

BMJ Open Gender differences in sleep disruption during COVID-19: cross-sectional analyses from two UK nationally representative surveys

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ABSTRACT

Objective COVID-19 related measures have impacted sleep on a global level. We examine changes in sleep problems and duration focusing on gender differentials.

Design Cross-sectional analyses using two nationally representative surveys collected during the first and second month after the 2020 lockdown in the UK.

Setting and participants Participants (age 17 years and above) from the first wave of the Understanding Society COVID-19 Study are linked to the most recent wave before the pandemic completed during 2018 and 2019 (n=14 073). COVID-19 Survey Data was collected from 2 to 31 May 2020 (n=8547) with participants drawn from five nationally representative cohort studies in the UK.

Analysis We conducted bivariate analyses to examine gender gaps in change in sleep problems and change in sleep duration overall and by other predictors. A series of multivariate ordinary least squares (OLS) regression models were estimated to explore predictors of change in sleep problems and change in sleep time.

Results People in the UK on average experienced an increase in sleep loss during the first 4 weeks of the lockdown (mean=0.13, SD=0.9). Women report more sleep loss than men (coefficient=0.15, 95% CI 0.11 to 0.19). Daily sleep duration on average increased by ten minutes (mean=-0.16, SD=1.11), with men gaining eight more minutes of sleep per day than women (coefficient=0.13, 95% CI 0.09 to 0.17).

Conclusion The COVID-19 related measures amplified traditional gender roles. Men's sleep was more affected by changes in their financial situation and employment status related to the crisis, with women more influenced by their emotional reaction to the pandemic, feeling anxious and spending more time on family duties such as home schooling, unpaid domestic duties, nurturing and caregiving. Based on our findings, we provide policy advice of early, clear and better employment protection coverage of self-employed and precarious workers and employer recognition for parents.

INTRODUCTION

As COVID-19 first unfolded in early 2020, the UK government announced a series of policy responses, including a strict lockdown and stay at home measures on 23 March 2020, the closing of schools and various employment

Strengths and limitations of this study

- This study extends our knowledge on the gendered impact of lockdowns during COVID-19, but also how different social structural conditions have diverse relationships with sleep disruption.
- The study may suffer from attrition bias and recall bias. The use of two nationally representative samples can assuage this concern since the results from the two samples are consistent.
- Our findings have clear employment and organisational policy implications for future lockdowns or pandemics.

and job retention schemes. The pandemic deeply impacted the daily lives of individuals, families and workers. Lockdown measures compelled people to stay at home, businesses and schools to close and the suspension of work or firing of employees. Lockdowns forced individuals to live in entirely new ways by home schooling children and experiencing unprecedented work-life conflict, anxiety and economic hardship. In addition to economic and coordination problems, these changes had the potential to induce psychological discomfort related to loss of control and uncertainty. One way to measure the deep mental health impacts of lockdown is through sleep loss and disruption, which has the potential for both short but also longer term negative health consequences. A recent study found that COVID-19 related measures impacted sleep on a global level and the disturbed sleep during the pandemic is strongly linked with mental distress.¹

Sleep is regulated by circadian rhythms, synchronised by external diurnal cycles, including sunlight and temperature.² This internal clock tells our bodies when to sleep, wake and eat. In modern societies, human's circadian clocks are also structured by daily employment and school schedules. Beyond



the external shock of the COVID-19 pandemic, several recent factors have emerged to disrupt our chronotypes to unprecedented levels. Indoor lighting, exposure to light pollution from streets and electronic devices such as laptops and smartphones places more individuals at risk of circadian disruption. With social distancing protocols in place amid the COVID-19 pandemic, individuals were increasingly connecting to the outside world through screens. The unexpected changes in lifestyles due to the pandemic may have interrupted the sleep–wake cycle in both infected patients and the general population and have short-term and long-term physiological, behavioural, cognitive and emotional consequences.³

Sleep is essential for physical⁴ and mental functioning.⁵ Sleep deprivation has been related to lower cognitive functioning, higher accident rates and increased interpersonal conflict.⁶ The impact of COVID-19 on sleep disruption, however, is not equally distributed. Previous research found that women have distinct and higher levels of sleep problems and disruption already in non-pandemic conditions.⁷ Gender differences in change in sleep problems and sleep duration during lockdown can be a function of compositional differences in work and family responsibilities, and psychological distress that may induced by health conditions, employment and financial circumstances. Initial research using one survey found that women have been more vulnerable to sleep deprivation during lockdown¹ and more prone to suffer from anxiety in the early stages of lockdown.⁸ However, evidence explaining such gender gap in sleep is limited and has not been replicated across multiple studies.

Understanding inequality in sleep quality and duration is especially important during COVID-19,^{9–11} since sleep is linked to the immune system and promotes inflammatory homeostasis, which affect the risks of infection.¹² The aim of this study is to examine changes in sleep problems and duration using two nationally representative web surveys collected during the first and second month after the lockdown in the UK, from April to May 2020, focusing on explaining gender differences in sleep patterns.

The current study contributes to existing research in several ways. First, the pattern of changes in sleep duration for men and women during the pandemic is understudied. COVID-19 has brought considerable and deep impacts to people's social life and daily routines, but the burden is not equally distributed by gender.¹² For example, since gender norms and predominant working patterns in the UK position men as the primary earners and women as the primary care givers, the spatial boundary between work and family life was blurred during the work-from-home period.¹³ Second, although some preliminary studies exist, they examine only one sample and do not focus in detail on gender differences. The current study draws from multiple longitudinal representative surveys in the UK to test and replicate our findings. Third, most COVID-19 studies are cross-sectional and therefore lack a benchmark of individuals' behaviour prior to the pandemic. By using pre-existing longitudinal

surveys, we are able to gauge changes in sleep disruption by comparing information from previous waves prior to the pandemic. A related and fourth contribution is that we draw on data from national representative surveys, moving away from small selective samples. A fifth extension that we assess is the sleep gender gap across the different domains of employment, time use, life course stage, financial implications and psychological distress.

We first describe the context of the initial lockdown in the UK in the spring of 2020, and how these measures impact sleep, and how that impact varies by gender and other factors. We hypothesise that women are more vulnerable to COVID-19 related impact on sleep, in terms of both sleep duration and disturbances. After describing our data, measures and analytical methods, we highlight key results followed by a discussion and reflection of the broader individual, policy and societal implications of these findings.

METHODS

Study design and participants

Understanding Society COVID-19 Study

The Understanding Society COVID-19 Study is a supplemental survey added to the existing UK Household Longitudinal Study (UKHLS), initiated in April 2020. Sampling strategies are available online.¹⁴ Participants who are 16 years old and over from the main UKHLS sample were asked to complete a short web survey every month (those without internet access are interviewed via telephone by trained professionals) designed to explore how the pandemic impacted individuals, families and communities across the UK. We use the first wave of the data (n=17 452, response rate=41%), which was completed in April and thus covered the first month of lockdown in the UK. The data were linked to the most recent wave (wave 9) before the pandemic (n=36 055), completed during 2018 and 2019. Linking the pre-COVID-19 and post-COVID-19 questionnaires resulted in a sample of 15 990 respondents. After pair-wise deletion of missing cases for key variables, we obtain an analytical sample of 14 073.

The COVID-19 Survey Data

From 2 to 31 May 2020, data from a web survey of over 18 000 individuals were collected.¹⁵ Participants who provided an email address were drawn from five nationally representative cohort studies in the UK, provided that they had not permanently withdrawn from the study, could be traced and were not known to have died.¹⁵ The five cohorts include Millennium Cohort Study (MCS), born in 2000–2002; Next Steps, born in 1989–1990; 1970 British Cohort Study (BCS70), born in 1970; National Child Development Study (NCDS), born in 1958; and National Study of Health and Development Study (NSHD), born in 1946. At the time of writing, the NSHD was not yet included in the data. We exclude the MCS and NSHD cohorts because these are younger and older individuals, and we are interested

in how work and family duties influence sleep patterns. The MCS participants are now aged 19 years and most of them are still in education, and the NSHD cohort has long past the retirement age and none of them had resident dependent children. The analyses thus relate to participants from three out of five of the studies included in the survey: Next Steps (n=1907; response rate=20%), BCS70 (n=4223; response rate=40%) and NCDS (n=5178; response rate=58%). After pair-wise deletion of missing cases for key variables, we obtain an analytical sample of 8547. We conduct cross-sectional analyses using these two sources of data.

Dependent variables

We studied two outcome variables: (1) change in whether the respondent lost sleep over worry prior and post the COVID-19 pandemic (*change in sleep problems*); and (2) change in self-reported hours of sleep prior and post the outbreak of COVID-19 (*change in sleep duration*). Sleep problems were asked in both the Understanding Society COVID-19 Study and the wave 9 follow-up survey. Respondents were asked whether they have recently lost much sleep over worry (a higher score indicates worse sleep problems). Changes in the sleep problem variable is generated using the respondents' answer in the COVID-19 study minus the respondents' answer in wave 9. A higher, positive score suggests experiencing more sleep loss over worry, with 0 indicating no change.

Number of hours slept at night pre and post COVID-19 was asked in the COVID-19 survey. Change in sleep duration was constructed using hours slept pre-COVID-19 minus hours slept post-COVID-19. Again, a higher and positive score suggests reduced sleep duration.

Independent variables

We generated explanatory and control variables capturing status and behavioural changes during the COVID-19 outbreak that may be determinants of changes in sleep quality and duration based on previous literature.¹⁶ These includes changes in financial situation, employment, health and feeling of loneliness, with higher scores denoting downward status. Most of the variables were included in both datasets, though questions may have slight variation. A detailed description of these variables and additional control variables are available in the online supplemental materials.

Analytical statistics

We conducted bivariate analyses to examine gender gaps in change in sleep problems and change in sleep duration overall and by life course stage, employment status, time use and psychological distress categories. We present means and SD of change in sleep problems and change in sleep hours pre and post the COVID-19 lockdown among men and women who reported the same employment status, were in the same life course stage, time use category, change in financial situation and psychological

distress level. We tested for statistical significance ($p < 0.05$) of differences for two comparisons. First, to assess the gender gap, we use separate regression models to predict the focal outcome (ie, employment, time use, life course, financial and psychological distress categories) with gender as the sole independent variable. Second, to assess differences across the previously mentioned variables among men only or women only, we use separate regression models to predict the sleep outcomes in question with employment, time use, life course, financial and psychological distress categories as the sole independent variable.

Our main analyses are a series of multivariate ordinary least squares (OLS) regression models predicting change in sleep problems and change in sleep time using status and behavioural change factors mentioned previously, controlling for life course stage, current employment status, race/ethnicity, educational attainment, spousal/partner's employment status, coronavirus symptoms, change in feeling of loneliness and depression, key worker and time spent in housework. All analyses are conducted using STATA V.16.

Patient and public involvement

Patients and the public were not involved in the development of research questions, design of the study, recruitment and conduct of the study, or dissemination of the study results. The datasets used in our study are fully anonymised. None of the authors was involved in anonymisation. We gained permission to access the datasets via UK Data Service website (<https://ukdataservice.ac.uk/>). Both original surveys received ethics approval. Detailed information is available online (for Understanding Society COVID-19 Study: <https://www.understandingsociety.ac.uk/documentation/mainstage/user-guides/main-survey-user-guide/ethics>; for COVID-19 Survey: <https://cls.ucl.ac.uk/about-2/information-governance/>).

RESULTS

Descriptive statistics

Fifty-eight per cent and 57% of the Understanding Society COVID-19 Study and the COVID-19 Survey analytical sample are women, respectively. People in the UK on average experienced an increase in sleep loss due to worry during the first 4 weeks of the COVID-19 lockdown (mean=0.13, SD=0.9), although half of the respondents report no change in sleep problems (online supplemental figure S1). Women (mean=0.20, SD=0.93) reported considerably more sleep loss due to worry compared with men (mean=0.05, SD=0.83). Although an increase in sleep loss was reported in some groups, in general, people's sleep duration on average increased by 10 min during the second 4 weeks of the pandemic lockdown in the UK (mean=-0.16, SD=1.11), with men (mean=-0.22, SD=0.97) on average gaining seven more minutes of sleep than women, which would average to 49 min extra per week (mean=-0.10, SD=1.21) (online

supplemental figure S2). **Table 1** presents the weighted distribution of respondents' characteristics for the two samples by sex.

Bivariate analyses

We find that gaps in changes in sleep problems due to worry are much larger by sex than by other observed predictors (**table 2**). In every category, women reported higher increases in sleep problems than men. The only exception was for losing a job, in which women reported fewer sleep problems than men, but the difference is not statistically significant at $p < 0.05$.

Change in sleep loss due to worry varied by life course stage, with young, single, childless men and older, single, childless women reporting the least changes in sleep problems. Conversely, partnered respondents with children 0–4 years old reported the highest increase in sleep problems. With the exception of young, partnered, childless respondents, women reported more sleep loss due to worry than men. Older, partnered, childless men enjoyed a 13 min increase, and older, single, childless men experienced a 5 min increase in sleep duration, while women in these life course stages had a deficit of about 2 min in sleep.

Within-gender comparisons showed that among both sexes, young, single, childless respondents reported a lower increase ($p < 0.05$) in sleep problems than partnered respondents with children younger than 5 years old. Young, partnered, childless women gained more sleep ($p < 0.05$) during the lockdown than young, single, childless women. However, women living with a partner with younger children slept less than childless women ($p < 0.05$).

Table 2 also shows that respondents who were self-employed reported the highest increase in sleep problems than other categories. The magnitude of this within-gender gap is much larger among women. In terms of change in employment status, women who were back in the labour force and women whose employment status did not change after the pandemic experienced increased sleep loss due to worry compared with men. Men who lost their job after the pandemic reported more sleep problems ($p < 0.05$) compared with men who were previously not employed but were employed at the time of survey. Women who were key workers suffered more sleep problems ($p < 0.05$) than male key workers.

In terms of changes in sleep duration, employed but furloughed men slept more than women in the same category. Lockdown increased sleep duration (ranging from 4 to 38 min) for both men and women in the labour force in our sample, likely due to the closure of businesses and working from home and subsequent replacement of commuting time. Respondents in the labour force gained more sleep ($p < 0.05$) than respondents not in the labour force, except for employed and not furloughed men. Although, both men and women who lost their job gained more time to sleep, the change in sleep duration of men is three times more than the change in sleep duration of women who lost their job ($-0.62/-0.18=3.4$).

Multivariate analyses on sleep problems

Table 3 shows that women report about 0.15 (95% CI 0.11 to 0.19) more sleep loss due to worry than men. Partnered respondents with young children and single parents reported a statistically significant increase (coef.=0.13, 95% CI 0.05 to 0.21) in sleep problems during the first 4 weeks of the lockdown than young, single, childless respondents.

Adjustments for additional variables did not reduce gender differences in changes in sleep problems, indicating that the gender gap is independent of these factors. Change in one's financial situation is associated with changes in sleep problems. One SD change in one's financial situation predicts a 0.05 (95% CI 0.03 to 0.07) worsening of sleep problems. Compared with respondents not in the labour force, self-employed respondents suffered an increase in sleep loss (coef.=0.08, 95% CI 0.01 to 0.16) due to worry. Individuals whose job status did not change and who lost their job experienced more sleep loss than those who with new jobs. Key workers and individuals who spent the highest amounts of time on housework were more likely to experience sleep problems than their counterparts.

Further adjustment for changes in psychological distress substantially reduced the gender difference to one-tenth of a SD in changes in sleep problems and increased the explanatory power. Both change in loneliness and change in feeling depressed predict sleep problems.

Adding interaction terms reveal that being a keyworker has a greater negative influence on women than men. Female keyworkers experienced more sleep disruption than male keyworkers (**figure 1A**). The relationship between change in financial situation, change in feeling depressed and change in sleep problems was related to gender (**figure 1B**). For men whose financial situation worsened, feeling more depressed was associated with a substantial increase in sleep problems, while for men whose financial situation improved, the feeling of being depressed had a small effect on sleep loss due to worry. Women were less sensitive to a change in the financial situation than men. For women who felt less depressed, a change in their financial situation had a negligible effect on changes in sleep problems. For women who felt more depressed, financial stress was associated with worsened sleep.

Multivariate analyses on sleep duration

Table 4 shows that women slept 8 min (95% CI 5 to 10 min) less than men compared with the respondents' sleep duration before the pandemic, after adjusting for sociodemographic characteristics. Adjusting for life stage slightly reduces the gender gap in change in sleep duration. Young, partnered and childless respondents reported sleeping 10 min (95% CI 3 to 17 min) longer during the first 4 weeks of the lockdown than their single counterparts. However, partnered respondents with younger children slept 24 min (95% CI 17 to 35 min) shorter than young people with no family role to fulfil.

Table 1 Weighted descriptive statistics for respondents' characteristics, all and by gender, understanding Society COVID-19 Study and COVID-19 Survey Data

	The COVID-19 Survey Data					
	Understanding Society COVID-19 Study			The COVID-19 Survey Data		
	All	Men	Women	All	Men	Women
	Mean (SD) /%	Mean (SD) /%	Mean (SD) /%	Mean (SD) /%	Mean (SD) /%	Mean (SD) /%
				T test/ χ^2		T test/ χ^2
					Min	Max
Change in sleep problems	0.13 (0.90)	0.05 (0.83)	0.20 (0.93)	10.02***	-3	3
Change in sleep duration					-0.16 (1.11)	-7 (1.21)
Age	51.69 (17.54)	54.8 (15.89)	51.64 (16.02)	11.57***	17	95
Cohort NCDS					0.50	0
Cohort BCS70					0.33	0
Cohort Next Steps					0.17	0
Higher education	0.30	0.31	0.28	15.25**	0.29	0
Vocational training	0.12	0.10	0.13	24.68***	0.18	0
A level and equivalent	0.22	0.24	0.20	17.56***	0.36	0
General Certificate of Secondary Education (GCSE)/O-level and below	0.36	0.34	0.38	16.68***	0.16	0
Change in financial situation	-0.06 (0.86)	-0.02 (0.85)	-0.10 (0.87)	2.62**	1.16 (1.27)	-4 (1.26)
Life course stage						
Young single childless	0.17	0.18	0.15	1.16	0.15	0
Young partnered childless	0.03	0.03	0.02	0.08	0.15	0
Partnered younger children	0.05	0.05	0.05	0.15	0.04	0
Partnered older children	0.14	0.15	0.14	0.03	0.17	0
Single parent	0.12	0.09	0.14	102.40***	0.02	0
Older partnered childless	0.32	0.36	0.29	132.51***	0.31	0
Older single childless	0.17	0.14	0.20	39.77***	0.15	0
Employed furloughed	0.12	0.14	0.11	0.56	0.16	0
Self-employed	0.07	0.09	0.06	65.57***	0.14	0
Employed not furloughed	0.41	0.40	0.41	16.30***	0.44	0
Not in labour force	0.40	0.37	0.42	0.66	0.26	0
Change in employment status					0.30	0

Continued



Table 1 Continued

	Understanding Society COVID-19 Study				The COVID-19 Survey Data							
	All		Men		Women		All		Men		Women	
	Mean (SD) /%	Mean (SD) /%	Mean (SD) /%	Mean (SD) /%	Mean (SD) /%	Mean (SD) /%	Mean (SD) /%	Mean (SD) /%	Mean (SD) /%	Mean (SD) /%	Mean (SD) /%	Mean (SD) /%
New job	0.05	0.04	0.05	0.05	0.08	0.05	0.05	0.11	80.61***	0	1	
No change	0.88	0.88	0.87	0.87	0.73	0.77	0.70	32.93***	0	1		
Lose job	0.07	0.08	0.07	0.07	0.19	0.18	0.19	0.22	0.22	0	1	
Partner's employment status												
Not in labour force	0.18	0.22	0.15	0.15	0.21	0.22	0.20	12.57***	0	1		
In labour force	0.26	0.30	0.22	0.22	0.44	0.45	0.43	0.20	0.20	0	1	
No Partner	0.56	0.48	0.63	0.63	0.35	0.32	0.37	12.98***	0	1		
Key worker	0.27	0.24	0.29	0.29	0.26	0.25	0.27	15.78***	0	1		
Time spent on housework												
Lowest quantile	0.38	0.48	0.28	0.28	0.44	0.55	0.35	230.51***	0	1		
Middle quantile	0.36	0.36	0.37	0.37	0.24	0.21	0.27	40.29***	0	1		
Highest quantile	0.26	0.16	0.35	0.35	0.31	0.24	0.38	109.78***	0	1		
Race												
White	0.94	0.93	0.94	0.94	0.96	0.96	0.96	5.86*	0	1		
Mixed	0.01	0.01	0.01	0.01	0.01	0.00	0.01	17.23**	0	1		
Asian	0.04	0.04	0.03	0.03	0.02	0.02	0.02	0.05	0	1		
Black	0.01	0.01	0.01	0.01	0.01	0.01	0.01	8.48**	0	1		
Physical activity												
No exercise	0.32	0.29	0.35	0.35	0.21	0.19	0.23	16.09***	0	1		
Some exercise	0.40	0.44	0.37	0.37	0.63	0.61	0.64	2.06	0	1		
Heavy exercise	0.28	0.28	0.28	0.28	0.17	0.16	0.17	5.35*	0	1		
COVID-19 related symptoms	0.12	0.11	0.12	0.12	0.53	0.49	0.55	19.56***	0	1		
Change in loneliness	-0.01 (0.69)	-0.04 (0.65)	0.03 (0.72)	0.03 (0.72)	-5.67***					-2	2	
Loneliness												
Hardly ever					0.65	0.72	0.59	120.43***	0	1		
Some of the time					0.27	0.23	0.32	77.90***	0	1		
Often					0.08	0.06	0.10	25.40***	0	1		

Continued

Table 2 Sleep characteristics by gender and employment status or life course stage, Understanding Society COVID-19 Study and COVID-19 Survey Data

	Change in sleep problems		Change in sleep duration	
	Men	Women	Men	Women
Life course stage				
Young single childless (ref.)	-0.001 (0.92)	0.23 (0.98)	-0.36 (1.23)	-0.22 (1.61)*
Young partnered childless	0.06 (0.74)	0.26 (0.93)*	-0.34 (1.01)	-0.35 (1.28)*†
Partnered younger children	0.22 (1.00)†	0.38 (1.00)†	0.03 (0.99)	-0.06 (1.30)*†
Partnered older children	0.11 (0.86)	0.23 (0.94)	-0.21 (1.00)	-0.10 (1.30)*
Single parent	0.16 (0.98)	0.26 (1.01)	-0.06 (0.96)	-0.04 (1.39)*
Older partnered childless	0.01 (0.77)	0.12 (0.87)	-0.22 (0.86)	0.03 (0.93)
Older single childless	0.06 (0.81)	0.11 (0.88)	-0.08 (0.77)†	0.02 (1.02)†
Change in financial situation	0.15 (0.87)†	0.33 (0.98)†	-0.22 (0.90)	-0.05 (0.14)†
Employment status				
Employed furloughed	0.10 (0.90)	0.22 (1.01)†	-0.63 (1.20)†	-0.21 (1.46)†
Self-employed	0.12 (0.80)†	0.30 (0.97)†	-0.30 (1.02)†	-0.38 (1.52)*†
Employed not furloughed	0.03 (0.85)†	0.26 (0.97)†	-0.15 (0.89)	-0.06 (1.08)*†
Not in the labour force (ref.)	0.05 (0.84)	0.09 (0.85)	-0.05 (0.85)	-0.03 (1.12)
Change in employment status				
New job (ref.)	-0.03 (0.85)	0.14 (1.03)	0.26 (0.90)	-0.06 (1.37)*
No change	0.05 (0.84)	0.20 (0.93)	-0.16 (0.88)†	-0.08 (1.11)
Lose job	0.19 (0.96)†	0.11 (0.90)*	-0.62 (1.21)†	-0.18 (1.43)†
Key worker	0.02 (0.87)	0.28 (0.98)	-0.08 (0.83)†	-0.01 (1.01)*†
Time spent on housework				
Lowest quantile (ref.)	0.05 (0.85)	0.12 (0.92)	-0.24 (0.99)	-0.08 (1.13)
Middle quantile	0.03 (0.84)	0.19 (0.94)	-0.20 (0.92)	-0.20 (1.30)*
Highest quantile	0.11 (0.88)†	0.24 (0.93)†	-0.19 (0.97)	-0.05 (1.20)
Change in loneliness	0.36 (0.86)†	0.47 (0.96)†		
Change in feeling of depressed	0.40 (0.83)†	0.52 (0.84)†		
Loneliness				
Hardly ever (ref.)			-0.23 (0.84)	-0.13 (1.01)
Some of the time			-0.10 (1.08)†	-0.03 (1.33)*†
Often			0.06 (1.42)†	0.08 (1.52)*†
Feeling of depressed				
Not at all (ref.)			-0.24 (0.80)	-0.14 (0.98)
Several days			-0.04 (1.18)†	-0.03 (1.35)*†
More than half the days			0.17 (1.55)†	0.22 (1.75)*†
Nearly every day			-0.09 (1.42)	0.28 (1.71)*†

*Gender difference is *not* statistically significant, based on linear regression models for each employment, life course stage or time use category with female as sole predictor.

†Within-gender difference between omitted life course stage (young, single, childless), employment status (not in the labour force), change in employment status (new job), non-key worker, worked less than 8 hours, time spent on housework (lowest quantile), loneliness (hardly ever) or feeling depressed (not at all) and focal category is statistically significant, based on linear regression models with these predictors as sole predictor. Change in financial situation and change in loneliness and feeling depressed are held at one SD above the mean as they are continuous measures.

post-traumatic stress disorder and anxiety disorders¹⁶ and have more sleep disturbances than men.⁷

However, the closure of non-essential work sectors has in general reduced the number of working hours for

the majority of people, and thus, we observe an increase in sleep duration during the lockdown. The increase is more pronounced in men than women. This is because men in general do more paid work than women and

Table 3 Selected coefficients and SEs from OLS regression models of changes in sleep problems, COVID-19 Survey Data

	Model 1	Model 2	Model 3	Model 4	Model 5
	Main effect (95% CI)	Main effect (95% CI)	Main effect (95% CI)	Main effect (95% CI)	Main effect (95% CI)
Female	0.15 (0.11 to 0.19)	0.14 (0.10 to 0.18)	0.13 (0.09 to 0.27)	0.09 (0.07 to 0.11)	-0.11 (-0.38 to 0.26)
Life course stage (ref=young single childless)					
Young partnered childless		0.01 (-0.09 to 0.11)	-0.01 (-0.09 to 0.07)	0.03 (-0.05 to 0.11)	0.08 (-0.06 to 0.22)
Partnered younger children		0.13 (0.05 to 0.21)	0.11 (0.03 to 0.19)	0.05 (-0.03 to 0.13)	0.07 (-0.05 to 0.19)
Partnered older children		0.05 (0.00 to 0.10)	0.03 (-0.03 to 0.09)	0.03 (-0.03 to 0.09)	0.06 (-0.04 to 0.16)
Single parent		0.07 (0.01 to 0.13)	0.05 (0.01 to 0.09)	0.07 (0.01 to 0.13)	0.09 (-0.01 to 0.19)
Older partnered childless		0.01 (-0.07 to 0.09)	0.01 (-0.07 to 0.09)	-0.01 (-0.09 to 0.07)	0.03 (-0.09 to 0.15)
Older single childless		0.03 (-0.05 to 0.11)	0.02 (-0.05 to 0.10)	0.01 (-0.07 to 0.09)	0.06 (-0.06 to 0.18)
Change in financial situation			0.09 (0.07 to 0.11)	0.05 (0.03 to 0.07)	0.04 (0.02 to 0.06)
Employment status (ref=not in the labour force)					
Employed, furloughed			0.01 (-0.07 to 0.09)	0.02 (-0.06 to 0.10)	0.04 (-0.06 to 0.14)
Self-employed			0.10 (0.02 to 0.18)	0.08 (0.01 to 0.16)	0.08 (-0.02 to 0.18)
Employed, not furloughed			0.04 (-0.02 to 0.10)	0.02 (-0.04 to 0.08)	0.04 (-0.04 to 0.12)
Change in employment status (ref=new job)					
No change			0.11 (0.03 to 0.19)	0.08 (0.02 to 0.14)	0.08 (0.02 to 0.14)
Lose job			0.11 (0.01 to 0.21)	0.05 (-0.03 to 0.13)	0.05 (-0.09 to 0.19)
Keyworker			0.05 (0.01 to 0.09)	0.05 (0.01 to 0.09)	0.01 (-0.05 to 0.07)
Time spent on housework (ref=lowest quantile)					
Middle quantile			0.02 (-0.02 to 0.06)	0.01 (-0.03 to 0.05)	0.02 (-0.02 to 0.06)
Highest quantile			0.07 (0.03 to 0.11)	0.05 (0.01 to 0.09)	0.05 (0.01 to 0.09)
Change in loneliness				0.05 (0.03 to 0.07)	0.05 (0.03 to 0.07)
Change in feeling depressed				0.35 (0.33 to 0.37)	0.34 (0.32 to 0.36)
Female×key worker					0.07 (0.01 to 0.13)
Female×change in financial situation					0.04 (0.01 to 0.08)
Female×change in feeling depressed					0.02 (0.01 to 0.04)
Change in financial situation×change in feeling depressed					0.06 (0.04 to 0.08)

Continued

Table 3 Continued

	Model 1	Model 2	Model 3	Model 4	Model 5
	Main effect (95% CI)	Main effect (95% CI)	Main effect (95% CI)	Main effect (95% CI)	Main effect (95% CI)
Female×change in financial situation×change in feeling depressed					-0.04 (-0.08 to -0.01)
Constant	0.04 (-0.14 to 0.22)	0.01 (-0.17 to 0.19)	-0.04 (-0.24 to 0.16)	-0.20 (-0.38 to -0.02)	-0.11 (-0.36 to 0.14)
N	14 073	14 073	14 073	14 073	14 073
Adj. R ²	0.012	0.013	0.026	0.190	0.192

Note: all models adjust for age and age-squared, race/ethnicity, educational attainment, physical activity, had any coronavirus-related symptoms, partner's employment status and region. Change in financial situation, change in loneliness and change in feeling depressed are standardised. Bold font indicates two-tailed tests are significant at the 95% level. OLS, ordinary least squares.

women do more unpaid work such as childrearing and housework. The lockdown reduced time in paid work but given that nurseries and schools were closed, considerably increased women's domestic burden. Our findings show that parents with younger children in the household and single parents developed the most sleep problems in the first 4 weeks of lockdown.

Men's sleep quality, however, was more sensitive to changes in the financial situation. This is attributed to gendered trade-offs in employment between couples. Women are prone to reduce paid work when caregiving

responsibilities and unpaid work are highest, whereas men often increase paid work when becoming fathers.¹⁷

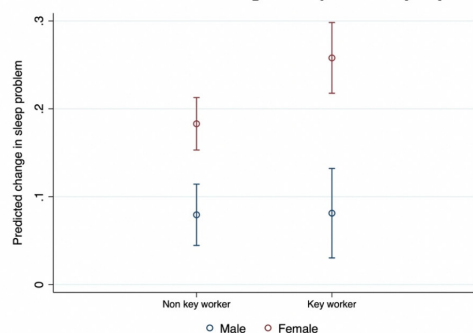
The self-employed had significantly more sleep problems, reflecting rising anxieties and fear of uncertainty over the future. They also slept more, likely due to business closure and shifts in time use. Our results indicate that entrepreneurs and those with small businesses or start-ups experienced stress and anxiety regarding job continuity and financial security. At the beginning of the lockdown, the UK government provided no support for self-employed people and the situation changed on 13 May 2020, when the Self-Employed Income Support Scheme became available.¹⁸ Our data were mostly collected before such a scheme became available and reflect the uncertainty and financial strain self-employed people went through during that time.

Being a keyworker also reduced sleep quality and duration. The effect of being a key worker on sleep disruption is stronger for women. Women are more likely to work in the frontline as key workers.¹³ Female key workers face challenges from their professions that are more front-facing and exposed to the virus, putting themselves and their families at risk, and from their growing family responsibilities. The double burden has strongly influenced female key workers sleep quality.

Men who lost their jobs after the lockdown have fewer work responsibilities and thus increased sleep time compared with men who started a new job after the lockdown, but for women there is no difference, indicating that women who lost their job seem have taken up more family obligations than men.

Our findings have clear policy implications for future lockdowns or pandemics. First, measures regarding job protection and furloughing need to be early, clear and cover a broader spectrum of employees. The early government measures in the UK ignored self-employed workers and arguably many underemployed and flexible workers still do not receive coverage.¹⁹ Although all governments acted under uncertainty, signalling support can lower anxiety and aid in individual, family and business

A Female-Male Differences in Change in Sleep Problem by Keyworkers



B Female-Male Differences in Change in Sleep Problem by Change in Financial situation and Change in feeling depressed

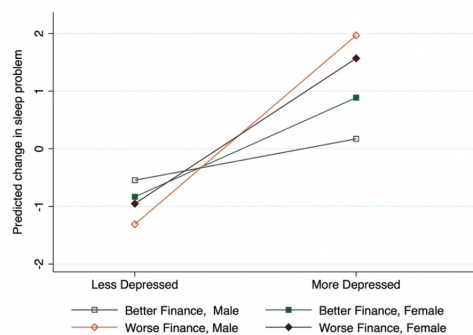


Figure 1 Predicted female–male differences in change in sleep problem (predicted values based on estimates from model 5, table 3).

Table 4 Selected coefficients and SEs from OLS regression models of changes in sleep duration, COVID-19 Survey Data

	Model 1	Model 2	Model 3	Model 4	Model 5
Female	0.13 (0.09 to 0.17)	0.11 (0.05 to 0.17)	0.11 (0.05 to 0.17)	0.08 (0.02 to 0.14)	-0.45 (-0.90 to 0.00)
Life course stage (ref=young single childless)					
Young partnered childless		-0.17 (-0.29 to -0.05)	-0.21 (-0.33 to -0.09)	-0.15 (-0.27 to -0.03)	-0.001 (-0.18 to 0.18)
Partnered younger children		0.41 (0.23 to 0.59)	0.40 (0.22 to 0.58)	0.42 (0.24 to 0.60)	0.28 (0.03 to 0.53)
Partnered older children		-0.01 (-0.13 to 0.11)	-0.11 (-0.23 to 0.08)	-0.06 (-0.18 to 0.06)	0.02 (-0.14 to 0.18)
Single parent		0.04 (-0.12 to 0.20)	0.04 (-0.12 to 0.20)	0.04 (-0.12 to 0.20)	-0.06 (-0.37 to 0.25)
Older partnered childless		0.08 (-0.12 to 0.28)	0.04 (-0.16 to 0.24)	0.06 (-0.14 to 0.26)	-0.16 (-0.15 to 0.15)
Older single childless		0.13 (-0.07 to 0.33)	0.10 (-0.10 to 0.30)	0.11 (-0.09 to 0.31)	-0.11 (-0.42 to 0.20)
Change in financial situation			-0.05 (-0.07 to -0.03)	-0.02 (-0.04 to -0.01)	-0.001 (-0.04 to 0.04)
Employment status (ref=not in the labour force)					
Employed, furloughed			-0.17 (-0.33 to -0.01)	-0.18 (-0.34 to -0.02)	-0.03 (-0.27 to 0.21)
Self-employed			-0.25 (-0.35 to -0.15)	-0.20 (0.30 to -0.10)	-0.20 (-0.34 to -0.06)
Employed, not furloughed			-0.16 (-0.24 to -0.08)	-0.09 (-0.19 to 0.01)	-0.13 (-0.27 to 0.01)
Change in employment status (ref=new job)					
No change			0.01 (-0.11 to 0.13)	0.03 (-0.09 to 0.15)	-0.11 (-0.33 to 0.11)
Lose job			-0.24 (-0.42 to -0.06)	-0.19 (-0.37 to -0.01)	-0.56 (-0.85 to -0.27)
Keyworker			0.08 (0.01 to 0.16)	0.10 (0.02 to 0.18)	0.16 (0.04 to 0.28)
Time spent on housework (ref=lowest quantile)					
Middle quantile			-0.03 (-0.09 to 0.03)	-0.05 (-0.11 to 0.01)	0.01 (-0.09 to 0.11)
Highest quantile			0.01 (-0.07 to 0.09)	0.01 (-0.07 to 0.09)	0.05 (-0.05 to 0.15)
Loneliness (ref=hardly ever)					
Some of the time				0.06 (0.01 to 0.12)	0.04 (-0.02 to 0.10)
Often				0.04 (-0.06 to 0.14)	0.04 (-0.08 to 0.16)
Feeling of depressed (ref=not at all)					
Several days				0.15 (0.09 to 0.21)	0.15 (0.09 to 0.21)
More than half the days				0.38 (0.24 to 0.52)	0.39 (0.25 to 0.53)
Nearly every day				0.30 (0.12 to 0.48)	0.30 (0.12 to 0.48)
Female×life course stage (ref=young single childless)					
Female×young partnered childless					-0.28 (-0.48 to -0.08)
Female×partnered younger children					0.28 (0.05 to 0.61)

Continued

Table 4 Continued

	Model 1	Model 2	Model 3	Model 4	Model 5
Female×partnered older children					-0.18 (-0.40 to 0.04)
Female×single parent					0.11 (-0.26 to 0.48)
Female×older partnered childless					0.37 (0.04 to 0.78)
Female×older single childless					0.40 (-0.01 to 0.81)
Female×change in employment status (ref=new job)					
Female×no change					0.18 (-0.07 to 0.43)
Female×lose job					0.60 (0.23 to 0.97)
N	8547	8547	8547	8547	8547
Adj. R ²	0.023	0.031	0.039	0.047	0.052

Note: all models adjust for age and age-squared, race/ethnicity, educational attainment, physical activity, loneliness, feeling of depressed, had any coronavirus-related symptoms, partner's employment status and region. Bold font indicates two-tailed tests are significant at the 95% level.

planning. Second, the disproportionate burden of lockdown on women requires more attention, particularly for those who were parents and single parents with young children in the household. More support for home-schooling, childcare and understanding from employers is essential for this group. Recognition by their employers to adjust workloads or avoid sanctions for decreased productivity during this period. The lockdown also magnified existing inequalities in the gendered division of household labour, suggesting that families could benefit from interventions or education to ease this imbalance.^{20 21} Finally, more mental and other support should be provided to key workers to avoid structural sleep deficits.

Limitations

Our study has some limitations. First, change in sleep is based on a single self-reported item and not on a validated questionnaire assessing sleep routines, sleep health or sleep quality, inaccuracy in the memory can bias our results. Objective sleep measures generated from, for example, wearable devices should be used to replicate our results when data become available. Second, people who are willing to participate in the survey after the lockdown are likely to be those who are less vulnerable; we therefore may suffer from the attrition bias. However, we applied sampling weights as the datasets we use are designed to be used with weights to correctly reflect the population structure and reduce sampling and response bias. Third, COVID-19 symptoms or test results were not included in our analyses due to large number of missing values.

CONCLUSION

Our study indicates that the COVID-19 pandemic and lockdown amplified traditional gender roles, which is

reflected in the gendered factors associated with sleep. Men's sleep was more affected by changes in their financial situation and employment status related to the crisis, highlighting their roles as providers in the family. Women's sleep, however, was more influenced by their emotional reaction to the pandemic, feeling more anxious and spending more time on family duties such as home schooling, unpaid domestic duties, nurturing and caregiving. Although the purpose of this article was to explain the gender gap in change in sleep during COVID-19, changes could not all be successfully explained away by gender differences. This is likely due to some underlying biological differences, such as hormonal changes, which have been shown as one of the mechanisms contributing to sleep differences between the sexes²² and to have a stronger influence on women.⁷

For change in sleep problems, coefficient larger than zero means increased sleep problems, ranging from -3 to 3. For change in sleep duration, the coefficient indicates change in number of hours slept per night ranging from -7 to 7 hours. Positive coefficient means slept longer and vice versa.

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Patient consent for publication Not applicable.

Ethics approval Both original surveys received ethics approval. Detailed information is available online (for Understanding Society COVID-19 Study: <https://www.understandingsociety.ac.uk/documentation/mainstage/user-guides/main-survey-user-guide/ethics>; for COVID-19 Survey: <https://cls.ucl.ac.uk/about-2/information-governance/>).

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data may be obtained from a third party and are not publicly available. The data that support the findings of this study are available from Understanding Society and The Covid Infection Study. Restrictions apply to the availability of these data, which were used under licence for this study. Data are available with the permission of Understanding Society and The Covid Infection Study.

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Gender differences in sleep disruption during COVID-19: evidence from two UK nationally representative surveys

Supplementary Materials

S1.1 Sleep in the age of COVID-19 lockdowns

Sleep can be analysed within two interrelated domains, sleep problems and duration. Sleep problems refers to the inability to fall asleep and sleep well at night, [1]. Sleep duration is a more objective measure of the actual time when the individual is asleep (at night). There are mixed findings on the correlation between sleep problems and length. For example, people with extremely short and long sleep durations were also more likely to report sleep disturbances, [2]. On the other hand, low or insignificant correlations between sleep duration and sleep quality were identified among children and adolescents, [3]. Multiple studies show that the influence of sleep problems and duration on health outcomes are not simply additive, [4] and recommend the inclusion of both facets of sleep where possible [5].

Sleep is regulated by circadian rhythms, synchronised by external diurnal cycles, including sunlight and temperature [6]. This internal clock tells our bodies when to sleep, wake and eat. In modern societies, human's circadian clocks are also structured by daily employment and school schedules. Beyond the external shock of the COVID-19 pandemic, several recent factors have emerged to disrupt our chronotypes to unprecedented levels. Indoor lighting, exposure to light pollution from streets and electronic devices such as laptops and smartphones places more individuals at risk of circadian disruption. With social distancing protocols in place amid the COVID-19 pandemic, individuals were increasingly connecting to the outside world through screens. Views on Instagram Live increased twofold in one week, Facebook witnessed a 70% increase in Messenger group video calls and WhatsApp reported a 40% increase in usage, [7]. Exposure to artificial light from television, smartphones, tablets and laptops, particularly before bedtime, is related to reduced sleep duration and quality, [8].

For workers fortunate enough to maintain their jobs, time and financial pressures were particularly acute on top of caregiving responsibilities – especially for those with young children. Working parents who could do their jobs online or at home were simultaneously juggling paid work with high caregiving demands. For keyworkers in occupations where they could not work from home, there was an increasing demand on shift working and long hours, coupled with anxiety, putting them at higher risk of sleep problems and deprivation. Early

evidence on the gender gap in work hours found that mothers reduced work time significantly more than fathers, especially for those with primary school-age or younger children for whom caregiving and home-schooling demands were highest, [9]. Moreover, women are disproportionately employed in lower-paid and less secure jobs in the UK, and thus were more likely to be out of the labour force or employed part-time, [9]. We expect that this disadvantaged labour market position, coupled with intensified family duties, posed unprecedented challenges to women's time use and mental health, which could translate into sleep disruption.

Sleep is also correlated with psychological distress. Complaints of poor sleep quality often co-occur in tandem with diagnosed cases of depression, [10], and there is a higher prevalence of depression in patients with obstructive sleep apnoea, [11]. Although sleep disorders are traditionally included as one of the symptoms of depression, the causal relationship between physiological distress and sleep problems remains obscure, [10]. Some studies find that sleep problems may cause depression, [12], whereas others indicate that sleep problems may reflect symptoms of depression. Studies have shown that the pandemic has more influence on women's psychological distress, [13]. Therefore, it may be that the gender differences in sleep are not only explained by structural differences such as labour market and family position, but also gender differences in coping with feelings of psychological distress related to the pandemic.

S1.2 COVID-19 first 2020 lockdown in the UK

The COVID-19 pandemic is not only a health crisis, but an economic and personal crisis for many individuals and families. With the often uncertain and repeated closure of non-key sectors, schools and day-care facilities, the COVID-19 pandemic has had deep and multifarious effects. As the pandemic first unfolded in early 2020, the UK government announced a series of policy responses, including a strict lockdown and stay at home measures on March 23 2020, the closing of schools and various employment and job retention schemes. These often varied between the four nations of the UK (England, Scotland, Northern Ireland and Wales), causing considerable confusion, uncertainty and debate. In the first lockdown, announced at the end of March, which is examined in this study, the British public were required to stay at home with the exception of essential shopping, limited outdoor exercise or necessary reasons (e.g., medical appointments or caring for a vulnerable person). All hospitality venues including non-

essential shops and restaurants were closed with the strong advice to ‘work at home.’ The first lockdown lasted for approximately seven weeks, easing slightly in May.

As the pandemic first unfolded in early 2020, the UK government announced a series of policy responses, including a strict lockdown and stay at home measures on March 23 2020, the closing of schools and various employment and job retention schemes. These often varied between the four nations of the UK (England, Scotland, Northern Ireland and Wales), causing considerable confusion, uncertainty and debate. In the first lockdown, announced at the end of March, which is examined in this study, the British public were required to stay at home with the exception of essential shopping, limited outdoor exercise or necessary reasons (e.g., medical appointments or caring for a vulnerable person). All hospitality venues including non-essential shops and restaurants were closed with the strong advice to ‘work at home.’ The first lockdown lasted for approximately seven weeks, easing slightly in May.

A core policy was the Job Retention Scheme, known as the ‘furlough’ scheme, announced by the UK Government on March 20, 2020, [14]. Furloughed employees received 80 per cent (up to a limit of £2,500/\$3,430 USD per month) of their regular wages via the Coronavirus Job Retention Scheme grant. The scheme was meant to keep workers on the payroll to allow them to easily slot back into their jobs once lockdown was lifted, with the aim to avoid large-scale redundancies and job loss. During the period of data collection in April 2020, many facts about the virus were unknown and the UK had extremely high COVID-19 death and hospitalisation rates, accompanied with considerable anxiety about the future of employment, businesses and uncertainty about the timing of the end of furlough and lockdown. In response to public concerns and a deepening of the pandemic, on May 12, 2020, the UK government extended the furlough scheme until October 2020, which covered around 7.5 million people. After considerable criticism, on March 26, 2020, the government also announced support for the self-employed of up to 80% of their profits up to £2,500/\$3,430 USD a month, [15], which became available on May 13, 2020 [16].

Changes in work arrangements during the lockdown were deep and, depending on an individual’s occupation, included changes in number and flexibility of working hours, paid and unpaid short leaves, and, often, financial consequences. The UK also has a relatively high number of workers in flexible and temporary work arrangements and for those in these positions, such as temporary agency work, subcontracted workers, the gig economy and zero-

hour (flexible) contracts, uncertainty was high and they often missed any financial compensation or protection covered by the Job Retention Schemes, [17]. Although people who were self-employed in non-key sectors or furloughed had more free time to catch up on sleep, the financial pressures and feeling of uncertainty remained, with the potential for anxiety and sleep loss. As of 2019, the self-employed in the UK represented around 15.3% of employment or just over 5 million workers, [18].

S1.3 Explanatory Variables

Change in financial situation is measured by the difference between the answers – higher score means worse financial situation. Both datasets have information on the participants' financial situation pre- and post- COVID-19 and used the same 5-point Likert scale with a higher score indicating difficulties in financial management. Using the same strategy, we created *change in employment status* with three categories: (1) find job; (2) no change; and (3) lose job. *Change in health status and the feeling of loneliness* are also included with higher scores meaning poorer health.

We created *life course stage* groups similar to those used by Burgard and Ailshire, [19], and Anxo and colleagues, [20] using information about parental and partnership status as well as age. Parental status divides respondents with no dependent children under the age of 18 living with them in April or May 2020, when the two surveys were conducted, from those who had coresident children either aged 5 to 18 (and no younger children) or younger than 5 years. Partnership status distinguishes whether a participant was living with a spouse or (unmarried) partner after the outbreak of the pandemic. We created categories of life course stage for individuals who were: (1) young (less than 50 years for Understanding Society COVID-19 Study and Next Steps cohort for the COVID-19 Survey data), single, and childless; (2) young, partnered, and childless; (3) partnered (of any age) with any younger children (under 5 years old); (4) partnered (of any age) with older children (ages 5 to 16 years) and no younger children; (5) single parents of any age; (6) older (50 years or older for Understanding Society COVID-19 Study and BCS70/NCDS for the COVID-19 Survey data), partnered, and childless; or (7) older, single and childless. Note that in our analyses 'childless' refers to no children living in the same household, it does not necessarily mean the respondent has never fathered/gave birth to any child. *Current employment status* distinguishes: (1) respondents not in the labour force from those who are, (2) employed but furloughed under the Coronavirus Job Retention Scheme, (3) are employed and not furloughed; and, (4) are self-employed.

S1.4 Covariates.

Age and *age-squared* in continuous form are included for Understanding Society COVID-19 Study. Since the COVID-19 survey in our analyses contains three age cohorts within which the respondent's age is the same, *age cohort* is controlled for in the COVID-19 Survey data. *Race/ethnicity* distinguishes: (1) white; (2) mixed; (3) Asian; (4) Black and (5) Other race individuals. *Educational attainment* is categorised into (1) Higher education; (2) Vocational Training; (3) A level and equivalent (i.e., Advanced High School Diploma); and (4) GCSE/O-level and below (i.e., High School Diploma without Honors or "Advanced Placement" classes and below). We adjusted for *spousal/partner's employment status* to acknowledge the availability of significant others in the household to do paid and unpaid work, distinguishing respondents: (1) who are single from (2) those with an employed spouse/partner or, (3) unemployed spouse/partner. *Having experienced any coronavirus related symptoms* is coded 1. *Change in feeling of loneliness* and *depression* are also accounted for in the Understanding Society COVID-19 Study. The COVID-19 Survey does not provide loneliness and depression information before the pandemic, thus we used post-COVID measures. We also distinguish whether the respondent is a *key worker* according to the Department of Health and Social Care guidance on testing eligibility (both datasets have constructed this variable). *Time spent in housework* is also adjusted. Note that the Understanding Society COVID-19 Study measured time use using weekly hours, while the COVID-19 Survey data measured time use by hour per day. We generated quartiles based on the full sample of respondents to reduce the influence of the skewed distribution of time use in housework. Finally, we controlled for the UK government office region the respondent is in to capture regional inequality and differential spread of infections related to the pandemic that may influence sleep quality and duration systematically.

S1.5 Results

Table 1 in the main text show that in both samples, the majority of single parents are single mothers, and men are more likely than women to be older, partnered and childless. Men and women have similar chances to be furloughed if employed, but women are less likely to be in the labour force. Comparing pre- and post-lockdown employment status, women are more likely to change their status from not being in the labour force to being employed, while men are more likely to report no change in their employment status. Women are more likely to work as front-line key workers. Women were substantially more likely than men to be in the highest

quantile of time spent on housework. Men are more likely than women to be living with a partner who is not in the labour force, and women are more likely to live alone with no partner. The proportion of women reporting often feeling lonely and depressed is much larger than for men, and the feelings have worsened since the lockdown compared to men. Women are less likely than men to engage in physical activities. Women are less likely than men to have higher education degrees, a difference observed only in the Understanding Society COVID-19 Study. During the first four weeks of the lockdown, respondents from the Understanding Society COVID-19 Study report a slightly better financial situation than before, with women reporting more financial improvements than men. Respondents from the COVID-19 Survey Data however report a considerably worsened financial situation during the second month of the lockdown, with similar levels between men and women. Most other demographic and survey characteristics are minor or as expected.

Figure S1. Distribution of changes in sleep problems, all and by gender, Understanding Society COVID-19 Study

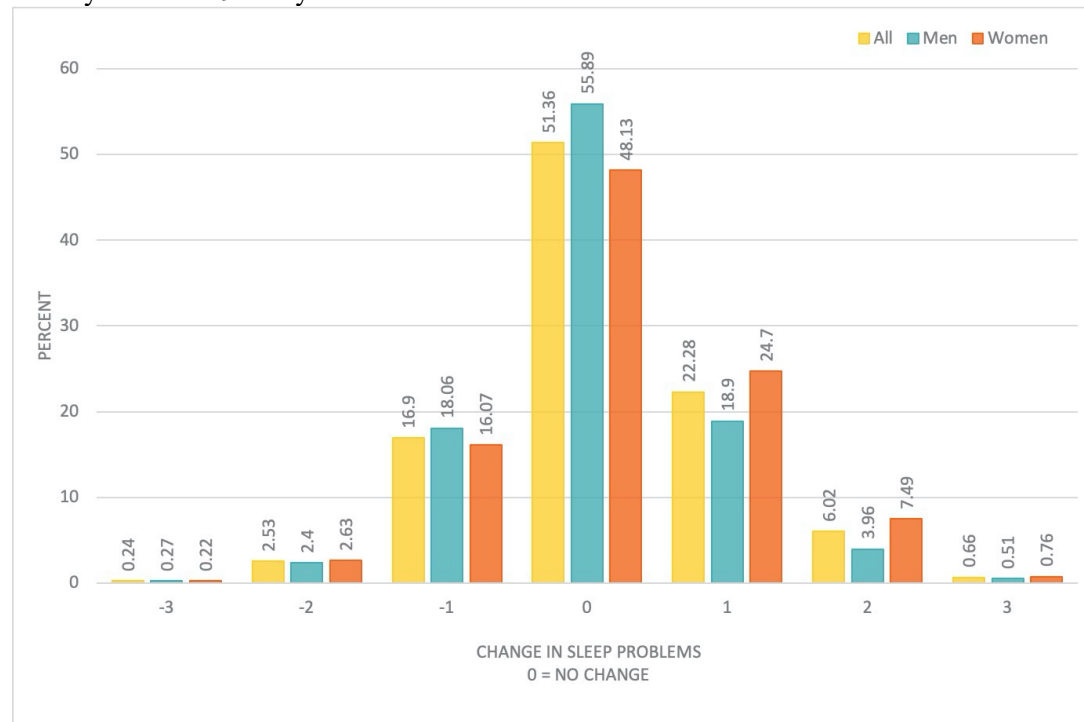
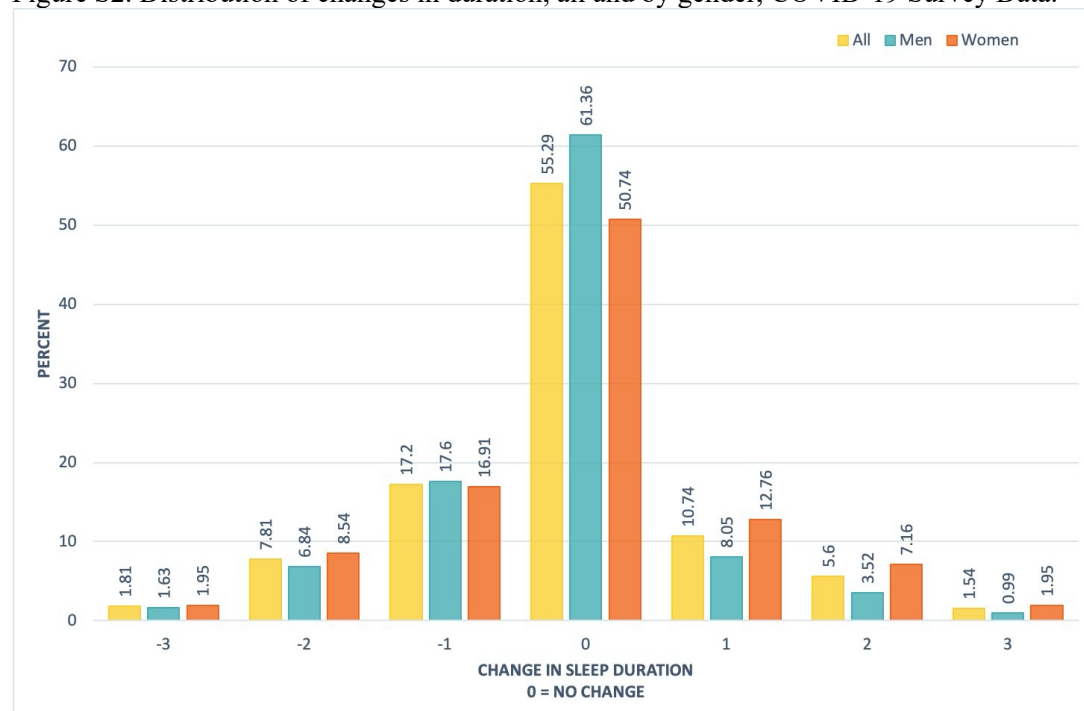


Figure S2. Distribution of changes in duration, all and by gender, COVID-19 Survey Data.



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