Original research

Mental health among UK university staff and postgraduate students in the early stages of the COVID-19 pandemic

Ewan Carr, Katrina Davis, Gabriella Bergin-Cartwright, Grace Lavelle, Daniel Leightley, Carolin Oetzmann, Catherine Polling, Sharon A M Stevelink, Alice Wickersham, Reza Razavi, Matthew Hotopf

ABSTRACT

Objectives To characterise the baseline King’s College London Coronavirus Health and Experiences of Colleagues at King’s cohort and describe patterns of probable depression and anxiety among staff and postgraduate research students at a large UK university in April/May 2020.

Methods An online survey was sent to current staff and postgraduate research students via email in April 2020 (n=2590). Primary outcomes were probable depression and anxiety, measured with the Patient Health Questionnaire-9 and Generalised Anxiety Disorder-7, respectively. Secondary outcomes were alcohol use and perceived change in mental health. Outcomes were described using summary statistics and multivariable Poisson regression was used to explore associations with six groups of predictors: demographics and prior mental health, living arrangements, caring roles, healthcare, occupational factors and COVID-19 infection. All analyses were weighted to account for differences between the sample and target population in terms of age, gender, and ethnicity.

Results Around 20% of staff members and 30% of postgraduate research students met thresholds for probable depression or anxiety on the questionnaires. This doubled to around 40% among younger respondents aged <25. Other factors associated with probable depression and anxiety included female gender, belonging to an ethnic minority group, caregiving responsibilities and shielding/isolating. Around 20% of participants were found to reach cut-off for hazardous drinking on Alcohol Use Disorders Identification Test, while 30% were drinking more than before the pandemic.

Conclusions Our study shows worrying levels of symptoms of depression, anxiety and alcohol use disorder in an occupational sample from a large UK university in the months following the outbreak of the COVID-19 pandemic.

INTRODUCTION

The COVID-19 pandemic has brought about profound changes to staff and students at UK universities. Social distancing measures, campus closures and a shift to remote teaching and research have reshaped established working practices. These changes may incur substantial psychological burdens. If increases in workplace demands are paired with a loss of resources, adverse psychological consequences such as burnout and common mental disorder may follow.

There is growing evidence of the harmful effects of the pandemic on mental health. These accrue both from immediate impact of the infection and associated containment measures—such as increased anxiety, social isolation and loneliness—as well as wider financial and labour market repercussions including the loss of paid work and economic uncertainty. It is, therefore, important for employers and policymakers to understand the impact of the pandemic on employees and to target support at staff most needing support. To date, however, there have been few studies of mental
health in occupational cohorts and most have been restricted to healthcare settings.\textsuperscript{10, 11}

Many studies of mental health during the pandemic have relied on online surveys with non-probability and convenience samples.\textsuperscript{12} While enabling rapid data collection, these samples introduce issues of non-representativeness. Risk factors for mental disorders, such as lower socioeconomic position and genetic risk of schizophrenia, have been shown to reduce participation in online surveys.\textsuperscript{13–16} Without detailed information about characteristics of the target population—or better yet, a sampling frame and use of probability samples—findings from web-based ‘opt-in’ samples on mental health should be treated with caution.

The King’s College London Coronavirus Health and Experiences of Colleagues at King’s (KCL CHECK) study is a research project established in April 2020 to understand the impact of the COVID-19 pandemic among staff and postgraduate research (PGR) students at King’s College London.\textsuperscript{18} The survey was conducted online with invitations sent via email. The survey drew on detailed administrative information about the target population (around 9800 staff members and 2500 PGR students) to describe and account for the representativeness of respondents versus the target population.

This paper aimed to (1) characterise the KCL CHECK baseline cohort, (2) describe the pattern of mental health outcomes, and (3) explore associations of probable depression and anxiety with COVID-19 and lockdown-related stressors. Our analysis considered factors previously associated with poor mental health, such as age, gender and ethnicity as well as factors introduced or amplified by the pandemic and lockdown.\textsuperscript{19}

**METHODS**

**King’s College London**

King’s is a large university in the UK with around 30 000 students.\textsuperscript{20} The university has campuses in central and south-east London and is partnered with three major trauma hospitals. Like other universities in the UK, on 23 March 2020, King’s closed its campuses to all but essential workers.

The KCL CHECK baseline survey (see online supplemental material) was an online survey of staff and PGR students at King’s who were invited to participate via email to their university email address. Reminders to participate were advertised via circulars and internal media. Between 15 April and 10 May 2020, 2590 participants (2106 staff; 484 PGR students) completed an online questionnaire covering demographic and occupational circumstances; work and home risk factors for COVID-19 and psychiatric outcomes.\textsuperscript{18} Participants were asked if they were either (1) a member of staff, (2) a PGR student or (3) both staff member and PGR student. This latter group (\(=4\%\)) was categorised as staff.

Information on the demographic composition of staff and PGR student populations was obtained from centrally held administrative records. Aggregate information on age group, gender and ethnicity were used to describe the representativeness of the survey compared with the target population and construct weights, as detailed below.

A CHERIES checklist (checklist for reporting results of internet e-surveys)\textsuperscript{21} is provided in online supplemental material.

**Measures**

**Outcomes**

The primary outcomes were reports of symptoms associated with depression and anxiety. Standard measures were used with cut-offs that are usually associated with clinically relevant symptoms of major depressive episode and generalised anxiety disorder. ‘Probable depression’ was defined as a score of 10 or greater on the Patient Health Questionnaire (PHQ-9).\textsuperscript{22} ‘Probable anxiety’ was defined as a score of 10 or greater on the Generalised Anxiety Disorder (GAD)-7.\textsuperscript{23} Where participants partially completed measures, up to two items were person-mean imputed for PHQ-9 and one for GAD-7.\textsuperscript{24}

We considered four secondary outcomes:

1. Perceived change in depression was assessed by asking participants, immediately following items measuring PHQ-9 depression, ‘How different are these feelings to how you felt before the pandemic?’ Increased depressed feelings were indicated by responses of ‘a little worse’ or ‘much worse’ versus ‘no different’, ‘a little better’ or ‘much better’.

2. Perceived change in anxiety was assessed using the same question following the GAD-7 items.

3. Alcohol use was measured with the Alcohol Use Disorders Identification Test (AUDIT)\textsuperscript{25} with ‘hazardous alcohol use’ defined at the clinical cut-off for hazardous or harmful alcohol use (a score of eight or greater) with up to a single missing item person-mean imputed.\textsuperscript{26}

4. Perceived change in alcohol use, compared with before the pandemic, was assessed by the question ‘Over the past week have you drunk alcohol more than you would usually, before the COVID-19 (coronavirus) pandemic?’ Responses were categorised as ‘more than usual’ versus ‘about the same’ or ‘less than usual’.

**Predictors**

We explored variables previously related to depression and anxiety as well as factors likely to be associated with increased vulnerability during the pandemic. All covariates were self-reported by participants at the baseline questionnaire and organised into six groups: (1) demographics (age, gender, ethnic group, birthplace) and prior mental health, (2) living arrangements, (3) caring roles, (4) healthcare, (5) occupational factors and (6) COVID-19 infection. These measures are detailed in online supplemental material.

**Statistical analyses**

**Weighting**

Weights were constructed using iterative proportional fitting (or ‘raking’) to account for differences in the composition of respondents compared with the population (all KCL staff and PGR students) in terms of age, gender and ethnicity.\textsuperscript{26, 27} Please see online supplemental material for detail.

**Descriptive analyses**

We first summarised differences between survey respondents and the target population in terms of age, gender and ethnicity. Second, we calculated counts and weighted percentages for demographic variables separately for staff and PGR students. Third, prevalences of primary and secondary outcomes were summarised using weighted percentages stratified by role, age group, gender, ethnic group and birthplace.

**Multivariable regression**

We used multivariable Poisson regression to explore factors associated with the primary outcomes of probable depression and probable anxiety. A Poisson model with a robust error variance\textsuperscript{28} was chosen over a binomial logistic model to avoid overestimating the relative risk (RR), given the high prevalence of outcomes in our sample.\textsuperscript{29} Overdispersion was tested using the...
method described in Gelman and Hill, p114,30 No evidence of overdispersion was found for either probable depression (χ² = 1653.0; dispersion ratio=0.824; p value=1.000) or probable anxiety (χ² = 1580.2; 0.789; 1.000).

An initial model considered how probable depression and anxiety were associated with age. This model included linear and non-linear terms for age only and was estimated for staff and PGR students separately. All other regression models were restricted to staff only due to the small sample of PGR students and because many covariates (eg, occupational factors) were not measured among students. We considered six models for each outcome. An initial model (model 1) included continuous age, gender, ethnic group and prior mental health diagnoses. Subsequent models considered living arrangements (model 2), caring roles (model 3), healthcare access (model 4), occupational factors (model 5) and experiences of COVID-19 infection (model 6). Models 2–6 additionally included age, gender, ethnic group and prior mental health as confounding variables. All estimates were weighted. Models were summarised using RRs and 95% CIs.

**Missing data**
This was an exploratory analysis that aimed to characterise the cohort and describe differences in the primary and secondary outcomes. Descriptive statistics were calculated using complete cases to retain all available information. For regression models, missing covariate and outcome information was multiply imputed using Amelia II.31 The imputation model included all variables used in the analytical model. Estimates were based on 100 imputation sets.

### RESULTS

#### Description of the cohort
The analytical sample comprised 2106 members of staff and 484 PGR students, representing 22% and 20% of KCL staff and PGR students, respectively. The sample was representative of the target population (KCL staff and PGR students) in terms of age, but female gender and White ethnicity were over-represented (online supplemental file 1). For example, 69% and 72% of staff and PGR students respondents were women, compared with 55% and 57% in the target population. Ethnic minority groups were substantially under-represented. Compared with the target populations, half as many respondents were of Asian ethnicity (staff: 6% vs 12%; PGR: 12% vs 23%) and less than half as many reported Black ethnicity (staff: 1% vs 5%; PGR: 2% vs 4%).

**Table 1** presents weighted demographic characteristics of the KCL CHECK baseline cohort for staff and PGR students separately. Most respondents reported being in a partnership and living with others. Nearly 1/3 of staff and 1/10 PGR students had children living at home. Around 1/10 respondents reported a caregiving role (besides childcare) and 1/10 reported being a keyworker.

#### Outcomes by demographic characteristics
**Figure 1** presents weighted percentages for the primary and secondary outcomes stratified by role (staff vs PGR student) and demographic characteristics. Among staff, 18% and 20% reported probable depression and anxiety, respectively (PHQ-9 or GAD-7 scores of 10 or greater), but this varied markedly by age. Among younger staff members (<25 years), 39% and 43% reported probable depression and anxiety, respectively, compared with 11% and 11% among staff aged >44. Among staff members, women were more likely than men to report

| Table 1 Demographic characteristics of KCL CHECK baseline cohort | Staff (n=2106) | PGR students (n=484) |
|-------------------|----------------|---------------------|
| **Count** (weighted %)* | **Count** (weighted %)* |
| **Gender** | | |
| Female | 1450 (56) | 345 (56) |
| Male | 645 (43) | 135 (43) |
| Other | 5 (0) | 0 (0) |
| Prefer not to say | 5 (0) | 5 (0) |
| Missing | 0 (0) | 0 (0) |
| **Age group** | | |
| 18–24 | 55 (3) | 65 (17) |
| 25–34 | 670 (32) | 310 (62) |
| 35–44 | 650 (31) | 65 (15) |
| 45–54 | 390 (18) | 20 (3) |
| 55–64 | 270 (13) | 15 (3) |
| 65+ | 70 (3) | 5 (1) |
| Missing | 0 (0) | 0 (0) |
| **Ethnicity** | | |
| White | 1740 (68) | 335 (53) |
| Black | 30 (5) | 10 (3) |
| Asian | 130 (13) | 60 (23) |
| Mixed | 80 (4) | 15 (6) |
| Other | 40 (7) | 29 (7) |
| Missing | 85 (4) | 45 (8) |
| **Relationship** | | |
| Single | 390 (20) | 130 (28) |
| Civil partnership, married, cohabiting | 1550 (73) | 300 (63) |
| Non-cohabiting | 80 (3) | 10 (2) |
| Divorced, separated, widowed | 80 (4) | 45 (8) |
| Missing | 85 (4) | 45 (8) |
| **Birthplace** | | |
| UK | 1290 (60) | 200 (37) |
| EU (not UK) | 385 (15) | 110 (18) |
| Other | 335 (21) | 125 (27) |
| Missing | 95 (4) | 45 (8) |
| **Housing arrangements** | | |
| Privately owned (self) | 940 (42) | 75 (14) |
| Rent (social) | 35 (2) | 5 (1) |
| Rent (private, voluntary) | 680 (33) | 295 (64) |
| Other | 360 (19) | 65 (13) |
| Missing | 90 (4) | 45 (8) |
| **Household members** | | |
| Lives with others | 1785 (85) | 395 (83) |
| Lives alone | 230 (11) | 45 (9) |
| Missing | 90 (4) | 45 (8) |
| **Number of children living with** | | |
| 0 | 1460 (69) | 430 (86) |
| 1 | 275 (13) | 20 (5) |
| 2+ | 370 (18) | 30 (8) |
| Missing | 0 (0) | 0 (0) |
| **Age of youngest child** | | |
| No children | 1300 (62) | 415 (84) |
| <5 | 225 (11) | 30 (9) |
| 5–11 | 205 (10) | 10 (3) |
| 12–17 | 130 (6) | 10 (1) |
| 18+ | 240 (11) | 15 (3) |
| Missing | 0 (0) | 0 (0) |
| **Other caring responsibilities** | | |
| None | 1825 (87) | 420 (86) |
| Has other caring role | 195 (9) | 20 (7) |
| Missing | 85 (4) | 45 (8) |
| **Participant is keyworker** | | |
| Not a keyworker | 1695 (79) | 375 (79) |
| Keyworker | 285 (13) | 50 (11) |
| Missing | 130 (6) | 60 (10) |
| **Another household member is keyworker** | | |
| No | 1530 (71) | 330 (69) |
| Missing | 175 (8) | 65 (12) |

*Counts rounded to nearest five to avoid disclosing small numbers. Percentages weighted to account for non-representativeness in terms of age group, gender and ethnic group.

KCL CHECK, King’s College London Coronavirus Health and Experiences of Colleagues at King’s; PGR, postgraduate research.
probable depression (16% vs 20%), anxiety (16% vs 24%) and were more likely to rate their anxiety and depression as worse than before the pandemic. Staff members reporting White ethnicity generally reported lower levels of probable depression and anxiety, compared with other ethnicities, but due to small group sizes, many of these are uncertain and did not reach statistical significance.

One-third of PGR students reported probable depression and anxiety. Differences by age and gender were similar to those for staff, with younger and female students being more likely to report probable depression and anxiety. Nearly twice as many female PGR students compared to men reported probable depression (39% vs 22%) and anxiety (39% vs 21%). There were differences in most outcomes by ethnicity, but these were uncertain due to small group sizes as above.

Regarding secondary outcomes, around two-thirds of respondents reported that their symptoms of depression and anxiety had worsened (‘Much worse’ or ‘A little worse’), compared with before the pandemic (62% and 71% among staff; 68% and 71% among PGRs, for depression and anxiety, respectively). Hazardous alcohol use (an AUDIT score of 8+) was reported by 22% of staff and 17% of students. Around 30% of staff and students said that their alcohol intake had increased compared with before the pandemic.

Figure 2 provides a closer look at non-linear relationships between age and the primary outcomes using weighted Poisson regression models. For staff, there was a clear negative association with age. The predicted probability of both probable depression and anxiety fell from 40% to 20% as age increased from 20 to 40 years. This negative trend was also seen among PGR students, but elevated rates of depression and anxiety were observed for a larger age range. In contrast to the steady decline seen for staff, higher rates of depression and anxiety persisted until age 35 and only declined after age 40.

Factors associated with probable depression and anxiety among staff

Tables 2 and 3 present, for staff only, associations between individual predictors and the relative risk of reporting probable depression and anxiety, respectively. We separately considered six groups of predictors.

Demographics

Staff reporting Black, Asian or other ethnicity were more likely, compared with staff reporting White ethnicity, to show probable depression (RR=1.26 to 1.74), but only associations for Asian ethnicity reached statistical significance after adjustment for age and gender. Staff reporting Asian ethnicity were nearly two times as likely to report depression, compared with staff of White ethnicity (RR=1.74; 95% CI 1.28 to 2.37). Staff living alone (RR=1.40; 95% CI 1.05 to 1.86) and staff living in rented accommodation (RR=1.24; 95%CI 0.97 to 1.57) were also more likely to show probable depression, compared with other
Carr E, et al. Occup Environ Med 2021;0:1–9. doi:10.1136/oemed-2021-107667

Exposure assessment

household arrangements. These associations were not found for anxiety.

Mental disorder diagnosis
Prior diagnoses of depression or anxiety were strongly associated with probable depression (RR for prior depression=2.29; CI 1.79 to 2.93; RR for prior anxiety=1.46; CI 1.14 to 1.88) and probable anxiety (RR for prior depression=1.44; CI 1.13 to 1.82; RR for prior anxiety=1.91; CI 1.51 to 2.42).

Caring role
We found no evidence that having one or two children living at home was associated with increased depression or anxiety, compared with no children at home. Staff with three or more children at home were more likely to show probable depression (RR=1.41; CI 0.91 to 2.18) and anxiety (RR=1.59; CI 1.00 to 2.53), although only the association for anxiety reached statistical significance. Staff reporting other caregiving responsibilities (besides childcare) were more likely to show probable depression (RR=1.46; CI 1.09 to 1.95) and anxiety (RR=1.48; CI 1.11 to 1.98), after adjusting for demographic variables and prior mental health.

Healthcare
Staff who needed, but could not access, healthcare were more likely to show probable depression (RR=1.59; CI 1.14 to 2.22), compared with staff who did not need to access healthcare. This association was also observed for probable anxiety but did not reach statistical significance (RR=1.37; CI 0.96 to 1.97). Reporting a long-term health condition was positively associated with probable depression and anxiety, but these associations did not reach statistical significance. Staff members shielding or self-isolating were twice as likely to show probable anxiety (RR=2.24; CI 1.38 to 3.66), compared with staff not shielding or self-isolating.

Occupational factors
We found no evidence of associations between remote working or job role with probable depression or anxiety. Staff on fixed-term or casual contracts were more likely to report probable anxiety, compared with those on open-ended contracts (RR=1.25; CI 1.00 to 1.58).

COVID-19 status
We found no evidence of an association between self-reported COVID-19 infection in the past 2 months and probable depression or anxiety.

DISCUSSION
In a large occupational sample during the early stages of the pandemic, we found a high prevalence of depression and anxiety symptoms, particularly among young people. Around 1/5 staff members and 1/3 PGRs scored above cut-off for depression (PHQ-9) and anxiety (GAD-7) questionnaires, respectively, and most felt that symptoms of depression and anxiety had worsened since before the pandemic. Around 20% of participants scored above cut-off on the AUDIT for hazardous alcohol use, while 30% were drinking more than before the pandemic.

Younger respondents were considerably more likely to show probable depression and anxiety: around 40% of staff aged 18–24, compared with 11% of staff aged 44 or older. Besides age, factors associated with probable depression and anxiety included female gender, caregiving responsibilities and shielding or isolating. It is notable that male staff were more likely to have hazardous alcohol use (27%) compared with anxiety (16%) or depression (16%), underlining the need to include this outcome when monitoring mental health.

Our results are consistent with other studies conducted during the early stages of the pandemic showing high prevalence of common mental disorder (CMD) including depression or anxiety. For instance, Lob et al reported findings from an
online survey answered by 51,000 people between March and May 2020 where 31% scored above cut-off for depression. Risk factors included being female, being younger and having a previous mental disorder. Henderson et al used surveys in existing national cohort studies during May 2020 and found similar patterns of CMD by age and gender with nearly 35% of women aged 19 having probable depression or anxiety, decreasing to 20% (age 30) and 14% (age 50).

This was a cross-sectional survey and data collection started during the pandemic. Although we asked people to judge their comparative anxiety and depression, without prepandemic measures of mental health it was hard to know the extent to which elevated mental distress was attributable to the pandemic. Prevalence of CMD was considerable before the pandemic. For example, the 2014 APMS found around 17%–18% of working age (16–64) respondents scored above cut-off for probable CMD, which rose to 26% among young women (ages 16–24). Longitudinal studies are needed to understand how high levels of mental distress are related to the pandemic.

In the UK, the UK Household Longitudinal Study provides longitudinal data from before and during the pandemic. Pierce et al found that probable CMD increased from 19% pre-pandemic to 27% in April to May 2020. The increase affected all groups but particularly women, the young (ages 16–24) and those with young children. They also found that participants had increased alcohol drinking frequency. Another study with longitudinal data was Avon Longitudinal Study of Parents and Children original cohort (mean age 28), which found an increase in probable anxiety (from 13% to 24%) but a decrease in probable depression (from 24% to 19%).

Risk factors for depression and anxiety in the first few months of the pandemic can be separated into general risk factors for CMD and specific stressors related to the pandemic. Some studies have suggested that the predictors of depression and anxiety have changed in the pandemic with increasing contributions from occupational factors and household composition. For our sample, younger age and female gender were associated with a higher prevalence of CMD, with both probable depression and anxiety. Of the specific COVID-19 stressors, suspecting recent COVID-19 infection was

| Table 2 | Associations of probable depression (PHQ-9 ≥10) with stressors estimated using multivariable Poisson regression (n=2106) |
|----------------|---------------------------------------------------------------|
|                | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 |
| Age 16-24      | 0.97 (0.96 to 0.98) | 0.97 (0.96 to 0.99) | 0.97 (0.96 to 0.98) | 0.97 (0.96 to 0.98) | 0.97 (0.96 to 0.98) | 0.97 (0.96 to 0.98) |
| Age 30-44      | 0.96 (0.77 to 1.23) | 0.97 (0.77 to 1.22) | 0.98 (0.78 to 1.23) | 1.01 (0.80 to 1.28) | 0.95 (0.76 to 1.20) | 0.97 (0.77 to 1.22) |
| Ethnic group  | White   | Black   | Asian   | Mixed   | Other   |
|                | (Ref)   | (Ref)   | (Ref)   | (Ref)   | (Ref)   |
|                | 1.27 (0.74 to 2.18) | 1.13 (0.66 to 1.92) | 1.23 (0.73 to 2.08) | 1.27 (0.74 to 2.17) | 1.27 (0.74 to 2.20) | 1.28 (0.75 to 2.20) |
|                | 1.74 (1.28 to 2.37) | 1.75 (1.30 to 2.37) | 1.73 (1.28 to 2.34) | 1.73 (1.28 to 2.34) | 1.73 (1.27 to 2.35) | 1.73 (1.28 to 2.35) |
|                | 0.83 (0.49 to 1.42) | 0.82 (0.48 to 1.41) | 0.84 (0.49 to 1.45) | 0.84 (0.49 to 1.43) | 0.83 (0.49 to 1.43) | 0.83 (0.49 to 1.41) |
|                | 1.26 (0.75 to 2.13) | 1.22 (0.74 to 2.03) | 1.19 (0.71 to 2.02) | 1.24 (0.73 to 2.10) | 1.26 (0.75 to 2.12) | 1.26 (0.75 to 2.13) |
| Previous depression | 2.29 (1.79 to 2.93) | 2.21 (1.73 to 2.84) | 2.25 (1.77 to 2.86) | 2.25 (1.76 to 2.88) | 2.29 (1.79 to 2.93) | 2.28 (1.78 to 2.93) |
| Previous anxiety | 1.46 (1.14 to 1.88) | 1.45 (1.13 to 1.86) | 1.45 (1.14 to 1.85) | 1.44 (1.13 to 1.84) | 1.46 (1.14 to 1.87) | 1.46 (1.14 to 1.88) |
| Lives alone    | 1.40 (1.05 to 1.86) | 1.40 (1.05 to 1.86) | 1.40 (1.05 to 1.86) | 1.40 (1.05 to 1.86) | 1.40 (1.05 to 1.86) | 1.40 (1.05 to 1.86) |
| Housing tenure | Other tenure       | Renting                                                                 |
|                | (Ref)   | 1.24 (0.97 to 1.57) | 1.24 (0.97 to 1.57) | 1.24 (0.97 to 1.57) | 1.24 (0.97 to 1.57) | 1.24 (0.97 to 1.57) |
| Number of children | 0       | 1       | 2       | 3+      |
|                | (Ref)   | 0.80 (0.53 to 1.19) | 0.78 (0.54 to 1.15) | 1.41 (0.91 to 2.18) |
| Other caring responsibilities | 1.46 (1.09 to 1.95) |
| Access to healthcare | Not needed       | Needed, could access               | Needed, but could not access |
|                | (Ref)   | 1.16 (0.92 to 1.48) | 1.59 (1.14 to 2.22) |
| Long-term health condition | 1.18 (0.92 to 1.51) |
| Currently shielding/isolating | 1.74 (0.90 to 3.38) |
| Key worker     | 0.91 (0.73 to 1.13) | 0.92 (0.76 to 1.13) |
| Started working remotely during pandemic | 0.92 (0.76 to 1.13) |
| Job role       | Academic, specialist and management                           | Teaching, facilities and clinical |
|                | (Ref)   | 1.00 (0.78 to 1.27) | 0.85 (0.56 to 1.29) |
| Contract type  | Open-ended/permanent                                        | Fixed term/casual |
|                | (Ref)   | 1.04 (0.82 to 1.32) |
| Thinks had COVID-19, past 2 months | 1.05 (0.83 to 1.33) |

Estimates are reported as relative risks (95% CIs). All estimates weighted to account for differences between sample and population in terms of age group, gender and ethnic group. Missing outcome and covariate information imputed using multiple imputations.

PHQ, Patient Health Questionnaire.
Exposure assessment

not associated with probable depression or anxiety, but currently self-isolating or shielding was associated with probable anxiety and being unable to access medical care was associated with probable depression and anxiety.

Gold-standard psychiatric diagnosis is via clinical interview. However, for research of this nature it is accepted practice to use validated questionnaires of symptoms of depression and anxiety, often in the preceding 2 weeks.41 However, it is not known how scores relate to clinical disorders during extremely adverse event such as pandemic and lockdown, when it is acknowledged that a normal reaction will include anxiety, anger and stress.42 We are not aware of any validation studies of the common questionnaires during the pandemic, nor any surveys in the UK that have used clinical interviews. The HUNT study in Norway43 have a repeated cross-sectional psychiatric interview as part of the larger cohort study and found a decrease in the prevalence of CMD during the first wave of the pandemic.

Strengths and limitations

This was an exploratory study that sought to describe our cohort and their mental health outcomes at baseline. We benefited from a large sample capturing nearly a quarter of staff. In contrast to many online surveys, we were able to draw on administrative records to understand the representativeness of respondents compared with the population and construct weights. We accounted for several important covariates. However, our survey was cross-sectional and cannot distinguish between observed associations due to the pandemic and those that existed previously. Female gender and White ethnicity were over-represented in the sample compared with the target population. While weights were constructed to account for these differences, weights cannot make up for missing experiences from groups and intersectional groups that are present in very small numbers (such as non-binary gender and Black staff) and for which more focused studies are necessary. Within weights, extreme values were trimmed to reduce variability of the weights, which may

Table 3  Associations of probable anxiety (GAD-7≥10) with stressors estimated using multivariable Poisson regression (n=2106)

| Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 |
|---------|---------|---------|---------|---------|---------|
| Age     | 0.97 (0.96 to 0.98) | 0.97 (0.95 to 0.98) | 0.96 (0.95 to 0.97) | 0.97 (0.96 to 0.98) | 0.97 (0.96 to 0.98) |
| Gender  | Male    | 0.81 (0.65 to 1.01) | 0.81 (0.65 to 1.02) | 0.81 (0.65 to 1.01) | 0.84 (0.67 to 1.05) | 0.79 (0.64 to 0.98) | 0.80 (0.64 to 1.01) |
| Ethnic group | White (Ref.) | (Ref.) | (Ref.) | (Ref.) | (Ref.) | (Ref.) |
| Black   | 0.86 (0.42 to 1.76) | 0.90 (0.44 to 1.83) | 0.84 (0.43 to 1.64) | 0.83 (0.41 to 1.67) | 0.92 (0.45 to 1.85) | 0.87 (0.42 to 1.77) |
| Asian   | 1.29 (0.95 to 1.77) | 1.29 (0.94 to 1.76) | 1.25 (0.91 to 1.70) | 1.28 (0.94 to 1.74) | 1.26 (0.93 to 1.71) | 1.29 (0.94 to 1.76) |
| Mixed   | 0.55 (0.31 to 0.99) | 0.55 (0.31 to 0.99) | 0.55 (0.31 to 1.00) | 0.54 (0.30 to 0.96) | 0.55 (0.31 to 1.00) | 0.55 (0.31 to 0.99) |
| Other   | 1.12 (0.69 to 1.81) | 1.14 (0.71 to 1.83) | 1.09 (0.67 to 1.77) | 1.12 (0.69 to 1.81) | 1.08 (0.67 to 1.74) | 1.12 (0.69 to 1.81) |
| Previous depression | 1.44 (1.13 to 1.82) | 1.45 (1.14 to 1.84) | 1.41 (1.12 to 1.78) | 1.43 (1.12 to 1.83) | 1.45 (1.15 to 1.84) | 1.43 (1.13 to 1.82) |
| Previous anxiety | 1.91 (1.51 to 2.42) | 1.93 (1.52 to 2.44) | 1.90 (1.51 to 2.40) | 1.90 (1.50 to 2.39) | 1.93 (1.54 to 2.43) | 1.91 (1.51 to 2.42) |
| Lives alone | 0.91 (0.64 to 1.31) | (Ref.) | (Ref.) | (Ref.) | (Ref.) | (Ref.) |
| Housing tenure | Other tenure | Renting | 0.89 (0.72 to 1.10) | (Ref.) | (Ref.) | (Ref.) |
| Number of children | 0 | 1 | 1.14 (0.80 to 1.61) | 1.03 (0.73 to 1.46) | 1.59 (1.00 to 2.53) | 1.48 (1.11 to 1.98) |
| 1 | 2 | 1.48 (1.11 to 1.98) | 1.48 (1.11 to 1.98) | 1.48 (1.11 to 1.98) | 1.48 (1.11 to 1.98) | 1.48 (1.11 to 1.98) |
| 2+ | 3+ | 1.48 (1.11 to 1.98) | 1.48 (1.11 to 1.98) | 1.48 (1.11 to 1.98) | 1.48 (1.11 to 1.98) | 1.48 (1.11 to 1.98) |
| Other caring responsibilities | Access to healthcare | Not needed | (Ref.) | (Ref.) | (Ref.) | (Ref.) |
| Needed, could access | Needed, but could not access | 1.06 (0.84 to 1.34) | 1.37 (0.96 to 1.97) | (Ref.) | (Ref.) | (Ref.) |
| Long-term health condition | 1.10 (0.87 to 1.40) | (Ref.) | (Ref.) | (Ref.) | (Ref.) | (Ref.) |
| Currently shielding/isolating | 2.24 (1.38 to 3.66) | (Ref.) | (Ref.) | (Ref.) | (Ref.) | (Ref.) |
| Key worker | 1.19 (0.89 to 1.59) | (Ref.) | (Ref.) | (Ref.) | (Ref.) | (Ref.) |
| Started working remotely during pandemic | 0.92 (0.76 to 1.13) | (Ref.) | (Ref.) | (Ref.) | (Ref.) | (Ref.) |
| Job role | Academic, specialist and management | (Ref.) | (Ref.) | (Ref.) | (Ref.) | (Ref.) |
| Research, clerical and technical | 0.87 (0.69 to 1.09) | (Ref.) | (Ref.) | (Ref.) | (Ref.) | (Ref.) |
| Teaching, facilities and clinical | 0.91 (0.63 to 1.32) | (Ref.) | (Ref.) | (Ref.) | (Ref.) | (Ref.) |
| Contract type | Open-ended/permanent | (Ref.) | (Ref.) | (Ref.) | (Ref.) | (Ref.) |
| Fixed term/casual | 1.25 (1.00 to 1.58) | (Ref.) | (Ref.) | (Ref.) | (Ref.) | (Ref.) |
| Thinks had COVID-19, past 2 months | 1.06 (0.84 to 1.32) | (Ref.) | (Ref.) | (Ref.) | (Ref.) | (Ref.) |

Estimates are reported as relative risks (95% CIs). All estimates weighted to account for differences between sample and population in terms of age group, gender and ethnic group. Missing outcome and covariate information imputed using multiple imputation.

GAD, Generalised Anxiety Disorder.
introduce bias. Another consideration is that occupational studies have previously been shown to report higher levels of psychological stress, compared with population studies, which should be considered when interpreting our results. Finally, these data were collected during the first period of lockdown in the UK, and some observations may be specific to those unprecedented circumstances.

CONCLUSIONS

Our study shows worrying levels of symptoms of anxiety, depression and alcohol use disorder in an occupational sample from a large UK university in the months following the outbreak of the COVID-19 pandemic and the subsequent lockdown. It is not known how much anxiety and depression symptomatology represents true pathology in the extreme circumstances, but the high levels of distress may be important in themselves, especially for people who may already have been vulnerable to mental disorder. Distress may be a risk for adverse outcomes in the future, especially if stress and isolation continue for extended periods. KCL CHECK is well placed to look at these longer term risks, with mental health questionnaires repeated every 2 weeks for 18 months. As an occupational cohort, our findings may be useful to target support measures and occupational health provisions. Employers may also be motivated to change practices, for example, to extend fixed-term contracts and allow flexibility for people with caring responsibilities.

Contributors All authors contributed to the design of the study. EC carried out the data analysis. EC and KD wrote the manuscript. All authors made substantive revisions to and approved the final manuscript. KD, GB-C, GL, DL, CO, CP and AW carried out the data collection. SAMS, RR and MH supervised the project. EC is the guarantor of the study.

Funding This paper represents independent research part-funded by the National Institute for Health Research (NIHR) Biomedical Research Centre at South London and Maudsley NHS Foundation Trust and King’s College London.

Disclaimer The views expressed are those of the author(s) and not necessarily those of the NHS, the NIHR or the Department of Health and Social Care.

Competing interests MH receives funding from Janssen as part of the RADAR-CNS consortium, which includes a project on depression. SAMS is a principal investigator of RADAR-CNS, a precompetitive public-private partnership co-funded by Innovative Medicines Initiative (European Commission) and European Federation of Pharmaceutical Industries and Associations (EFPIA). He has also been an independent expert witness in group litigations instructed by claimants against pharmaceutical companies for alleged harmful effects of their products.

Patient consent for publication Not applicable.

Ethics approval Ethical approval for KCL CHECK was obtained from King’s College London’s Psychiatry, Nursing and Midwifery Research Ethics Committee (HR-19/20-18247).

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement De-identified participant data are available for research purposes on request to the study authors, subject to approval.

Supplemental material This content has been supplied by the author(s). It has not been vetted by BMJ Publishing Group Limited (BMJ) and may not have been peer-reviewed. Any opinions or recommendations discussed are solely those of the author(s) and are not endorsed by BMJ. BMJ disclaims all liability and responsibility arising from any reliance placed on the content. Where the content includes any translated material, BMJ does not warrant the accuracy and reliability of the translations (including but not limited to local regulations, clinical guidelines, terminology, drug names and drug dosages), and is not responsible for any error and/or omissions arising from translation and adaptation or otherwise.

This article is made freely available for use in accordance with BMJ’s website terms and conditions for the duration of the covid-19 pandemic or until otherwise determined by BMJ. You may use, download and print the article for any lawful, non-commercial purpose (including text and data mining) provided that all copyright notices and trade marks are retained.

ORCID iDs

Ewan Carr http://orcid.org/0000-0002-1146-4922

Sharon A M Stevelink http://orcid.org/0000-0002-7655-7986

REFERENCES

1 Universities UK. Principles and considerations: emerging from lockdown, 2020. Available: https://universitiesuk.ac.uk/policy-and-analysis/reports/Pages/principles-considerations-emerging-lockdown-uk-universities-june-2020.aspx

2 Besser A, Lotem S, Zeigler-Hill V. Psychological stress and viral symptoms among university Professors in Israel: implications of the shift to online synchronous teaching during the COVID-19 pandemic. J Voice 2020;886. doi:10.1016/j.jvoice.2020.05.028. [Epub ahead of print: 05 Jun 2020]

3 Hayes S, Priestley JL, Ishkhamaknetov N. ‘I’m not Working from Home, I’m Living at Work’: Perceived Stress and Work-Related Burnout before and during COVID-19. PsyArXiv 2020.

4 Winter C, Weitman L, Sass Mikkelsen K, et al. Responding to COVID-19 through surveys of public servants. Public Adm Rev 2020; doi:10.1111/puar.13246. [Epub ahead of print: 27 05 2020].

5 Pierce M, Hope H, Ford J, et al. Mental health before and during the COVID-19 pandemic: a longitudinal population sample study of the UK. Lancet Psychiatry 2020;7:883–92.

6 Wright L, Stopeck A, Fanicourt D. Does thinking make it so? differential associations between adversity worries and experiences and mental health during the COVID-19 pandemic. J Epidemiol Community Health 2021;75:817–23.

7 Wu F, Liu M, Wang A, et al. Evaluating the association of clinical characteristics with neutralizing antibody levels in patients who have recovered from mild COVID-19 in Shanghai, China. JAMA Intern Med 2020;180:1356–62.

8 Giorgi G, Lecca L, Alessio F, et al. COVID-19-Related mental health effects in the workforce: a narrative review. Int J Environ Res Public Health 2020;17:7857.

9 Goddard L, Luyten J. Challenges and opportunities for occupational health and safety after the COVID-19 lockdowns. Occup Environ Med 2020;77:511–2.

10 Sasaki N, Kuroda R, Tsumo K, et al. The deterioration of mental health among healthcare workers during the COVID-19 outbreak: a population-based cohort study of workers in Japan. Scand J Work Environ Health 2020;46:639–44.

11 Lamb D, Gnanapragasam S, Greenberg N. The psychosocial impact of the COVID-19 pandemic on 4,378 UK healthcare workers and ancillary staff: initial baseline data from a cohort study collected during the first wave of the pandemic. medRxiv 2020.

12 Pierce M, McManus S, Jessop C, et al. Says who? The significance of sampling in mental health surveys during COVID-19. Lancet Psychiatry 2020;7:567–8.

13 Pearce N, Checkoway H, Kriebel D. Bias in occupational epidemiology studies. Occup Environ Med 2007;64:562–6.

14 Spitzer RL, Kroenke K, Williams JB, et al. The PHQ-9: validity of a brief depression severity measure. J Gen Intern Med 2001;16:706–13.

15 Spitzer RL, Kroenke K, Williams JB, et al. A brief measure for assessing generalized anxiety disorder: the GAD-7. Arch Intern Med 2006;166:1092–7.

16 Downey RG, King C. Missing data in Likert ratings: a comparison of replacement methods. J Gen Psychol 1998;125:175–91.

17 Saunders JB, Asland OG, Organization WH. WHO Collaborative project on the identification and treatment of persons with harmful alcohol consumption. Report on phase I: the development of a screening instrument. Geneva: World Health Organization, 1987.

18 Lumley T. Analysis of complex survey samples. J Stat Softw 2004;9:1–9.

19 Lumley T. Survey: analysis of complex survey samples 2020.
Exposure assessment

28 Zou G. A modified poisson regression approach to prospective studies with binary data. *Am J Epidemiol* 2004;159:702–6.

29 McNutt L-A, Wu C, Xue X, et al. Estimating the relative risk in cohort studies and clinical trials of common outcomes. *Am J Epidemiol* 2003;157:940–3.

30 Gelman A, Hill J. *Data analysis using regression and Multilevel/hierarchical models*. Cambridge: Cambridge University Press, 2006.

31 Honaker J, King G, Blackwell M. Amelia II: A Program for Missing Data. *J Stat Softw* 2011;45:1–47.

32 Hossain MM, Tasnim S, Sultana A. Epidemiology of mental health problems in COVID-19: a review 2020.

33 Vindegaard N, Benros ME. COVID-19 pandemic and mental health consequences: systematic review of the current evidence. *Brain Behav Immun* 2020;89:531–42.

34 Xiong J, Lipsitz O, Nasri F, et al. Impact of COVID-19 pandemic on mental health in the general population: a systematic review. *J Affect Disord* 2020;277:55–64.

35 Iob E, Steptoe A, Fancourt D. Abuse, self-harm and suicidal ideation in the UK during the COVID-19 pandemic. *Br J Psychiatry* 2020;217:543–6.

36 Henderson M, Fitzsimons E, Ploubidis G. Mental health during lockdown: evidence from four generations 2020;20.

37 McManus S, Bebbington P, Jenkins R. Mental health and wellbeing in England: Adult Psychiatric Morbidity Survey 2014 : A survey carried out for NHS Digital by NatCen Social Research and the Department of Health Sciences, University of Leicester, 2016.

38 Gupta A, Madhavan MV, Sehgal K, et al. Extrapulmonary manifestations of COVID-19. *Nat Med* 2020;26:1017–32.

39 Kwong ASF, Pearson RM, Adams MJ, et al. Mental health before and during the COVID-19 pandemic in two longitudinal UK population cohorts. *Br J Psychiatry* 2020;1-10.

40 Davillas A, Jones AM. The COVID-19 pandemic and its impact on inequality of opportunity in psychological distress in the UK. *SSRN Journal* 2020.

41 Kroenke K, Spitzer RL, Williams JBW, et al. The patient health questionnaire somatic, anxiety, and depressive symptom scales: a systematic review. *Gen Hosp Psychiatry* 2010;32:345–59.

42 Hisham LN, Townsend G, Gillard S. COVID-19 for a mental health epidemic. *BJPsych Bulletin* 2020;1–8.

43 Knudsen AKS, Steine-Larsen K, Gustavson K, et al. Prevalence of mental disorders, suicidal ideation and suicides in the general population before and during the COVID-19 pandemic in Norway: a population-based repeated cross-sectional analysis. *The Lancet Regional Health - Europe* 2021;4:10071.

44 Goodwin L, Ben-Zion I, Fear NT, et al. Are reports of psychological stress higher in occupational studies? A systematic review across occupational and population based studies. *PloS One* 2013;8:e78693.
Supplementary materials

Table of Contents

Definitions of predictor variables...............................................................................................................1
Derivation of sampling weights........................................................................................................................3
Supplementary Table 1......................................................................................................................................4
Demographic composition of staff responding to survey vs. composition of population..............................4
CHERRIES checklist.......................................................................................................................................5
References..........................................................................................................................................................9

Definitions of predictor variables

We explored six groups of predictor variables:

1.  Demographics and prior mental health

   Demographic variables included age, gender, ethnic group, and birthplace. Participants were able to define their gender as ‘Female,’ ‘Male,’ or ‘Other,’ as well as indicating they would ‘Prefer not to say.’ For the purposes of modelling, where small numbers in the latter two categories would be problematic, we have randomly allocated these responses to ‘Female’ or ‘Male’ based on the sample proportions. To avoid small cell sizes, ethnicity was coded into five categories following recommendations of the Office for National Statistics [1]: White, Mixed, Asian/Asian British, Black/African/Caribbean/Black British, or Other ethnic group. Birthplace was categorised as ‘United Kingdom,’ ‘European Union (not United Kingdom)’ or ‘Other.’

   Prior mental health was assessed using the question ‘Which of the following have you ever experienced (include only those that have been diagnosed by a doctor, psychiatrist or other health professional)?’ Using responses of ‘Depression’ for history of depression and ‘Generalised anxiety disorder,’ ‘Panic attacks’ or ‘Post-traumatic stress disorder’ for history of an anxiety disorder.

2.  Living arrangements

   Participants were asked “Which of the following best describes your current living arrangement?” Responses were dichotomised to indicate whether participants were ‘Living
alone’ (the participant reported living “Alone”) vs. ‘living with others.’ Housing tenure was measured as any ‘renting’ category vs. all other categories.

3. **Caring roles**

The number of children living in the household was measured as an ordinal variable (coded as 0, 1, 2 or 3+ children) and other caregiving responsibilities besides childcare was measured as a binary variable (0 = ‘No’; 1 = ‘Yes’).

4. **Healthcare**

We considered three variables measured healthcare. (i) Difficulties accessing healthcare from ‘Have you needed to access healthcare services since the beginning of the pandemic for reasons other than COVID-19 (coronavirus)?’ and ‘Were you able to access that service?’ categorised as ‘Did not need to access healthcare,’ ‘Needed healthcare and was able to access’ and ‘Needed healthcare and was not able to access.’ (ii) Presence of a long-term condition from ‘Do you have any physical conditions or illnesses lasting or expected to last 12 months or more?’ (iii) Reported self-isolating or shielding were also included in the healthcare category. ‘Self-isolating’ was defined as “avoiding contact with others and not leaving the home for any reason”. ‘Shielding’ was defined in the questionnaire as “a type of self-isolation, which involves not leaving your home for any reason for at least 12 weeks to reduce your risk of contracting COVID-19 (coronavirus)”.

5. **Occupational factors**

Four occupational factors were measured for staff but not students. These included (i) whether the respondent was in a key worker role (‘Are you currently fulfilling a ‘key worker’ role as identified by the government?’) and (ii) whether they were on a temporary contract (either ‘Fixed term’ or ‘Casual’ contract types). (iii) Participants newly working remotely were identified using questions about working remotely before the pandemic (‘No’ or ‘Occasionally’ vs. more often) and since the pandemic. (iv) Staff role, based on participants’ stated primary role (“Which of the following best describes your primary role as a member of staff at King’s College London?”), was organised into three categories reflecting seniority and the degree of contact with the public: ‘Academic, specialist and management,’ ‘Research, clerical and technical,’ and ‘Teaching, facilities, and clinical.’ These categorises were defined as shown below:

| Responses recorded in questionnaire | Derived category used in analyses |
|-----------------------------------|----------------------------------|
| Academic                          | “Academic, specialist and management” |
| Specialists and professionals     |                                  |

\[2\]
6. ‘COVID-19’ perceived infection status was defined using the question ‘Do you think that you have had COVID-19 (coronavirus) at any time?’ with responses dichotomised as ‘Definitely’ or ‘Probably’ vs. ‘No’ or ‘Unsure.’

**Derivation of sampling weights**

Sampling weights were calculated for staff and PGR students separately. Information on age group, gender, and ethnicity for the target population (all KCL staff and PGR students, respectively) were extracted from administrative records. The procedure to derive weights was:

1. We harmonised the categories in administrative records with those measured in the survey.
2. Missing information in the survey data (for age group, gender, and ethnicity) was imputed with k-nearest neighbours (with k=5 nearest neighbours) using the kNN function from the VIM [2] package for R [3].
3. Weights (W) were derived based on age group, gender, and ethnicity using raking (iterative proportional fitting) using the rake function of the survey package [4] for R.
4. Extreme values were trimmed to $W_T$, where:

   $$ W_T = \text{median}(W) + (5 \times \text{IQR}(W)) $$

   (IQR = inter quartile range). This involved setting any weight greater than $W_T$ to $W_T$. 

---

Carr E, et al. Occup Environ Med 2021;0:1–9. doi: 10.1136/oemed-2021-107667
Supplementary Table 1

Demographic composition of staff responding to survey vs. composition of population

Unweighted percentages.

|                      | Staff          |              | PGR students |              |
|----------------------|----------------|--------------|--------------|--------------|
|                      | Admin. records | Baseline survey | Admin. records | Baseline survey |
|                      | %              | %            | %            | %            |
| Gender               |                |              |              |              |
| Female               | 55             | 69           | 57           | 72           |
| Male                 | 45             | 31           | 43           | 28           |
| Age group (Staff)    |                |              |              |              |
| 16 - 25              | 5              | 4            | --           | --           |
| 26 - 35              | 35             | 34           | --           | --           |
| 36 - 45              | 28             | 29           | --           | --           |
| 46 - 55              | 18             | 19           | --           | --           |
| 56 - 65              | 11             | 11           | --           | --           |
| >=66                 | 3              | 3            | --           | --           |
| Age group (PGR students) |          |              |              |              |
| 18 - 24              | --             | --           | 18           | 14           |
| 25 - 29              | --             | --           | 39           | 47           |
| 30 - 39              | --             | --           | 31           | 25           |
| 40+                  | --             | --           | 12           | 13           |
| Ethnic group         |                |              |              |              |
| White                | 70             | 87           | 61           | 78           |
| Black                | 5              | 1            | 4            | 2            |
| Asian                | 12             | 6            | 23           | 12           |
| Mixed                | 4              | 4            | 5            | 3            |
| Other                | 8              | 2            | 7            | 5            |
## CHERRIES checklist

A CHERRIES checklist (Checklist for Reporting Results of Internet E-Surveys) [5] is provided below.

| Checklist Item | Explanation | Page Number |
|----------------|-------------|-------------|
| Describe survey design | Describe target population, sample frame. Is the sample a convenience sample? (In “open” surveys this is most likely.) | 4, 5. |
| IRB approval | Mention whether the study has been approved by an IRB. Described in [6]. | |
| Informed consent | Describe the informed consent process. Where were the participants told the length of time of the survey, which data were stored and where and for how long, who the investigator was, and the purpose of the study? | Described in [6]. |
| Data protection | If any personal information was collected or stored, describe what mechanisms were used to protect unauthorized access. | Described in [6]. |
| Development and testing | State how the survey was developed, including whether the usability and technical functionality of the electronic questionnaire had been tested before fielding the questionnaire. | Described in [6]. |
| Open survey versus closed survey | An “open survey” is a survey open for each visitor of a site, while a closed survey is only open to a sample which the investigator knows (password-protected survey). This was an open survey, with the restriction that invitations to participate were sent to participants’ university email account. | |
| Contact mode | Indicate whether or not the initial contact with the potential participants was made on the Internet. (Investigators may also send out questionnaires by mail and allow for Web-based data entry.) See page 5. | |
| Advertising the survey | How/where was the survey announced or advertised? Some examples are offline media (newspapers), or online (mailing lists – If yes, which ones?) or banner ads (Where were these banner ads posted and what did they look like?). It is important to know the wording of the announcement as it will heavily influence who chooses to participate. Ideally the survey announcement should be published as an appendix. The survey was advertised internally via newsletters and internal social media. Please refer to [6] for details. | |
| Web/E-mail | State the type of e-survey (eg, one posted on a Web site, or one sent out through e-mail). If it is an e-mail survey, were the responses entered manually into a database, or was there an automatic method for capturing responses? See page 5. Responses were automatically captured using online survey software. Please refer to [6] for details. | |
| Context | Describe the Web site (for mailing list/newsgroup) in which the survey was posted. What is the Web site about, who is visiting it, what are visitors normally looking for? Discuss to Not applicable. | |
| Question                                                                 | Answer |
|-------------------------------------------------------------------------|--------|
| What degree the content of the Web site could pre-select the sample or influence the results. For example, a survey about vaccination on a anti-immunization Web site will have different results from a Web survey conducted on a government Web site. |        |
| Mandatory/voluntary                                                     | Voluntary. |
| Incentives                                                              | No.    |
| Time/Date                                                               | 5.     |
| Randomization of items or questionnaires                                 | No.    |
| Adaptive questioning                                                    | Yes.   |
| Number of Items                                                         | This was dependent on the questionnaire instrument and device being used. On average, ≈3 items were displayed per page. |
| Number of screens (pages)                                               | This was dependent on the questionnaire instrument and device being used. On average, ≈10 pages were displayed. |
| Completeness check                                                      | Yes, this was provided by the survey software (Qualtrics). |
| Review step                                                             | Yes.   |
| Unique site visitor                                                     | Not applicable, view rates were not provided. |
| View rate (Ratio of)                                                    | Not applicable. |
| Metric                                      | Description                                                                                                                                                                                                 | Notes          |
|--------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| Unique survey visitors/unique site visitors | It is not unusual to have view rates of less than 0.1% if the survey is voluntary.                                                                                                                           |                |
| Participation rate (Ratio of unique visitors who agreed to participate/unique first survey page visitors) | Count the unique number of people who filled in the first survey page (or agreed to participate, for example by checking a checkbox), divided by visitors who visit the first page of the survey (or the informed consents page, if present). This can also be called “recruitment” rate. | Not applicable. |
| Completion rate (Ratio of users who finished the survey/users who agreed to participate) | The number of people submitting the last questionnaire page, divided by the number of people who agreed to participate (or submitted the first survey page). This is only relevant if there is a separate “informed consent” page or if the survey goes over several pages. This is a measure for attrition. Note that “completion” can involve leaving questionnaire items blank. This is not a measure for how completely questionnaires were filled in. (If you need a measure for this, use the word “completeness rate”.) | Not applicable. |
| Cookies used                               | Indicate whether cookies were used to assign a unique user identifier to each client computer. If so, mention the page on which the cookie was set and read, and how long the cookie was valid. Were duplicate entries avoided by preventing users access to the survey twice; or were duplicate database entries having the same user ID eliminated before analysis? In the latter case, which entries were kept for analysis (eg, the first entry or the most recent)? | Yes, cookies were assigned to unique users upon consenting to take part in the study. Cookies were valid for 7 days, and were checked on each page to validate the questionnaire completer. |
| IP check                                   | Indicate whether the IP address of the client computer was used to identify potential duplicate entries from the same user. If so, mention the period of time for which no two entries from the same IP address were allowed (eg, 24 hours). Were duplicate entries avoided by preventing users with the same IP address access to the survey twice; or were duplicate database entries having the same IP address within a given period of time eliminated before analysis? If the latter, which entries were kept for analysis (eg, the first entry or the most recent)? | Not applicable. |
| Log file analysis                          | Indicate whether other techniques to analyze the log file for identification of multiple entries were used. If so, please describe.                                                                                   | No.            |
| Registration                               | In “closed” (non-open) surveys, users need to login first and it is easier to prevent duplicate entries from the same user. Describe how this was done. For example, was the survey never displayed a second time once the user had filled it in, or was the username stored together with the survey results and later eliminated? If the latter, which entries were kept for | Not applicable. |
| Analysis (eg, the first entry or the most recent)? |  |
|---|---|
| **Handling of incomplete questionnaires** | Were only completed questionnaires analyzed? Were questionnaires which terminated early (where, for example, users did not go through all questionnaire pages) also analyzed? | Incomplete questionnaires were analysed. |
| **Questionnaires submitted with an atypical timestamp** | Some investigators may measure the time people needed to fill in a questionnaire and exclude questionnaires that were submitted too soon. Specify the timeframe that was used as a cut-off point, and describe how this point was determined. | Respondents had to complete the questionnaire within two weeks of consenting to participate and receiving the survey link via email. |
| **Statistical correction** | Indicate whether any methods such as weighting of items or propensity scores have been used to adjust for the non-representative sample; if so, please describe the methods. | See page 8 and supplementary materials. |
References

1 ONS. Ethnic group, national identity and religion - Office for National Statistics. Ethnic group, national identity and religion. 2020. https://www.ons.gov.uk/methodology/classificationsandstandards/measuringequality/ ethnicgroupnationalidentityandreligion#ethnic-group (accessed 10 Dec 2020).

2 Kowarik A, Templ M. Imputation with the R package VIM. Journal of Statistical Software 2016;74:1–16. doi:10.18637/jss.v074.i07

3 R Core Team. R: A language and environment for statistical computing. Vienna, Austria: 2020. https://www.R-project.org/

4 Lumley T. Analysis of complex survey samples. Journal of Statistical Software 2004;9:1–19.

5 Eysenbach G. Improving the Quality of Web Surveys: The Checklist for Reporting Results of Internet E-Surveys (CHERRIES). J Med Internet Res 2004;6. doi:10.2196/jmir.6.3.e34

6 Davis KAS, Stevelink SAM, Al-Chalabi A, et al. The King’s College London Coronavirus Health and Experiences of Colleagues at King’s Study (KCL CHECK) protocol paper: a platform for study of the effects of coronavirus pandemic on staff and postgraduate students. medRxiv 2020;2020.06.16.20132456. doi:10.1101/2020.06.16.20132456