidal ideation |
|-------------|---------------------------------------|------------------------------------------|---------------------------|---------------------------------|-----------------|
|             | P [95% CI]                            | P [95% CI]                               | P [95% CI]                | P [95% CI]                       | P [95% CI]      |
| Sex (reference: Female) | Male 0.89 [0.74, 1.08] | 0.25 [0.91, 1.13] | 0.39 [0.83, 1.20] | 0.32 [0.76, 1.37] | 0.90 [0.56, 1.45] |
| Age Group, years (reference: ≥ 65) | 18–24 4.37 [2.48, 7.72] | <0.0001 [3.00, 5.11] | 0.0001 [1.89, 5.19] | 0.22 [2.62, 11.95] | <0.0001 |
|             | 25–44 4.03 [2.40, 6.76] | <0.0001 [2.21, 5.38] | 0.0012 [2.45, 5.19] | 0.04 [3.51, 6.79] | 0.0002 |
|             | 45–64 2.35 [1.45, 3.82] | 0.0006 [1.56, 2.47] | 0.055 [1.93, 4.33] | 0.11 [2.05, 3.95] | 0.032 |
| Disability Status (reference: None) | Disability, with support from NDIS 1.58 [1.16, 2.14] | 0.0033 [1.54, 2.85] | 0.042 [1.38, 3.85] | 0.0005 [2.47, 3.58] | <0.0001 |
|             | Disability, without support from NDIS 1.94 [1.51, 2.50] | <0.0001 [1.40, 1.97] | 0.049 [1.11, 3.49] | 0.022 [2.40, 3.52] | <0.0001 |
| Employment Status (reference: Employed nonessential) | Employed essential 1.15 [0.89, 1.46] | 0.29 [0.83, 1.41] | 0.57 [0.54, 1.29] | 0.41 [1.07, 1.59] | 0.22 |
|             | Unemployed 1.32 [1.00, 1.75] | 0.054 [0.84, 1.25] | 0.38 [0.33, 2.17] | 0.20 [1.35, 2.17] | 0.22 |
|             | Student 0.82 [0.46, 1.47] | 0.51 [0.59, 1.64] | 0.87 [0.17, 1.74] | 0.27 [0.68, 4.22] | 0.42 |
|             | Retired 0.94 [0.66, 1.45] | 0.77 [0.43, 1.03] | 0.068 [0.28, 1.32] | 0.21 [0.59, 1.81] | 0.92 |
| Unpaid Caregiver Status (reference: No) | Unpaid caregiver of adults 1.31 [1.01, 1.71] | 0.042 [1.11, 1.96] | 0.0075 [1.61, 2.91] | 0.12 [1.55, 2.77] | 0.041 |
|             | Unpaid caregiver of children or adolescents 1.01 [0.79, 1.38] | 0.95 [0.61, 1.41] | 0.73 [1.20, 1.80] | 0.0001 [1.05, 1.89] | 0.86 |
|             | Multigenerational unpaid caregiver 1.54 [1.21, 1.97] | 0.0005 [2.11, 2.70] | <0.0001 [4.85, 7.90] | <0.0001 [2.95, 4.20] | <0.0001 |
| Political Ideology (reference: Centre) | Far left 1.08 [0.75, 1.56] | 0.69 [0.63, 1.56] | 0.96 [0.75, 1.66] | 0.48 [1.78, 2.96] | 0.026 |
|             | Slightly left 1.29 [0.98, 1.70] | 0.069 [0.71, 1.32] | 0.84 [0.89, 2.16] | 0.016 [1.32, 2.03] | 0.21 |
|             | Slightly right 1.34 [1.02, 1.76] | 0.039 [0.85, 1.50] | 0.39 [0.73, 1.97] | 0.47 [1.55, 2.29] | 0.025 |
|             | Far right 1.45 [1.08, 1.94] | 0.013 [1.29, 2.18] | 0.0001 [1.23, 3.30] | 0.0054 [1.29, 2.74] | 0.0010 |
| Apolitical and/or prefer not to answer Yes 1.32 [0.99, 1.75] | 0.056 [0.66, 1.28] | 0.62 [0.52, 1.84] | 0.95 [1.19, 1.98] | 0.49 |
|             | Believed high risk for severe COVID-19 (reference: No) 1.28 [1.02, 1.61] | 0.034 [0.84, 1.47] | 0.45 [0.75, 1.72] | 0.55 [1.11, 2.50] | 0.56 |

COVID-19 = coronavirus disease 2019, TSRD = trauma- and stressor-related disorder, aPR = adjusted prevalence ratio, CI = confidence interval, NDIS = National Disability Insurance Scheme.
Fig. 2. Adjusted prevalence ratios for demographics, sleep, and changes in behaviour associated with at least one adverse mental and behavioural health symptom among Victorian adults in September 2020.
Table 4
Estimated adjusted prevalence ratios for adverse mental and behavioural health conditions among Victorian adults in September 2020, by medical history, sleep, and behavioural changes.

| Medical conditions, Sleep, and Behavioural Changes | Anxiety or Depressive Disorder Symptoms | P       | Symptoms of a COVID-19 TSSRD | P       | Started or Increased Substance Use | P   | Suicidal Ideation | P   |
|-----------------------------------------------------|----------------------------------------|---------|--------------------------------|---------|-------------------------------------|-----|------------------|-----|
| Medical conditions, Sleep, and Behavioural Changes | aPR [95% CI]                           | –       | aPR [95% CI]                  | –       | aPR [95% CI]                       | –   | aPR [95% CI]      | –   |

**HISTORY OF OR CURRENT HEALTH CONDITIONS**
Diagnosed with a psychiatric condition (reference: No)
- Yes: 2.19 [1.79, 2.66]
- Diagnosed with a sleep condition (reference: No)
- Yes: 1.77 [1.47, 2.13]

**SLEEP MEASURES**
Diurnal preference (reference: Definite morning type)
- Rather morning type: 1.17 [0.91, 1.49]
- Rather evening type: 1.26 [0.97, 1.62]
- Definite evening type: 1.15 [0.84, 1.57]

Sleep duration, hours (reference: > 7)
- < 6: 1.44 [1.15, 1.80]
- 6-7: 0.90 [0.72, 1.14]

Symptoms of insomnia (reference: No)
- Yes: 1.97 [1.63, 2.37]

Compared with October through December 2019...
More time in bed (reference: No)
- Yes: 1.39 [1.16, 1.66]
- Less time in bed (reference: No)
- Yes: 0.94 [0.69, 1.29]

More trouble falling asleep (reference: No)
- Yes: 2.14 [1.80, 2.55]

Less trouble falling asleep (reference: No)
- Yes: 0.94 [0.68, 1.32]

More regular sleep schedule (reference: No)
- Yes: 0.72 [0.54, 0.96]

Less regular sleep schedule (reference: No)
- Yes: 1.44 [1.17, 1.79]

Daytime sleepiness (reference: Normal)
- Mild to moderate: 1.67 [1.34, 2.09]
- Excessive: 1.21 [0.94, 1.55]

**BEHAVIOURAL CHANGES**
Compared with October through December 2019...
Time spent outdoors (reference: About the same)
- Reduced by more than 1 h: 1.42 [1.12, 1.80]
- Reduced by less than 1 h: 1.53 [1.10, 2.14]
- Increased by less than 1 h: 0.84 [0.43, 1.65]
- Increased by more than 1 h: 1.02 [0.66, 1.57]

Time spent on screens (reference: About the same)
- Reduced by more than 1 h: 1.47 [1.09, 1.98]
- Reduced by less than 1 h: 1.21 [0.79, 1.85]
- Increased by less than 1 h: 1.06 [0.74, 1.52]
- Increased by more than 1 h: 1.28 [1.01, 1.62]

Daily hours spent following COVID-19 (reference: 0)
(continued on next page)
quota sampling and survey weighting to Census data were used to period length differences of 46 min (longer in September than April) and strengthen generalisability, the sample may not generalise to the 2020 nistic interviews may be less generalisable. Additionally, although Furthermore, data from participants willing to undergo lengthy diag (s), which have shown high correspondence with diagnoses. Moreover, data from participants willing to undergo lengthy diagnostic interviews may be less generalisable. Additionally, although quota sampling and survey weighting to Census data were used to strengthen generalisability, the sample may not generalise to the 2020 Victorian adult population due to potential residual differences between responders compared to the general population. Moreover, because we measured a cross-section of primarily different participants at each timepoint, we had limited power to examine longitudinal changes within individuals; however, evidence of significant survivorship bias in longitudinal mental health surveys may reduce the representativeness of such studies (Czeisler et al., 2021d). Seasonal variation in mood is a potential confounding factor in our study. Our data were, however, collected in April (mid-autumn) and September (spring), with photoperiod length differences of 46 min (longer in September than April) and average temperature differences of 2 °C (warmer in April than September). Previous longitudinal studies in Victoria found no seasonal variation in negative affect (Murray et al., 2001) and a population-based study of more than 150,000 participants in the UK suggest very small variations in depressive symptoms in women and none in men (Lyall et al., 2018). It is therefore unlikely seasonal variations in adverse mental health symptoms meaningfully altered our results. Assessment of this was not feasible while comparing the effect of the duration of exposure to the pandemic and related lockdowns. Finally, as we did not have pre-pandemic cross-sections of data, our findings do not answer the question as to whether these prevalence estimates represent increases compared with previous years; however, longitudinal surveys suggest that the prevalence of psychological distress increased in Australia, and particularly in Victoria (Biddle et al., 2020a, 2020b).

4.1. Limitations

This study had several limitations. Outcomes were self-reported rather than determined via diagnostic interviews, and it is possible that the survey instrument did not capture some changes in prevalence of adverse mental health symptoms. We did, however, use validated questionnaires for common mental health outcomes (anxiety, depression), which have shown high correspondence with diagnoses. Furthermore, data from participants willing to undergo lengthy diagnostic interviews may be less generalisable. Additionally, although quota sampling and survey weighting to Census data were used to strengthen generalisability, the sample may not generalise to the 2020 Victorian adult population due to potential residual differences between responders compared to the general population. Moreover, because we measured a cross-section of primarily different participants at each timepoint, we had limited power to examine longitudinal changes within individuals; however, evidence of significant survivorship bias in longitudinal mental health surveys may reduce the representativeness of such studies (Czeisler et al., 2021d). Seasonal variation in mood is a potential confounding factor in our study. Our data were, however, collected in April (mid-autumn) and September (spring), with photoperiod length differences of 46 min (longer in September than April) and average temperature differences of 2 °C (warmer in April than September). Previous longitudinal studies in Victoria found no seasonal variation in negative affect (Murray et al., 2001) and a population-based study of more than 150,000 participants in the UK suggest very small variations in depressive symptoms in women and none in men (Lyall et al., 2018). It is therefore unlikely seasonal variations in adverse mental health symptoms meaningfully altered our results. Assessment of this was not feasible while comparing the effect of the duration of exposure to the pandemic and related lockdowns. Finally, as we did not have pre-pandemic cross-sections of data, our findings do not answer the question as to whether these prevalence estimates represent increases compared with previous years; however, longitudinal surveys suggest that the prevalence of psychological distress increased in Australia, and particularly in Victoria (Biddle et al., 2020a, 2020b).

5. Conclusions

Despite a relatively low prevalence of SARS-CoV-2 and efforts to increase availability of mental health services, poor mental and behaviourial health symptoms were common in Victoria, Australia in September 2020, during one of the longest lockdowns globally. Given evidence of direct mental health effects of COVID-19, policymakers should not subscribe to the false choice between COVID-19 containment and mental health, as failing to control the former could significantly worsen the latter. However, our findings suggest that adverse mental health symptoms were common, even in a region with low SARS-CoV-2 prevalence. Therefore, as policymakers worldwide deliberate about the duration and intensity of COVID-19 mitigation policies now and during future waves of SARS-CoV-2 and other pathogens, it is essential that they account for the indirect mental health effects of such actions and implement strategies to attenuate them.

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CRediT authorship contribution statement

Mark E. Czeisler: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Visualization, Writing – original draft, Writing – review & editing. Joshua F. Wiley: Conceptualization, Formal analysis, Methodology, Writing – original draft, Writing – review & editing. Elise R. Facer-Chils: Methodology, Visualization, Writing – review & editing. Rebecca Robbins: Methodology, Writing – review & editing. Matthew D. Weaver: Methodology, Writing – review & editing. Laura K. Barger: Methodology, Writing – review & editing. Charles A. Czeisler: Conceptualization, Investigation, Methodology, Writing – review & editing. Mark E. Howard: Conceptualization, Investigation, Methodology, Supervision, Writing – review & editing. Shantha M.W. Rajaratnam: Conceptualization, Formal analysis, Funding acquisition, Investigation, Methodology, Supervision, Writing – review & editing.

Declaration of competing interest

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& et al., 2020; Moreno et al., 2020; The Lancet Infectious Diseases, 2020).

| Mental or Behavioural Health Condition | Anxiety or Depressive Disorder Symptoms | P | Symptoms of a COVID-19 TSRD | P | Started or Increased Substance Use | P | Suicidal ideation | P |
|--------------------------------------|---------------------------------------|---|-----------------------------|---|-----------------------------------|---|-----------------|---|
| Medical conditions, Sleep, and Behavioural Changes | aPR [95% CI] | – | aPR [95% CI] | – | aPR [95% CI] | – | aPR [95% CI] | – |
| 1 | 0.92 [0.69, 1.24] | 0.60 | 0.74 [0.51, 1.07] | 0.11 | 0.81 [0.44, 1.50] | 0.51 | 0.92 [0.56, 1.51] | 0.73 |
| 2–3 | 1.19 [0.86, 1.64] | 0.30 | 1.12 [0.75, 1.67] | 0.58 | 0.95 [0.66, 1.95] | 0.89 | 1.09 [0.61, 1.94] | 0.78 |
| ≥4 | 1.25 [0.97, 1.62] | 0.084 | 1.39 [1.06, 1.82] | 0.016 | 1.82 [1.27, 2.59] | 0.0010 | 1.44 [1.03, 2.03] | 0.035 |

COVID-19 = coronavirus disease 2019, TSRD = trauma- and stressor-related disorder, aPR = adjusted prevalence ratio, CI = confidence interval.
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