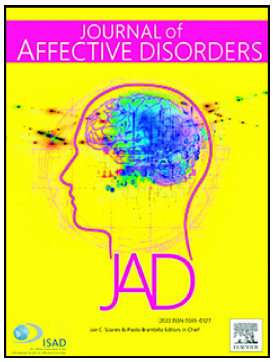

Explaining the pathways through which social capital buffered mental health during the COVID-19 pandemic: A longitudinal analysis

James Laurence

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Explaining the Pathways through which Social Capital Buffered Mental Health during the COVID-19 Pandemic: A Longitudinal Analysis

Authors:

James Laurence [corresponding author]

UCL Social Research Institute, University College London, London, UK

Email: j.laurence@ucl.ac.uk

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The data used in this study are from the COVID-19 Psychological Research Consortium Study (2020-22) and are publicly available: https://osf.io/v2zur/files/osfstorage.

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The research received funding from the Economic and Social Research Council. Informed consent to (a) participate in the study and (b) for data to be published was attained by the data providers - COVID-19 Psychological Research Consortium Study - when data was gathered (see User Guide: https://onlinelibrary.wiley.com/doi/full/10.1002/mpr.1861). The research was reviewed by the University College London ethics committee (ref.: 1837).

ABSTRACT

BACKGROUND

Research suggests that individuals' local social networks, norms of reciprocity and sense of belonging (their local social capital, henceforth LSC), can cushion the impact of adverse events on their mental health. However, to date, little research has explored the pathways through which LSC operates to buffer stressors, especially during major crises, e.g., the COVID-19 pandemic.

METHODS

This study draws on three waves of nationally representative UK panel data, conducted over the first year of the pandemic. It examines whether LSC buffered (moderated) trends in depression symptomology, and what social-resources (e.g., social support, sociability) and psychological-resources (e.g., resilience, loneliness) can explain any LSC stress-buffering role. Pooled cross-sectional, path analysis, and fixed effects longitudinal approaches are taken.

RESULTS

Individuals with higher LSC experienced more positive trajectories in mental health (fewer depressive symptoms) over the pandemic. Longitudinal analysis demonstrates two key pathways help explain these more positive trends in mental health. Greater psychological resilience and less loneliness are associated with lower depression, and individuals with higher LSC became increasingly more resilient and less lonely over the pandemic. In addition, higher LSC is associated with greater resilience, and individuals with higher resilience experienced more positive pandemic trends in mental health (a stress-buffering role of resilience).

LIMITATIONS

Results are sensitive to time variant unobserved heterogeneity bias and reverse causality bias.

CONCLUSIONS

These findings provide novel insights into the mechanisms explaining how LSC cushions mental health during major crises, broadening our understanding of the stress-buffering pathways of social networks in general.

1. INTRODUCTION

Extensive research documents the negative impact the COVID-19 pandemic had on mental distress globally (Nochaiwong et al., 2021; Prati & Mancini, 2021), even though a small minority of individuals saw distress decline (Prati & Mancini, 2024). While worsening mental health appeared evident among all social groups (Nochaiwong et al., 2021), differences in the depth of harm across groups raises key questions about what drove such heterogeneity (Prati & Mancini, 2021), leading to growing interest in the factors that buffered the pandemic's impact on mental distress, i.e., 'stress-buffering' characteristics (Ben-Zur & Michael, 2020; Cohen & Wills, 1985; Johnston et al., 2021; Laurence et al., 2024). One potentially key stress-buffering factor may have been neighbourhood social capital. Social capital constitutes 'social networks (a structural component), and norms of reciprocity and trust that arise from them (a cognitive component)' (Putnam, 2000). In relation to people's neighbourhoods, this comprises social ties between neighbours and norms of reciprocity, trust and belonging among them i.e., local social capital (henceforth, LSC) (Forrest & Kearns, 2001; Putnam, 2000). Research demonstrates how LSC can cushion mental health from adverse life events, such as bereavement or pecuniary shocks, but also from major crises, such as natural disasters or epidemics (Aldrich & Meyer, 2014; Aldrich & Sawada, 2015; Alonge et al., 2019; Fone et al., 2014; Kawachi & Berkman, 2000; Nakagomi et al., 2020; Noel et al., 2018; Wind & Komproe, 2012).

Studies have begun demonstrating a potential buffering role of LSC during the COVID-19 pandemic. Cross-sectional studies show people with more neighbour-contact or -support experienced a weaker positive association between pandemic-stressors and mental distress (Chen et al., 2021; Laurence & Kim, 2021). Longitudinal studies have demonstrated how

people with higher *pre-pandemic* LSC experienced smaller increases in mental distress with the onset of the pandemic (Han & Chung, 2023; Laurence et al., 2024; Sato et al., 2022; Zangger, 2023), resulting in more positive trajectories in mental health over the pandemic (O'Donnell et al., 2022; Perry et al., 2023). However, despite growing research examining *if* LSC protected individuals, to our knowledge, no research has examined *how* LSC protected mental health during the pandemic; that is, the mechanisms through which LSC might have cushioned mental health. This study addresses this key question.

1.1 Pathways of LSC stress-buffering

Multiple social-resource and psychological-resource pathways are proposed to account for the stress-buffering role of LSC. One social-resource pathway is that LSC acts a source of social support (instrumental/emotional/informational), providing aid to individuals during adversity, protecting their mental health (Cohen & Wills, 1985; Larnyo et al., 2024). Research on natural disasters in particular shows that local networks, involving norms of trust/reciprocity, protect individuals through providing "information, aid, financial resources, and child care along with emotional and psychological support" (Aldrich & Meyer, 2014, p.256; Aldrich & Sawada, 2015; Alonge et al., 2019; Noel et al., 2018; Wind & Komproe, 2012). Neighbourhood networks may have become particularly important for support during the COVID-19 pandemic, given restrictions on spatial mobility cut people off from accessing wider support networks (Den Broeder et al., 2022; Laurence & Kim, 2021). People with higher LSC are also more likely to *provide*, not just receive, social support (Dederichs, 2023), and providing support can also buffer mental health by fostering social contact, structuring time, and a sense of purpose and identity (Bowe et al., 2022; Wang et al., 2022).

Another pathway through which LSC may have cushioned mental health is via reducing loneliness. Both network dimensions of LSC and cognitive dimensions (e.g., neighbourhood belonging) are linked with less loneliness (Bello et al., 2024; Nyqvist et al., 2016). Where pandemic ordinances restricted wider social mixing, LSC may have offset the loss of social connectivity, acting as a compensatory source of social contact, reducing loneliness and protecting mental health (O'Donnell et al., 2022).

LSC may have also cushioned mental health through psychological-resources, especially psychological resilience (Li et al., 2021). Psychological resilience broadly constitutes a personal resource enabling individuals' to cope with, and adapt to, adversity, reducing the harm of stressors and supporting quicker recoveries (Southwick et al., 2014). LSC is believed to cultivate psychological resilience partly from social support that stems from LSC, which fosters resilience through greater access to coping resources (Gaffey et al., 2016; Zhang et al., 2023). LSC may also foster psychological resilience through a sense of purpose in life and a shared identity among neighbours, which are, in turn, linked to greater resilience (Li et al., 2021; Li et al., 2023; Visaria et al., 2023). Research indeed suggests pandemic-stressors had a weaker association with mental health among resilient individuals (Na et al., 2022; Verdolini et al., 2021).

LSC is also linked to other potential stress-buffering psychological resources, such as perceived control over one's life. While perceived control is often considered an aspect of personality (e.g., Judge et al., 2002), research shows how neighbourhoods with more LSC cultivate a more internalised locus of control (Ahlin, 2014). Internalised loci of control may, in turn, have buffered pandemic-stressors by supporting coping strategies to better adapt (Krampe et al., 2021).

1.2 Current study

This study explores whether individuals' LSC (norms/networks among neighbours) buffered the pandemic's impact on their mental wellbeing during periods of national lockdown. In particular, whether higher LSC is linked with more positive trajectories in mental wellbeing between the first and third UK lockdowns, and if so, what social-/psychological-pathways might account for any differences in trends. To examine these aims, the analysis draws on three waves of UK panel data (two waves conducted during the first lockdown and one wave conducted one year later during the third lockdown).

Based on the literature outlined, we formulate key research questions. Firstly (RQ1), did individuals with higher LSC *during* the pandemic report better trajectories in mental wellbeing (lower depression symptomology scores) over the first year of the pandemic? Secondly (RQ2), what social (support, volunteering, and meeting/interacting with people) and psychological (resilience, loneliness, and locus of control) pathways link LSC to mental distress during the pandemic? Thirdly (RQ3), which pathways linking LSC to mental distress (identified in RQ2) can explain any longitudinal stress-buffering role of LSC for pandemic-trajectories in mental distress (identified in RQ1)?

2. DATA AND METHODOLOGY

2.1 Data

The analysis uses data from the UK COVID-19 Psychological Research Consortium (C19PRC-UK) study (Hyland et al., 2021). The C19PRC is a nationally-representative, longitudinal dataset of UK adults (McBride et al., 2021a). Stratified-quota sampling was used to achieve national representativeness (based on age, sex and household income) from opt-in academic/market research internet panels (n=2,025 wave 1 sample). Surveys were completed online. The mean age of the sample was 45.44 years (*SD* = 15.90), 51.7 per cent were female, and 85.5 per cent were White British.

Analyses are primarily conducted on three waves of data in which LSC was measured: wave 1 (23-28 March 2020), wave 2 (22 April-1 May 2020) and wave 5 (24 March-20 April 2021). Top-up samples to correct for sample loss were added between waves 2-4 (n=1145). Attrition occurred across waves. 70 per cent of wave 1 respondents participated in wave 2 (a loss of n=619). Testing showed that being younger, female, non-religious, in rental accommodation, being employed, living alone, and living in a household with children at wave 1 predicted ($p<.05$) non-participation in wave 2[1]. 68 per cent of wave 2 respondents participated in wave 5 (a loss of n=458). Being younger, non-religious and in rental accommodation at wave 2 predicted ($p<.05$) non-participation in wave 5[2]. However, n=214 individuals from wave 1,

[1] Logistic regression using key demographics (see covariates section) to predict wave 1-wave 2 attrition.

[2] Logistic regression using key demographics (see covariates section) to predict wave 2-wave 5 attrition.

who did not participate in wave 2, did participate in wave 5, leading to a 57 per cent response rate of wave 1 respondents in wave 5. Interestingly, neither mental distress nor LSC predicted attrition. Among the booster sample added between waves 2 and 4 (n=1145), n=505 were present in wave 5 (response rate of 44 per cent). Where the panel data are analysed as cross-sections (see analytic plan below), cross-sectional weights[3] are applied to correct for non-response and booster samples. Where the data are analysed longitudinally, longitudinal weights are applied to correct for non-response[4].

We undertook additional approaches to address missingness. To address cases where individuals participated in a survey but had missing data on key variables, we applied multiple imputation (MI) using chained equations (10 datasets). The main reported results therefore use MI to address within-case missing information and weights to adjust estimates for complete-case missingness from attrition. However, we also tested imputing data for all missing data (within-/complete-case) and undertook a listwise deletion of cases with any missingness to examine consistency across approaches (see footnotes and supplementary-analysis in the results). The findings are highly similar.

[3] Survey raking algorithms were applied to generate weights to correct the sample in each wave to be representative of the initial wave 1 quota-sample based on proportions for gender, age, household income, household composition and urbanicity, ethnicity, and born in the UK (see McBride et al., 2021).

[4] Inverse probability weights are available which correct the longitudinal sample to be representative of the initial wave 1 sample based on proportions for gender, age, household income, household composition and urbanicity, ethnicity, and born in the UK.

The waves of data studied coincide with periods in which the UK was under lockdown. Wave 1 was conducted in the first week of the first full UK lockdown. Wave 2 was conducted one month later, when the full lockdown was still in place. Wave 5 was conducted around one year after wave 1 (24 March-20 April 2021), during the third UK lockdown, which began on 4 January 2021. However, by 29 March, schools had reopened and outdoor gatherings of two households were allowed, and by 12 April, outdoor venues (e.g., pub gardens) were reopened, although wider restrictions on social contact remained e.g., no indoor mixing.

2.2 Measures

2.2.1 Mental distress

Mental distress is captured by depression symptomology scores using the Patient Health Questionnaire-9 (PHQ-9) (Kroenke et al., 2001). Respondents were asked how frequently (4-category Likert scale of 'not at all' to 'nearly every day'), over the last two weeks, they experienced nine depressive symptoms, such as 'feeling down, depressed, or hopeless' (*see* Supplementary-Appendix A.1 for full details). Scores are summed to create a total depression symptomology score (range 0-27).

2.2.2 Local social capital

The data contain three items which capture LSC. Respondents were asked 'How strongly do you feel you belong to your immediate neighbourhood?' (4-point Likert scale of 'Not at all' to 'Very strongly'), capturing dimensions of cognitive LSC. This variable features frequently in measures of LSC (Aminzadeh et al., 2013; Li et al., 2005; Saville, 2021). Respondents were also asked two questions capturing structural dimensions, drawn from the UK Community Life survey (McBride et al., 2021b): 'How comfortable would you be with the following?': (a) 'Asking a neighbour to keep a set of keys to your home for emergencies'; and (b) 'Asking a neighbour to collect a few shopping essentials for you, if you were ill and at home on your own' (4-point Likert scale of 'Very uncomfortable' to 'Very comfortable'). These measures directly capture the local networks of reciprocity component of LSC (Forrest & Kearns, 2001; Putnam, 2000). Factor analysis (Promax rotation) demonstrates these measures load on to a single index of LSC (Minimum factor loading: .56; Eigen value: 1.68; Alpha coefficient: .8) (see Supplementary-Appendix A.2). The concept and measure of LSC applied here overlap with broader concepts of neighbourhood cohesion (O'Donnell et al., 2022; Perry et al., 2023). However, we draw on the concept of social capital in line with pandemic studies in this area (Chen et al., 2021; Han & Chung, 2023; Laurence & Kim, 2021; Laurence et al., 2024; O'Donnell et al., 2022; Sato et al., 2022; Zangger, 2023).

2.2.3 Mechanisms

We explore a range of social/psychological pathways through which LSC might cushion depression symptomology (*see* Supplementary-Appendix A.3 for full details). To capture social-resource pathways, we measure social support: 8-item Modified Medical Outcome

Social Support Survey (mMOS-SSS) (Moser et al., 2012). We also capture other elements of respondents' social-resources: number of volunteering activities undertaken; frequency of sociability (such as meeting friends/family, meeting groups in public spaces, providing in-person assistance); and number of face-to-face interactions. A range of scales, validated for use in general populations, are applied to capture psychological-resources. To measure psychological resilience we apply the 6-item Brief Resilience Scale (BRS) (Smith et al., 2008). Loneliness is measured using the 3-item short loneliness scale (Hughes et al., 2004). Lastly, we measure two dimensions of locus of control: the 'internal' subscale and the 'chance' subscale (Sapp & Harrod, 1993).

2.2.4 Covariates

Models adjust for multiple time-varying controls, including whether individuals had COVID-19, whether they experienced self-isolating, if they are employed, whether they live alone, whether they have children <18 in the household, their housing tenure, whether they live in a more urban/rural area, and their country of residence. At the community (Local Authority) level, models adjust for population density (people per km-squared in 2019) and COVID-19 case rate per 1,000 people, and Local Authority fixed effects. Models in which the data are treated as pooled cross-sections also adjust for time-invariant characteristics, including gender, ethnicity, religion and highest-qualification. Time-invariant controls drop out of the fixed effects modelling. See Supplementary-Appendix:A.4 for descriptives.

2.3 Analytic approach and plan

The analysis comprises three stages. The first stage examines whether there is evidence that LSC buffered depression symptomology during the pandemic by comparing trends in depression scores among individuals with higher/lower LSC over three waves of the data (waves 1, 2 and 5). Survey-period*LSC interaction terms formally test whether trends in depression symptomology are significantly different across individuals' LSC. We take two modelling approaches. The first approach treats each wave of data (1, 2 and 5) as a cross-section of the population, which are pooled and modelled together (Wooldridge, 2010). However, given observations are clustered within individuals, we correct standard errors for the clustering of residuals via linear multilevel random effects regression models with observations nested within respondents with robust standard errors. This approach provides a baseline estimate of levels of mental distress over time among individuals with higher/lower LSC. However, such estimates may be biased by unobserved time invariant heterogeneity. Accordingly, the second approach applies linear individual fixed-effects models with robust standard errors, focusing on within-person change over time. Comparing results across approaches helps explore whether time-invariant endogeneity may bias analyses of the stress-buffering role of LSC in pandemic studies more generally.

The second and third stages examine what mechanisms explain any buffering-effect of LSC. Stage two looks at what social/psychological pathways mediate any overall association between LSC and depressive symptomology during the pandemic. This analysis is based on waves 1, 2 and 5, where LSC is measured at wave 1, pathways are measured at wave 2, and depression symptomology is measured at wave 5 (although data for some mediators are

imputed using data from waves 1 and 3[5]). This allows us to arrange variables in the temporal order they are posited to operate: LSC (at t_1) predicting pathways (at t_2) predicting mental distress (at t_5). To test the role of multiple indirect pathways, path analysis models are applied within a generalized structural equation modelling (GSEM) framework to estimate models simultaneously and combine estimation-results to test formal significance of indirect pathways. We use the bootstrap method to estimate the strength/significance of indirect associations with bias-corrected (BC) confidence intervals, based on 5,000 bootstrap samples (Preacher & Hayes, 2008).

Stage three returns to examining the data longitudinally to look at whether key pathways identified in stage two – particularly loneliness and psychological resilience – can explain any differences in the depression symptomology trajectories among individuals with higher/lower LSC identified in stage one. This analysis focuses on two waves of data – waves 1 and 5 – given the availability of measures across waves. Table 1 summarises the analytic plan and how it connects to our research questions.

[Table 1 about here]

3. RESULTS

[5] Neither resilience nor social support were measured in wave 2. Therefore, we impute resilience at wave 2 (22 April-1 May 2020) using resilience values measured at wave 1 (23-28 March 2020). We impute social support at wave 2 using social support values measured at wave 3 (9–23 July 2020). To test whether such imputations might bias findings, we replicated all models but measuring mental health at waves 4 or 5. Substantively identical findings were returned.

3.1 Trends in depression symptomology and the stress-buffering role of LSC

The first analytic stage explores whether LSC buffered people's trajectories in depression symptomology over the pandemic, using three waves of data. Models 1 to 3 (Table 2) report the results of linear regressions, treating the panel data as pooled cross-sections. All models contain full controls although not reported (*see* Supplementary-Appendix A.5 for results). Model 1 demonstrates how depression increased from the start of the pandemic (March 2020) to one month later (April 2020) during the first UK lockdown. Depression scores were then around the same level one year later, in March-April 2021, during the third lockdown.

[Table 2 about here]

Model 2 includes the index of LSC, demonstrating that, during the pandemic, people reporting higher LSC reported lower depression symptomology. Model 3 then tests whether trends in depression over the pandemic differed significantly between those with higher/lower LSC by including interaction terms between each survey-period and LSC. Firstly, both interaction terms are significant and negative, and secondly, the interaction term between the March-April 2021 survey-period and LSC is over twice as strong as the interaction term between the April 2020 period and LSC.

To understand the implications of these results, Figure 1 plots trends in predicted depression scores (based on Model 3, Table 2) across the three waves of data, subdivided by whether individuals had low (10^{th} percentile) or high (90^{th} percentile) LSC. Across the first month of the UK lockdown (March to April 2020) individuals with lower LSC saw their depression

scores increase (+1 point), while scores among those with higher LSC remained stable (-0.02 points). One year later, during the third lockdown (March/April 2021), depression among those with lower LSC had further increased (+0.5 points) while depression among those with higher LSC had decreased (-0.5 points). LSC therefore appeared to buffer depression, resulting in less negative trajectories in depression symptomology, leading the gap in depression scores between individuals in the 10th and 90th percentiles of LSC to nearly triple in size.

[Figure 1 about here]

LSC could be acting as a proxy for other broadly stable characteristics (e.g. personality traits). To address this, Models 4-6 (Table 2) replicate the previous analysis (Models 1-3) but include individual-level fixed effects to examine within-person change over time. The results are highly similar. Overall, depression increases over the pandemic (Model 4). Increases in LSC are associated with decreases in depression (Model 5) and the survey-period*LSC interaction terms are significant and negative (although somewhat weaker and less significant) (Model 6). The only substantive difference is that in the pooled cross-sectional approach, LSC had a significant, negative association with depression in every wave. Under the fixed effect approach, LSC is negatively but not significantly associated with depression in wave 1 (March 2020): the marginal effect of LSC is -0.15 n/s (Model 6). However, the negative association gets stronger and becomes significant in April 2020 (marginal effect: -0.47*) and increases further by March-April 2021 (marginal effect: -0.81***)[6].

[6] See Supplementary-Appendix:A.6-A.7 for results based on full multiple imputation and listwise deletion of missing cases.

Additional testing shows that the survey-period*LSC interaction-terms remain significant even after including interaction terms between survey-periods and all other socio-demographic characteristics in the model (results available on request due to the number of models). Key results also remain robust to different modelling approaches[7]. We also explored whether LSC at t_{-1} predicted depression at t_0 after adjusting for depression at t_{-1} and covariates at t_{-1}, testing both pairs of waves (waves 1 and 2, and waves 2 and 5). While limited in our ability to perform stronger tests for causality, the findings that lagged LSC predicted contemporaneous depression after adjusting for lagged depression and covariates provide some evidence that the LSC/depression relationship is not solely one of reverse causality (see Supplementary-Appendix A.9).

3.2 Local social capital and pathways of stress-buffering

3.2.1 Path analysis of multiple stress-buffering pathways

The second analytic stage explores what pathways explain the observed LSC stress-buffering role. We first examine what pathways link higher LSC to lower depression during the pandemic. This analysis takes a path analysis approach, using LSC (wave 1, March 2020), pathway variables (primarily measured at wave 2, April 2020) and depression symptomology (wave 5, March-April 2021). Table 3 reports path analysis results (linear regressions within a

[7] We also tested (a) Poisson and negative binomial models (treating PHQ-9 scores as discrete non-negative integers); (b) using a binary measure of minimal/mild depression (scores 0-9) versus moderate/severe (scores 10+); and (c) logging the PHQ-9 score. The results are highly similar (Supplementary-Appendix:A.8).

GSEM framework), testing the strength/significance of the indirect pathways linking LSC and depression (see Supplementary-Appendix:A.10a-A.10b for full model results).

[Table 3 about here]

Model 1 tests the social-resource pathways. Part of why LSC is linked with lower depression during the pandemic is because individuals with more LSC are more likely to have volunteered and have higher social support. People with higher LSC were somewhat more likely to interact with people during the pandemic but this pathway is not significantly linked to depression scores. Social pathways, however, only account for a small proportion (12 per cent) of the negative overall LSC/depression association.

Model 2 tests the psychological-resource pathways alongside social-resources. LSC is linked to lower depression via higher psychological resilience and less loneliness, but not locus of control. In addition, the indirect association between LSC and depression via social support and volunteering are no longer significant, suggesting these pathways come through their association with resilience and loneliness. Overall, psychological pathways account for a larger share of the overall LSC/depression association (46 per cent).

3.2.2 Longitudinal analysis of the LSC stress-buffering pathways of psychological resilience and loneliness

The previous analysis demonstrates that resilience and loneliness are key pathways linking LSC with lower depression during the pandemic. The following section examines how far these pathways explain the more positive pandemic-trajectories in mental wellbeing of those

with higher LSC. To do so, we return to exploring the relationships longitudinally, utilising two waves of the data: wave 1 (March 2020) and wave 5 (March-April 2021). Models 1-5 (Table 4) apply linear regression models, treating the data as pooled cross-sections. Models 6-10 include individual-level fixed effects to examine within-person change over time (see Supplementary-Appendix A.11 for full model)[8].

[Table 4 about here]

Model 1 (Table 4) replicates the previously observed longitudinal stress-buffering role of LSC (observed in Model 4, Table 1). The interaction-term between survey-period (March-April 2021) and LSC is significant and negative, demonstrating healthier trajectories in mental distress among higher LSC individuals. There are two modes by which psychological resilience and loneliness could explain the longitudinal stress-buffering role of LSC. The first mode is that more resilient and/or less lonely people may experience lower depression, and people with higher LSC may have become less lonely and more resilient over time. Model 2 therefore adds psychological resilience and loneliness into the model. Resilience is negatively associated with depression and loneliness is positively associated with depression. In addition, the survey-period*LSC interaction-term is reduced by 42 per cent, although it remains significant. Supplementary modelling confirms that people with higher LSC had higher resilience and reported less loneliness, and that over the first year of the pandemic saw their resilience improve and loneliness decline more than those with lower LSC (see Supplementary-Appendix:A.14).

[8] See Supplementary-Appendix:A.12-A.13 for results based on full multiple imputation of missing cases and listwise deletion of missing cases.

The second mode is that people with higher LSC might be more psychologically resilient or less lonely, and more resilient/less lonely people may experience better trajectories in mental wellbeing over the pandemic. In other words, the stress-buffering role of LSC may be explained by a stress-buffering role of greater resilience/less loneliness. To test this explanation, Model 3 includes an interaction-term between survey-period and resilience, which is significant and negative. In addition, the survey-period*LSC interaction-term is reduced by 58 per cent (comparing Model 3 to Model 1, Table 4) and is no longer significant. Model 4 replicates this test but for loneliness. The interaction-term between survey-period and loneliness is significant and positive, while the survey-period*LSC interaction-term is reduced by 56 per cent but is still significant at the $p<.1$ level. These findings suggest people with higher LSC also had healthier trajectories in mental wellbeing (lower depression-scores) because they were more resilient/less lonely, and more resilient/less lonely people saw less negative trajectories in mental distress over the pandemic. Model 5 includes both sets of interaction-terms between survey-period and loneliness or resilience. However, when modelled together, they are reduced in size and significance, suggesting some shared variance between them.

To test these pathways more robustly, Models 6-10 apply individual-level fixed effects modelling. Model 6 replicates Model 1 showing the trajectory-moderating role of LSC. Model 7 replicates Model 2, demonstrating both resilience and loneliness continue to significantly predict depression. In addition, the survey-period*LSC interaction-term is reduced in size and significance (compared to Model 6). Model 8 replicates Model 3 using fixed-effects modelling. As previously observed, the survey-period*resilience interaction-term is significant and negative, and the survey-period*LSC interaction-term is reduced by an additional 23 per cent and is now non-significant. Model 9 replicates Model 4. However, the

survey-period*loneliness interaction-term is weaker and non-significant. Model 10 replicates Model 5, including both sets of interaction-terms between survey-period and loneliness/resilience. While both interaction-terms are reduced in size and significance, only the survey-period*resilience interaction-term remains significant.

These fixed-effects models therefore suggest two explanations for the longitudinal stress-buffering role of LSC. Firstly, LSC is associated with psychological resilience, resilience increased more over the pandemic among higher LSC individuals, and more resilient people experienced healthier depression trajectories over the pandemic (a stress-buffering role of resilience). Secondly, LSC is linked with lower loneliness, and loneliness decreased more over the pandemic among people with higher LSC. However, even though lonely people had lower depression, they experienced similar trends in depression over the pandemic.

4. DISCUSSION

Prior research shows that LSC (neighbourhood norms/networks) can buffer the negative impact of adversity on mental health. Drawing on this work, this study explored if and how LSC cushioned depression symptomology during the COVID-19 pandemic. Applying pooled cross-sectional and longitudinal fixed-effects modelling, the study finds that people with higher LSC experienced more positive trajectories in mental wellbeing during the pandemic, with the size of the gap in depression scores between those with higher/lower LSC tripling over the first year. One pathway that partially explains this apparent stress-buffering role of LSC is loneliness. People with higher LSC reported less loneliness, which was associated with fewer depressive symptoms, and over the first year of the pandemic they also became increasingly less lonely, accounting for part of why they experienced better trajectories in

mental wellbeing. Potentially, higher LSC provided greater opportunities for interactions to reduce loneliness (Kovacs et al., 2021), and over time, local networks may have become better organised/more active, further reducing loneliness. Where LSC was higher, neighbours may also have better mobilised to support one another, setting up mutual support groups or checking in on neighbours at risk of social isolation (Dederichs, 2023; Zangger, 2023), increasingly reducing loneliness.

The second LSC stress-buffering pathway is differences in psychological resilience. Firstly, people with higher LSC reported more psychological resilience, which was associated with fewer depressive symptoms, and they also became more resilient over the first year of the pandemic, accounting for part of why they experienced less negative trajectories in depression. LSC can foster psychological resilience through greater access to emotional/instrumental social support, increasing people's helping behaviours, and cultivating a greater purpose/shared identity (Li et al., 2021; Li et al., 2023; Na et al., 2022; Visaria et al., 2023; Zhang et al., 2023). Potentially, at the start of the pandemic, the initial pandemic-shock may have limited the capacity of individuals with higher LSC to receive/provide social support. However, over time, as neighbourhood networks became more organised, people with higher LSC may have had more access/opportunities to provide support in their communities, fostering a stronger sense of purpose and shared identity among neighbours, increasing their resilience, supporting mental wellbeing.

Psychological resilience is important because it also appeared to cushion the pandemic's impact on depression symptomology. In other words, higher LSC is associated with greater resilience, and more resilient people also experienced less negative pandemic-trends in depression symptomology by being better able to cope with, and adapt to, adversity i.e., a

stress-buffering role of resilience (Southwick et al., 2014). Loneliness and resilience also appear to account for why social support and volunteering are indirectly linked with depression during the pandemic.

These findings have important theoretical and practical implications. The results provide insights into theories on the stress-buffering role of LSC, especially during large-scale crises. Firstly, the novel application of individual fixed-effects modelling provides stronger evidence that LSC indeed exerted a stress-buffering role, relative to prior work analysing the cushioning role of static, pre-pandemic measures of LSC (Han & Chung, 2023; Laurence et al., 2024; Sato et al., 2022; Zangger, 2023). Secondly, the study advances our understanding of the pathways through which LSC appears to cushion stressors, providing the first evidence that both social-resources (e.g., social support) and psychological-resources (e.g., resilience) explain the better trends in mental wellbeing among higher LSC individuals during the pandemic. These findings also contribute to the broader literature on the protective role LSC can play during crises (e.g., Aldrich & Meyer, 2014; Alonge et al., 2019), Interestingly, psychological resilience not only accounts for the link between social support and lower mental distress during the pandemic, but also accounts for a much larger share of the overall relationship between LSC and mental distress. This may suggest that, even accounting for strong social support networks, norms of reciprocity and belonging among neighbours act as a form of weaker-tie, 'informal insurance' that people feel can provide support, even if they do not need draw on it (Aldrich & Meyer, 2014; Han & Chung, 2023). This perceived support among neighbours "might contribute to people's sense of security, certainty, and control over life, which would further protect people against depressive symptoms", especially during the pandemic (Han & Chung, 2023, p.115). These insights also shed light on the mechanisms

behind the broader literature on the stress-buffering role of social capital during adverse life events (Aminzadeh et al., 2013; Nakagomi et al., 2020; Zeng & Wu, 2022).

The study also has practical implications for crisis-preparedness. The findings further contribute to research suggesting LSC forms a key means of protecting mental health during large-scale crises. The data allows us to examine what groups exhibit lower LSC, including people who are younger, not in work, who live alone, do not own their homes, and live in cities and denser communities[9]. Other research demonstrates how areas with higher social capital also experienced lower infection rates, posited to stem from greater adherence to government mandates (Bartscher et al., 2021). Taken together, fostering LSC, such as investing in communities' social infrastructure, especially among more at-risk groups and communities (Borkowska & Laurence, 2021), could go a long way towards protecting health during major crises. The findings also highlight the importance of psychological resilience during adverse events. Efforts to promote this in societal institutions (such as schools, workplaces and community hubs) could foster additional protection in future crises.

The study has limitations. Despite adjusting estimates for unobserved time-invariant heterogeneity, findings are still at risk of bias from time-variant unobserved heterogeneity. Furthermore, given the measures of LSC, mechanisms, and mental wellbeing are self-reported at the same time-points, estimates are susceptible to endogeneity. For example, it may be that changes in depression scores are driving changes in LSC, or that changes in loneliness/resilience are driving changes in LSC, i.e., reverse causality. While studies suggest these relationships are reciprocal (e.g., Lebenbaum et al., 2021), and lagged testing provides some evidence that LSC does shape depression symptomology, the study is unable to make

[9] Results available on request

stronger causal inferences. Future research, applying more causally robust approaches (e.g., dynamic panel data models) could perform stronger tests. Unfortunately, the number of waves/availability of variables across them in the present data precluded such modelling.

There are also limitations to the structure of the data. Firstly, although the first wave of data was conducted in the first week of the first UK lockdown, the data did not contain a measure of pre-pandemic depression symptomology, preventing tests for any pre- to peri-pandemic LSC stress-buffering, although prior work demonstrates trends in mental health across social capital changed significantly with the onset of the pandemic (e.g., Han & Chung, 2023; Laurence et al., 2024; Sato et al., 2022; Zangger, 2023). This raises the possibility that the different observed trends in mental distress across LSC reflect pre-pandemic differences in trends across LSC, unrelated to the pandemic. However, additional analysis finds evidence that LSC did cushion the impact of the pandemic itself. Testing showed increasing anxiety around the Covid-19 pandemic is positively associated with depression symptomology, but this association is weaker among individuals with higher LSC (see Supplementary-Analysis:A.15). Secondly, as LSC was only measured during periods of restrictions (March 2020, April 2020, and March-April 2021) it is unclear how trends in depression symptomology differed across LSC outside of lockdowns. Thirdly, the study focused solely on the stress-buffering role of LSC during the pandemic. As discussed, LSC can also buffer mental health from adverse life events outside of crisis-periods (Aminzadeh et al., 2013; Nakagomi et al., 2020; Zeng & Wu, 2022). However, we cannot assume that the same pathways similarly explain the stress-buffering of individual adverse life events compared to large-scale crises such as the pandemic without further analysis. Fourthly, to our knowledge, there are no validated scales of LSC. Instead, studies draw on indicators of people's attitudes/behaviours towards their neighbourhood that conceptually align with LSC, as

evidenced in the pandemic studies cited here. While we believe our measure of LSC aligns with the concept of LSC (e.g., Forrest & Kearns, 2001; Putnam, 2000), and uses similar measures applied elsewhere, the risk remains that the findings may be tied specifically to the measures applied here.

In sum, this study demonstrates novel evidence that social pathways (social support, volunteering) but especially psychological pathways (less loneliness, more psychological resilience) were key channels through which LSC buffered mental wellbeing during the COVID-19 pandemic. In doing so, the study suggests that building and maintaining a strong social infrastructure across communities should form a key part of crisis-preparedness.

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Table 1 – Summary of analytical approach and plan

Analytic stage (RQ)	Aim	Approach	Waves of data used	Methods applied
1 (RQ1)	Examine whether LSC buffered the impact of the pandemic on mental distress	Compare trends in depression symptomology over the pandemic among individuals with higher/lower LSC	1, 2 and 5	Longitudinal: Pooled cross-sectional and fixed effects
2 (RQ2)	Examine the pathways which link LSC with mental distress during the pandemic	Test what social/psychological resource pathways have significant indirect associations between LSC and depression symptomology	1, 2, 3	Cross-sectional: Path analysis
3 (RQ3)	Examine which pathways linking LSC to mental distress (identified in R2) can explain any stress-buffering role of LSC on mental distress during the pandemic (identified in R1)	Test whether loneliness and psychological resilience can explain any differences in trends in depression symptomology among individuals with higher/lower LSC	1, 5	Longitudinal: Pooled cross-sectional and fixed effects

Notes: RQ = research question

Table 2 – Pooled cross-section and fixed-effects modelling of the stress-buffering role of social capital for depression symptomology

Outcome:	Model 1 Depress.	Model 2 Depress.	Model 3 Depress.	Model 4 Depress	Model 5 Depress	Model 6 Depress
Model type:	P. X-sec	P. X-sec	P. X-sec	FE	FE	FE
Survey: March 2020 (baseline)	ref.	ref.	ref.	ref.	ref.	ref.
April 2020	0.407**	0.374*	0.380**	0.330+	0.318+	0.318+
	(0.145)	(0.145)	(0.144)	(0.191)	(0.191)	(0.190)
March-April 2021	0.401*	0.312+	0.277	0.261	0.218	0.170
	(0.187)	(0.186)	(0.185)	(0.244)	(0.244)	(0.243)
Index of local social capital		-0.797***	-0.422*		-0.520*	-0.156
		(0.125)	(0.163)		(0.216)	(0.266)
April 2020 * Social capital			-0.344*			-0.320+
			(0.163)			(0.198)
Mar-Apr 2021 * Social capital			-0.722***			-0.653**
			(0.181)			(0.213)
Constant	8.214	8.180	8.161	6.946**	7.015**	7.301**
	(1.044)	(1.032)	(1.026)	(2.386)	(2.343)	(2.300)
Observations	5253	5253	5253	3462	3462	3462

Notes: P. X-Sec = pooled cross-sectional; FE = fixed effects; *** p<.001, ** p<.01, * p<.05, + p<.10; C19PRC-UK waves 1, 2, 5; robust standard errors in parentheses; all models contain full individual-level and community-level controls (*see* Supplementary-Appendix A.5 for full results).

Table 3 – Path analysis of indirect pathways linking social capital to depression symptomology

	Model 1			Model 2		
Indirect pathways		CI Lower	CI Upper		CI Lower	CI Upper
Social resources						
F of meeting social contacts	0.008	[-0.002	0.025]	0.006	[-0.002	0.018]
Volunteered	**-0.009**	**[-0.025**	**-0.001]**	-0.006	[-0.016	-0.000]
F of interaction	0	[-0.006	0.008]	0.002	[-0.002	0.01]
Social support	**-0.02**	**[-0.032**	**-0.004]**	0.003	[-0.005	0.015]
Psychological resources						
Loneliness				**-0.031**	**[-0.065**	**-0.003]**
Resilience				**-0.03**	**[-0.052**	**-0.012]**
Control - internal				-0.0081	[-0.024	0.002]
Control - chance				0.002	[-0.001	0.009]
Indirect effect	-0.016	[-0.039	0.005]	**-0.063**	**[-0.112**	**-0.015]**
Direct effect	**-0.118**	**[-0.198**	**-0.032]**	**-0.072**	**[-0.136**	**0.001]**
Total effect	**-0.134**	**[-0.215**	**-0.053]**	**-0.134**	**[-0.215**	**-0.053]**
% of total effect indirect	11.9%			46.3%		
% of total effect direct	88.1%			53.0%		

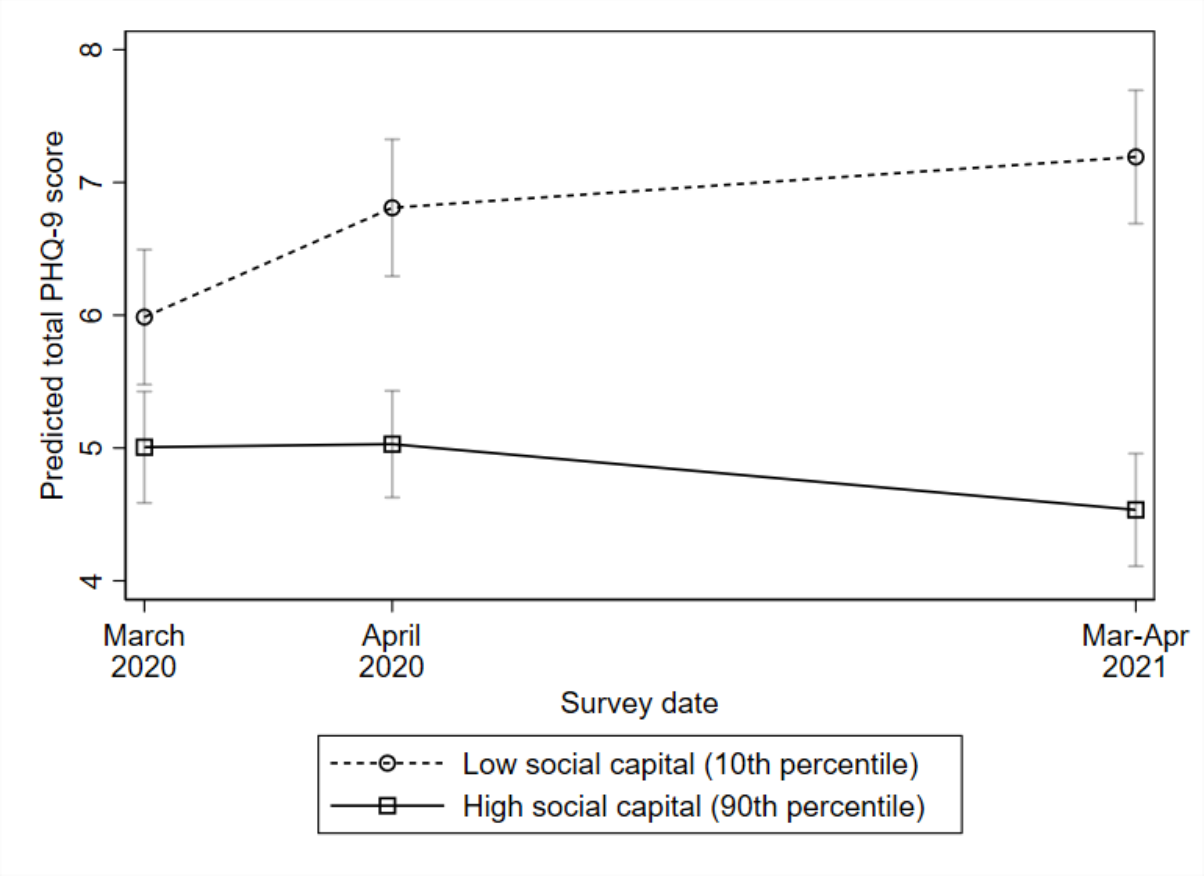
Notes: bold pathways significant at the 95% level; CI=confidence intervals; bias-corrected confidence intervals (5000 repetitions); standardised variables; C19PRC-UK waves 1 (social capital), 2 (pathways), and 5 (depression); full results in Supplementary-Appendix A.10a-A.10b.

Table 4 – Pooled cross-section and fixed-effects modelling of the stress-buffering pathways of social capital for depression symptomology

Outcome:	Model 1 Depress.	Model 2 Depress.	Model 3 Depress.	Model 4 Depress	Model 5 Depress	Model 6 Depress	Model 7 Depress	Model 8 Depress	Model 9 Depress	Model 10 Depress
Model type:	P. X-sec	P. X-sec	P. X-sec	P. X-sec	P. X-sec	FE	FE	FE	FE	FE
Survey: March 2020 (baseline)										
March-April 2021	0.305	0.300	0.307	0.325	0.323	0.176	0.187	0.165	0.185	0.168
	(0.212)	(0.195)	(0.195)	(0.199)	(0.198)	(0.273)	(0.272)	(0.268)	(0.270)	(0.269)
Index of local social capital	-0.535***	-0.145	-0.182	-0.169	-0.188	-0.264	-0.301	-0.323	-0.300	-0.318
	(0.171)	(0.148)	(0.150)	(0.149)	(0.150)	(0.321)	(0.309)	(0.310)	(0.308)	(0.310)
Mar-Apr 2021 * Social capital	-0.707***	-0.407*	-0.298	-0.304+	-0.257	-0.633**	-0.512*	-0.371	-0.414+	-0.343
	(0.186)	(0.171)	(0.181)	(0.182)	(0.186)	(0.224)	(0.215)	(0.232)	(0.230)	(0.236)
Psychological resilience		-1.477***	-1.313***	-1.480***	-1.364***		-0.743**	-0.510+	-0.738**	-0.548*
		(0.113)	(0.128)	(0.113)	(0.126)		(0.267)	(0.266)	(0.266)	(0.265)
Loneliness		2.552***	2.555***	2.377***	2.428***		1.568***	1.571***	1.382***	1.470***
		(0.126)	(0.127)	(0.142)	(0.145)		(0.257)	(0.258)	(0.275)	(0.280)
Mar-Apr 2021 * Resilience			-0.341*		-0.239			-0.431*		-0.356+
			(0.150)		(0.162)			(0.187)		(0.211)
Mar-Apr 2021 * Loneliness				0.362*	0.261				0.343	0.185
				(0.180)	(0.194)				(0.222)	(0.249)
Constant	8.071***	8.195***	8.229***	8.206***	8.226***	9.093***	8.625***	8.580***	8.468**	8.496**
	(1.069)	(0.890)	(0.890)	(0.892)	(0.891)	(2.663)	(2.590)	(2.582)	(2.605)	(2.593)
Observations	3571	3571	3571	3571	3571	2294	2294	2294	2294	2294

Notes: P. X-sec = pooled cross-sectional; FE = fixed effects; *** p<.001, ** p<.01, * p<.05, + p<.10; C19PRC-UK waves 1, 5; robust standard errors in parentheses; standardised independent variables; models contain full individual-level and community-level controls (*see* Supplementary-Appendix A.11 for full results).

Figure 1 – Trends in depression symptomology over the pandemic among individuals with low and high levels of local social capital



CRediT Author Statement

JAMES LAURENCE: Conceptualization; Methodology; Formal analysis; Data Curation; Writing - Review & Editing; Visualization; Project administration; Funding acquisition.

Declaration of interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Highlights

- More social capital linked with more positive trends in mental health over pandemic
- Two key pathways help explain this stress-buffering role of social capital
- People with more social capital became comparatively less lonely and more resilient
- Less loneliness and more psychological resilience linked with better mental health
- More resilient people also saw more positive mental health trends over the pandemic