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Home alone together: Differential links between momentary contexts and real-time loneliness among older adults from Chicago during versus before the COVID-19 pandemic[☆]

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ABSTRACT (299 / 300 WORDS)

Studies show that older adults were lonelier during versus before the COVID-19 pandemic. This may be due in part to guidelines particularly recommending that older adults stay at home, given their elevated risk of COVID-19 complications. However, little is known about the extent to which this population experienced greater intensity in *momentary* loneliness during versus before the pandemic, and how this relates to their real-time contexts. Here, we build upon recent findings from the Chicago Health and Activity Space in Real-Time (CHART) study that revealed associations between momentary contexts and loneliness among older adults. We analyze ecological momentary assessments (EMAs) from both pre- and during COVID-19 among a subsample of CHART respondents ($N = 110$ older adults age 65–88 in 2020). Pre-pandemic data were collected across three waves from April 2018–October 2019, and pandemic data were collected across three additional waves from June–September 2020. Participants responded to smartphone “pings” (five per day for 7 days per wave; $N = 5596$ and $N = 7826$ before and during the pandemic, respectively) by reporting their momentary loneliness and context (e.g., home). Findings from multi-level regression models suggest that respondents were lonelier in mid-2020 than in years prior, as well as when at home and alone; they were also more likely to be at home during the pandemic. However, the loneliness-inducing effects of being at home (vs. outside the home) and alone (vs. with others) were weaker during versus before COVID-19. Results provide important nuance to broader trends in loneliness among older adults during the pandemic. Specifically, older adults may have adopted new technologies to support social connectedness. It is also possible that, during a time in which social and physical distancing characterized public health guidelines, these contexts grew less isolating as they became a shared experience, or that publicly shared spaces provided fewer opportunities for social engagement.

Author contributions

E. Compernelle and L. E. Finch cleaned the data and wrote the communications of findings. E. Compernelle performed all statistical analyses. All authors aided in interpretation of findings and edited and approved of the final manuscript.

1. Introduction

Loneliness is a negative emotional state that results from a perceived discrepancy between desired and actual social connections (Peplau and

Perlman, 1982). Loneliness is strongly linked with myriad adverse mental and physical health outcomes (Cacioppo and Cacioppo, 2014; National Academies of Sciences, 2020; Ong et al., 2016).

About 43% of adults age 45 and older reported feeling lonely in 2018 (National Academies of Sciences 2020), and preliminary research found that loneliness among U.S. older adults increased with the advent of the COVID-19 pandemic (Hawkley et al., 2021; Luchetti et al., 2020). Given these trends, research identifying the factors that may be driving increased loneliness is warranted.

Importantly, preliminary investigations in this area have often evaluated associations between pandemic loneliness with more static or

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demographic factors, such as gender and living arrangements (Wilson-Genderson et al., 2021). Although such investigations have yielded key insights, the pandemic has also likely upended everyday experiences of older adults, including where and with whom they spend their time. Specifically, public health agencies encouraged older adults to spend more time at home and away from others. Measuring time spent in these physical and social contexts retrospectively poses risk for biased estimates, but capturing this information momentarily via self-reported ecological momentary assessments (EMAs) in real-time is a stronger methodological approach.

Prior EMA findings from the longitudinal Chicago Health and Activity Space in Real-Time (CHART) study revealed that before the pandemic, being momentarily at home (vs. elsewhere) and alone (vs. with others) were each associated with greater momentary loneliness among older adults (Compennolle et al., 2021). What remains unknown is whether these contexts affected loneliness differently on a momentary basis during the pandemic.

No known research has addressed this question, but there are several reasons to expect that being home (vs. not) and/or alone (vs. not) might induce less loneliness during versus before the pandemic. First, protective effects of being outside of the home (vs. at home) for loneliness may be diminished due to lower perceived quantity and/or quality of social interactions there (e.g., fewer people to interact with, avoidance of public interaction to reduce COVID-19 exposure). Second, during the pandemic, social norms may have normalized the experience of being alone. And with fewer formal and informal social gatherings taking place, there may have been fewer catalysts for older adults to feel left out.

Here, we extend the aforementioned CHART findings of real-time contextual influences on older adults' momentary loneliness by considering how these associations differ during compared to before the COVID-19 crisis (Compennolle et al., 2021). During (versus before) the pandemic, we expect that:

1. Older adults experienced more intense momentary loneliness.
2. Older adults were more likely to be momentarily (a) home and (b) alone.
3. Being momentarily (a) home and (b) alone were each associated with lower intensity loneliness.

2. Methods

2.1. Sample and study design

The CHART study enrolled a total of 450 older adults 65 years and older living in the Chicago area at baseline. Using probability-based sampling, participants were recruited from 10 different neighborhoods that were themselves selected to capture racial and ethnic and socioeconomic variation across residential and geographic areas. Three initial waves of data collection spanned 18 months in 2018–2019, with waves spaced approximately 5–6 months apart (hereafter referred to as “Waves 1–3” or “pre-pandemic”). A subsample of respondents from Wave 3 (June to October 2019) were recruited to participate in three pandemic waves spanning 4 months in Fall (2020), each spaced approximately one month apart (hereafter referred to as “Waves 4–6, or “during the pandemic”). These 125 respondents submitted EMAs both pre- and during the pandemic, with averages of 53.3 EMAs (range 1–116) and 71.5 (range 4–101), respectively, and included at least 10 individuals from each of the sampled 10 neighborhoods.

2.2. Procedures

Participants provided informed consent prior to data collection in Waves 1 and 4, after which they completed an in-person interview. Participants were provided with an Android smartphone, which they were asked to carry with them for 7 consecutive days in each wave. The

MetricWire application was pre-installed. Participants were “pinged” by the app five times per day for each of the 7 days in each wave. The five daily pings were triggered at a random time within five 2.5-h time windows between 8 a.m. and 8 p.m. If a participant did not begin completing a given survey, the app sent reminders 10 and 20 min later.

2.3. Measures

2.3.1. Individual-level

Analyses include key socio-demographic characteristics that have been linked to individuals' risk of loneliness. *Race and ethnicity* was constructed using two self-reported items: race (White, Black/African American, Asian, Native Hawaiian or other Pacific Islander, American Indian or Alaskan Native, other) and ethnicity (Hispanic/Latino or not). Respondents are coded as non-Hispanic White, non-Hispanic Black, and non-Black Hispanic, with those not identifying with these groups dropped due to small cell size. Age at baseline is included as a continuous variable.

2.3.2. EMA-level

EMA items were presented in either English or Spanish, depending on respondent preference. Participants were asked at the time of each ping, “Did you feel lonely?” with *loneliness* response options including: not at all (1), slightly (2), moderately (3), very (4), or don't know. Regarding physical context, participants reported whether they were at home; at someone else's home; in transit by bus, train, subway, taxi, or car; in transit by foot; at work; or someplace else. Analyses include a dichotomous variable that collapses these responses: *at home* and not at home (reference). Participants also indicated whether they were *alone* (reference: with others). The MetricWire app recorded the date and time when each EMA was submitted. We include a dichotomous measure indicating whether an EMA occurred pre-pandemic or *during the pandemic*.

Finally, various time-varying statuses were assessed at each interview in waves 1–4. *Health status* (categorical) indicates excellent/very good (reference); good; and fair/poor health. *Marital status* indicates whether the respondent is married or living with a partner (reference); separated or divorced; widowed; and never married. *Employment status* indicates any employment (reference: no employment), including part- or full-time.

3. Analytic sample

Following prior studies, we excluded from analysis EMAs that were started more than 30 min after ping receipt or that took more than 30 min to complete. Additional analytic decisions unique to this dataset are summarized in Supplementary materials and described in more detail in a recent study using these data (Compennolle et al., 2021). The resulting analytic sample comprised 13,422 EMAs among 110 respondents. Overall, respondents answered an average of 122 EMAs (range 7–215) across the six waves. The total response rate was about 58% valid EMAs out of all 23,100 possible EMAs. The conditional response rate for Wave 1 was 82%, 98% for Wave 2, 92% for Wave 3, 97% for Wave 4, 95% for Wave 5, and 95% for Wave 6. Likelihood of non-response was not strongly correlated with any of the loneliness or momentary context measures (r range = 0.00–0.06).

3.1. Analytic approach

We used multilevel regressions that adjusted for the clustering of reports of momentary context (EMAs; level 1) within individuals (respondents; level 2) over time. For models predicting momentary loneliness (RQs 1 and 3), a hierarchical linear model defining two levels was specified as follows, with i for a given EMA; and j for a given respondent:

$$\text{Level 1: } Y_{ij} = \beta_{0j} + \beta_1 X_{1ij} \dots + \beta_k X_{kij} + e_{ij}$$

$$\text{Level 2 : } \beta_{0j} = \gamma_{01}W_j + \gamma_{00} + u_{0j}$$

In the Level 1 equation, Y_{ij} is the predicted value of reported loneliness in EMA i submitted by respondent j ; β_{0j} are respondent-specific intercepts; e_{ij} is the error term; $\beta_1 - \beta_j$ are the effects parameters of the explanatory context, key time-varying covariates (e.g., whether during the pandemic), and a respondent's lagged loneliness report; and $X_{1ij} - X_{jit}$ are these variables in the model. In the Level 2 equation, γ_{00} represents the respondent-level intercept, u_{0j} is the respondent-level error term, and W_j and γ_{01} are fixed effects and time-invariant covariates at Level 2 (e.g., race and ethnicity), respectively.

For models predicting likelihood of exposure to specific contexts pre-versus during the pandemic (RQ 2), we used multilevel logistic regression, controlling for the same covariates. Last, for RQ 3 (whether COVID-19 modifies the association in RQ 1), we used similar linear models discussed above and included interaction terms in the Level 1 model, where b_m are the effects parameters of the interaction between two explanatory variables (e.g., location and COVID-19) and $X_{it1}X_{it2}$ are the corresponding interaction variables. For RQs 1 and 3, a positive coefficient indicates a more intense feeling of loneliness and, for RQ 2, a higher log-odds of experiencing a particular context.

Models include a measure of respondents' previous loneliness report due to the autocorrelation between responses. Additional models controlling for time between loneliness reports; time-varying number of surveys completed at the time of an EMA; timing of EMA (i.e., survey window, day of week, season); and neighborhood at baseline yielded similar results, as did three-level regression models accounting for clustering of EMAs within a single day. Results from multilevel ordinal logistic regression models (see Supplementary Materials) yielded similar results. Analyses were conducted using STATA Version 16. Statistical significance was set at $p < .05$.

4. Results

4.1. Descriptive statistics

Table 1 presents descriptive statistics at the respondent-level. A majority of respondents were female (57%). Most respondents identified as either non-Hispanic White (44%) or non-Hispanic Black (44%), with 13% identifying as Hispanic. A majority (67%) of the sample had some college education or a college degree. Respondents were on ~72.4 years old at baseline. Overall, respondents were in relatively good health, married, and not employed.

Respondents' momentary experiences are also presented in Table 1. Compared to before the pandemic, respondents experienced greater intensity loneliness during the pandemic and were at home more often (79% and 70% of EMAs, respectively); however, they were not more likely to be alone (~55% of EMAs in both time periods).

4.2. Multivariate models

4.2.1. The COVID-19 pandemic (research question 1)

Table 2 presents results from a multilevel linear regression model of the relationship between respondents' loneliness and the pandemic. Results show that older adults experienced greater intensity momentary loneliness during the pandemic versus before ($\beta = 0.03$, 95% CI [0.01, 0.04]). Results in Models 2 and 3 are consistent with existing studies: relative to being outside the home and to being with others, respondents currently at home or alone reported higher levels of loneliness ($\beta = 0.06$; 95% CI [0.04, 0.07] and $\beta = 0.09$; 95% CI [0.07, 0.10], respectively).

4.2.2. Differential exposure to contexts, pre-versus during the pandemic (research question 2)

Table 3 presents results from multilevel logistic regression models predicting respondents' likelihood of momentarily being at home and

Table 1

Descriptive statistics for loneliness and key measures included in analyses ($N = 110$; 13,422 EMAs), pre- and during the pandemic.

Respondent-level ($N=110$)	Pre-Pandemic		During Pandemic		95% CI/chi-square statistic
	Mean/ %	SD	Mean/ %	SD	
Gender					
Man	43				
Woman	57				
Race and ethnicity					
Non-Hispanic white	44				
Non-Hispanic Black	44				
Non-Black Hispanic	13				
Education					
Less than High School	16				
High School	16				
Some college	27				
College +	40				
Age	72.35	5.54			
Health status (baseline)					3.66
Excellent/very good	44		39		
Good	43		41		
Fair/poor	14		21		
Marital Status (baseline)					0.13
Married/living with partner	36		35		
Separated/divorced	16		16		
Widowed	31		33		
Never married	17		15		
Employment status (baseline)					[-0.14, 0.08]
Employed, any	22		24		
Not employed	78		76		
EMA-level ($N=13,422$)	Pre-Pandemic ($N = 5596$)		During Pandemic ($N = 7826$)		95% CI
	Mean/ %	SD	Mean/ %	SD	
Loneliness (1-4)	1.19	0.50	1.24	0.57	[-0.06, -0.03]
Location					[-0.10, -0.07]
Home	70		79		
Not at home	30		21		
Who with					[-0.02, 0.01]
Alone	54		55		
Not alone	46		45		

Note: SD = standard deviation. Measures of loneliness are coded so that higher values represent greater loneliness. Confidence intervals (CIs) are from t -tests of significance.

being alone. Respondents were more likely to be at home during versus before the pandemic ($\beta = 0.42$; 95% CI [0.33, 0.51]), but were not significantly more or less likely to be alone ($\beta = 0.02$; 95% CI [-0.07, 0.11]).

4.2.3. The COVID-19 pandemic as a modifier of contextual effects (research question 3)

Model 1 in Table 4 presents results from a multilevel linear regression model testing whether the effect of being home on loneliness varied by the pandemic; Model 2 shows results from a similar model but testing the effect of being alone. Across these models, the main effects of being home, being alone, and occurring during the pandemic are each still significantly associated with greater loneliness. However, respondents reported lower intensity momentary loneliness while at home during versus before the pandemic ($\beta = -0.08$; 95% CI [-0.11, -0.05]). The same is true for being alone: respondents experienced lower intensity momentary loneliness when alone during the pandemic than when alone pre-pandemic ($\beta = -0.04$; 95% CI [-0.07, -0.02]).

Additional analyses combine these physical and social context

Table 2
Multilevel linear regression models reporting coefficients and standard errors for loneliness regressed on context and the pandemic.

	Model 1		Model 2		Model 3	
	β (SE)	95% CI	β (SE)	95% CI	β (SE)	95% CI
EMA-level						
During pandemic (ref: pre-pandemic)	0.03 (0.01)	[0.01,0.04]				
Location (ref: home)						
At home			0.06 (0.01)	[0.04,0.07]		
Who with (ref: alone)						
Alone					0.09 (0.01)	[0.07,0.10]
Health status (ref: excellent/very good)						
Good	-0.01 (0.01)	[-0.04,0.01]	-0.01 (0.01)	[-0.04,0.01]	-0.01 (0.01)	[-0.04,0.01]
Fair/poor	-0.07 (0.02)	[-0.10,-0.03]	-0.07 (0.02)	[-0.10,-0.03]	-0.07 (0.02)	[-0.10,-0.03]
Marital status (ref: married/partnered)						
Separated/divorced	0.10 (0.03)	[0.04,0.16]	0.09 (0.03)	[0.03,0.15]	0.07 (0.03)	[0.00,0.13]
Widowed	0.18 (0.03)	[0.12,0.24]	0.17 (0.03)	[0.11,0.23]	0.15 (0.03)	[0.09,0.21]
Never married	0.13 (0.04)	[0.06,0.20]	0.11 (0.04)	[0.04,0.18]	0.10 (0.04)	[0.03,0.17]
Employment status						
Employed (any)	0.01 (0.01)	[-0.02,0.03]	0.01 (0.01)	[-0.02,0.03]	0.01 (0.01)	[-0.01,0.03]
Respondent-level						
Gender						
Female	-0.07 (0.05)	[-0.17,0.04]	-0.07 (0.05)	[-0.17,0.04]	-0.06 (0.05)	[-0.16,0.05]
Race and ethnicity (ref: Non-Hispanic White)						
Non-Hispanic Black	-0.03 (0.06)	[-0.15,0.10]	-0.03 (0.06)	[-0.15,0.10]	-0.02 (0.06)	[-0.14,0.11]
Non-Black Hispanic	-0.04 (0.09)	[-0.21,0.13]	-0.04 (0.09)	[-0.21,0.13]	-0.05 (0.09)	[-0.22,0.13]
Education (ref: some High School)						
High school	-0.03 (0.09)	[-0.20,0.14]	-0.03 (0.09)	[-0.20,0.15]	-0.03 (0.09)	[-0.20,0.14]
Some college	0.04 (0.08)	[-0.11,0.20]	0.05 (0.08)	[-0.11,0.21]	0.04 (0.08)	[-0.12,0.20]
College +	-0.03 (0.09)	[-0.20,0.14]	-0.03 (0.09)	[-0.20,0.14]	-0.03 (0.09)	[-0.20,0.14]
Age at baseline	0.00 (0.00)	[-0.01,0.01]	0.00 (0.00)	[-0.01,0.01]	0.00 (0.00)	[-0.01,0.01]
Previous loneliness report	0.32 (0.01)	[0.31,0.34]	0.32 (0.01)	[0.31,0.34]	0.32 (0.01)	[0.31,0.34]
Constant	0.75 (0.35)	[0.07,1.43]	0.76 (0.35)	[0.07,1.44]	0.73 (0.35)	[0.04,1.43]
Variance components						
EMA-level variance	0.13		0.13		0.13	
Respondent-level variance	0.06		0.06		0.06	
Additional information						
Log likelihood	-5589.7		-5572.4646		-5531.2305	
R2	0.39		0.39		0.38	
Number of EMA observations	13344		13344		13344	
Number of respondents	110		110		110	

Note: Standard errors are presented below estimates, with 95% confidence intervals (CIs) to the right. Measures of loneliness are coded so that higher values represent greater loneliness.

measures into one linear regression model to further examine differences in pandemic-context-loneliness associations; results are presented in Supplemental Materials. We regress loneliness onto a categorical measure, indicating being momentarily: (1) at home and alone (reference); (2) at home and not alone; (3) not at home and alone; and (4) not at home and not alone. Fig. 1 presents the average marginal effects of social and physical contexts #2–4 described above (compared to being home and alone) on loneliness, both pre- and during the pandemic. As shown there, being outside the home and/or being with someone else did not protect against loneliness to the same extent during the pandemic as it did pre-pandemic. Physical context is particularly noteworthy: although being with others provided less protection during the pandemic, reductions in loneliness intensity in response to being outside

the home were markedly smaller during versus pre-pandemic (middle and right-most bars). In fact, being alone and outside of the home provided virtually no protection against loneliness relative to being alone and at home (the middle bars). In addition, whereas being at home and with others was associated with greater loneliness than being outside of the home and with others before the pandemic, these two contexts were linked with similar levels of loneliness during the pandemic.

5. Discussion

To our knowledge, this is the first study to examine older adults' momentary loneliness during the pandemic, and how or whether their real-time contexts shaped this association. We leverage rich EMA data

Table 3
Multilevel logistic regression models reporting log-odds and standard errors for physical and social context exposures regressed on the pandemic.

	Home		Alone	
	β (SE)	95% CI	β (SE)	95% CI
EMA-level				
During pandemic (ref: pre-pandemic)	0.42 (0.05)	[0.33,0.51]	0.02 (0.05)	[-0.07,0.11]
Health status (ref: excellent/very good)				
Good	0.10 (0.08)	[-0.05,0.25]	0.24 (0.08)	[0.07,0.40]
Fair/poor	0.30 (0.11)	[0.07,0.52]	0.19 (0.11)	[-0.03,0.41]
Marital status (ref: married/partnered)				
Separated/divorced	-0.20 (0.19)	[-0.57,0.17]	0.96 (0.21)	[0.56,1.36]
Widowed	-0.23 (0.19)	[-0.60,0.14]	0.66 (0.20)	[0.26,1.06]
Never married	-0.10 (0.21)	[-0.52,0.32]	0.36 (0.23)	[-0.10,0.82]
Employment status				
Employed (any)	0.16 (0.07)	[0.02,0.31]	-0.10 (0.08)	[-0.25,0.05]
Respondent-level				
Gender				
Female	0.33 (0.23)	[-0.12,0.77]	-0.28 (0.37)	[-1.01,0.45]
Race and ethnicity (ref: Non-Hispanic White)				
Non-Hispanic Black	0.35 (0.27)	[-0.18,0.88]	-0.48 (0.45)	[-1.35,0.40]
Non-Black Hispanic	-0.09 (0.37)	[-0.81,0.64]	0.82 (0.61)	[-0.38,2.01]
Education (ref: some High School)				
High school	-0.33 (0.38)	[-1.08,0.42]	-0.30 (0.62)	[-1.51,0.91]
Some college	-0.50 (0.35)	[-1.19,0.19]	0.06 (0.56)	[-1.04,1.17]
College +	-0.42 (0.38)	[-1.17,0.32]	-0.53 (0.61)	[-1.73,0.67]
Age at baseline	0.05 (0.02)	[0.01,0.09]	0.00 (0.03)	[-0.06,0.07]
Constant	-2.46 (1.51)	[-5.42,0.51]	0.12 (2.47)	[-4.72,4.95]
Variance components				
Respondent-level variance	1.07		3.14	
Additional information				
Log likelihood	-6643.0		-6886.1	
R2	0.14		0.33	
Number of EMA observations	13344		13344	
Number of respondents	110		110	

Note: Standard errors are presented below estimates, with 95% confidence intervals (CIs) to the right.

among a diverse sample of Chicago adults both *before and during the pandemic*. First, we find that older adults experienced more intense momentary loneliness during versus before the pandemic. Although the effect sizes are small, these results are consistent with existing literature that identifies key loneliness-inducing contexts, and even small differences can accumulate to produce heightened loneliness in general during the pandemic (Compennolle et al., 2021; Hammoud et al., 2021; Wu et al., 2021). Second, older adults were more likely to be at home during versus before the pandemic; this may be in response to public health distancing guidelines and is consistent with previous studies (Van Kessel et al., 2021). Third, regardless of their likelihood of being at home and/or alone, older adults were significantly less lonely when at home during the pandemic than they were prior; this is also true for being alone.

We speculate that these novel findings may be due to older adults' adaptation to technological modes of communication, thereby facilitating social connectivity via remote options. Another possibility is that being home and/or alone has become less of an adverse experience

Table 4
Multilevel linear regression models reporting coefficients and standard errors for loneliness regressed on the interaction between context and the pandemic.

	Home		Alone	
	β (SE)	95% CI	β (SE)	95% CI
EMA-level				
During pandemic (ref: pre-pandemic)	0.08 (0.01)	[0.06,0.11]	0.05 (0.01)	[0.03,0.07]
Location (ref: home)				
At home	0.10 (0.01)	[0.07,0.12]		
Who with (ref: alone)				
Alone			0.11 (0.01)	[0.09,0.13]
During pandemic x at home	-0.08 (0.02)	[-0.11,-0.05]		
During pandemic x alone			-0.04 (0.01)	[-0.07,-0.02]
Health status (ref: excellent/very good)				
Good	-0.02 (0.01)	[-0.04,0.01]	-0.02 (0.01)	[-0.04,0.01]
Fair/poor	-0.07 (0.02)	[-0.10,-0.04]	-0.07 (0.02)	[-0.11,-0.04]
Marital status (ref: married/partnered)				
Separated/divorced	0.11 (0.03)	[0.05,0.17]	0.08 (0.03)	[0.02,0.14]
Widowed	0.19 (0.03)	[0.13,0.25]	0.16 (0.03)	[0.10,0.23]
Never married	0.13 (0.04)	[0.06,0.21]	0.12 (0.04)	[0.04,0.19]
Employment status				
Employed (any)	0.00 (0.01)	[-0.02,0.02]	0.01 (0.01)	[-0.01,0.03]
Respondent-level				
Gender				
Female	-0.07 (0.05)	[-0.18,0.03]	-0.06 (0.05)	[-0.17,0.04]
Race and ethnicity (ref: Non-Hispanic White)				
Non-Hispanic Black	-0.03 (0.06)	[-0.16,0.09]	-0.02 (0.06)	[-0.15,0.10]
Non-Black Hispanic	-0.04 (0.09)	[-0.21,0.13]	-0.04 (0.09)	[-0.21,0.13]
Education (ref: some High School)				
High school	-0.02 (0.09)	[-0.20,0.15]	-0.03 (0.09)	[-0.20,0.15]
Some college	0.05 (0.08)	[-0.11,0.21]	0.04 (0.08)	[-0.12,0.20]
College +	-0.02 (0.09)	[-0.20,0.15]	-0.03 (0.09)	[-0.20,0.14]
Age at baseline	0.00 (0.00)	[-0.01,0.01]	0.00 (0.00)	[-0.01,0.01]
Previous loneliness report	0.32 (0.01)	[0.30,0.34]	0.32 (0.01)	[0.30,0.34]
Constant	0.70 (0.35)	[0.01,1.39]	0.70 (0.35)	[0.01,1.39]
Variance components				
EMA-level variance	0.13		0.13	
Respondent-level variance	0.06		0.06	
Additional information				
Log likelihood	-5551.6		-5517.8	
R2	0.38		0.38	
Number of EMA observations	13344		13344	
Number of respondents	110		110	

Note: Standard errors are presented below estimates, with 95% confidence intervals (CIs) to the right. Measures of loneliness are coded so that higher values represent greater loneliness.

during the pandemic because many others across the globe are also increasingly home and/or alone, perhaps fostering feelings of inclusion (Hawkey et al., 2020). At the same time, the converse is also notable: older adults were *lonelier* outside the home and/or when they were with others during the pandemic. This suggests that these typically protective contexts were qualitatively different during the pandemic, providing

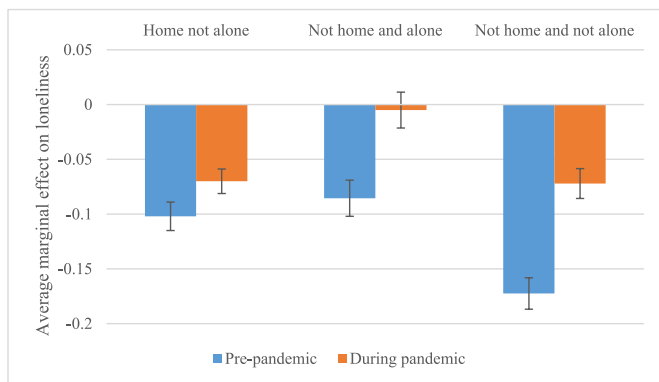


Fig. 1. Average marginal effects of social and physical context on momentary reports of loneliness, pre- and during the pandemic (reference: being home and alone).

less social interaction or even perceived higher risk of transmission, and thus less benefit for loneliness.

6. Limitations

Findings may not generalize beyond older adults outside of Chicago, particularly those in rural areas or areas with more or less racial and ethnic diversity. Although only 125 of the initial 450 respondents participated during the pandemic, all 10 Chicago neighborhoods remained represented, and missingness was not strongly associated with key study measures. Moreover, our multilevel analysis emphasized change *within* individuals, thereby capturing variation in momentary loneliness among *the same individuals before and during the pandemic*. Future research should investigate whether and how these associations vary by race and ethnicity. In addition, results may not generalize to older adults who do not have interest or experience with smartphones.

7. Conclusions

Results suggest that being momentarily *outside* the home (rather than at home) is a previously overlooked factor influencing older adults' worsened mental health during the pandemic. Although not directly tested here, it is possible that physical and social distancing guidelines

could have contributed to the overall more intense loneliness experienced by older adults during versus before the pandemic. Nevertheless, the present findings suggest a two-pronged policy approach to combat loneliness during public health crises, including promoting social connectivity at home as well as implementing efforts to foster social connectivity in public spaces. For instance, prior research suggests that video conference programs and exercise interventions (Williams et al., 2021) and fostering social cohesion and safe, walkable spaces (Bergefurt et al., 2019) are protective for loneliness.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.socscimed.2022.114881>.

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