RESEARCH ARTICLE SUMMARY

PERSONNEL ECONOMICS

Home alone: Remote work, isolation, and mental health

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INTRODUCTION: Remote work has quadrupled in the half-decade since the start of the COVID-19 pandemic. Although there is a burgeoning literature examining remote work's impact on workers' productivity, less research considers its impact on workers' well-being. We used differential changes in remote work across different occupations to assess remote work's impact on isolation and mental health.

RATIONALE: We compared postpandemic changes in isolation and mental health for workers in jobs amenable to remote work ("remotable" jobs; for example, software engineering and marketing) to changes among people in nonremotable jobs (such as mechanical engineering and nursing) using a difference-in-differences approach. This methodology leveraged the large, persistent increase in remote work for people in remotable jobs since the start of the COVID-19 pandemic, a shift that was much more muted among those in nonremotable jobs. We focused on occupation-level shifts in remote work rather than personal choices, as decisions to work remotely may themselves reflect individuals' mental health status. Our analysis drew on five representative surveys of Americans spanning the years 2011 to 2024 ($N = 588{,}322$), excluding the peak pandemic years of 2020–2021, and classified occupations by their remotability using the Dingel-Neiman index.

RESULTS: Relative to those in nonremotable jobs, workers in remotable jobs spent approximately one additional hour alone per workday after the pandemic. Those in remotable jobs also differentially increased days spent entirely alone and decreased after-work socializing. The rise in isolation was sharpest for those living alone, whose likelihood of spending the whole day without social contact rose by 7 percentage points (83%).

Mental distress simultaneously increased: Scores on the Kessler (K-6) measure of generalized psychological distress rose by 0.1 standard deviations for those in remotable jobs relative to those in nonremotable jobs. The increase in distress was roughly twice as large for those living alone compared with those living with family. Alternative measures of mental distress—such as the frequency of depression, mental health care utilization, and antidepressant prescriptions—show similar trends. In contrast, workers in remotable jobs did not differentially increase visits to non–mental health care providers or non–mental health prescriptions (statins, for example), suggesting that the change was not merely driven by increased flexibility for doctor visits.

The results persist largely unchanged when controlling for occupations' exposure to artificial intelligence and when focusing on within-individual changes in mental distress. We do not find similar mental health deterioration for workers who were recently, but were not currently, employed in remotable jobs, bolstering the argument that our results stem from the working arrangements themselves.

The analyzed period saw a general increase in mental distress. Our analysis suggests that remote work accounts for roughly a third of that increase.

CONCLUSION: Our results suggest that remote work substantially increases isolation and worsens mental health, particularly for those living alone. Although a large body of research finds that workers want to work remotely, our findings suggest that workers may not realize the costs of remote work for their well-being, which may take time to accumulate. Understanding remote work's impact on mental health is important for workers deciding where to work and for firms and governments setting remote-work policies. □

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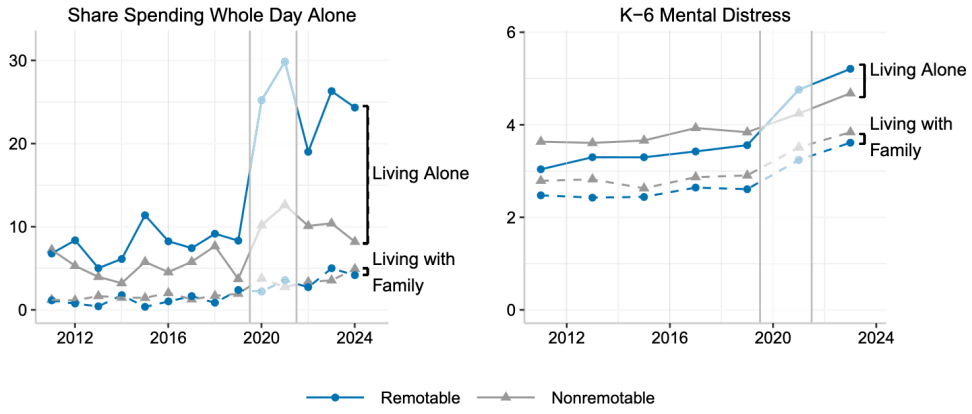

Time alone and mental distress increase more in remotable jobs. Comparing workers in remotable and nonremotable jobs demonstrates that remote work increases both time spent alone and mental distress, specifically among those who are not living with family.

PERSONNEL ECONOMICS

Home alone: Remote work, isolation, and mental health

Natalia Emanuel[1]*, Emma Harrington[2], Amanda Pallais[3]

How does remote work affect isolation and mental health? We drew on five nationally representative surveys of American workers ($N = 588{,}322$) conducted from 2011 to 2024, omitting the peak pandemic years of 2020–2021. Our difference-in-differences approach compared changes in mental health among people in remotable jobs—who experienced a large and persistent rise in remote work since COVID-19—to people in nonremotable jobs, where remote work increased far less. We found that remote work increases time spent alone, worsens mental well-being across multiple measures, and increases the use of mental health services and prescriptions. These effects were concentrated among individuals living alone. We estimate that the rise of remote work explains about a third of the increase in isolation and mental distress between 2011–2019 and 2022–2024.

Remote work has quadrupled in the half-decade since the onset of the COVID-19 pandemic, rising from 7% of American workers in 2019 to 28% in 2023 (*1*). This seismic shift in the structure of people's days could affect not only their work but also their well-being.

The impact of remote work on mental health is theoretically ambiguous. On the positive side, most workers say they enjoy remote work (*2*). A 2024 survey found that 55% of workers believed that hybrid work would be best for their mental health, while another 24% believed that fully remote work would be best (*3*). Workers typically report being willing to accept a 4 to 10% pay cut in exchange for the option to work remotely (*4*–*6*). Among workers who opt into remote work arrangements, studies have found that remote work increases workplace satisfaction, improves perceived work-life balance, and reduces attrition (*7*–*9*).

On the negative side, evidence points to risks associated with remote work. In the US Census Bureau's Summer 2022 Household Pulse Surveys, remote and hybrid workers were more likely than on-site workers to report symptoms of anxiety or depression, with 14% higher rates among remote workers and 9% higher rates among hybrid workers (*10*). One explanation is that working from home increases social isolation by limiting a key source of connection: the workplace. Indeed, a 2022 survey found that adults were most likely to form friendships at work—more so than at places of worship or in neighborhoods, clubs, or their children's schools (*11*). In his call to address "Our Epidemic of Loneliness and Isolation," former US Surgeon General Vivek Murthy emphasized that "both social isolation and loneliness have been shown to independently increase the likelihood of depression or anxiety" (*12*). Medical studies have found that social isolation is a powerful predictor of mortality, on par with smoking or high blood pressure (*13*, *14*). Yet relatively little attention has been paid to how the rise of remote work may contribute to greater social isolation and deteriorating mental health. Those gaps motivated this study's research questions (RQs):

RQ1: Did workers in jobs amenable to remote work (hereafter called "remotable") versus workers in jobs that typically require on-site work (hereafter called "nonremotable") experience differential changes in time spent alone?

RQ1.1: Did effects on time spent alone differ on the basis of whether workers lived alone or cohabited with family?

RQ2: Did workers in remotable jobs experience differential changes in mental distress compared with workers in nonremotable jobs?

RQ2.1: Did effects on mental distress differ on the basis of whether workers lived alone or cohabited with family?

To answer these questions, we drew on five nationally representative surveys of Americans spanning 2011 to 2024, excluding the peak pandemic years of 2020–2021 [$N = 588{,}322$; supplementary materials (SM) section A describes each dataset]. To isolate the effect of remote work, we leveraged the fact that COVID-19 generated a far larger and more persistent increase in remote work for people in remotable jobs—such as software engineering and marketing, which can be done from home—than for those in nonremotable jobs, such as mechanical engineering and nursing, which tend to require physical presence. We defined remotable occupations using the Dingel-Neiman remotability index (*15*). We then compared changes in isolation and mental health for those in remotable jobs our treatment group, to those in nonremotable jobs our best approximation of a control group (SM section B). We focused on occupation-level shifts rather than personal choices about remote work, which may result from individuals' mental health status.

Results

Before the pandemic, workers in both remotable and nonremotable jobs spent relatively few days working from home. The pandemic led to a large increase in remote work for those in remotable jobs, such that by 2024, workers in remotable jobs spent 31.1% of workdays fully remote, whereas people in nonremotable jobs spent only 8.9% fully remote (Fig. 1). Those in remotable jobs experienced a 17.9 percentage point (pp) differential increase in fully remote work ($P < 0.0001$). Table S11 shows similarly large increases in other measures of remote work.

RQ1: Shift toward time alone

Along with spending less time in the office, workers in remotable jobs spent more time working alone after the pandemic, logging 1.2 more work hours alone per day relative to nonremotable workers (58.0% increase; $P < 0.0001$). Remote work thus shifted workers away from collaborative and toward solo work. Assuming that this differential shift was driven by days people worked from home, our two-stage least-squares estimate implies that people spent 6.6 additional hours working alone on remote days (6.6 = 1.17 hours/0.179 differential shift in remote work; see SM section B2 for methodology). Consistent with this, descriptively, when people worked from home in 2022–2024, 84.0% of them spent their entire workday working alone, compared with 23.2% of workers who went on-site. This drastic difference in people's work may have directly affected their well-being: People rated work done alone as 0.3 standard deviations less meaningful than work done with others when the American Time Use Survey (ATUS) asked about respondents' state of mind during each activity in 2012, 2013, and 2021.

When work became more isolated, people did not substantially compensate by socializing more outside of work hours, as also found elsewhere (*16*). As a result, the rise of remote work translated into large increases in overall time spent alone. As illustrated in Fig. 2, people averaged about 5.4 waking hours alone on prepandemic workdays. After the pandemic, time alone rose for both types of workers, but the difference-in-differences estimate shows that those in remotable jobs spent an additional 1.1 waking hours alone relative to those in nonremotable jobs ($P < 0.0001$).

The shift toward time alone extended to more intense forms of solitude, as shown in the difference-in-differences estimates in Fig. 3. The rise of remote work led to a 1.9 pp (50.0%) relative increase in the share of remotable workers spending their whole day alone ($P = 0.013$).

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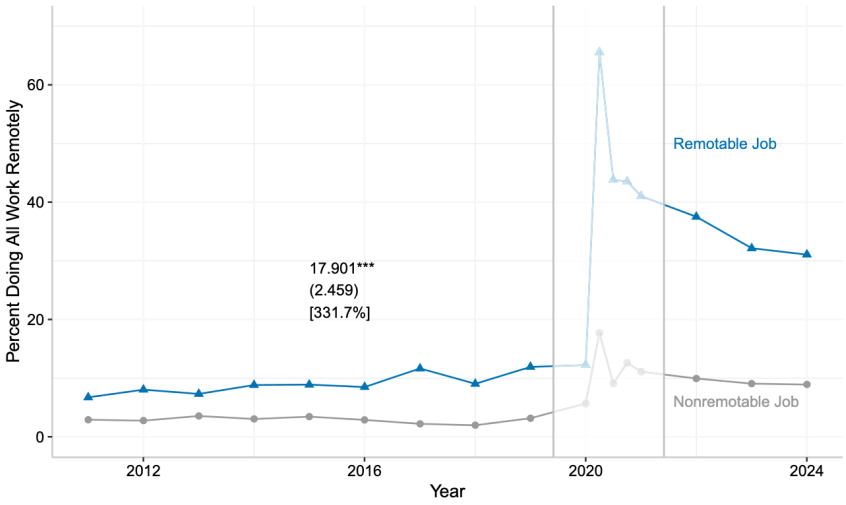

Fig. 1. Shifts in remote work. Graph showing the percentage of workdays spent entirely remote for people in remotable and nonremotable occupations. We include three points for 2020 rather than just one to show the dynamics of the pandemic. The annotation shows the difference-in-differences point estimate from Eq. 1, which includes the controls listed in table S9 and excludes 2020 and 2021. The standard error, clustered at the occupation level, is in parentheses, and the percent change relative to the overall prepandemic mean is in square brackets. ***$P < 0.01$. Regression analyses with fixed effects and results using alternative measures of remote work are in table S11.

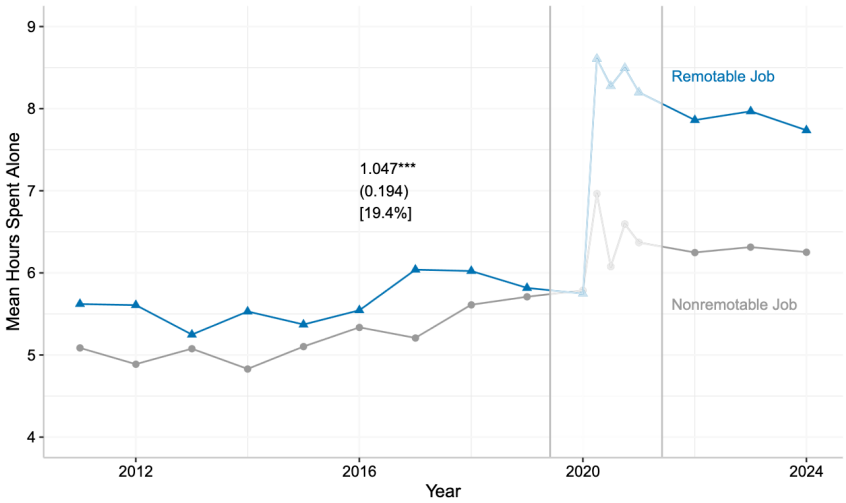

Fig. 2. Changes in waking hours spent alone. Graph showing average waking hours spent alone for workers in remotable and nonremotable occupations. We include three points for 2020 rather than just one to show the dynamics of the pandemic. The annotation shows the point estimate for the difference-in-differences estimate from Eq. 1, which includes the controls listed in table S9 and excludes 2020 and 2021. The standard error, clustered at the occupation level, is in parentheses, and the percent change relative to the overall prepandemic mean is in square brackets. ***$P < 0.01$.

Moreover, remotable workers experienced a 1.0 pp (72.2%) relative increase in the share of days with no human contact: no idle chitchat with a barista, no hello from a co-worker, no smile from a passerby at the grocery store ($P = 0.035$). This isolation is particularly potent given the evidence that even the briefest of social interactions can improve mental well-being, often more so than people expect (*17*–*19*). If these changes are driven by the days people work from home, our two-stage least-squares estimate suggests that working from home increases the likelihood of spending one's whole day alone by 10.6 pp and the likelihood of having no human contact by 5.7 pp (see SM section B2 for methodology).

The rise in extreme solitude partly reflects the fact that remote workers often spend their whole day at home. Among remotable workers, there was a quadrupling of spending all waking hours at home after the pandemic relative to nonremotable workers (4.7 pp increase relative to 1.1 pp before the pandemic; $P < 0.0001$). Being at home may increase frictions to social contact outside of work hours. Indeed, we saw a decline in socializing with friends after work for workers in remotable versus nonremotable jobs (Fig. 3, column 3).

Nationally, time spent alone has been increasing (fig. S1). Between 2011–2019 and 2022–2024, there was a 4.3 pp increase in the share of people who spent all day alone. We estimate that 36% of this change can be attributed to the rise in remote work (table S12; see SM section B3 for methodology).

RQ1.1: Heterogeneity based on cohabitation

The increase in extreme forms of solitude is concentrated among those living alone, as shown in Fig. 3. Those living alone experienced 10 times as large an increase in spending all day alone as those cohabiting (7.0 pp versus 0.7 pp in fig. S2; P of difference = 0.006) and 13 times as large an increase in spending all day with no ambient human contact (3.9 pp versus 0.3 pp in fig. S2; P of difference = 0.036). The decline in social time with friends after work was also concentrated among people living alone, with three times as large an effect for them (2.0 pp versus 0.6 pp in fig. S2), although this difference is not statistically significant.

If these changes are driven by days people work from home, they suggest that, for those living alone, remote work increases the chances of spending the whole day alone by 43.4 pp and the chance of spending one's whole day with no human contact by 24.3 pp. These estimates align closely with the descriptive evidence on how isolated work-from-home days are for people who live alone: in 2022–2024, 45.9% of such days were spent entirely alone, and 31.1% were spent without any ambient social contact.

RQ2: Increases in mental distress

Between the pre- and postpandemic periods, mental distress increased for everyone, but it increased significantly more for those in remotable jobs. Figure 4 illustrates this pattern for the Kessler (K-6) Psychological Distress Scale, our main mental health measure. Before the pandemic, there were stable differences in mental distress across occupational groups. People working in nonremotable jobs tended to have marginally more distress than those in remotable jobs. Yet mental distress changed in parallel. With the pandemic—and the ensuing increase in remote work for those in remotable jobs—the picture shifted. Mental distress rose precipitously for those who were in remotable jobs, for whom time alone ballooned. For those in nonremotable jobs, mental distress ticked up only marginally vis-à-vis preexisting trends.

Among those in remotable jobs, there was a 0.3 unit increase in the K-6 distress score relative to an average score of 3.0 before the pandemic (standard deviation change = 0.08; $P = 0.063$) in the Panel Study of Income Dynamics (PSID). In the National Health Interview Study (NHIS), we found the same 0.3 unit deterioration ($P = 0.007$). We saw deterioration in each of the six subcomponents of the K-6 distress

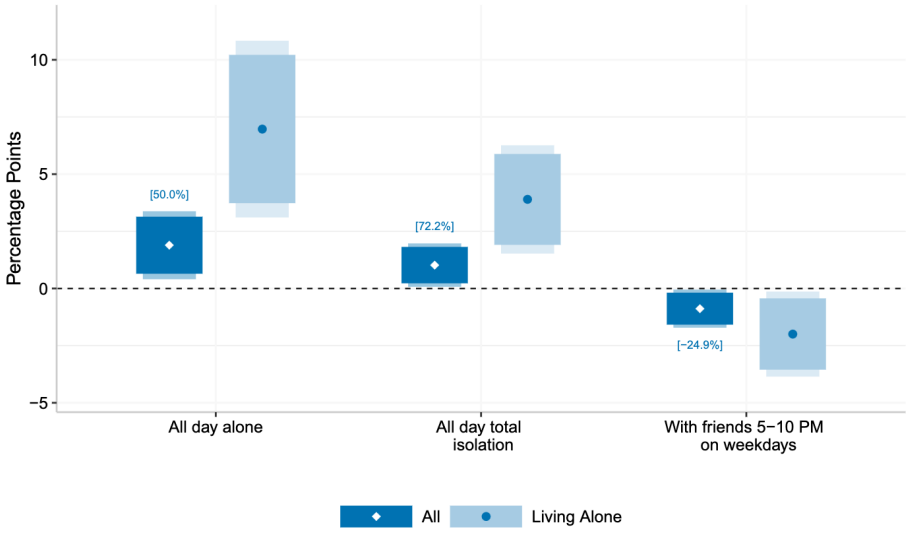

Fig. 3. Differential shifts in social contact. Graph showing the differential postpandemic shift in different measures of social contact among remotable workers. The dots and diamonds show point estimates, with the wider and narrower bars showing 90 and 95% confidence intervals, respectively. The annotations show the percent change from the full sample's prepandemic mean. Each outcome is plotted separately for everyone and for those living alone (i.e., without a partner or children). The leftmost coefficients focus on the outcome of spending all day alone (i.e., without doing an activity with another person). The next measure focuses on spending all day alone and without any "ambient socializing" from being in populated spaces such as the gym or grocery store. The rightmost measure focuses on having a social evening with friends on a weekday. All three measures are from ATUS data. Measures for those living with their partner or children may be found in fig. S2A.

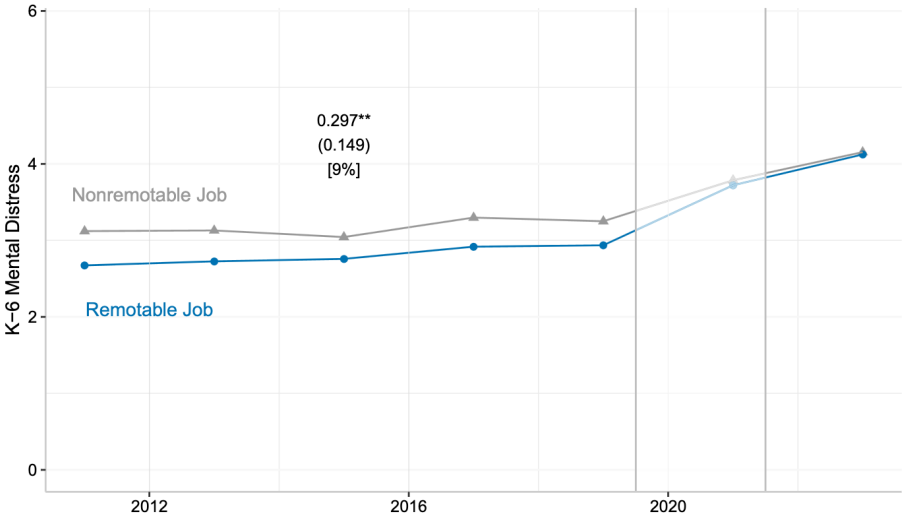

Fig. 4. Increases in mental distress. Graph showing means of the K-6 distress scale for those in remotable and nonremotable occupations. The blue circles represent people in remotable jobs, and the gray triangles represent those in nonremotable jobs. Data come from the PSID. The annotated number shows the difference-in-differences estimate, the standard error is in parentheses, and percent change from the overall prepandemic mean is in square brackets. *$P < 0.1$.

scale: feeling worthless, hopeless, restless, nervous, that everything is an effort, and so sad that nothing can cheer them up (fig. S3). The K-6 measure also has clinical thresholds for any, moderate, and severe psychological distress (*20*). The PSID showed increases at all thresholds, albeit statistically significant only for moderate distress. The NHIS showed significant increases for all thresholds (table S13).

To explore whether remote work benefits some workers' mental health, we plotted the full distribution of the K-6 distress scores before and after the pandemic for remotable and nonremotable workers (fig. S4). We found a uniform shift toward worse mental health for remotable workers, who showed less mass at low distress levels after the pandemic. This pattern suggests that few remotable workers see mental health benefits from remote work.

Contextualizing the magnitude of our estimates: Our estimates capture changes in mental distress between workers in remotable and nonremotable occupations. Given that not all workers in remotable occupations shifted to remote work after the pandemic began—and some workers in nonremotable jobs did—the magnitudes cannot be interpreted as the effect of switching from fully on-site to fully remote work.

A natural rescaling would be to divide the change in distress by how much remote work differentially changed in remotable versus nonremotable jobs (the 17.9 pp differential increase in Fig. 1), yielding a two-stage least-squares estimate of the worker-level effect of going fully remote. However, this approach requires strong assumptions (detailed in SM section B2): In particular, it will overestimate the worker-level effect of working remotely if the rise of remote work also harms those who stay on-site but now go into emptier offices. Under these strong assumptions, going fully remote increases K-6 distress by 1.55 units, nearly equivalent to a one-unit increase on two of the six K-6 dimensions (a 0.43 standard deviation increase).

Another way to benchmark the magnitude of our results is by assessing what fraction of the national rise in mental distress they could explain (see SM section B3 for methodology). From 2011–2019 to 2022–2024, the average PSID respondent's K-6 distress scale increased by 0.7 units (fig. S1). Our estimates suggest that remote work can explain 32% of this overall increase in mental distress (table S12).

Alternative measures of mental distress: Other measures of mental distress show similar upticks among those in remotable jobs (Fig. 5). The frequency with which feelings of distress interfered with daily life differentially increased among people in remotable jobs by 6.2% ($P = 0.033$). Those in remotable jobs experienced a 21.7% increase in instances of feeling very sad or depressed relative to those in nonremotable jobs (prepandemic mean of 16.9 times per year, $P = 0.0018$). In a supplementary analysis of the General Social Survey (GSS), we found that those in remotable jobs experienced a decrease of 16.3% in mental health, mood, and ability to think between 2018 and 2021 relative to those in nonremotable jobs ($P < 0.0001$; table S16), although the latest data from 2021 is during the height of the pandemic.

Mental health care utilization: Those in remotable jobs became 4.6 pp more likely to see a mental health professional than those in nonremotable jobs (compared with a prepandemic mean = 7.9 pp; $P < 0.0001$; table S14). People in remotable jobs also began taking relatively more prescription medications for mental health conditions. They saw a 1.8 pp increase in depression and/or anxiety prescriptions

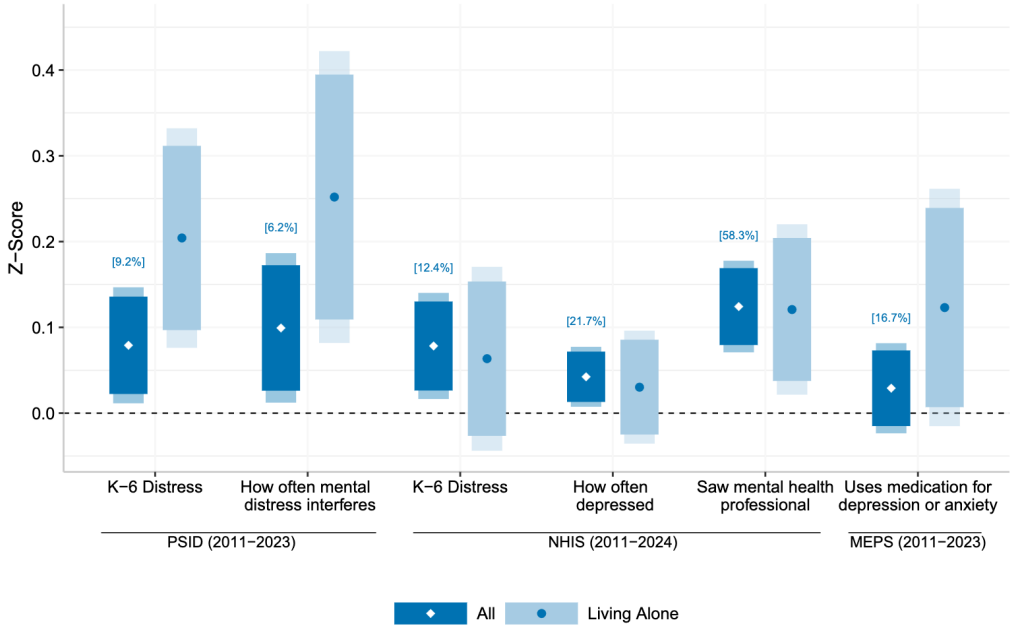

Fig. 5. Increases in mental distress using alternative measures. Graph showing the differential postpandemic change in *z*-scores of different mental health measures among remotable versus nonremotable workers. The dots and diamonds show point estimates, with the wider and narrower bars showing 90 and 95% confidence intervals, respectively. The annotations show the percent change from the overall prepandemic mean in the nonstandardized variables. Each outcome is plotted separately for everyone and for those living alone (i.e., without a partner or children). From left to right, the graph shows the K-6 measure of psychological distress from the PSID (*1*), how often mental distress interferes with the respondent's life or activities from the PSID (*15*), the K-6 measure of psychological distress from the NHIS (*2*), the number of days per year that a person reports being depressed from the NHIS (*3*), the share of people who used mental health care in the NHIS (*4*), and the share of people who used medication for depression or anxiety from the MEPS (*5*). Additional information on each measure can be found in SM section A.

(prepandemic mean = 10.9%; $P = 0.066$) and a 1.9 pp increase in all mental health prescriptions (prepandemic mean = 11.6%; $P = 0.05$; table S15).

A potential alternative explanation is that, instead of worsening mental health, remote work simply afforded more flexibility to seek out health care during the workday. However, two placebo checks argue against this explanation. First, remote workers did not increase physical exams or routine checkups—if anything, these visits decreased (table S14, column 4). Second, they did not differentially increase their use of non–mental health prescriptions, such as statins for high cholesterol (table S15, column 5).

RQ2.1: Heterogeneity by cohabitation

The increase in mental distress tended to be particularly acute for those living alone. For those living alone, before the pandemic, mental health was worse among those in nonremotable jobs, whereas afterward it was worse among those in remotable jobs. This reversal represents a 0.8 unit (or 0.21 standard deviation) relative increase on the K-6 distress scale for those in remotable jobs ($P = 0.003$). This is approximately equal to increasing the frequency of one of the K-6 components of distress by one category, such as going from being nervous some of the time to nervous most of the time.

Among those cohabiting, mental distress rose for people in both remotable and nonremotable jobs in tandem: There was no statistically significant differential increase in mental distress for those in remotable jobs (coefficient = 0.0631; $P = 0.713$; fig. S6B, second column).

People who were both living alone and in remotable jobs also saw large increases in other measures of mental distress. Among those living alone, the frequency with which feelings of distress interfered with their daily lives increased by 15.1% among those in remotable jobs relative to nonremotable jobs ($P = 0.004$; Fig. 5, second column). This change is more than twice as large as the aggregate effect of remote work. Remote workers living alone experienced an outsized increase in their use of prescription mental health medications: a 5.1 pp differential increase in depression and/or anxiety prescriptions ($P = 0.039$) and a 5.3 pp increase in all mental health medications ($P = 0.025$), both of which are more than twice as large as the aggregate effect of remote work. For the other measures of distress, the effects are not statistically different for those living alone versus those cohabiting.

Robustness

Our findings are robust to alternative specifications. We add year and occupation fixed effects (table S16) or use alternative definitions of remotability (table S17) and cohabitation (fig. S6).

One concern was that certain people switched into remotable occupations during the pandemic and that this shift in selection drove our results. We addressed this concern in three ways. First, we found no trend break in the share of people in remotable occupations around COVID-19 (fig. S7). Second, we showed that our results were similar when we included individual fixed effects that absorb consistent individual differences in mental distress (table S18). Finally, in this panel design, we showed robustness to holding constant the prepandemic occupation and thereby eliminating the influence of occupational switchers on our estimates (table S19).

We also used a placebo check that focuses on people who were recently, but not currently, employed in remotable versus nonremotable occupations. Among the unemployed, the estimated effect of the rise of remote work on time alone was marginally negative and significantly different from the positive effect among employed workers ($P = 0.006$; fig. S5A). For mental health, we focused on the NHIS, because the other surveys either did not record unemployed people's former occupations [the Medical Expenditure Panel Survey (MEPS)] or had <250 unemployed people in the postperiod (the PSID and GSS). We found that K-6 distress declined nonsignificantly among formerly remotable workers, a change significantly different from the relative increase among currently employed remotable workers ($P = 0.028$; fig. S5B shows the results for all the feasible datasets). This analysis suggests that the effects are driven by shifts in working conditions rather than other factors differentially affecting the types of people in remotable and nonremotable occupations.

Probing alternative explanations: Undoubtedly, there are potential alternative explanations for the differential deterioration in mental health among those in remotable jobs, such as the introduction of generative artificial intelligence (AI), political shifts, or lingering effects of the pandemic. Workers in AI-exposed occupations—which also tend to be more remotable—might plausibly show rising distress owing to job security concerns rather than remote work. To test this, we leveraged an AI occupational exposure index (*21*, *22*). We found that the mental health effects load on remotability rather than AI exposure (table S20). Additionally, the time series changes in mental health coincide with

the pandemic and not the rapid diffusion of AI following ChatGPT's release in late 2022. Furthermore, we might expect the mental health effects of AI to be particularly large among those who recently lost their jobs, but instead we found more muted effects for the unemployed (fig. S5). Together, these findings suggest that remote work is a more plausible explanation for deteriorating mental health than generative AI during our study period.

The evidence also suggests that political shifts do not confound our results. We found that there are only small differences between Democrats and Republicans in their likelihood of being in remotable jobs in the GSS. As a result, controlling for trends in mental health by political affiliation does not change the estimated effect of the rise in remote work (table S21).

Finally, it is also possible that correlations between the lingering stress of the pandemic and remote work may be at play. To probe this, we correlated local area COVID-19 deaths with both pandemic-era and postpandemic shares of people in remotable jobs. We found correlations of 0.03 and 0.009, respectively, suggesting that the effects are not driven by pandemic deaths.

Discussion

In this study, we analyzed remote work's impact on time spent alone and mental health. In five nationally representative surveys of Americans, spanning 2011 to 2024 and excluding the peak pandemic years, we compared those in remotable and nonremotable jobs. We found that remote work leads to a substantial increase in time spent alone. It also increases mental distress as measured by the K-6 Psychological Distress Scale, a finding corroborated by two other self-reported mental health measures and reflected in elevated use of mental health services and prescription medications. The increases in time alone and mental distress are larger for those living alone.

Our paper contributes to a burgeoning literature on the impacts of remote work. Much of the causal evidence has focused on worker productivity (*7*–*9*, *23*–*28*). Our study highlights a less-studied consequence of remote work: worsening of workers' well-being. This paper complements pandemic-era surveys finding that isolation was consistently associated with heightened stress (*29*–*32*). We also build on research showing that remote work reduces communication between co-workers (*33*–*35*) and that hybrid workers spend more time alone on remote days than in-person ones (*36*).

We built on this existing work in several ways. First, we examined a period after the peak of the pandemic to better capture long-term impacts. Second, we used variation in remote work driven by occupational shifts, which sidesteps concerns about self-selection into remote work. Third, our time-use analyses included hours outside of work, giving us a more holistic picture of remote work's impact on isolation. Fourth, our across-worker comparison allowed us to capture the effects of remote work on total time alone, including any reallocation across days, which within-worker designs that compare remote and on-site days miss. Fifth, we examined more extreme forms of isolation, such as days with no human contact, and showed that the impacts of remote work vary substantially by whether workers live alone. Finally, we used validated measures of mental health alongside behavioral indications of mental well-being, such as prescription medication utilization.

Our findings may seem puzzling in light of the fact that many workers prefer to work remotely (*4*–*9*). One possible explanation is that the benefits of remote work (e.g., skipping a daily commute) are immediate and salient, whereas the costs of remote work (e.g., frayed connections with co-workers) take time to materialize. This aligns with evidence that working more remotely early in 2020 predicted greater distress later that year (*32*). If the toll of isolation accumulates gradually, workers may find it difficult to differentiate remote work's effects on mental well-being from the impacts of broader societal trends or other personal life events, such as illness or divorce. Moreover, a large body of research in psychology shows that people underestimate how much brief social interactions can improve their mental well-being (*17*–*19*), making it hard to project how losing everyday workplace encounters can undermine mental health.

Limitations

Our study has important limitations. We used validated measures where possible, including the K-6 measure of psychological distress. Yet for isolation, our data did not include ingredients for constructing validated measures, such as the Berkman-Syme Social Network Index (*37*).

While our analysis used nationally representative surveys of American workers, it did not include workers outside the United States. Our analyses leveraged the fact that the COVID-19 pandemic led to large and persistent increases in remote work in remotable occupations. To net out the direct effects of the pandemic, we used workers in nonremotable jobs as a control group. However, this difference-in-differences approach assumes that workers in remotable and nonremotable occupations faced similar pandemic shocks. Although we exclude the peak pandemic years of 2020–2021, a lasting differential effect of the pandemic on remotable workers could confound our results. For this to explain our findings, however, such a confounder would also need to disproportionately affect those living alone relative to those cohabiting—and those currently employed relative to those recently employed.

We cannot distinguish the effects of fully remote and hybrid work. Possibly, having one or two days of remote work per week would have considerably smaller impacts on mental distress—or even protective impacts for some workers—than more intensive forms of remote work. However, as hybrid work has become the dominant form of remote work in recent years, it would be harder for the occupation-level shifts we estimate to be driven exclusively by fully remote work. Likewise, we cannot determine whether there are particular subpopulations for whom remote work may have positive effects on their mental health, but we believe that exploring heterogeneity would offer valuable insights.

Given that our data end in 2024, we cannot fully capture long-term adaptations among remotable workers. If those in remotable jobs have made compensatory changes—such as cultivating social connections outside of work—they may not yet have reaped the full benefits. Extending the analysis beyond 2024 will be important for understanding whether the mental health effects of the pandemic-era shift to remote work persist, attenuate, or further compound over time.

Finally, our occupation-level analysis prevents us from distinguishing the effects of a worker's own remote work decision from those of her colleagues, whose remote work decisions may also contribute to her well-being. However, because firm policies affect both a worker's and her colleagues' work locations, the combined effect is the relevant parameter for firms choosing remote work policies—or governments aiming to influence those policies.

Policy implications and future directions

Workers are choosing which jobs to take and how often to go into the office; firms are actively crafting remote work policies for their employees; and governments are deliberating over laws guaranteeing workers' right to request remote work, as in France, Portugal, and Australia (*38*, *39*). Our findings suggest that the mental health effects of remote work merit a central place in these deliberations. Because individuals may struggle to overcome isolating work arrangements on their own, firm policies—and the government regulations shaping them—play a key role. Across a range of remote work arrangements, both individuals and organizations may want to prioritize making remote work less isolating by, for example, coordinating in-office days for hybrid workers or encouraging informal interaction, even online.

Our research also speaks to policy efforts to reduce rising social isolation (*40*, *41*), which have been shown to be as harmful for life expectancy

as smoking (*14*). We highlight an understudied determinant of social isolation: the nature of work. Our research builds on evidence that employment enhances psychosocial well-being (*42*), showing that being in person is a key source of that benefit.

Nevertheless, important questions remain open. Does going into the office a few days per week mitigate the negative mental health impacts of remote work? To what extent does a worker's mental health depend on the work location decisions of her co-workers? And, although the average effect is negative, are there some workers for whom remote work improves mental health?

As remote work continues to be a feature of many occupations, our findings offer insights about its effects on mental health. These findings can help guide individuals deciding how to structure their work, organizations determining their workplace policies, and governments shaping the legal landscape around where work takes place.

Materials and methods summary

Difference-in-differences analyses

This study examined how remote work affects isolation and mental distress. Our empirical strategy leveraged the surge in remote work due to the COVID-19 pandemic. This change increased remote work much more in remotable occupations, such as software engineering and clerical work, than in nonremotable occupations that rely on physical presence, such as medicine and food preparation. Using a difference-in-differences design, we compared changes in isolation and mental distress before and after the pandemic for our treatment group of workers in remotable occupations and those in our control group of workers in nonremotable occupations. Including this control group accounted for any lasting effects of the pandemic experienced by everyone and thus better isolated the impact of the rise of remote work.

Our focus on remotable occupations rather than remote workers has two advantages. First, individuals' own remote work decisions may result from mental distress if, for example, people experiencing depression choose to work from home. This selection problem is unlikely to plague an occupation-level analysis, where shifts in remote work are largely outside an individual's control. Second, occupational analyses include any spillover effects that arise from colleagues' absence from the office, which shape one's own opportunities for social contact.

We estimate

$$Y_{it} = \beta \text{Remotable}_{it} \cdot \text{Post}_t + \alpha_0 \text{Remotable}_{it} + \alpha_1 \text{Post}_t + X_{it}^0 \Gamma + \epsilon_{it} \quad (1)$$

where Y_{it} captures the outcome of interest, either isolation or mental distress; Remotable_{it} is an indicator for whether person i has an occupation at time t that can be completed remotely; Post_t is an indicator for being after the rise of remote work (2020 or later). Our pooled estimates exclude 2020 and 2021 to capture differences between those in remotable and nonremotable jobs after the intensity of the pandemic faded. X_{it} captures gender, age, marital status, parental status, race, and education (see table S9 for more information on these variables). Robustness checks include occupation and year fixed effects. We use surveys' individual-level weights. Standard errors are clustered at the occupation level.

β captures the causal effect of the rise of remote work under the assumption that people in remotable and nonremotable occupations would have had similar trends in isolation and mental distress had there been no differential rise in remote work. Reassuringly, these trends were parallel before the pandemic. Additionally, we showed that our results are robust to considering potential confounders, including generative AI and the United States' changing political landscape.

We also probed heterogeneity in the effects to test a causal interpretation. If the estimated coefficients are causal, we would expect them to be more pronounced among those currently employed in remotable and nonremotable jobs than those currently unemployed but previously employed in these sectors. Second, we would expect the mental health effects to be more pronounced for those living alone, for whom working at home and alone can lead to a bigger increase in isolation.

Measures

To identify the impact of remote work on time alone and mental health, we drew on multiple nationally representative data sources (table S1).

Remotable occupations: To define an occupation's remotability, we used the Dingel-Neiman index (*2*), which is based on occupational characteristics from the US Department of Labor's O*NET database. The goal of this widely used index is to differentiate between occupations where the tasks could feasibly be done from home (e.g., writing emails) and those where they cannot (e.g., operating on patients). Just over a third of workers (36.2%) are employed in remotable occupations (SM section A1).

Time alone: The ATUS asks individuals about each activity they perform, where it took place, and who was with them (as long as the respondent was not sleeping, grooming, or doing other personal activities) (*43*). These data allowed us to determine how many waking hours were spent alone and whether the individual spent the entire day alone. We also constructed a stricter measure of "no human contact": days where the individual neither spent time with another person nor was ever in a space with potential for ambient human contact, such as a gym, coffee shop, or grocery store (table S10). We used data from 14 annual waves of the ATUS, covering 61,644 unique respondents between 2011 and 2024.

Mental health: We used multiple measures of mental health. Our preferred measure was the Kessler (K-6) Psychological Distress Scale (*44*, *45*): a clinically validated index of nonspecific distress based on how often in the past 30 days the respondent felt worthless, hopeless, restless, nervous, that everything is an effort, or so sad that nothing could cheer them up (*20*). We used this measure from seven biennial waves of the PSID, spanning 2011 to 2023 and including 38,397 unique respondents (*46*). The PSID also asks respondents who report mental distress how frequently this distress interrupts their daily lives. Because the PSID follows the same respondents over time, it was our preferred sample.

The NHIS was administered annually from 2011 to 2024. It includes the K-6 psychological distress components in most years and asks how often the respondent felt depressed in the past 30 days (*47*). Separately, it asks respondents whether they saw a mental health care professional in the past 12 months or wanted to but could not afford to do so. The analysis uses all respondents asked each respective question: 264,634 for the K-6 measure, 136,541 for depression frequency, and 268,710 for mental health care utilization. Because the NHIS underwent a restructuring in 2019 (SM section A4), we consider the NHIS a supplementary analysis and include robustness exercises to the specific survey changes in the supplement.

We used the MEPS to capture prescription medication utilization from 2011 to 2023 (*48*). We focused on prescription drugs commonly used to treat depression and/or anxiety and other mental health conditions. In a placebo check, we considered utilization of medications not generally used to treat mental health conditions to demonstrate that our findings do not just result from remote workers having more time to seek health care. Our analysis used 216,304 respondents.

Finally, in 2018 and 2021, the GSS asked 3267 total respondents, "In general, how would you rate your mental health, including your mood and your ability to think?" (*49*). As 2021 was during the height of the pandemic, we considered the GSS a supplementary analysis (table S21). Yet, because the GSS uniquely asks about people's political orientation, it was useful for probing the role of politics.

Living alone: We assessed whether the changes in time alone and mental distress were more acute for those living alone. Our primary definition distinguishes between those who live with their partner and/or children and those who do not. For ease of exposition, we refer to the latter as living alone. In the SM, we show robustness to other definitions (fig. S6).

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Competing interests: The authors declare that they have no competing interests. **Data, code, and materials availability:** All datasets are publicly available for download and are included in our online repositories. Our code is likewise available in the same repository. Our main repository, containing code, documentation, and all datasets (except the PSID), is located in Dryad (*50*). The PSID extract may only be posted on the PSID Public Data Extract Repository and may be accessed through the Inter-university Consortium for Political and Social Research (ICPSR) (*51*).

SUPPLEMENTARY MATERIALS

science.org/doi/10.1126/science.aec7671
Materials and Methods; Figs. S1 to S7; Tables S1 to S21; References (*52*, *53*);
MDAR Reproducibility Checklist

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