The COVID-19 Lockdown and Changes in Routine-Oriented

Depression, Anxiety, and Insomnia in South Africa

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ABSTRACT

Background. We assessed the impact of lockdown in response to the COVID-19 pandemic on routine-oriented lifestyle behaviours and symptoms of depression, anxiety and insomnia in South Africans. **Methods.** In this observational study, 1048 adults (median age: 27y; n=767 females; n=473 students) responded to an online survey on work, exercise, screen, alcohol, caffeine and sleep behaviours, depression, anxiety and insomnia before and during lockdown. Comparisons were made between males and females, and students and non-students. **Results.** During lockdown, males reported larger reductions in higher intensity exercise and alcohol use than females, while depressive symptoms increased more among females, more of whom also reported poorer sleep quality. Students demonstrated larger delays in work and sleep timing, greater increases in sitting, screen, sleep duration, napping, depression and insomnia and larger decreases in work hours, exercise time and sleep regularity compared to non-students. **Conclusions.** Students experienced more changes in their routine-oriented behaviours than non-students, coupled with larger increases in depression and insomnia. The dramatic change in their work and sleep timing suggests habitual routines that are at odds with their chronotype, with their sleep changes during lockdown likely reflecting "catch-up" sleep in response to accumulated sleep debt under usual routines.

INTRODUCTION

On 30 January 2020, the World Health Organization (WHO) declared the outbreak of the novel coronavirus SARS-CoV-2, causative agent of coronavirus disease (COVID-19), a global public health emergency. In response, many countries instituted unprecedented, but necessary measures to limit the spread of the virus through local or national lockdowns, including the closure of all but essential services and businesses, the requirement for most people to stay at home and only leave their homes to obtain medical support or to purchase groceries. The timing of national lockdowns relative to the detection of the first local case varied, and if implemented, were done so after localised or national recommendations to reduce transmission, had been in place for a few weeks. By March 2020, however, as cases started to emerge in Europe and the Americas, many Sub-Saharan African countries implemented lockdowns while their national caseloads were relatively small.[1] Twenty-one days after the first COVID-19 case in the country, the South African government initiated a national lockdown at Alert Level 5. The Alert Level 5 restrictions did not allow people to leave their homes except for essential services and no alcohol or tobacco products were sold during this period. These measures resulted in changes in the daily lives of the South African population, including but not limited to, having to work from home or having no work at all, home-schooling children and removing exercise and socialising opportunities.

Since the start of the pandemic, researchers have studied the effects of the imposed restrictions on various lifestyle behaviours (such as sleep, levels of physical activity and other activities of daily living) independently. Many studies across continents have reported that lockdown resulted in delayed bedtimes and wake-up times, as well as increased sleep duration, but with mixed results relating to sleep quality.[2-7] While delays in sleep timing led to a better match between the biological and societal sleep-wake timings or social jetlag in adults from three European countries, it was associated with reduced sleep quality and worse mental and physical health.[8] In some instances, increases in physical activity have been reported,[9] while in other studies people reported being less physically active during lockdown, coupled with increases in sitting or lying down time[5, 7, 9, 10] and screen time[6]. It is likely that, among other things, the diversity in restrictions related to lockdown between countries, might be in part responsible for the variation in observations related to changes in lifestyle-type behaviours. Amongst a Scottish cohort, lockdown resulted in increases in alcohol consumption, worsening of diet, reductions in physical activity and poorer sleep quality, with the latter three being associated with a worsening in mood.[7] In a Chinese cohort, remaining more physically active was associated with a better quality of life score, and this relationship was mediated by sleep quality.[5] Thus there also appears to be interrelations between lifestyle changes and mood.

Many authors have reported increased levels of anxiety and depression during all phases of hard lockdown.[3] While not based on data from the current pandemic, Brooks et al. (2020) highlight how and why the implementation of quarantine measures affect psychological well-being. This rapid review identified the duration of quarantine, fear of infection, fear of inadequate supplies, frustration and boredom and a lack of information as the main drivers of this.[11] South Africans, under the 36-day Alert Level 5 lockdown, were likely to have been affected by most or all of these factors to some extent.

To the best of our knowledge, no study yet has looked at multiple lifestyle behavioural changes within a population and specifically within a low- to middle-income country (LMIC) such as South Africa, during the COVID-19 lockdown period. Because many individuals living in LMICs reside in resource-constrained settings, changes in daily routines may have a severe impact on their physical and psychological health. Moreover, the particular lockdown restrictions in South Africa were more stringent than in many high income countries that have been studied. Behavioural aspects of daily life that are typically routine-oriented include work/education, physical activity, screen-time, caffeine and alcohol use and sleep-wake behaviour and many of these behaviours are co-dependent and important components of physical and mental well-being. The restrictions imposed by the South African government during Alert Level 5 lockdown directly affected work, physical activity and alcohol use for most of the public. We were interested in describing the pattern of observed routine- and health-related changes comparing pre-lockdown to hard lockdown in a local sample.

The primary aim of the study was to quantify any changes in work, physical activity, screen time, caffeine and alcohol use and sleep-wake behaviours, as well as symptoms of anxiety, depression and insomnia before and during the national Alert Level 5 lockdown in response to the COVID-19 pandemic. As we distributed this survey partly through university channels, a high number of students responded. Since we anticipated that students 1) have fewer work-related time constraints and 2) are younger than the non-students, a secondary aim was to determine whether these changes differed between the student and non-student populations. Similarly, considering underlying gender-related differences in circadian and sleep timing[12, 13] we also investigated whether females and males may have been affected differently by lockdown with respect to our measured outcomes.

METHODS

Study design and setting

This was a retrospective, observational study, which made use of an online survey (hosted on the Google Forms platform). The survey, which was in English and took approximately 20min to complete, was initially circulated on formal academic mailing lists and platforms, as well as various social media networks, an approach that was similar to that adopted in similar studies during this time (Blume et al., 2020; Cellini et al., 2020; Korman et al., 2020; Rossi et al., 2020). Participants were also encouraged to pass on the survey through their own networks. Thus, this study adopted a combination of convenience and snowball sampling strategies in the interests of disseminating the survey rapidly. Participation in the survey took place between 12 May and 15 June 2020, while participants were under Alert Levels 4 and 3 lockdown. Participants were required to answer questions related to two time points: Before

Lockdown (defined as the three months prior to lockdown, i.e. January, February and March 2020) and During Lockdown (defined as the five weeks of Alert Level 5 lockdown, i.e. 27 March to 30 April 2020).

Participants and recruitment

Persons older than 18 years of age, with a primary place of residence in South Africa prior to, and during, the period of COVID-19 restrictions were eligible to participate. All participants gave informed consent prior to completing the survey, and ethical clearance was obtained from the Ethical Standards Committee at Rhodes University (2020-1459-3468) and the University of Cape Town's Department of Psychology Ethics Committee (PSY2020-014).

Survey

Demographic information collected included age, gender, home environment, medical history, sleep disorders, and chronic medication use. Participants were also asked whether or not they had been tested for COVID-19, and whether or not they had tested positive for the SARS-CoV-2 virus at the time of completion of the questionnaire. The remainder of the questions required participants to provide answers for two time points: Before lockdown and during lockdown. Employment status was categorised as: employed (i.e. organisation- or self-employed, regardless of working hours), unemployed (i.e. not employed, on leave, volunteer, retired) or student/studying (regardless of study hours). Variables relating to the home environment and employment status were used to describe socio-economic status of participants. Daily habits relating to time spent working or studying (regardless of employment or student status), exercising, sitting or using screens, as well as caffeine and alcohol use were captured. Additional information relating to meal and snack timing were also obtained, but are not reported here. The International Physical Activity Questionnaire-short form (IPAQ)[14] was used to assess levels of vigorous physical activity (VPA), moderate physical activity (MPA) and walking, reported as frequency per week and as minutes per day.

Participants reported on their usual bedtime, wake-up time, sleep duration, sleep quality (poor, fair, good, excellent), sleep onset latency (<5min, 5-20min, 20-30min, 30-45min, 45-60min, >60min to fall asleep), regularity in bedtime, wake-up time and sleep duration variability (<1h, 1h, 1.5h, 2h, 2.5h, 3h, >3h variation in a given week), napping habits and use of sleeping medication.

The Patient Health Questionnaire-2[15] typically used as a "first-step" to screen for depression, was used to assess the frequency of depressed mood and anhedonia. Scores range from 0-6, with higher scores indicating greater levels of depression and scores of 4 or more indicating likelihood of a depressive disorder. The Generalized Anxiety Disorder 7-item (GAD-7) scale[16] was included as an easy-to-use self-administered patient questionnaire to screen for generalised anxiety disorder (GAD). Scores range from 0-21, with higher scores indicating greater levels of anxiety. We used cut-off scores of 5 for mild, 10 for moderate and 15 for severe anxiety.[16]

The Insomnia Severity Index[17, 18] was used to measure participants' perception of insomnia symptoms. It comprises seven items assessing the perceived severity of difficulties initiating sleep, staying asleep, and early morning awakenings, satisfaction with current sleep pattern, interference with daily functioning, noticeability of impairment attributed to the sleep problem, and degree of distress or concern caused by the sleep problem. Scores range from 0-28, with higher scores indicating a higher degree of insomnia severity. Scores of 0–7 indicate "no clinically significant insomnia", 8–14 "subthreshold insomnia", 15–21 "clinical insomnia (moderate severity)" and 22–28 "clinical insomnia (severe)".

Data and statistical analyses

Data are presented as mean ± standard deviation (SD), median with interquartile range (IQR) or count (percentages). Employment status was collapsed into three categories: Employed (employed and working, employed but not working, self-employed and working, self-employed but not working); Not employed (unemployed, on leave, volunteer, retired); or Student. We excluded IPAQ data of participants (n=16) whose sum of total walking, MPA and VPA was greater than 960min (16h). Values greater than 180min/day of walking, MPA or VPA were re-coded to 180min, and those lower than 10min/day were re-coded to 0 as recommended.[19] The difference between reported bedtime and wake-up time was used to determine time-in-bed. Sleep onset latency was collapsed into three categories: <5min, 5-30min, >30min. Sleep regularity was also collapsed into three categories: ≤1.5h, 1.5-3h, ≥3h.

The Shapiro-Wilks test was used to assess normality. Time spent in moderate and vigorous physical activity (MVPA: MPA+VPA), walking time and screen use at nighttime were skewed so were log transformed; the log transformed variables met the normality criteria, and were used subsequently for analyses. Between group comparisons were made using independent t-tests, Mann-Whitney U, Chi-squared or Fisher's Exact tests. Comparisons between the Before and During Lockdown timepoints were made using paired t-tests, the Wilcoxon Sign Rank test, McNemar's test or Bowker's test of symmetry. Post hoc analyses used the Bonferroni correction to account for multiple comparisons. We used mixed models analyses and logistic regressions to explore main effects of time (Before vs. During lockdown), gender (male vs. female) or student (student vs. non student), and their respective interactions, covarying for age. For continuous, normally distributed dependent variables, we used Proc mixed in SAS specifying a random intercept, and a compound symmetry covariance structure. Data were analysed using Stata v15.1 (StataCorp, Texas, USA) and SAS 9.3 (SAS, North Carolina USA) and significance was accepted at p<0.050.

RESULTS

Descriptive characteristics

The median age of our respondents was similar to that of South Africa (26.4y, Statistics South Africa, www.statssa.gov.za), but skewed towards females (73%) and clustered in three of South Africa's four most densely populated Provinces. Data for the gender comparisons are presented on those respondents who self-identified as females (n=767) or males (n=261). Owing to small sample sizes, data for participants who identified as non-binary gender (n=15) or who "preferred not to say" (n=5) are presented in Supplementary Table S1. The data for these 20 participants are included in all other non-gender-stratified analyses. Females were older and reported suffering from more chronic health or sleep conditions and fewer females had been tested for SARS-CoV-2 than males (Table 1). Students were younger, more likely to be males, with a higher housing density, fewer children in their care and more had been tested for SARS-CoV-2 than non-students. Among all participants, anxiety (30.4%) and depression (26.6%) were the most common self-reported chronic conditions, followed by asthma (11.5%), high blood pressure (7.9%), thyroid disease (4.6%) and high cholesterol (4.4%); and 33.9% of participants reported taking prescription medication.

Among all participants who were employed before lockdown (n=535), 4 (0.7%) became unemployed and 7 (1,3%) changed to being a student during lockdown; of those who were unemployed before lockdown (n=40), 6 (15%) gained employment and 2 (5%) became students during lockdown; and of those who were students before lockdown (n=473), 8 (1.7%) became employed and 1 (0.2%) became unemployed during lockdown. Among the female participants who were employed before lockdown (n=408), 4 (1%) became unemployed and 4 (1%) became students; of those female participants who were unemployed (n=33), 3 (9%) gained employment and 2 (6%) become students; and of those who were students (n=326), 5 (1.5%) become employed and 1 (0.3%) became unemployed during lockdown. Among the male participants who were employed before lockdown (n=124), 3 (2.5%) became students; of those who were unemployed (n=6), two gained employment (33%); and of those who were students (n=131), 2 (1.5%) became employed during lockdown. There were no gender differences in change in employment status during lockdown among those who were employed (p=0.254), unemployed (p=0.290) or students (p=1.000) prior to lockdown.

Changes in routine-oriented lifestyle behaviours

All participants

Changes in measured routine-oriented lifestyle behaviours reported before and during lockdown in all participants are presented in Table 2. Hours engaged in work or study per week reduced ($p<0.001$) and work start times shifted later ($p<0.001$) during lockdown compared to before. Fewer people exercised during lockdown; time spent exercising at moderate and vigorous intensities and time spent walking both decreased and more sitting time per day was reported (all $p<0.001$). Total, daytime and nighttime screen time increased in all participants (all $p<0.001$). More people consumed caffeine-containing products and the volume of caffeinated drinks consumed increased; while the number of people consuming alcohol and the number of alcoholic drinks per day reduced during lockdown (all $p<0.001$). Bedtime and wake-up time were delayed while both time-in-bed and total sleep time increased during lockdown (all $p<0.001$).

Male and female comparisons

Comparative changes in routine-oriented lifestyle behaviours between males and females before and during lockdown are shown in Table 3. Significant group-by-time interaction effects were observed for MVPA and alcohol units: males reported a larger reduction in time spent in MVPA per day ($p=0.025$) and in number of alcohol drinks per day ($p<0.001$) than females. To further understand the nature of changes observed between males and females, we analysed the frequencies by which these lifestyle behaviour variables increased, decreased or showed no change (Supplementary Table S2). The data indicate that proportionally more males reported a reduction in MVPA than females during lockdown ($p=0.017$).

There were significant gender main effects for time spent walking, screen time (total, daytime and nighttime), caffeine and alcohol use, bedtime and wake-up time. Overall, females reported more time spent walking ($p=0.021$), less total ($p<0.001$), daytime ($p=0.002$) and nighttime screen time ($p=0.009$); drank more caffeinated beverages ($p=0.028$) but less alcohol ($p=0.004$) and went to bed ($p<0.001$) and woke up earlier ($p=0.020$) compared to males. There were also time main effects for all variables (all p<0.001) except for the number of people using caffeine, in line with the changes presented in Table 3.

Student and non-student comparisons

Comparative changes in routine-oriented lifestyle behaviours between students and non-students before and during lockdown are presented in Table 4. Significant group-by-time interaction effects were observed for all variables except number who reported exercising, MVPA, caffeine and alcohol use. Specifically, students reported a greater reduction in hours spent working/studying per week (p=0.021), a greater delay in work/study start time (p<0.001) and end time (p<0.001), a larger decrease in time spent walking (p<0.001), larger increases in sitting time (p<0.001), total screen time (p<0.001) daytime screen time (p<0.001) and nighttime screen time (p<0.001), larger delays in both bedtimes (p<0.001) and wake-up times (p<0.001), and larger increases in time-in-bed (p<0.001) and sleep duration (p<0.001) compared to the non-students.

Analyses of the directional changes of these variables indicate that more students reported a reduction in work hours per week (p=0.006), exercise time (p=0.011) and walking time (p<0.001) and an increase in sitting time (p<0.001), total screen time (p<0.001) and total sleep time (p<0.001) than non-students (Figure 1). More non-students reported no changes in work hours (p<0.001), walking time (p<0.001), sitting time (p<0.001) and total screen time (p<0.001), a reduction in total sleep time (p<0.001) and an increase in walking time (p<0.001) compared to the students (Figure 1).

There were student status main effects for work/study start time, exercise, sitting time, and screen time. Overall, students started (p<0.001) and ended (p<0.001) working/studying later, were less likely to exercise (p<0.001), spent more time sitting (p<0.001), had more total (p<0.001) and nighttime (p<0.001) screen time, were less likely to drink caffeine (p<0.001) or alcohol (p<0.001), went to bed (p<0.001) and woke up (p<0.001) later and reported a longer sleep duration (p=0.006) than non-students. In line with the changes presented in Table 4, there were also time main effects for all variables (all $p<0.001$) except for the number of people using caffeine.

Changes in sleep characteristics

Comparative changes in sleep habits between males and females, students and non-students are presented in Supplementary Table S3. More females reported reduced sleep quality (p=0.003) and an increase in sleep onset latency (SOL) (p=0.002) than males, while more males reported no change in either sleep quality (p=0.003) or SOL (p=0.007) than females. All variables differed between the students and non-students (Figure 2). More students reported an improvement in sleep quality (Figure 2A) and a longer SOL (Figure 2C), more napping (Figure 2E), both an increase and decrease (Figure 2B) in bedtime regularity, a decrease in wake-up time regularity (Figure 2D) and an increase in total sleep time regularity (Figure 2F) compared to non-students. More non-students reported no changes in sleep quality (Figure 2A), sleep onset latency (Figure 2B), napping (Figure 2C), bedtime regularity (Figure 2B), wake-up time regularity (Figure 2D) and total sleep time regularity (Figure 2E) compared to students.

Changes in symptoms of depression, anxiety and insomnia

Symptoms of depression (PHQ score), anxiety (GAD score) and insomnia (ISI score) worsened in all participants (Table 2, all $p<0.001$). Figure 3 presents comparative changes in these variables between the males and females, and between the students and non-students. There was an time-by-group interaction effect for depression (Figure 3A, p=0.028) such that while depression increased in both genders ($p<0.001$), the change in symptoms of depression was worse among females (p=0.012).

There was a time-by-group interaction effect for symptoms of depression (Figure 3B, p=0.015), between the students and non-students. Symptoms of depression worsened in both groups (both p<0.001), but the change was larger among the students (p<0.001). Similarly, there was a time-by-group interaction effect for symptoms of insomnia (Figure 3F, p=0.002); such that while both groups reported more symptoms of insomnia during lockdown (p<0.001), the extent to which this changed was worse among the students (p<0.001).

DISCUSSION

We characterise the changes in multiple routine-oriented work and lifestyle behaviours in response to the initial COVID-19 lockdown restrictions in relatively young South Africans (median age: 27y), comprising both students and non-students. Similar to previous reports[2-10, 20-24] we also demonstrate detrimental effects of lockdown on sitting, screen time, exercise and symptoms of insomnia, depression and anxiety; reduced work/study hours and alcohol use; increased caffeine use and longer sleep durations; and shifts to later work start times, bedtimes and wake-up times. We build on these observations by specifically comparing females to males, and students to non-students.

Remarkably, only two routine-oriented lifestyle behaviours changed differently between females and males. Compared to females, males reported larger reductions in both higher intensity exercise and alcohol use than females during lockdown. In part, the change in the nature of exercise among males might be attributed to the fact that males did more moderate and vigorous physical activity before lockdown, which they may not have been able to sustain during lockdown while confined to their homes. Similarly, the ban on access to alcohol during lockdown in South Africa coupled with the fact that males reported a higher daily alcohol use prior to lockdown than females, may explain why males reported a greater reduction in alcohol use during lockdown.

The lockdown-induced changes in sleep timing and duration were not different between the genders. Consistent with observations from cohorts in Greece[21] and Italy[24], more females in our cohort reported a worsening of sleep quality and time to fall asleep during lockdown than males. Thus while these data suggest higher susceptibility to sleep quality-type challenges among women, both in “everyday” and extraordinary times, that we show no difference in the worsening of insomnia symptoms between the males and females is in contrast to evidence suggesting that women are more vulnerable to insomnia-related sleep challenges than men.[25] While several studies reported that depression and anxiety worsened more among women than men in response to lockdown,[26-28] we only observed a larger increase in depressive symptoms among females during lockdown. It would be interesting to understand that longer term response differences between the genders since one study showed that while females initially presented with increased depressive symptoms during the third week of lockdown compared to males, at subsequent follow-up four weeks later (still during lockdown), there was no difference between the genders.[29] The authors ascribed this change to long-term resilience in females rather than males.

There were distinct differences in the nature of changes in routine-oriented lifestyle behaviours between students and non-students in this cohort. Specifically, students demonstrated larger delays in work hours and sleep timing with greater increases in sitting, screen time, sleep duration and napping and larger decreases in work hours, exercise time (walking, moderate and vigorous activities) and sleep regularity compared to non-students. In contrast, the routines of non-students appeared to remain more intact, with no changes in work hours, sitting, screen time, walking, napping or regularity in sleep timing and duration reported.

While delays in work/study start-time are likely due to increased flexibility in the temporal demands that accompanied working- or studying-from-home arrangements,[30] the larger delays in the students might be attributed to the less structured nature of studying compared to working. To some extent this might be supported by the shift towards less regular sleep patterns reported by the students than non-students. Having consistent bedtimes, wake-times, mealtimes and exercise sessions each day, for example, are important biologically in reinforcing one’s circadian rhythms, which in turn promotes good physical and mental health.[31-33] Disrupting these routines can dampen circadian rhythms, which in turn may exacerbate poor sleep and increase levels of daytime fatigue, both of which may reduce motivation to exercise, lead to poorer food choices and increase anxiety and or depression levels.[32, 33] Indeed, we observed larger increases in symptoms of depression and insomnia among the students in this study.

The delay in the onset of working/studying would likely have been associated with the significant delay in the bed- and wake-times during lockdown, which was broadly consistent with previous studies from other countries.[2, 3, 8] Cellini et al. (2020) reported that both workers and students shifted their bedtimes later to a similar extent, but workers delayed wake-up times more than students (1h13min and 45min respectively).[3] In contrast, we show that both bedtime and wake-up times are delayed to a greater extent in the students (bedtime: ±1h50min, wake-up time: ±2h40) that non-students (bedtime: ±55min, wake-up time: ±1h10min).

It is interesting that while Cellini et al. (2020) saw a greater increase in time-in-bed for workers (~26 min) than students (~5min) in Italy, we observed that students increased self-reported time-in-bed by ±50min compared to ±16min in the non-students. That both students and non-students increased their sleep times in South Africa may reflect societal differences between Italy and South Africa, which allow Italian students to maintain bed and wake times that permit them to get sufficient sleep (~8.4 hours in bed) during term times. We speculate that the increased sleep duration, napping and sleep quality reported by students in this study when they had fewer societal-imposed temporal demands likely reflects "catch-up" sleep in response to accumulated sleep debt under normal routines. Furthermore, the dramatic change in sleep timing among students, known to be in a phase of life where chronotype is later, suggests habitual sleep routines that are at odds with their chronotype. Perhaps a later start time for classes in South Africa should be considered by the relevant authorities as this would allow time for sleep for adolescent students which may improve mental and physical health, as well as academic achievement.[34-37]

The shift towards more sedentary behaviour was more apparent among the students in this study who increased sitting (±3.5h) and screen (±4.5h) time more during lockdown than the non-students (sitting: ±2h, screen: ±3h). Furthermore, the larger increase in nighttime screen time may have influenced to some extent their sleep timing. Exposure to artificial light at night, such as from the screens of electronic devices, can suppress melatonin production, delay and dampen circadian rhythms, affect alertness and enable individuals to extend their activity period into the night (reviewed in[38]) and thus delay sleep onset. Based on these known effects of caffeine and screen use, these factors may have contributed to the delayed bedtimes observed during lockdown. However, Cellini et al. (2020) observed only mild effects on bed and wake times with increased screen time at night.

Finally, it is worth noting that under lockdown there was a 3% reduction in the number of people employed or self-employed in our cohort, which was less than the 8.1% reduction in employment status reported in a survey by Stats SA between 29 April and 6 May 2020. The overall unemployment rate in South Africa was estimated to be 30.1% in the first quarter of 2020, increasing to 42.0% in the second quarter (Stats SAP0211 - Quarterly Labour Force Survey (QLFS), 2nd Quarter 2020) and these employment statistics are not reflected in the participants of this study possibly due to the high percentage of students in the sample and the channels through which the survey was distributed. There was, however, a 7.3% reduction in the number of people actively engaging in work/study in our sample during lockdown. Reported weekly work/study hours reduced from 40h to 30h during lockdown, a result that is comparatively similar to that reported by Blume et al. (2020).

The study had several limitations. Given that the dissemination of the survey occurred through the research group's social media and institutional networks, it is likely that this sampling approach may have introduced selection bias. We may only have reached individuals with access to social media and those connected to the academic circles and networks of the investigators. This may have accounted for the overrepresentation of female and student participants, and the clustering of respondents in three of our larger provinces in South Africa. Thus, the results of this study are not necessarily representative of the broader South African population. The survey required participants to retrospectively self-report on work and lifestyle habits prior to lockdown, which may have introduced some recall bias. We tried to minimise this as far as possible by including clear questions, relating to well-defined time periods. An additional limitation is that survey did not explore how work and lifestyle factors may have differed between weekdays and weekend days. ~~Therefore~~Thus, the generalisability of these findings should be considered in light of these limitations.

CONCLUSIONS

The negative psychological effects of quarantine that have been previously reported on were apparent in the participants of this study subjected to severe national lockdown restrictions imposed in South Africa. The effects of these restrictions on routine-oriented lifestyle behaviours were significant and largely similar to the changes seen in other countries. We expand on these observations by showing differences in response to lockdown between males and females, and between students and non-students. Sleep and depression in females were more negatively impacted than males, and more males reduced physical exercise and alcohol intake than females.

We speculate that the sleep changes reported by students during lockdown may reflect "catch-up" sleep in response to accumulated sleep debt under normal routines. Indeed the dramatic change in work and sleep timing among students suggests habitual routines that are too early for their likely later chronotypes, which typically results in sleep deprivation when societal temporal demands are biased towards earlier start times. Thus our data may be useful in preliminary engagements with relevant stakeholders to lobby for later class start times in South Africa to improve learning and health outcomes. The interactions between mental health, sleep and physical activity due to the disruption of daily routines imposed by lockdown need to be explored to understand the potential long-term consequences on mental and physical health.

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TABLES

Table 1. Descriptive characteristics of all participants before lockdown, and stratified by gender and student status.

	All (n=1048)	Females (n=767)*	Males (n=261)*	p-value	Students (n=473)	Non-students (n=575)	p-value
Age (y)	27 (21, 42)	29 (21,43)	25 (20, 37)	**0.013**	21 (19, 23)	40 (30,51)	**<0.001**
No. of females (%)*	767 (73.2%)	-	-	-	326 (71.3%)	441 (77.2%)	**0.002**
House density (people/room)	0.50 (0.33, 0.67)	0.50 (0.33, 0.67)	0.50 (0.36, 0.75)	0.101	0.55 (0.40, 1.00)	0.43 (0.33. 0.60)	**<0.001**
No. children in respondent's care	0 (0, 1)	0 (0, 1)	0 (0, 0)	0.282	0 (0, 0)	0 (0, 2)	**<0.001**
Employment status (Employed: not employed: student)	535:40:473 (51:4:45%)	408:33:326 (53:4:43%)	124:6:131 (48:2:50%)	0.053	0:0:473 (0:0:100%)	535:40:0 (93: 7:0%)	**<0.001**
No. with chronic	565 (53.9%)	431 (56.2%)	117 (44.8%)	**0.002**	265 (56.3%)	300 (52.2%)	0.214

condition (%)							
No. with sleep condition (%)	348 (33.2%)	267 (34.8%)	70 (26.8%)	**0.018**	153 (32.4%)	195 (33.9%)	0.592
No. tested for COVID-19 (%)	49 (3.8%)	23 (3.0%)	16 (6.1%)	**0.037**	32 (5.6%)	8 (1.7%)	**<0.001**
No. diagnosed with COVID-19 (%)	2 (0.2%)	2 (0.3%)	0 (0.0%)	1.00	1 (0.2%)	1 (0.2%)	1.00

Data are presented as median (interquartile range) or count (%). *excluded gender = non-binary (n=15) or prefer not to say (n=5). P-values represent between-group comparisons using Mann-Whitney U or Fisher's Exact tests.

Table 2. Changes in routine-oriented lifestyle behaviours and symptoms of anxiety, depression and insomnia during lockdown in all participants.

		Before	During	p-value
Work/study duration (h/week)*		40 (30, 45) (n=1008)	25 (10, 40) (n=1011)	**<0.001**
Work/study start time (hh:mm)*		8:00 (7:30, 9:00) (n=980)	9:30 (8:30, 11:00) (n=899)	**<0.001**
Work/study end time (hh:mm)*		17:00 (16:00, 18:30) (n=977)	17:00 (15:00, 19:00) (n=895)	0.075
Exercise	Yes (%)	715 (68.23) (n=1048)	639 (60.97) (n=1048)	**<0.001**
	MVPA (min/wk)	180 (20, 360) (n=1037)	75 (0, 240) (n=1041)	**<0.001**
Walking (min/wk)		180 (60, 388) (n=1036)	30 (0, 120) (n=1041)	**<0.001**
Sitting time (h/day)		6 (4, 8) (n=1005)	9 (7, 12) (n=1004)	**<0.001**
Total screen time (h/day)		7.62 ± 3.37 (n=1017)	11.32 ± 3.84 (n=1017)	**<0.001**
Daytime screen time (h/day)		5.16 ± 2.69 (n=1017)	7.23 ± 2.89 (n=1017)	**<0.001**
Nighttime screen time (h/day)		2.46 ± 1.42 (n=1017)	4.09 ± 2.13 (n=1017)	**<0.001**
Caffeine use	Yes (%)	875 (83.49) (n=1048)	894 (85.31) (n=1048)	**<0.001**

	No./day	2.39±1.89 (n=1048)	2.99±2.27 (n=1048)	**<0.001**
Alcohol use	Yes (%)	629 (60.02) (n=1048)	445 (42.46) (n=1048)	**<0.001**
	No./day	1 (0-4) (n=1048)	0 (0-2) (n=1048)	**<0.001**
Bedtime (hh:mm)		22:37 ± 1:16 (n=1046)	23:56 ± 2:16 (n=1043)	**<0.001**
Wake-up time (hh:mm)		06:20 ± 1:10 (n=1045)	08:11 ± 2:14 (n=1044)	**<0.001**
Time-in-bed (h)		7.74 ± 1.23 (n=1043)	8.25± 1.61 (n=1042)	**<0.001**
Total sleep time (h)		7.24 ± 1.10 (n=1048)	7.53±1.69 (n=1048)	**<0.001**
PHQQH score (au)		1 (0-2) (n=1048)	2 (2-4) (n=1048)	**<0.001**
GAD score (au)		4 (2-7) (n=1048)	9 (4-14) (n=1048)	**<0.001**
ISI score (au)		4 (2-8) (n=1048)	10 (4-15) (n=1048)	**<0.001**

Data are presented as mean ± standard deviation, median (interquartile range) or count (%), with sample size (n) for each variable. *data only included for participants categorized as employed or student. au: arbitrary units; MVPA: moderate to vigorous intensity physical activity; PHQ: patient health questionnaire; GAD: general anxiety disorder; ISI: insomnia severity index. P-values were determined using dependent t-tests, Wilcoxon rank sum and McNemars tests.

Table 3. Comparative changes in routine-oriented lifestyle behaviours and during lockdown between females and males.

	Females (n=767)		Males (n=261)		Effects		
	Before	**During**	**Before**	**During**	**Group****	**Time**	**Interaction****
Work/study duration (h/week)*	40 (30, 45)	25 (10, 40)	40 (32, 48)	30 (15, 40)	-1.91 (1.27) 0.098	-9.18 (1.23) **<0.001**	0.33 (1.43) 0.815
Work/study start time (hh:mm)*	8:00 (7:30, 9:00)	9:30 (8:30, 11:00)	8:00 (8:00, 9:00)	9:30 (8:30, 11:30)	-0.05 (0.22) 0.940	1.52 (0.24) **<0.001**	0.09 (0.28) 0.759
Work/study end time (hh:mm)*	17:00 (16:00, 18:30)	17:00 (14:30, 19:00)	17:00 (16:30, 19:00)	17:00 (15:00, 19:30)	-0.25 (0.32) 0.620	-1.28 (0.39) **<0.001**	0.25 (0.46) 0.580
Exercise Yes (%)	515 (67.1)	474 (61.8)	190 (72.8)	156 (59.8)	0.91 [0.72-1.16] 0.450	0.66 [0.55- 0.79] **<0.001**	1.43 [0.99-2.03] **0.052**
Exercise MVPA (min/wk)	150 (0, 320)	70 (0, 220)	230 (60, 450)	90 (0, 270)	-0.10 (0.04) $^{\alpha}$ 0.068	-0.25 (0.04) $^{\alpha}$ **<0.001**	0.10 (0.05) $^{\alpha}$ **0.025**

Walking (min/wk)	180 (60, 420)	30 (0, 120)	175 (60. 360)	20 (0, 90)	0.05 (0.04) $^{\alpha}$ **0.021**	-0.43 (0.05) $^{\alpha}$ **<0.001**	0.05 (0.06) $^{\alpha}$ 0.343
Sitting time (h/day)	6.42±3.10	9.11±3.73	6.74±2.93	9.51±3.52	-0.32 (0.25) 0.098	2.76 (0.20) **<0.001**	-0.07 (0.24) 0.751
Total screen time (h/day)	7.41±3.35	11.06±4.95	8.22±3.33	12.02±3.40	-0.83 (0.26) **<0.001**	3.73 (0.22) **<0.001**	-0.14 (0.26) 0.581
Daytime screen time (h/day)	5.01±2.67	7.09±2.97	5.61±2.68	7.57±2.63	-0.61 (0.20) **0.002**	1.94 (0.17) **<0.001**	0.21 (0.19) 0.530
Nighttime screen time (h/day)	2.40±1.41	3.97±2.09	2.62±1.46	4.45±2.24	-0.03 (0.02) $^{\alpha}$ **0.009**	0.22 (0.01) $^{\alpha}$ **<0.001**	-0.01 (0.02) $^{\alpha}$ 0.430
Caffeine use Yes (%)	647 (84.4)	668 (87.1)	213 (81.6)	214 (82.0)	1.34 [0.95-1.90] 0.117	1.13 [0.99-1.30] 0.069	1.22 [0.93-1.59] 0.148
Caffeine use No./day	2.44±.1.92	3.11±2.28	2.24±1.78	2.70±2.17	0.20 (0.15) **0.028**	0.46 (0.10) **<0.001**	0.21 (0.11) 0.055

Alcohol use Yes (%)	453 (59.1)	330 (43.0)	166 (63.6)	111 (42.5)	0.92 [0.71-1.19] 0.512	0.47 [0.41-0.54] **<0.001**	1.23 [0.95-1.60] 0.107
No./day	1 (0, 4)	0 (0, 2)	2 (0, 5)	0 (0, 2)	-1.20 (0.28) **0.004**	-1.67 (0.23) **<0.001**	0.95 (0.26) **<0.001**
Bedtime (hh:mm)	22:31 ± 1:01	23:49 ± 2:14	22:54 ± 1:24	24:14 ± 2:17	-0.39 (0.13) **<0.001**	1.32 (0.12) **<0.001**	-0.00 (0.14) 0.990
Wake-up time (hh:mm)	6:17 ± 1:07	8:06 ± 2:08	6:31 ± 1:16	8:21 ± 2:26	-0.23 (0.13) **0.020**	1.82 (0.13) **<0.001**	-0.02 (0.15) 0.870
Time-in-bed (h)	7.79 ± 1.23	8.27 ± 1.62	7.62 ± 1.19	8.14 ± 1.51	0.17 (0.0) 0.065	0.52 (0.10) **<0.001**	-0.03 (0.12) 0.770
Total sleep time (h)	7.22 ± 1.12	7.50 ± 1.74	7.30 ± 1.03	7.57 ± 1.48	-0.08 (0.10) 0.352	0.27 (0.11) **<0.001**	0.008 (0.12) 0.960

Data are presented as mean ± standard deviation, median (interquartile range) or count (%), with the effect data presented as beta (standard error) p-value or odds ratio [95%Wald confidence interval] p-value. *data only included for males and females categorized as employed or student; **males used as the reference group, α= variable log transformed for analysis Beta (SE) presented on the log-transformed variable. Proc Genmod with a random statement (SAS 9.3 ®) used for binary outcome variables; Proc mixed (mixed models analysis) used for continuous outcome variables (SAS 9.3 ®). MVPA: moderate to vigorous intensity physical activity.

Table 4. Changes in routine-oriented lifestyle behaviours during lockdown between students and non-students.

	Students (n=473)		**Non-students (n=575)**		**Effects**		
	Before	**During**	**Before**	**During**	**Group****	**Time**	**Interaction****
Work/study duration (h/week)*	36 (30. 45)	25 (15, 40)	40 (30, 45)	25 (4, 40)	-3.2 (1.1) **0.048**	-10.3 (0.9) **<0.001**	2.9 (1.3) **0.021**
Work/study start time (hh:mm)*	8:00 (8:00, 9:00)	10:30 (9:00, 12:30)	8:00 (7:30, 9:00)	9:00 (8:00, 10:00)	1.0 (0.2) **<0.001**	0.9 (0.2) **<0.001**	1.3 (0.2) **<0.001**
Work/study end time (hh:mm)*	17:00 (16:00, 21:00)	17:00 (14:00, 20:00)	17:00 (16:00, 17:30)	17:00 (15:00, 18:30)	1.22 (0.28) **<0.001**	0.02 (0.28) **<0.001**	-2.33 (0.40) **<0.001**

Exercise	Yes (%)	296 (62.6)	265 (56.0)	419 (72.9)	374 (65.0)	0.67 [0.53-0.79] **<0.001**	0.72 [0.62-0.84] **<0.001**	1.1 [0.79-1.47] 0.620
	MVPA (min/wk)	180 (20, 360)	60 (0, 190)	180 (20, 360)	90 (0, 255)	0.01 (0.03) 0.450	-0.15 (0.03) **<0.001**	-0.06 (0.04) 0.160
Walking time (min/wk)		225 (120, 420)	15 (0, 80)	135 (40, 280)	40 (0, 150)	0.21 (0.03)[α] 0.568	-0.22 (0.03)[α] **<0.001**	-0.38 (0.04)[α] **<0.001**
Sitting time (h/day)		6.70±2.85	10.32±3.38	6.34±3.22	8.33±3.68	0.38 (0.21) **<0.001**	1.98 (0.13) **<0.001**	1.63 (0.20) **<0.001**
Total screen time (h/day)		7.43±3.18	12.12±3.65	7.76±3.50	10.69±3.87	-0.15 (0.23) **<0.001**	2.92 (0.14) **<0.001**	1.60 (0.22) **<0.001**
Daytime screen time (h/day)		4.73±2.36	7.38±2.81	5.50±2.88	7.11±2.96	-0.66 (0.17) 0.196	1.62 (0.11) **<0.001**	0.93 (0.17) **<0.001**
Nighttime screen time (h/day)		2.70±1.52	4.74±2.22	2.27±1.30	3.58±1.92	0.06[α] (0.01) **<0.001**	0.19[α] (0.01) **<0.001**	0.05[α] (0.00) **<0.001**
Caffein	Yes (%)	351 (74.2)	367 (77.6)	524 (91.1)	527 (91.7)	0.30 [0.21-0.42] **<0.001**	1.16 [1.01-1.33] 0.094	1.17 [0.90-1.55] 0.192

	No./day	1.81±1.72	2.39±2.15	2.86±1.90	3.49±2.24	-1.03 (012) **<0.001**	0.65 (0.06) **<0.001**	-0.07 (0.10) 0.466
Alcohol use	Yes (%)	241 (51.0)	111 (23.5)	388 (67.5)	298 (51.8)	0.47 [0.37-0.58] **<0.001**	0.48 [0.43-0.54] **<0.001**	.087 [0.68-1.17] 0.202
	No./day	1 (0, 3)	0 (0, 1)	2 (0, 5)	1 (0, 3)	-1.24 (0.24) **<0.001**	-0.93 (0.15) **<0.001**	-0.08 (0.23) 0.725
Bedtime (hh:mm)		23:05±1.19	00:54±2:29	22:14±1:05	23:10±1:41	0.82 (0.11) **<0.001**	0.92 (0.08) **<0.001**	0.88 (0.12) **<0.001**
Wake-up time (hh:mm)		6:40±1.12	9:17±2:18	6:06±1:04	7:17±1:44	0.53 (0.10) **<0.001**	1.19 (0.08) **<0.001**	1.38 (0.12) **<0.001**
Time-in-bed (h)		7.58±1.36	8.39±1.70:	7.87±1.10	8.14±1.51	-0.29 (0.08) 0.610	0.27 (0.07) **<0.001**	0.50 (0.10) **<0.001**
Total sleep time (h)		7.17±1.16	7.82±1.77	7.30±1.05	7.29±1.59	-0.13 (0.09) **0.006**	-0.01 (0.07) **<0.001**	0.64 (0.11) **<0.001**

Data are presented as mean ± standard deviation, median (interquartile range) or count (%), with the effect data presented as beta (standard error) p-value or odds ratio [95%Wald confidence interval] p-value. *data only included for males and females categorized as employed or student; **males used as the reference group, α= variable log transformed for analysis Beta (SE) presented on the log-transformed variable. Proc Genmod with a random statement (SAS 9.3 ®) used for binary outcome variables; Proc mixed (mixed models analysis) used for continuous outcome variables (SAS 9.3 ®). MVPA: moderate to vigorous intensity physical activity

FIGURE LEGENDS

Figure 1. Comparative changes in routine-oriented lifestyle behaviours between Students (n=575) and Non-students (n=473). Data are presented as frequencies. P-values were determined using Chi-squared tests and Fisher's exact tests were used for post hoc analyses. *indicate significant between-group post hoc differences.

Figure 2. Comparative changes in sleep habits between Students (n=473) and Non-students (n=575). Data are presented as frequencies. P-values were determined using Chi-squared tests and Fisher's exact tests were used for post hoc analyses. *indicate significant between-group post hoc difference.

Figure 3. Comparative changes in symptoms of depression (A, B), anxiety (C, D) and insomnia (E, F) during lockdown between females versus males (left panel) and students versus non-students (right panel). All data points are plotted with the median and interquartile ranges. Horizontal grey-dashed lines represent respective categorical cut-offs for each scale. PHQ: Patient Health Questionnaire-2; GAD: Generalized Anxiety Disorder; ISI: Insomnia Severity Index. P-values were determined using mixed effects models, covarying for age.

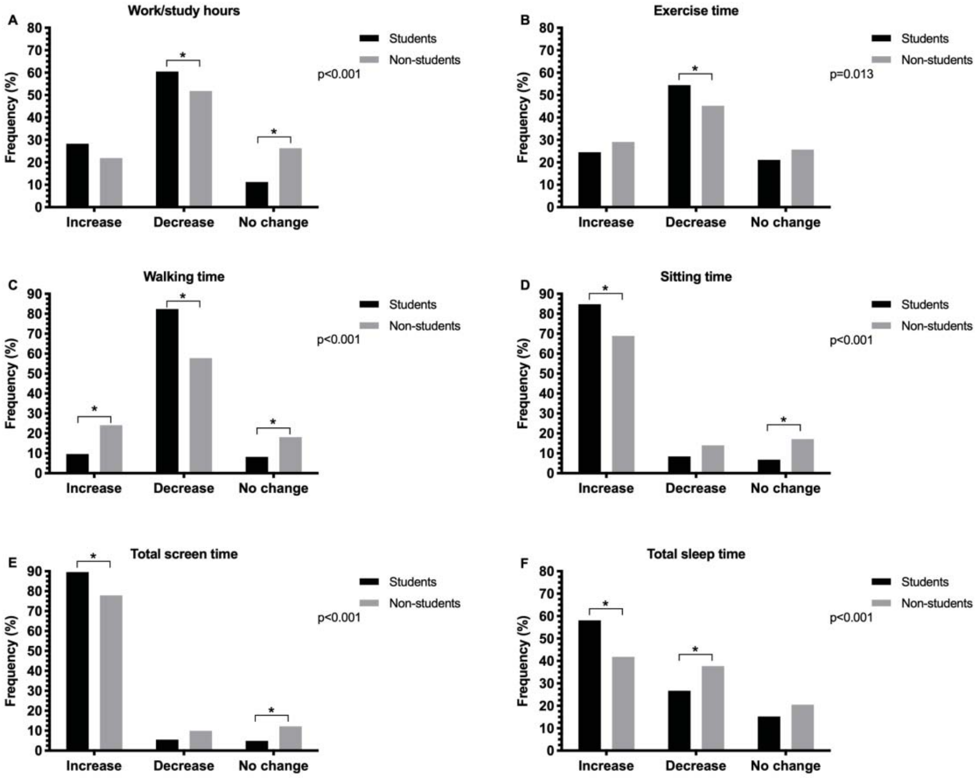

Figure 1. Comparative changes in routine-oriented lifestyle behaviours between Students (n=575) and Non-students (n=473). Data are presented as frequencies. P-values were determined using Chi-squared tests and Fisher's exact tests were used for post hoc analyses. *indicate significant between-group post hoc differences.

182x146mm (300 x 300 DPI)

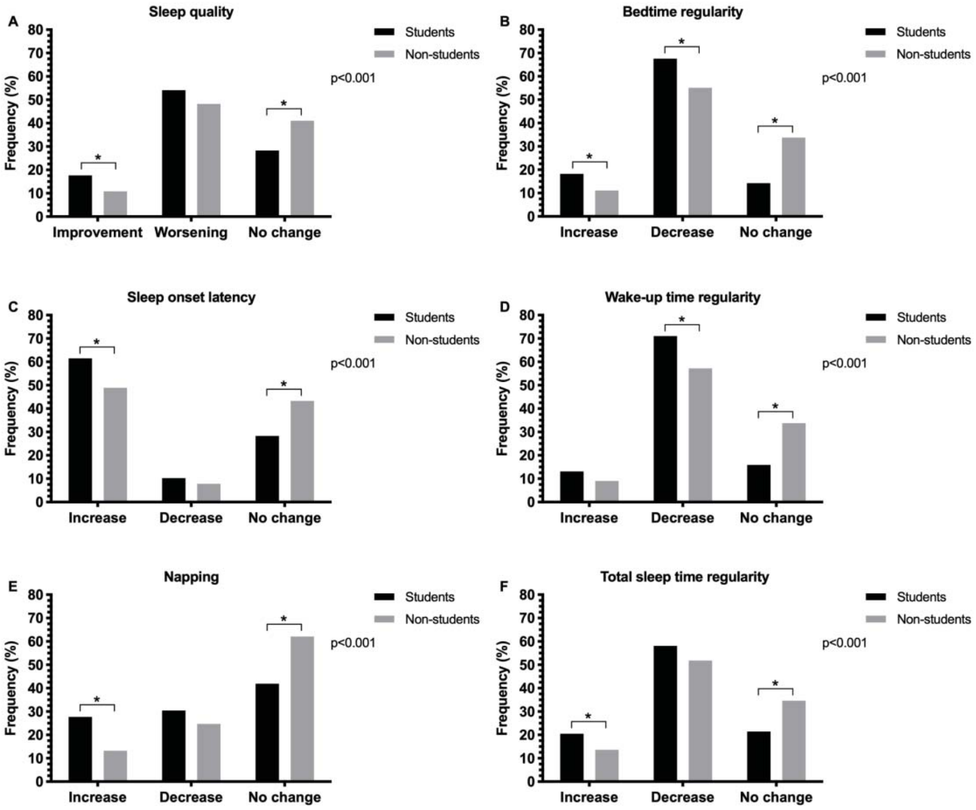

Figure 2. Comparative changes in sleep habits between Students (n=473) and Non-students (n=575). Data are presented as frequencies. P-values were determined using Chi-squared tests and Fisher's exact tests were used for post hoc analyses. *indicate significant between-group post hoc difference.

172x144mm (300 x 300 DPI)

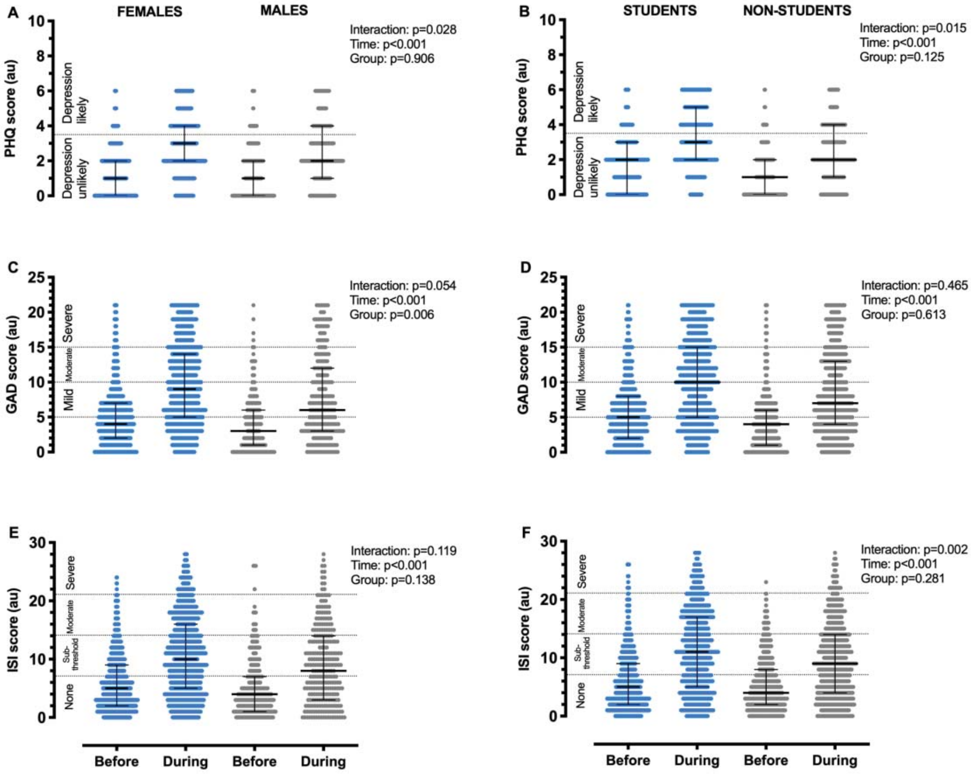

Figure 3. Comparative changes in symptoms of depression (A, B), anxiety (C, D) and insomnia (E, F) during lockdown between females versus males (left panel) and students versus non-students (right panel). All data points are plotted with the median and interquartile ranges. Horizontal grey-dashed lines represent respective categorical cut-offs for each scale. PHQ: Patient Health Questionnaire-2; GAD: Generalized Anxiety Disorder; ISI: Insomnia Severity Index. P-values were determined using mixed effects models, covarying for age.

183x146mm (300 x 300 DPI)

SUPPLEMENTARY DATA

Table S1. Descriptive and lockdown-related change characteristics among individuals identifying with the non-binary gender, or who preferred not to say.

	Non-binary (n=15)		Prefer not to say (n=5)[#]	
Age (y)	22 (19, 27)		19 (18, 19)	
House density (people/room)	0.6 (0.4, 0.7)		0.5 (0.3, 1.0)	
No. children in respondent's care	0 (0, 0)		0 (0, 0)	
Employment status (Employed: not employed: student)	2:2:11 (13:13::74)		0:0:5 (0:0:100%)	
No. with chronic condition (%)	14 (93.3)		3 (60)	
No. with sleep condition (%)	8 (53)		3 (60)	
No. tested for COVID-19 (%)	1 (7)		0 (0)	
No. diagnosed with COVID-19 (%)	0 (0)		0 (0)	
	Before	**During**	**Before**	**During**
Work/study hours (h/wk)	38 (25, 45)	20 (2, 30)	10.5 (8, 30)	21 (5. 25)
Walking (min/wk)	240 (160, 600)	20 (0, 60)	250 (140, 700)	0 (0, 20)
MVPA (min/wk)	120 (70, 180)	30 (0, 100)	450 (120, 840)	0 (0, 20)
Sitting time (h/day)	7 (4, 9)	10 (7, 12)	3 (2, 7)	14 (11, 14)
Total screen time (h/day)	6.5 (5, 11)	11 (10, 14)	7 (6, 10)	16 (12, 17)
Time-in-bed (h)	8 (7, 9)	9 (8, 11)	7 (6, 9)	7 (7, 7)
Total sleep time (h)	7 (6, 8)	8 (6, 10)	6 (5, 9)	7 (7, 9)
PHQ score (au)	2 (2, 4)	4 (3, 6)	1 (0, 4)	5 (3, 5)
GAD score (au)	8 (6, 14)	13 (7, 15)	4 (3, 7)	17 (11, 19)

ISI score (au)	7 (3, 13)	14 (7, 20)	4 (3, 5)	17 (14, 19)

Data are presented for descriptive purposes and statistics were not conducted owing to small sample size. MVPA: moderate and vigorous physical activity; PHQ: patient health questionnaire; GAD: general anxiety disorder, ISI: insomnia severity index.

Table S2. Comparative changes in time spent working and or studying, exercising, sitting, using screens and sleeping between males and females, and between students and non-students

		Females (n=767)[#]	Males (n=261)[#]	p-value	Students (n=473)	Non-students (n=575)	p-value
Work/study time (h/wk)	Increase	190 (24.8%)	64 (24.5%)	0.760	134 (28.3%)	126 (21.9%)	**<0.001**
	Decrease	424 (55.3%)	150 (57.5%)		286 (60.5%)*	298 (51.8%)*	
	No change	153 (19.9%)	47 (18.0%)		53 (11.2%)*	151 (26.3%)*	
Exercise time (MVPA min/wk)	Increase	211 (27.9%)	66 (25.6%)	**0.039**	114 (24.5%)	166 (29.1%)	**0.013**
	Decrease	354 (46.8%)*	143 (55.4%)*		253 (54.4%)*	257 (45.2%)*	
	No change	191 (25.3%)	49 (19.0%)		98 (21.1%)	146 (25.7%)	
Walking (min/wk)	Increase	136 (18.0%)	45 (17.4%)	0.907	44 (9.6%)*	137 (24.1%)*	**<0.001**
	Decrease	513 (68.0%)	179 (69.4%)		383 (82.4%)*	328 (57.8%)*	
	No change	106 (14.0%)	34 (13.2%)		38 (8.2%)*	103 (18.1%)*	
Sitting time (h/day)	Increase	558 (75.9%)	189 (75.9%)	0.387	385 (84.8%)*	378 (68.9%)*	**<0.001**
	Decrease	89 (12.1%)	24 (9.6%)		38 (8.4%)	77 (14.0%)	
	No change	88 (12.0%)	36 (14.4%)		31 (6.8%)*	94 (17.1%)*	
Total screen time (h/day)	Increase	618 (82.8%)	213 (83.9%)	0.893	403 (89.6%)*	442 (77.9%)*	**<0.001**
	Decrease	59 (7.9%)	20 (7.9%)		25 (5.5%)	56 (9.9%)	
	No change	69 (9.3%)	21 (8.12)		22 (4.9%)*	69 (12.2%)*	
Time-in-bed	Increase	426 (55.8%)	143 (55.7%)	0.186	294 (62.5%)*	287 (50.3%)*	**<0.001**

(h)	Decrease	213 (27.9%)	61 (23.7%)		108 (23.0%)*	171 (30.0%)*	
	No change	124 (16.3%)	53 (20.6%)		68 (14.5%)	112 (19.7%)	
Total sleep time (h)	Increase	379 (49.4%)	128 (49.1%)	0.120	275 (58.1%)*	240 (41.8%)*	**<0.001**
	Decrease	260 (33.9%)	76 (29.1%)		126 (26.7%)*	217 (37.7%)*	
	No change	128 (16.7%)	57 (21.8%)		72 (15.2%)	118 (20.5%)	

Data are presented as count (%). P-values were determined using Chi-squared tests and Fisher's exact tests were used for post hoc analyses. * indicate post hoc differences between-groups.

Table S3. Comparative changes in depression, anxiety and insomnia symptoms, and sleep characteristics between males and females, and between students and non-students.

		Females (n=767)*	Males (n=261)*	p-value	Students (n=473)	Non-students (n=575)	p-value
PHQ symptom severity	Worsened	495 (64.6%)	160 (61.3%)	0.541	313 (66.2%)	357 (62.1%)	**0.006**
	Improved	70 (9.1%)	29 (11.1%)		56 (11.8%)	47 (8.2%)	
	No change	202 (26.3%)	72 (27.6%)		104 (22.0%)*	171 (29.7%)*	
GAD symptom severity	Increase	593 (77.3%)	188 (72.0%)	**0.021**	356 (75.3%)	440 (76.5%)	0.117
	Decrease	92 (12.0%)	28 (10.7%)		66 (13.9%)	59 (10.3%)	
	No change	82 (10.7%)*	45 (17.3%)*		51 (10.8%)	76 (13.2%)	
ISI symptom severity	Increase	544 (71.0%)*	164 (62.9%)*	**<0.001**	338 (71.5%)	384 (66.8%)	**0.012**
	Decrease	133 (17.3%)	39 (14.9%)		84 (17.7%)	92 (16.0%)	
	No change	90 (11.7%)*	58 (22.2%)*		51 (10.8%)*	99 (17.2%)*	
Sleep quality	Improvement	106 (13.8%)	36 (13.8%)	**0.005**	83 (17.6%)*	62 (10.8%)*	**<0.001**
	Worsening	410 (53.5%)*	112 (42.9%)*		256 (54.1%)	277 (48.2%)	
	No change	251 (32.7%)*	113 (43.4%)*		134 (28.3%)*	236 (41.0%)*	
Sleep onset latency	Increase	440 (57.4%)*	121 (46.4%)*	**0.008**	291 (61.5%)*	281 (48.9%)*	**<0.001**
	Decrease	64 (8.3%)	26 (9.9%)		48 (10.2%)	45 (7.8%)	
	No change	263 (34.3%)*	114 (43.7%)*		134 (28.3%)*	249 (43.3%)*	
Napping	Increase	207 (27.0)	70 (26.8)	0.225	144 (30.4)	142 (24.7)	**<0.001**
	Decrease	159 (20.7)	42 (16.1)		131 (27.7)*	76 (13.2)*	

	No change	401 (52.3)	149 (57.1)		198 (41.9)*	357 (62.1)*	
Bedtime regularity	Increase	100 (13.0%)	43 (16.5%)	0.181	86 (18.2%)*	64 (11.1%)*	**<0.001**
	Decrease	479 (62.5%)	147 (56.3%)		320 (67.6%)*	317 (55.1%)*	
	No change	188 (24.5%)	71 (27.2%)		67 (14.2%)*	194 (33.8%)*	
Wake-up time regularity	Increase	87 (11.3%)	25 (9.6%)	0.682	62 (13.1%)	52 (9.0%)	**<0.001**
	Decrease	487 (63.5%)	164 (62.8%)		336 (71.0%)*	329 (57.2%)*	
	No change	193 (25.2%)	72 (27.6%)		75 (15.9%)*	194 (33.8%)*	
Total sleep time regularity	Increase	130 (17.0%)	41 (15.7%)	0.297	97 (20.5%)*	78 (13.6%)*	**<0.001**
	Decrease	426 (55.5%)	135 (51.7%)		275 (58.1%)	298 (51.8%)	
	No change	211 (27.5%)	85 (32.6%)		101 (21.4%)*	199 (34.6%)*	

Data are presented as count (%). P-values were determined using Chi-squared test.