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.

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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 means 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

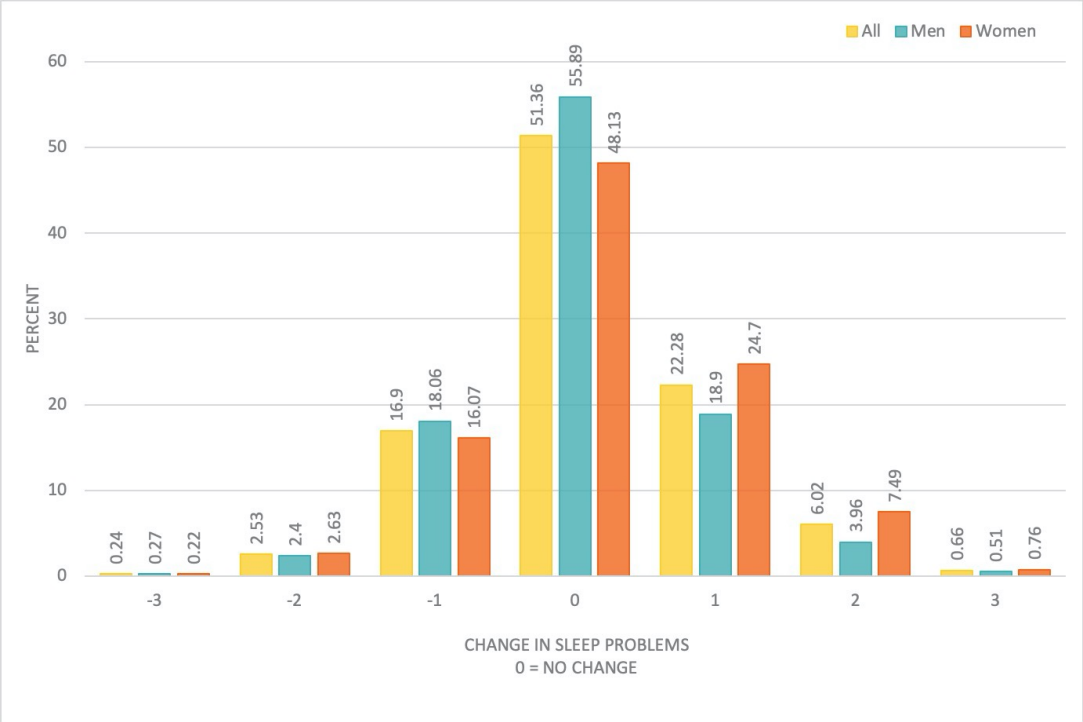
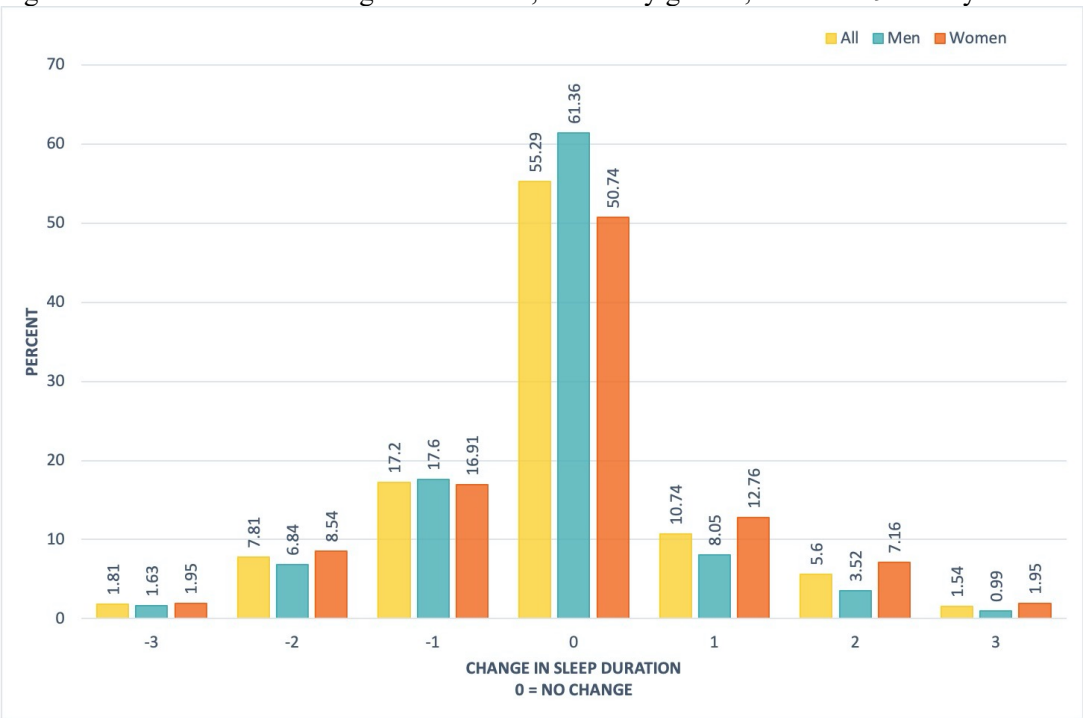


Figure S2. Distribution of changes in duration, all and by gender, COVID-19 Survey Data.



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