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OXFORD

# Social Isolation and Worsening Health Behaviors Among Older Adults During the COVID-19 Pandemic

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**Decision Editor**: Anna Zajacova, PhD (Social Sciences Section)

## Abstract

**Objectives:** We examine the relationship between social isolation, poor health behaviors, and the perceived worsening of older adults' health behaviors following the coronavirus outbreak. We assess the extent to which psychological pathways mediate the relationship between social isolation and worsening health behaviors.

**Methods:** Drawing on data from the National Social Life Health and Aging Project Round 3 (2015) and its coronavirus immune disease 2019 (COVID-19) substudy (2020; *N* = 2,549), we use generalized linear models to explore how indicators of social isolation during the COVID-19 pandemic—infrequent in-person contact with friends and family in 2020 and decreased in-person contact with friends and family since COVID-19 started—are associated with (1) poor health behaviors (low physical activity, drinks per week, smoking, and poor sleep) in 2020 and (2) perceived worsening of health behaviors (reports of decreased physical activity, increased drinking and smoking, and feeling less rested) since the pandemic started.

**Results:** Infrequent in-person contact was not associated with poor health behaviors. Decreases in in-person contact, on the other hand, were associated with worsening health behaviors. Older adults who reported decreases in in-person contact were more likely to perceive a decrease in physical activity, an increase in drinking, and feeling less rested. Emotional well-being, particularly loneliness compared to anxiety or depressive feelings, partially mediated the relationship between perceived worsening of health behaviors and a decrease in in-person contact with friends, and to a lesser extent, with family.

**Discussion:** Our study suggests that in-person contact may play a distinct role in shaping older adults' well-being during the pandemic.

**Keywords:** COVID-19, Health behaviors, Social contact, Social isolation

Social isolation, the lack of sufficiently close ties to others, can be detrimental to health and longevity, especially for older adults (Holt-Lunstad et al., 2015; Yang et al., 2016). Social isolation may affect health and length of life in part by increasing risks of loneliness, anxiety, and depression (Santini et al., 2020), which in turn, damage health behaviors, such as physical activity (K. E. J. Philip et al., 2020; Schrempft et al., 2019), alcohol consumption (R. K. McHugh & Weiss, 2019), smoking (Fluharty et al., 2017; K. E. Philip et al., 2022), and sleep (Benson et al., 2021; Yu et al., 2018).

The novel coronavirus immune disease 2019 (COVID-19) pandemic profoundly altered social lives, physically isolating many individuals from family and friends outside their households. This led to dramatic declines in face-to-face—in-person—contact, leaving remote modes unaffected. These declines in in-person contact have been linked to poorer psychological well-being among older adults (Hawkley et al., 2021; Litwin & Levinsky, 2021), but how in-person contact may be related to older adults' health behaviors during COVID-19 is less explored. Here, we examine the association

of social isolation during COVID-19 with worsening health behaviors, which play an important role in maintaining health (DiPietro, 2001; Robbins et al., 2021; Rogers et al., 2005; Thun et al., 1997) and the potential mediating role played by emotional well-being in this process. We focus especially on declines in in-person social contact and compare contact with family members outside the household to contact with friends.

The present study focuses on older adults as they have been at heightened risk of serious consequences of contracting COVID-19 and of social isolation from efforts to reduce this risk. Using data from the National Social Life Health and Aging Study and the NSHAP COVID-19 substudy conducted in 2019/20, we addressed the overarching question: Did the declines in in-person contact with family and friends that accompanied the COVID-19 pandemic put older adults at risk of poor and worsening health behaviors? Did loneliness, anxiety, and depression mediate this relationship? In doing so, this study extends prior research by highlighting a specific form of social contact—in-person contact—and by exploring

how limited in-person contact may have shaped older adults' health and well-being during the pandemic.

## Background

Social Isolation and Health Behaviors

Social isolation is a well-known risk factor for morbidity and mortality (Holt-Lunstad et al., 2015; Yang et al., 2016) and health behaviors may be a potential pathway that links social isolation and health outcomes. According to Berkman et al. (2000)'s model of *Social Integration to Health*, health behaviors are the channels through which macro-, mezzo-, and micro-mechanisms may affect health, including physical health and mortality. This model points to exercise, alcohol consumption, and smoking as important health behaviors. Regular physical activity has been shown to improve health and functioning (DiPietro, 2001), whereas heavy alcohol consumption (Thun et al., 1997) and smoking (Rogers et al., 2005) damage health and increase the risk of mortality. Poor quality sleep has recently come to the fore as an important negative health behavior, associated with increased morbidity and mortality (Robbins et al., 2021). Recent research finds that social isolation increases the risks that people show reduced objective physical activity (Schrempft et al., 2019), increase alcohol consumption (Ferrante et al., 2020), taking up or continue smoking (Ikeda et al., 2021), and have poor sleep quality (McLay et al., 2021).

Several mechanisms are theorized to explain the association between social isolation and health behaviors. Socially isolated individuals are more likely than the well-connected to lack social contacts that directly and indirectly promote healthy behaviors and inhibit harmful behaviors (Kobayashi & Steptoe, 2018; Schrempft et al., 2019; Shankar et al., 2011). Specifically, socially isolated individuals may lack close contacts who can discourage risky health behaviors and encourage better ones through social control (Umberson, 1992; Umberson et al., 2010). Isolated individuals may also have less access to resources from others, such as information and social support, which facilitate healthy behaviors (Cornwell & Waite, 2012; Goldman & Cornwell, 2015). In addition, social connections can generate a sense of belonging and commitment to others, which in turn, can motivate individuals to avoid risky health behaviors (Berkman et al., 2000; Thoits, 2011).

Emotional well-being is another important potential mediating factor that links social isolation to health behaviors and, importantly, functions as a pathway through which other mediators operate (Umberson et al., 2010). In community-dwelling species such as humans, being isolated from one's group is dangerous and can generate feelings of loneliness, anxiety, and depression (Robb et al., 2020; Santini et al., 2020). Such feelings can diminish one's motivation and energy to engage in healthy behaviors such as exercising and contribute to psychological distress which is associated with health-risk behaviors including heavy drinking and smoking (Jokela et al., 2020; Megherbi-Moulay et al., 2022). Poor emotional well-being can also generate stress which, in turn, disrupts sleep quality (J. E. McHugh & Lawlor, 2013). Furthermore, feelings of loneliness, anxiety, and depression may arise from the lack of close contacts who can provide social support or a sense of belonging, which are themselves mediators of the social isolation—health behaviors association. Thus, loneliness, anxiety, and depressive feelings may mediate the relationship between social isolation and health behaviors, in a process in which lack of social contact increases loneliness, anxiety, and depressive symptoms, which then interfere with healthy behaviors. Indeed, these indicators of poor emotional well-being are associated with reductions in exercise (Hawkley et al., 2009), increases in alcohol use (R. K. McHugh & Weiss, 2019), smoking (Fluharty et al., 2017), and greater risks of poor sleep (Benson et al., 2021).

Social isolation during COVID-19 appears to have had an adverse impact on older adults' emotional well-being (E. Y. Choi et al., 2021; Kim & Jung, 2021). Relatedly, a recent literature points to changes in health behaviors during COVID-19 that may have resulted from increased social isolation. Physical activity seems to have declined among older adults early in the pandemic era (Hoffman et al., 2022; Lefferts et al., 2022), and one study in Japanese older adults (Otaki et al., 2022) found links between reduced in-person social contact and decreased physical activity. There is some evidence that U.S. older adults' frequency of drinking alcohol increased through the early months of the pandemic (Nordeck et al., 2022). Longitudinal assessments of smoking behavior and sleep during the pandemic are rare, but findings among U.K. older adults revealed an increase in the proportion of smokers as a consequence of the pandemic (Gaggero, 2023), and subjective sleep quality declined among Brazilian older adults from pre- to post-pandemic—especially for those compliant with stay-at-home orders (Taporoski et al., 2022). Although recent research has linked social isolation to emotional well-being and, separately, to health behaviors, studies have not examined emotional well-being as a potential mediator that may explain the relationship between social isolation and changes in health behaviors during the pandemic.

## In-Person Contact and Health Behaviors During COVID-19

The outbreak of COVID-19 significantly increased older adults' social isolation, particularly affecting in-person contact. Limited contact with others is a central indicator of social isolation and is closely associated with poor health and mortality (Shankar et al., 2011; Shor & Roelfs, 2015). Berkman et al. (2000)'s model of *Social Integration to Health* describes in-person contact as a characteristic of network ties at the mezzo level. Mandates for social distancing—a shock at the macro-, socio-structural level of the model—resulted in changes in in-person social contact (mezzo level) for individuals during the pandemic. These changes, in turn, may have affected downstream health behaviors both directly and indirectly through the pathways as mentioned earlier. For example, it is likely more difficult to monitor health behaviors such as regular physical activity or heavy drinking via remote contact than in-person. Also, older adults may be less motivated to follow norms about health behaviors since it is difficult to compare and match one's health behaviors to behaviors of similar others in reference groups when they cannot meet each other (Thoits, 2011). However, previous research rarely distinguished between the various modes of contact, instead frequently aggregating in-person contact with remote modes like phone calls, text messages, or video chats (Cornwell & Waite, 2009). We argue here that seeing others in person may carry benefits that are not replaced by remote forms of contact. Recent evidence shows that decreased in-person contact and increased remote modes of contact during COVID-19 are associated with worse emotional well-being (N. G. Choi et al.,

2022; Litwin & Erlich, 2023). However, whether in-person contact is associated with health behaviors during the pandemic remains largely unexplored.

Social isolation in the form of limited in-person contact during the current pandemic could be experienced as rare in-person contact or as a decrease in in-person contact. Older adults with infrequent in-person contact likely have limited access to social ties that might provide direct support. They likely lack the companionship, instrumental, or emotional support to maintain healthy behaviors. On the other hand, older adults who experience a decrease in in-person contact since the pandemic started may feel a sense of loss and may experience a disruption in their regular sources of social support and exchange. This may be particularly relevant to those who perceive this decrease. Feeling that there is a decrease in in-person visits during COVID-19 reflects an individual's self-assessment of disruption brought on by the pandemic. Importantly, a decrease in in-person contact may be unrelated to infrequent in-person contact. That is, older adults who report a decrease in in-person contact may still be regularly meeting with their social ties. The difference in an individual's frequency of in-person visits before and during the pandemic might be small, but to the extent that these visits were an important part of their social life, the decrease may generate feelings of dissatisfaction and a sense of disconnection. Such feelings may be associated with health-compromising behaviors.

COVID-19 disrupted many older adults' in-person interactions with their family and friends, who are central to older adults' social lives. Rarely seeing family and friends in-person and seeing family and friends in-person less often during the pandemic may adversely affect health behaviors, but different mechanisms may be involved for family and friends. Family members are more likely to provide instrumental support, as family relationships are characterized by norms and obligations (Silverstein et al., 2006). Resident and nonresident family members, particularly adult children, indirectly affect the health and health behaviors of older adults by providing help such as transportation and household work and resources such as information and emotional support (Choi et al., 2015; Schoeni et al., 2022). Family members may also directly regulate older adults' health by discouraging risky behaviors and encouraging beneficial ones (Umberson, 1992). Friendships, on the other hand, are grounded on reciprocity and companionship, and maintained through shared activities and mutual interests (Pinquart & Sörensen, 2000). Although friends can facilitate health-risk behaviors, such as heavy drinking (Vogelsang & Lariscy, 2020) and smoking (Blok et al., 2017) to the extent these behaviors are "social" activities, friend networks are also associated with health-promoting behaviors, such as physical activity (Watt et al., 2014) and sleep quality (Mesas et al., 2020). Notably, the companionship and shared activities such as exercise classes or walks that characterize friendships were probably both restricted by pandemic lockdowns. Not being able to socialize with friends like they used to before the pandemic may have contributed to older adults' poor emotional well-being, which in turn, may have increased the likelihood of engaging in health-risk behaviors.

## The Present Study

This study examines the role of in-person contact for poor and perceived worsening health behaviors during the COVID-19 pandemic. Based on prior research and Berkman et al. (2000)'s model of *Social Integration to Health*, we hypothesized that (1) those who report that they rarely had in-person contact with family and/or friends will be more likely to engage in poor health behaviors net of previous levels; (2) those who had less in-person contact with family and/or friends during the pandemic will be more likely to perceive that their health behaviors have gotten worse during the pandemic; and (3) loneliness, anxiety, and depressive symptoms will mediate some of the relationship between in-person contact and health behaviors during the pandemic.

## Method

### Data and Sample

This study uses data from the National Social Life, Health, and Aging Project (NSHAP; Waite et al. 2021). NSHAP is a nationally representative, longitudinal study of community-dwelling older adults interviewed in person in 2005, 2010, and 2015 (O'Muircheartaigh et al., 2021). NSHAP focuses on the links between social well-being and other dimensions of health among older adults. Questions on social contact were asked in each round of the survey, as were questions on physical activity, alcohol consumption, smoking, and sleep. In response to the COVID pandemic, NSHAP designed a questionnaire that was administered via the web, phone, or paper and pencil as respondents preferred. This NSHAP COVID-19 substudy surveyed 2,672 older adults among 4,777 NSHAP respondents surveyed in 2015 (Round 3) between September 14, 2020 and January 27, 2021 (response rate: 58.1%). The survey questionnaire for the NSHAP COVID study is available in NIH Disaster Research Response Resources (National Institutes of Health, 2020). Our analytic sample includes respondents born between 1920 and 1965 (age range: 55–99) who participated in both Round 3 NSHAP and the NSHAP COVID-19 substudy ($N = 2,549$). Due to different levels of missingness across the dependent variables, the number of cases in the analysis varied across outcomes.

### Measures

#### Dependent variables

*Poor health behaviors during the pandemic.*—This study examines four health behaviors: physical activity, drinks per week, smoking status, and sleep quality. The first three health behaviors were measured nearly identically in Round 3 and in the COVID-19 substudy. Sleep quality was measured differently across the two-time points, as we describe subsequently.

*Low physical activity.*—Respondents were asked: "On average during the past month, how often have you participated in vigorous physical activity or exercise?" The NSHAP Round 3 used the last 12 months as the time referent. Responses range from "*never*" (=1) to "*5 or more times per week*" (=6), but we reverse-coded so that a higher value indicates lower levels of physical activity.

*Drinks per week.*—We measured drinks per week by multiplying the responses for a number of days per week during the past month the respondents had any alcohol and the number of drinks on the days that they had any alcohol. NSHAP Round 3 used the last three months as the time referent.

*Current smoker.*—Respondents were asked how many cigarettes, cigars, pipes, or electronic cigarettes they smoked per day during the past month. NSHAP Round 3 asked whether the respondents smoked cigarettes, cigars, or a pipe at the

time of the survey. We used these items to identify current smokers at each time point.

*Poor sleep.*—Sleep quality in the NSHAP COVID-19 sub-study was assessed with the question "How often do you feel really rested when you wake up in the morning?" Responses range from "*never*" (=1) to "*most of the time*" (=4), but we reverse-coded so that a higher value indicates worse sleep quality.

Corresponding measures of physical activity, alcohol consumption, and smoking behavior from Round 3 are included in all models as baseline measures. Sleep quality at baseline was measured by asking respondents to rate the statement "my sleep was restless" on a 4-point scale ranging from "*rarely or none of the time*" (=1) to "*most of the time*" (=4).

*Perceived worsening of health behaviors since the pandemic started.*—In the NSHAP COVID-19 substudy, after respondents reported frequency of physical activity, alcohol consumption, smoking, and feeling rested, they were asked whether this was "*more,*" "*less,*" or "*about the same*" (reference) as before the pandemic.

### Independent variables

*Infrequent in-person contact in 2020.*—Respondents were asked how often they had in-person contact with non-household (1) family and, separately, (2) friends during a typical week since the pandemic started. Responses range from "*at least daily*" (=1) to "*never*" (=5). Older adults who meet family/friends in person less than once a week are considered as having infrequent in-person contact. We define infrequent in-person contact with family/friends as less than once a week.

*Decreased in-person contact since the pandemic started.*—Follow-up questions asked whether in-person contact frequency with family/friends represented an increase, decrease, or no change compared with pre-pandemic. We compare older adults who reported a decrease to those who reported otherwise.

### Mediators

*Loneliness.*—We use the 3-item UCLA loneliness scale that asked respondents how often they felt (1) left out, (2) isolated from others, and (3) lonely during the past month on a 4-point Likert scale ranging from "*never*" (=0) to "*often*" (=3). Total scores ranged from 0 to 9 with higher scores indicating greater loneliness (Payne et al., 2014).

*Anxiety.*—Anxiety was measured using the Generalized Anxiety Disorder scale-2 (GAD-2). Respondents were asked how often they have been bothered by (1) feeling nervous, anxious, or on edge and (2) not being able to stop or control worrying during the past month on a 4-point Likert scale ranging from "*not at all*" (=0) to "*nearly every day*" (=3). The total score ranged from 0 to 6, with higher scores indicating greater anxiety.

*Depressive feelings.*—Respondents were asked how often they felt depressed during the past month on a 4-point Likert scale ranging from "*rarely or none of the time*" (=1) to "*most of the time*" (=4).

### Covariates

Sociodemographic factors included in the study are gender, age, race/ethnicity, educational attainment, and marital/partner status. All sociodemographic factors come from the COVID-19 substudy except educational attainment, which is taken from the NSHAP Round 3.

We control for an increase in remote modes of contact by using six measures that asked respondents whether they experienced changes in contact frequency with friends via (a) phone (b) messages (email, text, and social media) (c) video calls (e.g., Zoom and FaceTime) with nonresident (1) family and (2) friends. Respondents who reported an increase in contact are compared to those who report no change or a decrease.

We also adjust for COVID-19-related factors—financial situation during the pandemic (better off, same as before, worse off) and concern about COVID-19 (0–10)—which have been associated with poor emotional well-being (Abrams et al., 2022; Zheng et al., 2021) and health risk behaviors (Lee et al., 2023; Sampson et al., 2021). Additionally, we control for comorbidities (0–11), functional limitations (0–6), change in household size from 2015 to 2020 (decrease, no change, and increase), interview month (September 2020, October 2020, November 2020, December 2020, and January 2021), and survey mode (web, phone, and paper and pencil). Comorbidities and functional limitations are reported at baseline. Comorbidity scores (0–11) are based on the modified Charlson Comorbidity Index, adapted for NSHAP (Vasilopoulos et al., 2014). Functional limitations (0–6) are measured by summing the number of difficulties in performing the following six Activities of Daily Living: walking across a room; dressing; bathing; eating; getting in or out of bed; and using the toilet (Huisingh-Scheetz et al., 2014).

### Analytic Plan

We first fit a series of generalized linear models predicting each self-reported health behavior during the pandemic (Table 2). For each health behavior, a baseline model presents the effect of infrequent in-person contact with family and friends, adjusting for corresponding baseline health behavior and other covariates. The subsequent model incorporates emotional well-being measures. By including the baseline health behavior, our models capture whether infrequent in-person contact affects health behaviors during COVID-19 holding constant the level of health behaviors in 2015. We use ordered logistic regressions for physical activity and poor sleep, negative binomial regression for drinks per week, and logistic regression for smoking status. Next, we fit a series of multinomial logistic regression models predicting the risk of perceiving worsening health behavior and perceiving improvement of health behavior, where the reference category is perceiving no change in health behavior (Table 3). The main independent variables are decreases in in-person contact with family and friends since the pandemic. The models proceed in the same stepwise fashion, adjusting for the same set of covariates as before. Finally, we use the Karlson/Holm/Breen (KHB; Breen et al., 2013) method to test the hypothesis that emotional well-being during the pandemic mediates the association between social isolation and health behaviors.

To account for attrition from Round 3 to the NSHAP COVID-19 substudy, we apply inverse probability weights to our sample. We first use a logit regression to predict respondents' probability of retention using age, gender, race, education, marital status, self-reported physical health, and household size. Then, the inverse of this probability is multiplied by existing NSHAP weights that adjust for nonresponse. Missing data were accounted for with multiple imputations with chained equations ($m$ = 20). Because the KHB method only permits estimating the overall mediation

**Table 1.** Weighted Descriptive Statistics

| | Mean (*SD*) or % | *n* |
|---|---|---|
| **Health behaviors in 2020** | | |
| Physical activity | | 2,496 |
| Never | 13.4% | |
| Less than 1 time per month | 10% | |
| 1–3 times per month | 15.8% | |
| 1–2 times per week | 18.7% | |
| 3 or 4 times per week | 21.8% | |
| 5 or more times per week | 20.3% | |
| Drinks in week | 3.7 (12.8) | 2,396 |
| Smoking | 11.4% | 2,405 |
| Feeling rested in the morning | | 2,453 |
| Never | 5.2% | |
| Rarely | 18.9% | |
| Sometimes | 33% | |
| Most of the time | 42.9% | |
| **Perceived changes in health behavior since the pandemic** | | |
| Physical activity | | 2,487 |
| Decreased | 26.3% | |
| About the same | 62.3% | |
| Increased | 11.4% | |
| Alcohol consumption | | 1,316 |
| Decreased | 13.6% | |
| About the same | 70.9% | |
| Increased | 15.6% | |
| Smoking | | 318 |
| Decreased | 13.4% | |
| About the same | 74.9% | |
| Increased | 11.8% | |
| Feeling rested | | 2,447 |
| Decreased | 14.8% | |
| About the same | 79.3% | |
| Increased | 5.9% | |
| **Social isolation during COVID-19** | | |
| Infrequent in-person contact with family | 61.7% | 2,523 |
| Infrequent in-person contact with friends | 69.2% | 2,518 |
| Decreased in-person contact with family | 36.8% | 2,490 |
| Decreased in-person contact with friends | 38.4% | 2,487 |
| **Emotional well-being during COVID-19** | | |
| Loneliness (0–9) | 3.1 (2.6) | 2,473 |
| Anxiety (0–6) | 1.3 (1.5) | 2,499 |
| Depressive feelings (1–4) | 1.7 (0.9) | 2,519 |
| **Increase in remote modes of contact since the pandemic started** | | |
| Phone calls with family | 24.5% | 2,509 |
| Messages with family | 25.2% | 2,474 |
| Video calls with family | 22.4% | 2,434 |
| Phone calls with friends | 16% | 2,522 |
| Messages with friends | 19.9% | 2,480 |
| Video calls with friends | 16.3% | 2,444 |
| **Sociodemographic and control variables** | | |

**Table 1.** Continued

| | Mean (*SD*) or % | *n* |
|---|---|---|
| Age | 68.7 (9.5) | 2,549 |
| Female | 54.1% | 2,549 |
| Race-ethnicity | | 2,549 |
| White | 75.8% | |
| Black | 12.0% | |
| Non-Black Hispanic | 8.4% | |
| Other | 3.8% | |
| Education | | 2,549 |
| <High school | 11.4% | |
| High school | 24.3% | |
| Some college | 35.2% | |
| College degree or higher | 29.2% | |
| Partnered | 64.3% | 2,512 |
| Functional health: ADLs (0–6) | .46 (1.2) | 2,549 |
| Comorbidities (0–11) | .94 (1.3) | 2,549 |
| Concern about COVID-19 (1–10) | 7.5 (2.7) | 2,447 |
| Financial situation during COVID-19 | | 2,518 |
| Better off | 4.7% | |
| About the same | 73.8% | |
| Worse off | 21.5% | |
| Interview mode | | |
| Web | 52.1% | 2,549 |
| Phone | 10.2% | |
| Paper | 37.7% | |
| Interview month | | 2,521 |
| September | 41.1% | |
| October | 16.3% | |
| November | 25% | |
| December | 9.1% | |
| January | 8.5% | |
| Change in household size | | 2,520 |
| Decrease | 23.9 | |
| No change | 63.9 | |
| Increase | 12.2 | |
| **Baseline health behaviors in 2015 (Round 3)** | | 2,548 |
| Physical activity | | |
| Never | 15.8% | |
| Less than 1 time per month | 8.9% | |
| 1–3 times per month | 10.1% | |
| 1–2 times per week | 16.8% | |
| 3 or 4 times per week | 22.6% | |
| 5 or more times per week | 25.8% | |
| Drinks in week | 3.2 (6.8) | 2,543 |
| Smoking | 15.1% | 2,549 |
| Restless sleep | | 2,543 |
| Rarely or none of the time | 35.1% | |
| Some of the time | 34.4% | |
| Occasionally | 16% | |
| Most of the time | 14.6% | |

*Notes*: ADL = activities of daily living; COVID-19 = Corona Virus Immune Disease-2019.
Descriptive statistics reported here are calculated before multiple imputation. Our regression models account for missing data using multiple imputation.

**Table 2.** Social Isolation and Emotional Well-being During COVID-19 for Predicting Poor Health Behaviors

| | Low physical activity (6 = "never") | | Drinks in week | | Current smoker | | Feeling rested (4 = "never") | |
|---|---|---|---|---|---|---|---|---|
| | Model 1 OR (95%CI) | Model 2 OR (95%CI) | Model 3 IRR (95% CI) | Model 4 IRR (95% CI) | Model 5 OR (95%CI) | Model 6 OR (95%CI) | Model 7 OR (95%CI) | Model 8 OR (95%CI) |
| Physical activity in 2015 (1–6) | 1.43*** [1.35, 1.51] | 1.42*** [1.35, 1.50] | | | | | | |
| Drinks per week in 2015 | | | 1.22*** [1.19, 1.25] | 1.22*** [1.19, 1.25] | | | | |
| Smoker in 2015 | | | | | 126.04*** [71.4, 222.4] | 139.02*** [76.3, 253.2] | | |
| Restless sleep in 2015 (1–4) | | | | | | | 1.50*** [1.38, 1.63] | 1.38*** [1.27, 1.51] |
| Social isolation | | | | | | | | |
| Infrequent in-person family contact during COVID-19 | 1.01 [0.87, 1.17] | 0.99 [0.86, 1.15] | 1.13 [0.87, 1.45] | 1.09 [0.86, 1.38] | 1.50 [0.84, 2.69] | 1.48 [0.85, 2.59] | 1.10 [0.89, 1.35] | 1.05 [0.84, 1.31] |
| Infrequent in-person friend contact during COVID-19 | 1.23 [0.99, 1.54] | 1.22 [0.98, 1.52] | 0.83 [0.64, 1.07] | 0.82 [0.63, 1.06] | 0.61 [0.31, 1.23] | 0.67 [0.34, 1.31] | 0.98 [0.78, 1.22] | 0.91 [0.73, 1.13] |
| Emotional well-being during COVID-19 | | | | | | | | |
| Loneliness (0–9) | | 1.02 [0.98, 1.08] | | 1.05 [0.99, 1.10] | | 0.85* [0.75, 0.98] | | 1.11*** [1.05, 1.17] |
| Anxiety (0–6) | | 1.08 [1.00, 1.18] | | 1.02 [0.92, 1.14] | | 1.17 [0.88, 1.56] | | 1.35*** [1.25, 1.46] |
| Felt depressed (1–4) | | 1.11 [0.96, 1.27] | | 1.06 [0.88, 1.27] | | 1.12 [0.76, 1.66] | | 1.29*** [1.13, 1.47] |
| Increase in remote modes of contact since COVID-19 | | | | | | | | |
| Increased phone family contact | 0.87 [0.68, 1.12] | 0.87 [0.68, 1.12] | 0.83 [0.63, 1.10] | 0.82 [0.63, 1.08] | 1.18 [0.52, 2.64] | 1.23 [0.54, 2.85] | 0.89 [0.69, 1.14] | 0.88 [0.69, 1.13] |
| Increased messaging family contact | 1.10 [0.87, 1.38] | 1.11 [0.87, 1.40] | 1.15 [0.87, 1.51] | 1.14 [0.87, 1.49] | 0.93 [0.48, 1.82] | 0.88 [0.44, 1.76] | 0.87 [0.65, 1.15] | 0.86 [0.65, 1.14] |
| Increased video call family contact | 0.98 [0.76, 1.27] | 0.98 [0.75, 1.28] | 1.13 [0.84, 1.53] | 1.13 [0.84, 1.52] | 1.24 [0.49, 3.14] | 1.30 [0.51, 3.28] | 1.33* [1.05, 1.69] | 1.34* [1.05, 1.69] |
| Increased phone friend contact | 1.05 [0.80, 1.37] | 1.05 [0.80, 1.37] | 0.99 [0.74, 1.32] | 1.01 [0.75, 1.37] | 0.76 [0.37, 1.59] | 0.81 [0.37, 1.79] | 1.25 [0.89, 1.76] | 1.24 [0.86, 1.78] |
| Increased messaging friend contact | 1.00 [0.78, 1.29] | 0.95 [0.73, 1.23] | 0.88 [0.68, 1.14] | 0.82 [0.62, 1.08] | 0.65 [0.22, 1.88] | 0.67 [0.22, 2.02] | 1.08 [0.79, 1.48] | 0.92 [0.68, 1.23] |
| Increased video call friend contact | 0.91 [0.68, 1.21] | 0.90 [0.68, 1.21] | 1.16 [0.82, 1.66] | 1.21 [0.85, 1.72] | 0.25* [0.09, 0.70] | 0.24** [0.08, 0.66] | 0.75* [0.57, 0.98] | 0.72* [0.54, 0.94] |
| Constant | | | 1.87 [0.48, 7.38] | 1.57 [0.40, 6.09] | 0.38 [0.03, 4.51] | 0.46 [0.04, 5.48] | | |
| N | 2,496 | | 2,396 | | 2,405 | | 2,453 | |

*Notes:* ADL = activity of daily living; CI = confidence interval; COVID-19 = Corona Virus Immune Disease-2019; IRR = incident rate ratio; OR = odds ratio. We use ordered logistic regressions for physical activity and poor sleep, negative binomial regression for drinks per week, and logistic regression for smoking status. Regressions also control for age, gender, race/ethnicity, marital status, education at round three, comorbidities at round three, ADL problems at round three, financial situation during COVID-19, concern about COVID-19, change in household size, interview month and survey mode.
*$p < .05$; **$p < .01$; ***$p < .001$ (two-tailed tests).

**Table 3.** Multinomial Logistic Models Predicting Perceived Worsening of Health Behaviors Since COVID-19 Began (Relative Risk Ratios, 95% Confidence Intervals)

| | Physical activity | | Drinking | | Smoking | | Feeling rested | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | Less vs about the same | | More vs about the same | | More vs about the same | | Less vs about the same | |
| | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 | Model 7 | Model 8 |
| **Social isolation** | | | | | | | | |
| Decrease in in-person family contact since COVID-19 | 1.88*** [1.42, 2.48] | 1.77*** [1.32, 2.37] | 1.52* [1.07, 2.16] | 1.47* [1.03, 2.09] | 1.81 [0.43, 7.51] | 2.03 [0.51, 8.13] | 1.51* [1.04, 2.20] | 1.45 [0.99, 2.14] |
| Decrease in in-person friend contact since COVID-19 | 1.71*** [1.31, 2.24] | 1.52** [1.17, 1.98] | 2.04** [1.34, 3.12] | 1.66* [1.07, 2.59] | 1.07 [0.33, 3.51] | 0.91 [0.29, 2.85] | 1.86** [1.33, 2.75] | 1.60* [1.07, 2.39] |
| **Emotional well-being during COVID-19** | | | | | | | | |
| Loneliness (0–9) | | 1.20*** [1.13, 1.28] | | 1.20** [1.07, 1.36] | | 1.01 [0.80, 1.29] | | 1.27*** [1.18, 1.37] |
| Anxiety (0–6) | | 1.07 [0.96, 1.20] | | 1.20 [1.00, 1.46] | | 1.15 [0.78, 1.69] | | 1.12 [0.99, 1.27] |
| Felt depressed (1–4) | | 0.91 [0.76, 1.10] | | 1.16 [0.83, 1.62] | | 1.22 [0.55, 2.70] | | 1.34** [1.08, 1.66] |
| **Increase in remote modes of contact since COVID-19** | | | | | | | | |
| Increased phone family contact | 1.00 [0.70, 1.43] | 0.96 [0.66, 1.39] | 1.06 [0.59, 1.91] | 1.14 [0.62, 2.11] | 1.90 [0.50, 7.27] | 1.97 [0.55, 7.11] | 0.95 [0.65, 1.37] | 0.94 [0.66, 1.35] |
| Increased messaging family contact | 1.12 [0.81, 1.54] | 1.16 [0.84, 1.60] | 1.14 [0.65, 1.99] | 1.07 [0.59, 1.93] | 0.50 [0.11, 2.35] | 0.54 [0.12, 2.42] | 1.01 [0.71, 1.42] | 1.07 [0.73, 1.57] |
| Increased video call family contact | 0.96 [0.68, 1.36] | 0.96 [0.68, 1.37] | 1.12 [0.61, 2.05] | 1.15 [0.62, 2.12] | 1.87 [0.38, 9.08] | 2.11 [0.39, 11.43] | 1.64** [1.13, 2.39] | 1.82** [1.24, 2.69] |
| Increased phone friend contact | 1.75** [1.24, 2.48] | 1.76** [1.24, 2.49] | 1.63 [0.86, 3.08] | 1.62 [0.80, 3.26] | 0.53 [0.11, 2.60] | 0.39 [0.07, 2.29] | 1.31 [0.78, 2.20] | 1.39 [0.79, 2.46] |
| Increased messaging friend contact | 1.26 [0.90, 1.76] | 1.16 [0.83, 1.62] | 1.22 [0.72, 2.07] | 1.16 [0.67, 2.02] | 5.10 [0.93, 28.04] | 4.72 [0.84, 26.46] | 1.72* [1.05, 2.82] | 1.50 [0.90, 2.51] |
| Increased video call friend contact | 0.93 [0.66, 1.33] | 0.96 [0.67, 1.38] | 1.10 [0.57, 2.12] | 1.13 [0.57, 2.24] | 0.49 [0.06, 4.17] | 0.47 [0.06, 3.87] | 0.71 [0.43, 1.15] | 0.70 [0.42, 1.17] |
| Constant | 0.29 [0.08, 1.05] | 0.18 [0.05, 0.65] | 0.67 [0.07, 6.41] | 0.22 [0.02, 2.07] | 12.75 [0.12, 1376.4] | 8.97 [0.05, 1475.6] | 0.24 [0.06, 1.01] | 0.06*** [0.01, 0.26] |
| *N* | 2,487 | | 1,316 | | 318 | | 2,447 | |

*Notes:* ADL = activity of daily living; COVID-19 = Corona Virus Immune Disease-2019.
Regressions also control for age, gender, race/ethnicity, marital status, education at round three, comorbidities at round three, ADL problems at round three, increase in remote modes of contact, financial situation during COVID-19, concern about COVID-19, change in household size, interview month and survey mode. Models predicting perceived improvement of health behaviors (i.e., more physical activity, less drinking, less smoking, and feeling more rested) relative to perceiving no change are shown in Supplementary Table 2 and 3.
*$p$ < .05; **$p$ < .01; ***$p$ < .001 (two-tailed tests).

effect with imputed data, mediation analyses are carried out using non-imputed data to quantify and compare the contribution of each mediator—loneliness, anxiety, and depressive feelings—to the association between social isolation and health behaviors. All models also use the NSHAP sample clustering and stratification to account for sample selection (O'Muircheartaigh et al., 2021). All analyses are conducted using Stata 16.0.

## Results

### Sample Characteristics

Table 1 shows weighted descriptive statistics for all study variables. The average age of the respondents was 69. The sample was slightly more female than male (54%). A majority of respondents were white (76%), had some college or higher level of education (64%), and were partnered (64%).

Approximately two-thirds of the sample reported seeing family (62%) and friends (69%) less than once a week or never during a typical week since the pandemic started. The correlation between low in-person contact with family and low in-person contact with friends was 0.3. About four in ten respondents experienced a decline in in-person contact with family (37%) and friends (38%), with the two correlated at 0.45, suggesting that those who reduced contact with family also reduced contact with friends.

Around 23% of the sample reported doing physical activity less than once a month or never. Respondents reported that they consume 3.7 drinks on average per week. Current smokers accounted for 11% of the sample. More than half of the sample (57%) reported that they sometimes, rarely, or never feel rested in the morning. A decrease in physical activity was the most common worsening health behavior. About one in four people perceived a decrease in physical activity since the pandemic started (26%). This was followed by 16% of the sample reporting increased alcohol consumption, 15% reporting feeling less rested after sleep, and 12% reporting increased smoking.

### Poor Health Behaviors During COVID-19

Table 2 shows odds ratios predicting low physical activity levels (Models 1 and 2), current smoking status (Models 5 and 6), and poor sleep quality (Models 7 and 8), and incident rate ratios predicting drinks per week (Models 3 and 4) in 2020 net of these health behaviors in 2015. This table shows estimates only for measures of social isolation, increase in remote modes of contact, and emotional well-being but the models include all the covariates described previously (see Supplementary Table 1).

Results show no evidence of an association between social isolation and poor health behaviors during COVID-19. We also find little evidence that increases in remote modes of contact during COVID-19 are associated with poor health behaviors. Increases in video call contact are the only measure that shows some association with poor health behaviors—current smoking status and poor sleep quality, specifically. However, the positive or negative association depends on whether the contact was made with friends or family. Older adults who reported an increase in video call contact with friends had lower odds of being a current smoker (OR = 0.25, $p < .05$) and being in a worse sleep quality category (OR = 0.75, $p < .05$). On the other hand, increase in video call contact with family was associated with worse quality sleep (OR = 1.33, $p$

$< .05$). These associations remained the same after including emotional well-being measures.

Emotional well-being during the pandemic was not related to low physical activity or a number of drinks but was associated with current smoking status and poor sleep quality. Those who reported higher loneliness had lower odds of smoking during the pandemic (OR = 0.85, $p < .05$). All three emotional well-being measures—loneliness (OR = 1.11, $p < .001$), anxiety (OR = 1.35, $p < .001$), and depressive feelings (OR = 1.29, $p < .001$)—were associated with higher odds of poor sleep. In all cases, previous levels of the behavior strongly predicted the same behaviors during the pandemic. These results provide no evidence for our first hypothesis that those who rarely had in-person contact with family and friends will be more likely to engage in poor health behaviors net of previous levels.

Additionally, we find associations between COVID-19-related factors—concern about COVID-19 and financial situation since COVID-19—and poor health behaviors (see Supplementary Table 1). Unexpectedly, higher concern about COVID-19 was associated with fewer number of drinks per week and lower odds of being in a worse poor sleep quality category, suggesting that perhaps those with higher concern about COVID-19 are trying to maintain a healthy lifestyle. At the same time, it could also be that those who engage in healthy behaviors are more likely to be concerned about COVID-19. Respondents who are financially better off since COVID-19 reported fewer drinks per week and were at lower odds of being in a lower physical activity level compared with respondents reporting no change.

### Perceived Worsening of Health Behaviors Since the Pandemic Started

Table 3 shows results from multinomial logistic regression models predicting perceived changes in health behaviors since the start of the pandemic. Perceived worsening and improvement of health behaviors are compared to perceiving no change, the reference category. Declines in in-person contact during COVID-19 were not associated with perceived improvement in any health behaviors, so we report only the perceived worsening of health behaviors here. The full results are shown in Supplementary Tables 2 and 3. In general, a reduction in in-person contact since the pandemic was associated with the worsening of all health behaviors except smoking. These results are consistent and appear for decreases in contact both with family and with friends. The single exception is that we see no association between decreases in contact with family and poor sleep. An increase in remote modes of contact was generally not associated with worsening health behaviors.

Table 3, Models 1–4 show that decreases in in-person contact since COVID-19 are associated with perceptions of reduced physical activity and increased drinking. Older adults who reported a decrease in in-person contact with family (RRR = 1.88, $p < .001$) and friends (RRR = 1.71, $p < .001$) were at higher risk of perceiving a decrease in physical activity versus perceiving no change (Model 1). Similarly, there was a significant association between a decrease in in-person contact with family (RRR = 1.52, $p < .05$) and friends (RRR = 2.04, $p < .01$) and a perceived increase in drinking (Model 3). These findings remained robust after loneliness, anxiety, and depressive feelings were included in Model 2 for physical activity and Model 4 for drinking. Anxiety and depressive feelings showed no effect, but higher levels of loneliness

are associated with perceiving a decrease in physical activity (RRR = 1.20, $p < .001$) and an increase in drinking (RRR = 1.20, $p < .01$). Although remote modes of contact were not associated with increased drinking, increase in phone contact with friends was associated with perceiving a decrease in physical activity (RRR = 1.76, $p < .01$).

Models 5 and 6 of Table 3 report the results of increased smoking. We find no significant associations between the decrease in in-person contact and increased smoking. As shown in Model 6, emotional well-being was also not associated with increased smoking.

Models 7 and 8 of Table 3 show the analysis of perceived worsening sleep quality. Both decrease in in-person contact with family (RRR = 1.51, $p < .05$) and friends (RRR = 1.86, $p < .01$) were associated with a higher risk of reporting feeling less rested relative to perceiving no change (Model 7). However, the decrease in in-person contact with family was no longer significant when emotional well-being measures were included (Model 8). Loneliness (RRR = 1.27, $p < .001$) and depressive feelings (RRR = 1.34, $p < .01$) were found to have a positive association with feeling less rested since the pandemic. Older adults who increased video contact with family were also at a higher risk of feeling less rested relative to perceiving no change (RRR = 1.82, $p < .01$).

These results provide partial support for our second hypothesis, that those who reported a decline in in-person contact with family and with friends would be more likely to perceive that their health behaviors had gotten worse. We see no evidence of this for increased smoking but strong support for decreases in in-person contact with both family and friends for physical activity, drinking, and sleep quality.

Corona Virus Immune Disease-2019 (COVID-19)-related factors are also associated with the perceived worsening of some health behaviors (see Supplementary Tables 2 and 3). Higher concern about COVID-19 was associated with higher risks of perceiving decreased physical activity. Compared to respondents who reported no change, respondents who reported that they were financially worse off since the pandemic were at higher risks of perceiving increased smoking and decreased sleep quality.

### Mediation Effects

Table 4 shows the results from the KHB mediation analyses, which test our third hypothesis, that emotional well-being mediates the relationship between social isolation and health behaviors. "Indirect effects" show how much of the relationship between social isolation and health behaviors, adjusted for covariates, is explained by emotional well-being. We only test the mediating role of emotional well-being when social isolation was a significant predictor of the outcome measure in the main analysis. When more than one social isolation measure was statistically significant, we included all significant measures in the mediation analysis as the KHB method allows the decomposition of multiple key variables simultaneously. Results reveal that emotional well-being partially mediates the effect of a decrease in in-person contact on perceived worsening of health behaviors. We also find that the degree of mediation is larger for loneliness than for anxiety and depressive feelings.

Specifically, emotional well-being accounts for 11.8% of the effect of a decrease in in-person family contact on the decrease in physical activity (Path A) and 29.4% of the effect of a decrease in in-person friend contact on the decrease in

physical activity (Path B). Loneliness contributes heavily, as it explains 11.5% out of the 11.8% of the mediation effect for Path A and 28% out of the 29.4% of the mediation effect for Path B. Emotional well-being does not mediate the association between decrease in in-person family contact and increase in drinking (Path C), but it explains 33.9% (21.9% via loneliness, 7.2% via anxiety, and 4.8% via depressive feelings, respectively) of the effect of decrease in in-person friend contact and increase in drinking (Path D). Finally, while we see no evidence of mediation in the association of decreased in-person contact with family and decrease in sleep quality (Path E), emotional well-being explains about 33.8% (26.8% via loneliness, 3.8% via anxiety, and 3.2% via depressive feelings, respectively) of the effect of a decrease in in-person friend contact on the decrease in sleep quality (Path F). These results provide strong partial support for our third hypothesis, that emotional well-being mediates the association between in-person contact and health behaviors. We find evidence of this for decreased in-person contact with friends and perceived worsening of health behaviors, with loneliness playing a prominent role.

## Discussion

This study addressed the overarching question: Did the social isolation that accompanied the COVID-19 pandemic put older adults at risk of poor and worsening health behaviors? Specifically, we examined whether social isolation as assessed by low levels of in-person contact and by decreases in in-person contact during the pandemic is associated with self-reported poor health behaviors during the pandemic and perceived worsening of health behaviors since the pandemic began. We focused on four health behaviors: physical activity; alcohol consumption; smoking; and sleep quality. We also examined the role of loneliness, anxiety, and depressive symptoms as mediators in the relationship between social isolation and worsening health behaviors. We find partial support for the hypothesis that older adults with decreases in in-person contact with family and/or friends face higher odds of perceived worsening of health behavior. We find strong support for our hypothesis that emotional well-being mediates this relationship for in-person contact with friends, and less support for family.

This study makes three key contributions to the growing knowledge of older adults' experience during the pandemic. First, our results and the findings of others about the pandemic highlight the importance of in-person social contact. A decrease in in-person contact was associated with worsening health behaviors, even after adjusting for increased use of remote modes of contact. Notably, an increase in remote modes of contact for the most part did not show an association with health behaviors. Furthermore, remote modes that were associated with health behaviors showed conflicting results. These results suggest that older adults who are seeing family and friends in-person less often during the pandemic are at a greater risk of worsening health behaviors and that an increase in remote modes of contact does not make up for the decreased in-person contact. Our findings are consistent with recent studies that showed in-person contact has benefits for emotional well-being not duplicated by remote contact, even if "face-to-face" via technological means (Hawkley et al., 2021; Litwin & Levinsky, 2021). Identifying what is particular to in-person contact compared with other remote

**Table 4.** KHB Mediation Analysis Results by Emotional Well-being

| Decrease in physical activity | A. Decrease in in-person family contact → Emotional well-being → Decrease in physical activity | | | B. Decrease in in-person friend contact → Emotional well-being → Decrease in physical activity | | |
|---|---|---|---|---|---|---|
| | Coefficient | Z | Explained (%) | Coefficient | Z | Explained (%) |
| Total effect | 0.666*** | 3.66 | | 0.502** | 3.10 | |
| Direct effect | 0.588** | 3.20 | 88.2 | 0.354* | 2.23 | 70.6 |
| Indirect effect | 0.079* | 2.00 | 11.8 | 0.148** | 3.31 | 29.4 |
| via loneliness | | | 11.5 | | | 28.0 |
| Via anxiety | | | 0.9 | | | 2.0 |
| Via depressive feelings | | | −0.6 | | | −0.6 |
| Increase in drinking | C. Decrease in in-person family contact → Emotional well-being → Increase in drinking | | | D. Decrease in in-person friend contact → Emotional well-being → Increase in drinking | | |
| | Coefficient | Z | Explained (%) | Coefficient | Z | Explained (%) |
| Total effect | 0.542* | 2.59 | | 0.790** | 3.33 | |
| Direct effect | 0.464* | 2.24 | 85.7 | 0.522* | 2.18 | 66.1 |
| Indirect effect | 0.078 | 0.96 | 14.3 | 0.268** | 2.89 | 33.9 |
| Via loneliness | | | | | | 21.9 |
| Via anxiety | | | | | | 7.2 |
| Via depressive feelings | | | | | | 4.8 |
| Feeling less rested | E. Decrease in in-person family contact → Emotional well-being → Feeling less rested | | | F. Decrease in in-person friend contact → Emotional well-being → Feeling less rested | | |
| | Coefficient | Z | Explained (%) | Coefficient | Z | Explained (%) |
| Total effect | 0.506* | 2.42 | | 0.695*** | 3.54 | |
| Direct effect | 0.372 | 1.79 | 73.5 | 0.460* | 2.32 | 66.2 |
| Indirect effect | 0.134 | 1.76 | 26.5 | 0.235** | 2.93 | 33.8 |
| Via loneliness | | | | | | 26.8 |
| Via anxiety | | | | | | 3.8 |
| Via depressive feelings | | | | | | 3.2 |

*Notes*: All models adjust for covariates are shown in Table 3. Analyses were carried out using non-imputed data.
*p < .05; ** p < .01; ***p < .001 (two-tailed tests).

modes is beyond the scope of this paper, but we speculate that social support and social control, which are mechanisms that link social ties to health behavior, might operate differently in-person. Social support can be exchanged via remote modes of contact, but there may be needs for various types of support that go unnoticed unless family or friends make an in-person visit. Similarly, social control involves family and friends taking deliberate actions to change a person's health behavior. We speculate that social control is likely most effective when family and friends can intervene in-person than by remote contact. Future research should explore why and how in-person contact differs from other remote modes of contact in shaping older adults' health and health behaviors.

Second, our findings point to the importance of change during the pandemic, with declines in in-person social contact linked to perceptions that health behaviors have gotten worse. As we hypothesized, those who reported a decline in their frequency of in-person contact were significantly more likely to report a decline in their health behaviors. This was the case for both in-person contact with family and in-person contact with friends, for decreased physical activity and increased drinking. Decreased sleep quality was associated with in-person contact with friends, but not family. Increased smoking was not associated with in-person contact.

These self-reported changes in in-person contact and health behaviors capture older adults' perceptions of change. The

structure of the NSHAP COVID-19 substudy questions about changes in social and health behaviors captures each respondent's *subjective evaluation* of the changes. We argue that this approach and the information it captures are fundamentally different in important ways from the usual approach of simply asking people how often a behavior currently occurs. Two respondents may report the same current frequency of in-person contact with family during the pandemic, but the two may differ in whether this frequency is enough to meet their wants and needs, or whether this is less than they were accustomed to pre-pandemic—key considerations that may have implications for their health behaviors.

The answers to questions that ask people how much things have changed reflect at least in part how the individual *feels* about the change. Thus, our measurement of the number of drinks during the pandemic reflects the amount and allows us to measure changes in a number of drinks, whereas the respondent's self-assessment of whether this was more, about the same, or less may also capture the accompanying sense of loss or gain. The same evaluation could affect responses on how in-person contact has changed, with those who very much miss the contact rating even an objectively small decline in contact frequency as "less."

Self-perceived changes may be more important than self-reported levels in capturing older adults' well-being during the pandemic as they reflect the disruption caused by COVID-19.

Our finding corresponds to prior research that shows measures that reflect perceptions such as self-rated health (Idler & Benyamini, 1997) and perceived social support (Thoits, 2011) are correlated with health and mortality at least as strongly as more objective measures. In the context of COVID-19, older adults may be integrating their experience of disruptive change when they report self-perceived changes.

Third, our study provides a potential underlying mechanism—emotional well-being– linking a decrease in in-person contact and worsening health behaviors. Extant research has documented changes in health behaviors during COVID-19, but studies rarely examined why these changes might be occurring. We hypothesized that emotional well-being would mediate some of the relationships between in-person contact and health behaviors during the pandemic and find some support for this. Our findings are in line with recent studies suggesting that decreases in-person contact increase depressive feelings and loneliness (N. G. Choi et al., 2022; Teo et al., 2015). Such feelings stemming from decreased in-person contact may, in turn, lead to worsening health behaviors, as documented by previous research (Benson et al., 2021; Hawkley et al., 2009). Notably, our results from the mediation analysis show mediation by emotional well-being is stronger for decreases in in-person contact with friends than for family. This difference may in part be due to the different functions and support provided by family and friends (Huxhold et al., 2014; Wellman & Wortley, 1990). Friendships are based on reciprocity, and they tend to provide companionship. Spending less time with friends in-person during the pandemic is likely associated with loneliness as friends are maintained through socializing with each other. Indeed, our findings showed that loneliness explained most of the mediation effect among the three emotional well-being indicators. On the other hand, worsening health behaviors owing to seeing family members less often during the pandemic likely also involves other mediators such as material and instrumental support and social control, which our study did not test. For example, both family and friends can directly discourage negative health behaviors through social control, but, unlike family ties, friendship might dissolve if one feels the intervention to be overbearing or that the recipient of the attempts at control is unresponsive (Offer & Fischer, 2018).

Our study has some limitations. First, our study did not account for relationship quality. Declines in contact with close friends and family may have effects that more distant ties do not. Second, we only look at nonresident family ties in our model. Though we speculate that the impact of the pandemic on older adults' relationship to resident family ties is smaller compared to the impact on nonresident family ties, measures that assess both resident and nonresident family ties would provide more insight into family relationships during COVID-19. Third, we cannot determine causality as most of the covariates are measured at only one point in time. Despite these shortcomings, our study is one of the few that tested the association between in-person contact and health behaviors while adjusting for other modes of contact. Studies prior to COVID-19 mostly measured social contact without this differentiation. Our study also includes baseline health behaviors in 2015, which allowed us to look at changes in health behaviors over time.

In conclusion, our results point to the unique role of in-person interaction for social well-being. Even before the outbreak of COVID-19, social isolation among older adults has been recognized as a serious public health concern that is associated with morbidity and mortality. Although remote modes of contact such as the phone or the Internet seem promising in facilitating social interactions, our study shows that in-person contact may play a distinct role in shaping older adults' health behaviors and well-being, not compensated by remote modes of contact. The pandemic has offered an unusual opportunity to assess the role of in-person contact in many areas of life, which could result in major advances in our understanding of human behavior. Future research should further investigate the disruption in in-person contact by the COVID-19 pandemic and its long-term implications for older adults' social integration and well-being.

## Supplementary Material

Supplementary data are available at *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences* online.

## Funding

## Conflict of Interest

A.K. reports personal consulting fees from Papa Inc. outside of the submitted research.

## Author Contributions

K.W. Choi, L.J. Waite, L. Finch, and A. Kotwal planned the study. K.W. Choi and L.J. Waite designed the data analyses. K.W. Choi performed the data analyses. K.W. Choi and L.J. Waite wrote the initial draft of the manuscript. K.W. Choi, L.J. Waite, L. Finch, and A. Kotwal revised the article.

## References

Abrams, L. R., Finlay, J. M., & Kobayashi, L. C. (2022). Job transitions and mental health outcomes among U.S. adults aged 55 and older during the COVID-19 pandemic. *Journals of Gerontology, Series B: Psychological Sciences and Social Sciences*, 77(7), e106–e116. https://doi.org/10.1093/geronb/gbab060

Benson, J. A., McSorley, V. E., Hawkley, L. C., & Lauderdale, D. S. (2021). Associations of loneliness and social isolation with actigraph and self-reported sleep quality in a national sample of older adults. *Sleep*, 44(1), zsaa140. https://doi.org/10.1093/sleep/zsaa140

Berkman, L. F., Glass, T., Brissette, I., & Seeman, T. E. (2000). From social integration to health: Durkheim in the new millennium. *Social Science & Medicine*, 51(6), 843–857. https://doi.org/10.1016/S0277-9536(00)00065-4

Blok, D. J., de Vlas, S. J., van Empelen, P., & van Lenthe, F. J. (2017). The role of smoking in social networks on smoking cessation and relapse among adults: A longitudinal study. *Preventive Medicine*, 99, 105–110. https://doi.org/10.1016/j.ypmed.2017.02.012

Breen, R., Karlson, K. B., & Holm, A. (2013). Total, direct, and indirect effects in logit and probit models. *Sociological Methods & Research*, 42(2), 164–191. https://doi.org/10.1177/0049124113494572

Choi, E. Y., Farina, M. P., Wu, Q., & Ailshire, J. (2021). COVID-19 social distancing measures and loneliness among older adults. *Journals of Gerontology, Series B: Psychological Sciences and Social Sciences*, 77(7), e167–e178. https://doi.org/10.1093/geronb/gbab009

Choi, H., Schoeni, R. F., Langa, K. M., & Heisler, M. M. (2015). Older adults' residential proximity to their children: Changes after cardiovascular events. *Journals of Gerontology, Series B: Psychological Sciences and Social Sciences*, 70(6), 995–1004. https://doi.org/10.1093/geronb/gbu076

Choi, N. G., Hammaker, S., DiNitto, D. M., & Marti, C. N. (2022). COVID-19 and loneliness among older adults: Associations with mode of family/friend contacts and social participation. *Clinical Gerontologist*, 45(2), 390–402. https://doi.org/10.1080/07317115.2021.2013383

Cornwell, E. Y., & Waite, L. J. (2009). Social disconnectedness, perceived isolation, and health among older adults. *Journal of Health and Social Behavior*, 50(1), 31–48. https://doi.org/10.1177/002214650905000103

Cornwell, E. Y., & Waite, L. J. (2012). Social network resources and management of hypertension. *Journal of Health and Social Behavior*, 53(2), 215–231. https://doi.org/10.1177/0022146512446832

DiPietro, L. (2001). Physical activity in aging: Changes in patterns and their relationship to health and function. *Journals of Gerontology, Series A: Biological Sciences and Medical Sciences*, 56(Suppl 2), 13–22. https://doi.org/10.1093/gerona/56.suppl_2.13

Ferrante, G., Camussi, E., Piccinelli, C., Senore, C., Armaroli, P., Ortale, A., Garena, F., & Giordano, L. (2020). Did social isolation during the SARS-CoV-2 epidemic have an impact on the lifestyles of citizens? *Epidemiologia & Prevenzione*, 44(5–6 Suppl 2), 353–362. https://doi.org/10.19191/EP20.5-6.S2.137

Fluharty, M., Taylor, A. E., Grabski, M., & Munafò, M. R. (2017). The association of cigarette smoking with depression and anxiety: A systematic review. *Nicotine & Tobacco Research*, 19(1), 3–13. https://doi.org/10.1093/ntr/ntw140

Gaggero, A. (2023). The consequences of the Coronavirus Disease 2019 pandemic on smoking behavior: Evidence from the English longitudinal study of ageing. *Nicotine & Tobacco Research*, 25(2), 261–265. https://doi.org/10.1093/ntr/ntac097

Goldman, A. W., & Cornwell, B. (2015). Social network bridging potential and the use of complementary and alternative medicine in later life. *Social Science & Medicine*, 140, 69–80. https://doi.org/10.1016/j.socscimed.2015.07.003

Hawkley, L. C., Finch, L. E., Kotwal, A. A., & Waite, L. J. (2021). Can remote social contact replace in-person contact to protect mental health among older adults? *Journal of the American Geriatrics Society*, 69(11), 3063–3065. https://doi.org/10.1111/jgs.17405

Hawkley, L. C., Thisted, R. A., & Cacioppo, J. T. (2009). Loneliness predicts reduced physical activity: Cross-sectional & longitudinal analyses. *Health Psychology: Official Journal of the Division of Health Psychology, American Psychological Association*, 28(3), 354–363. https://doi.org/10.1037/a0014400

Hoffman, G. J., Malani, P. N., Solway, E., Kirch, M., Singer, D. C., & Kullgren, J. T. (2022). Changes in activity levels, physical functioning, and fall risk during the COVID-19 pandemic. *Journal of the American Geriatrics Society*, 70(1), 49–59. https://doi.org/10.1111/jgs.17477

Holt-Lunstad, J., Smith, T. B., Baker, M., Harris, T., & Stephenson, D. (2015). Loneliness and social isolation as risk factors for mortality: A meta-analytic review. *Perspectives on Psychological Science*, 10(2), 227–237. https://doi.org/10.1177/1745691614568352

Huisingh-Scheetz, M., Kocherginsky, M., Schumm, P. L., Engelman, M., McClintock, M. K., Dale, W., Magett, E., Rush, P., & Waite, L. (2014). Geriatric syndromes and functional status in NSHAP: Rationale, measurement, and preliminary findings. *Journals of Gerontology, Series B: Psychological Sciences & Social Sciences*, 69(Suppl 2), S177–S190. https://doi.org/10.1093/geronb/gbu091

Huxhold, O., Miche, M., & Schüz, B. (2014). Benefits of having friends in older ages: Differential effects of informal social activities on well-being in middle-aged and older adults. *Journals of Gerontology, Series B: Psychological Sciences & Social Sciences*, 69(3), 366–375. https://doi.org/10.1093/geronb/gbt029

Idler, E. L., & Benyamini, Y. (1997). Self-rated health and mortality: A review of twenty-seven community studies. *Journal of Health and Social Behavior*, 38(1), 21–37. https://doi.org/10.2307/2955359

Ikeda, T., Cable, N., Saito, M., Koyama, S., Tsuji, T., Noguchi, T., Kondo, K., Osaka, K., & Aida, J. (2021). Association between social isolation and smoking in Japan and England. *Journal of Epidemiology*, 31(10), 523–529. https://doi.org/10.2188/jea.JE20200138

Jokela, M., García-Velázquez, R., Gluschkoff, K., Airaksinen, J., & Rosenström, T. (2020). Health behaviors and psychological distress: Changing associations between 1997 and 2016 in the United States. *Social Psychiatry and Psychiatric Epidemiology*, 55(3), 385–391. https://doi.org/10.1007/s00127-019-01741-7

Kim, H. H., & Jung, J. H. (2021). Social isolation and psychological distress during the COVID-19 Pandemic: A cross-national analysis. *Gerontologist*, 61(1), 103–113. https://doi.org/10.1093/geront/gnaa168

Kobayashi, L. C., & Steptoe, A. (2018). Social isolation, loneliness, and health behaviors at older ages: Longitudinal cohort study. *Annals of Behavioral Medicine*, 52(7), 582–593. https://doi.org/10.1093/abm/kax033

Lee, K., Sayre, B., Martin, S., James, T. A., & Duarte, A. (2023). Covid-19-stress associated with worse sleep quality, particularly with increasing age. *Journals of Gerontology, Series B: Psychological Sciences & Social Sciences*, 78(7), 1163–1168. https://doi.org/10.1093/geronb/gbac173

Lefferts, E. C., Saavedra, J. M., Song, B. K., & Lee, D. (2022). Effect of the COVID-19 pandemic on physical activity and sedentary behavior in older adults. *Journal of Clinical Medicine*, 11(6), 1568. https://doi.org/10.3390/jcm11061568

Litwin, H., & Erlich, B. (2023). The short and long-term correlates of change in loneliness status: The role of epidemic control measures during the COVID-19 pandemic. *Journal of Aging & Social Policy*, 0(0), 1–16. https://doi.org/10.1080/08959420.2023.2226292

Litwin, H., & Levinsky, M. (2021). Social networks and mental health change in older adults after the COVID-19 outbreak. *Aging & Mental Health*, 26(0), 925–931. https://doi.org/10.1080/13607863.2021.1902468

McHugh, J. E., & Lawlor, B. A. (2013). Perceived stress mediates the relationship between emotional loneliness and sleep quality over time in older adults. *British Journal of Health Psychology*, 18(3), 546–555. https://doi.org/10.1111/j.2044-8287.2012.02101.x

McHugh, R. K., & Weiss, R. D. (2019). Alcohol use disorder and depressive disorders. *Alcohol Research: Current Reviews*, 40(1), arcr.v40.1.01. https://doi.org/10.35946/arcr.v40.1.01

McLay, L., Jamieson, H. A., France, K. G., & Schluter, P. J. (2021). Loneliness and social isolation is associated with sleep problems among older community dwelling women and men with complex needs. *Scientific Reports*, 11(1), Article 1. https://doi.org/10.1038/s41598-021-83778-w

Megherbi-Moulay, O., Igier, V., Julian, B., Franchitto, N., & Sordes, F. (2022). Alcohol use in older adults: A systematic review of biopsychosocial factors, screening tools, and treatment options. *International Journal of Mental Health and Addiction*, 1–43. https://doi.org/10.1007/s11469-022-00974-z

Mesas, A. E., Peppard, P. E., Hale, L., Friedman, E. M., Nieto, F. J., & Hagen, E. W. (2020). Individuals' perceptions of social support from family and friends are associated with lower risk of sleep complaints and short sleep duration. *Sleep Health*, 6(1), 110–116. https://doi.org/10.1016/j.sleh.2019.08.013

National Institutes of Health. (2020). *National Social Life, Health, and Aging Project (NSHAP) COVID-19 study: Survey questionnaire.*

*Disaster research response (DR2) Resources portal*. https://tools.niehs.nih.gov/dr2/index.cfm/resource/24240

Nordeck, C. D., Riehm, K. E., Smail, E. J., Holingue, C., Kane, J. C., Johnson, R. M., Veldhuis, C. B., Kalb, L. G., Stuart, E. A., Kreuter, F., & Thrul, J. (2022). Changes in drinking days among United States adults during the COVID-19 pandemic. *Addiction*, 117(2), 331–340. https://doi.org/10.1111/add.15622

Offer, S., & Fischer, C. S. (2018). Difficult people: Who is perceived to be demanding in personal networks and why are they there? *American Sociological Review*, 83(1), 111–142. https://doi.org/10.1177/0003122417737951

O'Muircheartaigh, C., English, N., Pedlow, S., & Schumm, L. P. (2021). Sample design and estimation in the national social life, health, and aging project: Round 3 (2015–2016). *Journals of Gerontology, Series B: Psychological Sciences & Social Sciences*, 76(Suppl 3), S207–S214. https://doi.org/10.1093/geronb/gbab182

Otaki, N., Yokoro, M., Yano, M., Imamura, T., Akita, M., Tanino, N., & Fukuo, K. (2022). Social contact impacts physical activity and sedentary behavior among older adults in Japan due to COVID-19. *BMC Geriatrics*, 22(1), 491. https://doi.org/10.1186/s12877-022-03188-z

Payne, C., Hedberg, E. C., Kozloski, M., Dale, W., & McClintock, M. K. (2014). Using and interpreting mental health measures in the national social life, health, and aging project. *Journals of Gerontology, Series B: Psychological Sciences & Social Sciences*, 69(Suppl 2), S99–S116. https://doi.org/10.1093/geronb/gbu100

Philip, K. E., Bu, F., Polkey, M. I., Brown, J., Steptoe, A., Hopkinson, N. S., & Fancourt, D. (2022). Relationship of smoking with current and future social isolation and loneliness: 12-year follow-up of older adults in England. *Lancet Regional Health: Europe*, 14, 100302. https://doi.org/10.1016/j.lanepe.2021.100302

Philip, K. E. J., Polkey, M. I., Hopkinson, N. S., Steptoe, A., & Fancourt, D. (2020). Social isolation, loneliness and physical performance in older-adults: Fixed effects analyses of a cohort study. *Scientific Reports*, 10(1), Article 1. https://doi.org/10.1038/s41598-020-70483-3

Pinquart, M., & Sörensen, S. (2000). Influences of socioeconomic status, social network, and competence on subjective well-being in later life: A meta-analysis. *Psychology and Aging*, 15, 187–224. https://doi.org/10.1037//0882-7974.15.2.187

Robb, C. E., de Jager, C. A., Ahmadi-Abhari, S., Giannakopoulou, P., Udeh-Momoh, C., McKeand, J., Price, G., Car, J., Majeed, A., Ward, H., & Middleton, L. (2020). Associations of social isolation with anxiety and depression during the early COVID-19 pandemic: A survey of older adults in London, UK. *Frontiers in Psychiatry*, 11, 591120. https://doi.org/10.3389/fpsyt.2020.591120

Robbins, R., Quan, S. F., Weaver, M. D., Bormes, G., Barger, L. K., & Czeisler, C. A. (2021). Examining sleep deficiency and disturbance and their risk for incident dementia and all-cause mortality in older adults across 5 years in the United States. *Aging (Albany, NY)*, 13(3), 3254–3268. https://doi.org/10.18632/aging.202591

Rogers, R. G., Hummer, R. A., Krueger, P. M., & Pampel, F. C. (2005). Mortality attributable to cigarette smoking in the United States. *Population and Development Review*, 31(2), 259–292. https://doi.org/10.1111/j.1728-4457.2005.00065.x

Sampson, L., Ettman, C. K., Abdalla, S. M., Colyer, E., Dukes, K., Lane, K. J., & Galea, S. (2021 ). Financial hardship and health risk behavior during COVID-19 in a large US national sample of women. *SSM - Population Health*, 13, 100734. https://doi.org/10.1016/j.ssmph.2021.100734

Santini, Z. I., Jose, P. E., York Cornwell, E., Koyanagi, A., Nielsen, L., Hinrichsen, C., Meilstrup, C., Madsen, K. R., & Koushede, V. (2020). Social disconnectedness, perceived isolation, and symptoms of depression and anxiety among older Americans (NSHAP): A longitudinal mediation analysis. *Lancet Public Health*, 5(1), e62–e70. https://doi.org/10.1016/S2468-2667(19)30230-0

Schoeni, R. F., Cho, T. -C., & Choi, H. (2022). Close enough? Adult child-to-parent caregiving and residential proximity. *Social Science & Medicine*, 292, 114627. https://doi.org/10.1016/j.socscimed.2021.114627

Schrempft, S., Jackowska, M., Hamer, M., & Steptoe, A. (2019). Associations between social isolation, loneliness, and objective physical activity in older men and women. *BMC Public Health*, 19(1), 74. https://doi.org/10.1186/s12889-019-6424-y

Shankar, A., Mcmunn, A., Banks, J., & Steptoe, A. (2011). Loneliness, social isolation, and behavioral and biological health indicators in older adults. *Health Psychology*, 30(4), 377–385. https://doi.org/10.1037/a0022826

Shor, E., & Roelfs, D. J. (2015). Social contact frequency and all-cause mortality: A meta-analysis and meta-regression. *Social Science & Medicine*, 128, 76–86. https://doi.org/10.1016/j.socscimed.2015.01.010

Silverstein, M., Gans, D., & Yang, F. M. (2006). Intergenerational support to aging parents: The role of norms and needs. *Journal of Family Issues*, 27(8), 1068–1084. https://doi.org/10.1177/0192513x06288120

Taporoski, T. P., Beijamini, F., Gómez, L. M., Ruiz, F. S., Ahmed, S. S., von Schantz, M., Pereira, A. C., & Knutson, K. L. (2022). Subjective sleep quality before and during the COVID-19 pandemic in a Brazilian rural population. *Sleep Health*, 8(2), 167–174. https://doi.org/10.1016/j.sleh.2021.11.007

Teo, A. R., Choi, H., Andrea, S. B., Valenstein, M., Newsom, J. T., Dobscha, S. K., & Zivin, K. (2015). Does mode of contact with different types of social relationships predict depression in older adults? Evidence from a nationally representative survey. *Journal of the American Geriatrics Society*, 63(10), 2014–2022. https://doi.org/10.1111/jgs.13667

Thoits, P. A. (2011). Mechanisms linking social ties and support to physical and mental health. *Journal of Health and Social Behavior*, 52(2), 145–161. https://doi.org/10.1177/0022146510395592

Thun, M. J., Peto, R., Lopez, A. D., Monaco, J. H., Henley, S. J., Heath, C. W., & Doll, R. (1997). Alcohol consumption and mortality among middle-aged and elderly U.S. Adults. *New England Journal of Medicine*, 337(24), 1705–1714. https://doi.org/10.1056/NEJM199712113372401

Umberson, D. (1992). Gender, marital status and the social control of health behavior. *Social Science & Medicine*, 34(8), 907–917. https://doi.org/10.1016/0277-9536(92)90259-s

Umberson, D., Crosnoe, R., & Reczek, C. (2010). Social relationships and health behavior across the life course. *Annual Review of Sociology*, 36(1), 139–157. https://doi.org/10.1146/annurev-soc-070308-120011

Vasilopoulos, T., Kotwal, A., Huisingh-Scheetz, M. J., Waite, L. J., McClintock, M. K., & Dale, W. (2014). Comorbidity and chronic conditions in the National Social Life, Health and Aging Project (NSHAP), Wave 2. *Journals of Gerontology, Series B: Psychological Sciences & Social Sciences*, 69(Suppl 2), S154–S165. https://doi.org/10.1093/geronb/gbu025

Vogelsang, E. M., & Lariscy, J. T. (2020). Let's drink to being socially active: Family characteristics, social participation, and alcohol abuse across mid- and later-life. *Journal of Health and Social Behavior*, 61(4), 453–469. https://doi.org/10.1177/0022146520962456

Watt, R. G., Heilmann, A., Sabbah, W., Newton, T., Chandola, T., Aida, J., Sheiham, A., Marmot, M., Kawachi, I., & Tsakos, G. (2014). Social relationships and health related behaviors among older US adults. *BMC Public Health*, 14(1), 533. https://doi.org/10.1186/1471-2458-14-533

Waite, L. J., Cagney, K. A., Dale, W., Hawkley, L. C., Huang, E. S., Lauderdale, D. S., … Schumm, L. P. National Social Life, Health, and Aging Project (NSHAP): Round 3 and COVID-19 Study, [United States], 2015-2016, 2020-2021. Inter-university Consortium for Political and Social Research [distributor], 2022-11-17. https://doi.org/10.3886/ICPSR36873.v7

Wellman, B., & Wortley, S. (1990). Different strokes from different folks: Community ties and social support. *American Journal of Sociology*, 96(3), 558–588. https://doi.org/10.1086/229572

Yang, Y. C., Boen, C., Gerken, K., Li, T., Schorpp, K., & Harris, K. M. (2016). Social relationships and physiological determinants of longevity across the human life span. *Proceedings of the National Academy of Sciences*, 113(3), 578–583. https://doi.org/10.1073/pnas.1511085112

Yu, B., Steptoe, A., Niu, K., Ku, P. -W., & Chen, L. -J. (2018). Prospective associations of social isolation and loneliness with poor sleep quality in older adults. *Quality of Life Research*, 27(3), 683–691. https://doi.org/10.1007/s11136-017-1752-9

Zheng, J., Morstead, T., Sin, N., Klaiber, P., Umberson, D., Kamble, S., & DeLongis, A. (2021). Psychological distress in North America during COVID-19: The role of pandemic-related stressors. *Social Science & Medicine*, 270, 113687. https://doi.org/10.1016/j.socscimed.2021.113687