Loneliness during lockdown: trajectories and predictors during the
COVID-19 pandemic in 35,712 adults in the UK

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Abstract

There are increasing worries that lockdowns and “stay-at-home” orders due to the COVID-19 pandemic could lead to a rise in loneliness, which is recognised as a major public health concern. But profiles of loneliness during the pandemic and risk factors remain unclear. Data from 35,712 UK adults in the UCL COVID -19 Social Study (a panel study collecting data weekly during the pandemic) were analysed from 21/03/2020-03/05/2020. The sample was well-stratified and weighted to population proportions of gender, age, ethnicity, education and geographical location. Growth mixture modelling was used to identify the latent classes of loneliness growth trajectories and their predictors. Analyses revealed four classes, with the baseline loneliness level ranging from low to high. In the first six weeks of lockdown, loneliness levels increased in the highest loneliness group, decreased in the lowest loneliness group, and stayed relatively constant in the middle two groups. Younger adults (OR=2.17-6.81), women (OR=1.59), people with low income (OR=1.3), the economically inactive (OR=1.3-2.04) and people with mental health conditions (OR=5.32) were more likely to be in highest loneliness class relative to the lowest. Further, living with others or in a rural area, and having more close friends or greater social support were protective. Perceived levels of loneliness in the first few weeks of lockdown during COVID-19 were relatively stable in the UK, but for many people these levels were high with no signs of improvement. Results suggest that more efforts are needed to address loneliness, especially amongst young people.

Key words: loneliness, mental health, growth trajectory, Covid-19, coronavirus, isolation
Introduction

The COVID-19 pandemic has triggered lockdowns and “stay-at-home” orders in countries around the world. Individuals have been forced to withdraw from usual face-to-face social activities other than with people they live with for substantial periods. This has led to concerns that there could be adverse effects on loneliness, in particular for individuals considered “high risk” for whom stay-at-home orders may be maintained even when orders are officially relaxed for other people [1].

Loneliness is a major public health concern as research has shown associations with heightened risk of mental illness, including depression, generalised anxiety, and suicidal ideation [2]. People who are lonely are more likely to develop cardiovascular disease, stroke, and coronary heart disease [3,4], as well as experience cognitive decline and develop dementia [5–8]. Loneliness is also associated with increased all-cause mortality risk [9]. Biological studies of the mechanisms underlying these adverse associations have highlighted inflammatory pathways as one explanation for such findings, with loneliness associated with higher levels of inflammation and impaired immune regulation [10–12], which are in turn associated with chronic stress, depression, and cardiovascular risk factors [13]. Behavioural studies of mechanisms have also highlighted the adverse effects of loneliness on health behaviours such as smoking, drinking, and over-eating [14]. As such, the potential effects of COVID-19 on loneliness are not just relevant from an individual well-being perspective, but also in terms of the mental and physical health outcomes that could occur as a result.

But it remains unclear how loneliness levels have changed during the COVID-19 pandemic. Analyses of Google Trends suggest that Google searches for loneliness increased in the month leading up to lockdowns in Western European countries, with levels then staying high for the fortnight following before returning to usual levels [15]. But comparisons using
validated measures of loneliness are lacking. Further, it is unclear what the trajectories of loneliness have been since social distancing measures were introduced, what the risk factors are for high levels of loneliness, and whether any factors might have been protective against adverse loneliness experiences. Cross-sectional data from Spain have suggested that women are at higher risk of experiencing loneliness during the pandemic, as are younger adults, and that higher contact with relatives might be protective [16], which echoes previous data on usual risk factors [17]. But much more detailed, longitudinal research is needed.

Loneliness and in particular the identification for factors that could buffer against it, have been highlighted as mental health research priorities in COVID-19 [18]. Therefore this study explored trajectories of loneliness since lockdown commenced in the UK in a large sample of 35,712 adults tracked across 6 weeks. It also sought to identify risk and resilience factors for loneliness experiences, including exploring (i) which socio-demographic characteristics or existing mental illness were risk factors for loneliness during lockdown, (ii) whether social factors including living status, social network size and social support protected against experiences of loneliness, and (iii) whether any protective social factors moderated any relationship between mental illness and loneliness.

Methods

Participants

We used data from the UCL COVID-19 Social Study; a large panel study of the psychological and social experiences of over 50,000 adults (aged 18+) in the UK during the COVID-19 pandemic (the study is still recruiting so the exact sample size is still changing). The study commenced on 21st March 2020 involving online weekly data collection from participants for the duration of the COVID-19 pandemic in the UK. Whilst not random, the study has a well-stratified sample that was recruited using three primary approaches. First,
snowballing was used, including promoting the study through existing networks and mailing lists (including large databases of adults who had previously consented to be involved in health research across the UK), print and digital media coverage, and social media. Second, more targeted recruitment was undertaken focusing on (i) individuals from a low-income background, (ii) individuals with no or few educational qualifications, and (iii) individuals who were unemployed. Third, the study was promoted via partnerships with third sector organisations to vulnerable groups, including adults with pre-existing mental illness, older adults, and carers. The study was approved by the UCL Research Ethics Committee [12467/005] and all participants gave informed consent. In this study, we focused on participants who had at least three repeated measures between 21st March and 03 May 2020. This provided us with data from 39,601 participants. Of these, 10% participants withheld data on socio-demographic factors including gender and income so were excluded, providing a final analytic sample size of 35,712.

Patient and Public Involvement

The research questions in the UCL COVID-19 Social Study built on patient and public involvement as part of the UKRI MARCH Mental Health Research Network, which focuses on social, cultural and community engagement and mental health. This highlighted priority research questions and measures for this study. Patients and the public were additionally involved in the recruitment of participants to the study and are actively involved in plans for the dissemination of findings from the study.

Measures

Loneliness was measured using the three-item UCLA loneliness scale (UCLA-3). The questions include: 1) how often do you feel lack companionship? 2) how often do you feel isolated from others? 3) how often do you feel left out? Responses to each question were scored on a three-point Likert scale ranging from hardly ever/never, to some of the time, to
often. Using the sum score, this provided a loneliness scale ranging from 3 to 9, with a higher score indicating increased loneliness.

Covariates included age groups (18-29, 30-45, 46-59 and 60+), gender (woman vs. man), ethnicity (non-white vs. white), education (low: GCSE or below, medium: A levels or equivalent, high: degree or above), low income (household annual income <£30,000 vs. higher household annual income), employment status (employed, unemployed, student and inactive other), and area of living (rural vs. urban). Given living status (alone vs with others) is highly correlated with marital status, meaning that only one of these factors could be included within the model to avoid multicollinearity, we included living status as it is a clearer indicator of social interactions in the home.

We also assessed social relationship measures, including having large friend network (number of close friends >=3), high usual social contact (at least weekly face-to-face contact)
and high perceived social support (measured using the brief form of the perceived social support (F-SozU K-6) scale [19]. Each item of F-SozU K-6 is rated on a 5-point scale from “not true at all” to “very true”, with higher scores indicating higher levels of perceived social support. Minor adaptations were made to the language in the scale to make it relevant to experiences during COVID-19 (see Supplementary Table S1 for a comparison of changes). In addition, we also examined mental illness as a predictor of loneliness trajectories, through participant report of clinical diagnoses of depression, anxiety, or other psychiatric conditions (yes/no).

Analysis

To identify growth trajectories of loneliness and their predictors, we used the growth mixture modelling (GMM) approach. The conventional growth modelling approach assumes one homogeneous growth trajectory, allowing individual growth factors to vary randomly around the overall mean. GMM, on the other hand, relaxes this assumption and enables researchers to explore distinctive latent growth trajectory classes. In this sense, it is similar to the group-based trajectory modelling, but GMM allows individual trajectories to vary within latent classes. For detailed explanation of GMM, refer to [20].

The model specification in this study is presented in Figure 1. The six repeated measures of loneliness were used as the indicators of the latent growth factors, the intercept and slope, which were influenced by the latent growth trajectory class. In this model, we made no assumption about the shape of growth trajectories which was left to be determined by the data. This was achieved by setting the time scores as free parameters (*), except for two fixed to 0 and 1 for the model to be identified. Moreover, the residuals of adjacent loneliness measures were specified to be correlated to capture the possibility of unknown shared causes of the covariance between repeated measures.

Starting with the unconditional GMM, we compared models with different number of classes on the basis of Bayesian criteria, Bayesian information criterion (BIC) and sample-size
adjusted Bayesian information criterion (ABIC), along with Vuong-Lo-Mendell-Rubin likelihood ratio (LMR-LR) test and Adjusted Lo-Mendell-Rubin likelihood ratio (ALMR-LR) test. After finding the optimal number of classes, we also tested other growth functions, such as linear and quadratic growth models. Finally, we introduced covariates to explain the observed heterogeneity between classes.

Weights were applied throughout the analyses. All data were weighted to the proportions of gender, age, ethnicity, education and country of living obtained from the Office for National Statistics [21]. The descriptive and regression analyses were implemented in Stata v15 (StataCorps, Texas) and GMM in Mplus Version 8 [22].

Results

Trajectories of loneliness during lockdown

The first step was to determine the optimal number of latent trajectory classes. The model fit indices of models under comparison are presented in Table 1. Across models with different number of classes, the 4-class model had the lowest BIC and ABIC. In addition, the LMR-LR and ALMR-LR tests in the 5-class model both had a P-value>0.05, confirming that the 4-class model was favoured. After identifying the number of classes, we explored alternative model specifications of the shape of growth trajectories. As shown in the lower panel of Table 1, both the 4-class linear and quadratic growth models had a higher BIC and ABIC compared with the 4-class model with free time scores, which, therefore, was taken as the optimal model.
Table 1 Model fit indices for different model specifications

| Model specification               | Parameters | BIC   | ABIC  | LMR-LR | ALMR-LR | Entropy |
|-----------------------------------|------------|-------|-------|--------|---------|---------|
| 1-class GMM (free time score)     | 20         | 50275 | 50269 | NA     | NA      | NA      |
| 2-class GMM (free time score)     | 23         | 49552 | 49545 | <0.001 | 0.001   | 0.773   |
| 3-class GMM (free time score)     | 26         | 48387 | 48379 | <0.001 | <0.001  | 0.914   |
| 4-class GMM (free time score)     | **29**     | 48031 | 48022 | **<0.001** | **<0.001** | **0.877** |
| 5-class GMM (free time score)     | 32         | 48113 | 48102 | 0.098  | 0.107   | 0.885   |
| 4-class GMM (linear)              | 25         | 48542 | 48534 | NA     | NA      | 0.892   |
| 4-class GMM (quadratic)           | 32         | 48515 | 48505 | NA     | NA      | 0.867   |
The estimated growth trajectory for each class is shown in Fig 2. Generally speaking, loneliness was stable over the first six weeks of lockdown. However, for the class with the highest initial status (LC4 the loneliest, 14.4%), there was a nearly one point increase in the estimated mean of loneliness from the third to the fifth week. This was followed by a decrease in week 6. Changes in loneliness across time were also observed in the lowest loneliness class (LC1, 48.6%), with levels decreasing between week 3 and 5 and then rebounding in week 6.

Protective factors for experiences of loneliness during lockdown

Table 2 presents the results from the GMM with covariates. Using LC1 (lowest loneliness) as the reference, the odds of being in a higher loneliness class were higher in a dose-response pattern with age. Adults aged 18-29 had a 6.8 times higher odds of being in the highest-risk class compared to adults aged 60+, while adults aged 30-45 had a 4.1 times higher odds and adults aged 46-59 had a 2.2 times higher odds. Women had a higher odds of being in a higher loneliness class, with a 59% higher odds of being in the loneliest class. Ethnicity was not a risk factor for being more lonely, and nor was education. Low household income did not
predict membership of the LC2 class (medium-low loneliness) but did predict membership of higher loneliness classes, with people earning less than £30,000 per year having a 31% higher odds of being in the highest loneliness class. Relative to people who were employed, being unemployed was not a risk factor for being lonely, but students and people who were inactive (e.g. home makers or people who were retired) had 2.1 and 1.3 times the odds of being in the highest loneliness class respectively. Mental health was a significant predictor of higher loneliness, with people with a diagnosed mental health condition having a 5.4 times higher odds of being in the highest loneliness class.

In looking at which social factors might be protective, living with others was protective against loneliness, with a 76% lower odds of being in the highest risk class compared to people living alone. Living in a rural area was also protective, with a 23% lower odds of being in the highest loneliness class. People with a larger circle of close friends had a 62% lower odds of being in the highest loneliness class, while people with low perceived social support had a 90% lower odds of being in the highest loneliness class.

However, when looking at interactions, there was no evidence that any social factors moderated the relationship between mental illness and loneliness (see Supplementary Table S3).
Table 2 Estimated odds ratios, standard errors, p values of the predictors of latent growth trajectory classes (N=53,712)

| Variables                  | Med-low (vs. lowest) | Med-high (vs. lowest) | Highest (vs. lowest) |
|----------------------------|----------------------|-----------------------|----------------------|
|                            | OR       | SE    | P     | OR       | SE    | P     | OR       | SE    | P     |
| Age 18-29                  | 3.07     | 0.54  | 0.000 | 3.51     | 0.51  | 0.000 | 6.81     | 1.19  | 0.000 |
| 30-45                      | 1.78     | 0.22  | 0.000 | 2.52     | 0.23  | 0.000 | 4.10     | 0.50  | 0.000 |
| 46-59                      | 1.25     | 0.13  | 0.044 | 1.68     | 0.14  | 0.000 | 2.17     | 0.23  | 0.000 |
| 60+                        | Ref.     | Ref.  | Ref.  | Ref.     | Ref.  | Ref.  | Ref.     | Ref.  | Ref.  |
| Gender Women (Ref. men)    | 1.31     | 0.11  | 0.005 | 1.43     | 0.09  | 0.000 | 1.59     | 0.13  | 0.000 |
| Ethnicity Non-white (Ref. white) | 1.38    | 0.25  | 0.127 | 1.07     | 0.13  | 0.614 | 1.03     | 0.17  | 0.850 |
| Education GCSE or below    | Ref.     | Ref.  | Ref.  | Ref.     | Ref.  | Ref.  | Ref.     | Ref.  | Ref.  |
| A-levels or equivalent     | 1.07     | 0.12  | 0.556 | 1.09     | 0.09  | 0.295 | 1.13     | 0.11  | 0.234 |
| Degree or above            | 1.04     | 0.12  | 0.710 | 1.00     | 0.08  | 0.966 | 0.90     | 0.09  | 0.257 |
| Household income Low (<30k) (Ref. high) | 1.00    | 0.10  | 0.974 | 1.19     | 0.08  | 0.019 | 1.30     | 0.11  | 0.006 |
| Employment status Employed | Ref.     | Ref.  | Ref.  | Ref.     | Ref.  | Ref.  | Ref.     | Ref.  | Ref.  |
| Unemployed                 | 1.28     | 0.33  | 0.392 | 1.39     | 0.33  | 0.229 | 1.74     | 0.43  | 0.082 |
| Student                    | 1.42     | 0.37  | 0.258 | 1.49     | 0.28  | 0.080 | 2.04     | 0.44  | 0.018 |
| Inactive other             | 0.99     | 0.10  | 0.930 | 0.94     | 0.07  | 0.436 | 1.30     | 0.13  | 0.016 |
| Mental health Diagnosed condition | 2.07    | 0.23  | 0.000 | 3.18     | 0.26  | 0.000 | 5.32     | 0.52  | 0.000 |
| Living status Living with others (Ref. alone) | 0.45     | 0.04  | 0.000 | 0.42     | 0.03  | 0.000 | 0.24     | 0.02  | 0.000 |
| Area of living Rural (Ref. urban) | 0.99    | 0.09  | 0.930 | 0.86     | 0.05  | 0.010 | 0.77     | 0.07  | 0.001 |
| Number of close friends Large (>=3) (Ref. small) | 1.02     | 0.09  | 0.852 | 0.87     | 0.06  | 0.023 | 0.62     | 0.05  | 0.000 |
| Usual face-to-face contact At least weekly (Ref. < weekly) | 0.94     | 0.08  | 0.454 | 1.14     | 0.07  | 0.047 | 1.10     | 0.09  | 0.273 |
| Perceived social support High (sum score >=18) (Ref. low) | 0.49     | 0.05  | 0.000 | 0.25     | 0.02  | 0.000 | 0.10     | 0.01  | 0.000 |
Discussion

This is the first study to examine the growth trajectories and predictors of loneliness during lockdown due to the Covid-19 pandemic. We identified four major classes of loneliness, ranging from low to high. In the first 6 weeks of lockdown, loneliness levels increased in the highest loneliness group and decreased in the lowest loneliness group and stayed relatively constant in the middle two groups, but there was some regression to the mean in the highest and lowest groups into week 6. Demographic factors such as younger age, being female, low household income, and being a student or being inactive in employment were all risk factors for being in a higher loneliness class, as was a diagnosis of a mental health condition. Living with others, living in a rural area, having more close friends, and having greater perceived social support were all protective against higher loneliness levels, even during lockdown when usual face-to-face contact was disrupted. There was only limited evidence that loneliness was higher for people who usually had more face-to-face contact, and this did not predict being in the highest loneliness class. However, there was no evidence that protective social factors moderated the relationship between poor mental health and risk of loneliness.

It is concerning that 14% of participants were in the highest loneliness class, with average loneliness levels of around 8-8.5. Data on national levels of loneliness in the UK outside of COVID-19 suggest that usually only 6.1% of adults experience scores of 8 or 9 on the UCLA-3 loneliness scale [paper under review]. The UCL COVID-19 Social Study did not use a random sample, so we do not claim prevalence figures, but the findings nonetheless suggest that there are a substantial number of people feeling high levels of loneliness. It is also notable that loneliness for this group increased, particularly around week 5 of the lockdown. This period coincided with two weeks following the Easter bank holiday, a traditional moment of national celebration, so may have been a response to being unable to engage in planned social activities. But it is also possible that fatigue relating to lockdown may have exacerbated existing loneliness symptoms. For the lowest loneliness class, these findings were the opposite, with a gradual decrease over the first month of lockdown, with lowest levels recorded in week 5. Whether the indications of return to levels prior to the week-5 change since in the highest and lowest loneliness class is a result of any change in announcements around the easing of lockdown or simply a regression to the mean remains to be explored in future analyses.
Nevertheless, it is striking that there are no marked changes over time, and that loneliness levels appear to have been established early in the lockdown period.

The findings on women and young people being highest risk for loneliness echoes previous research on risk factors both during the pandemic [16], and ordinarily [17]. Young people may engage in more gregarious social activity in normal life, so suffer more during isolation. Similarly, our finding that people with a diagnosed mental illness had a higher odds of being more lonely aligns with research showing a bidirectional link between loneliness and mental health [23]. A number of social factors, though, were identified as resilience factors that protected against loneliness, including living with others, living in a rural location, having 3 or more close friends, and having high perceived social support. This echoes previous research suggesting a relationship between social network size and social support and lower risk of loneliness [24–27]. It is notable that usually having frequent face-to-face contact was not a risk factor for higher loneliness during lockdown, which suggests that experiencing a sudden change in social behaviours does not in itself predict loneliness.

It is important to consider how to tackle loneliness during the COVID-19 pandemic. The results presented here highlight the importance of targeting younger adults, especially those aged 18-29 and students. There have been calls for the promotion of digital technologies to bridge social distance, as well as the development of outreach and screening for loneliness alongside associated mental health conditions so that social support can be provided [28]. Our results suggest that these may be supportive given the finding that perceived social support is protective against loneliness. However, it is notable that none of the protective social factors moderated the relationship between mental illness and loneliness. Previous work has suggested that social factors can mediate the relationship between loneliness and depression [29], and much research has shown the relationship between social factors, loneliness and trajectories of depression [30]. But less work has been done looking at how mental health and social factors interact to predict trajectories of loneliness. Some previous research has suggested that factors such as social support do not consistently buffer the relationship between loneliness and stress [27], with context playing a key role. This raises the question as to whether the social situation during COVID-19 provides a unique context for understanding
the interplay between loneliness and mental health. The pandemic has disrupted usual social behaviours and is posing a major challenge for mental health. As such, having more friends may be protective against loneliness to a certain extent amongst individuals without diagnosed mental health conditions, but may be insufficient in the face of higher levels of anxiety or depression. Indeed, it is notable that loneliness during COVID-19 has been associated with poorer mental health and greater worries around the health impact of the virus [31,32], suggesting that there may be an exacerbation of worries amongst those who are lonely. Therefore, strategies to address loneliness in people with mental illness may require greater nuance than merely providing extra social support. Schemes that have previously been used to address loneliness in individuals with mental illness, such as social prescribing schemes that combine social activities with clinical support, may be promising avenues to pursue. Further, addressing loneliness may be an important target in reducing symptoms of anxiety and depression in individuals with mental illness (22).

A main limitation of this study is that the UCL Covid-19 Social Study did not use a random sample, and therefore our reported statistics cannot be taken as accurate prevalence for loneliness in the UK. The study does have a large sample size with wide heterogeneity, including good stratification across all major socio-demographic groups, and analyses were weighted on the basis of population estimates of core demographics, with the weighted data showing good alignment with national population statistics and another large scale nationally representative social survey. But we cannot rule out the possibility that the study inadvertently attracted individuals experiencing more extreme psychological experiences, with subsequent weighting for demographic factors failing to fully compensate for these differences. Further, these analyses focused on trajectories during lockdown, but how this compares to individuals’ usual experiences of loneliness remains to be explored in future studies.

Overall, these findings suggest that perceived levels of loneliness in the first few weeks of lockdown during COVID-19 were relatively stable in the UK, but for many people these levels were high with no signs of improvement. People with pre-existing mental health diagnoses, younger adults and women were at greatest risk of experiencing high levels of loneliness, but certain social factors such as living with others, having
close friends, and having strong perceived social support were protective. Our results suggest that more interventions and guidelines are needed to help reduce loneliness, especially amongst young people.

Declarations

Ethics approval and consent to participate

Ethical approval for the COVID-19 Social Study was granted by the UCL Ethics Committee. All participants provided fully informed consent. The study is GDPR compliant.

Transparency statement

DF affirms that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as originally planned have been explained.

Availability of data and materials

Anonymous data will be made available following the end of the pandemic.

Competing interests

All authors declare no conflicts of interest.

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by the investigators and were unrestricted. All authors had full access to all of the data (including statistical reports and tables) in the study and can take responsibility for the integrity of the data and the accuracy of the data analysis.

Authors’ contributions

FB, AS and DF conceived and designed the study. FB analysed the data and FB and DF wrote the first draft. All authors provided critical revisions. All authors read and approved the submitted manuscript.

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