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Research Article

In-Person Social Interactions and Anxiety During the COVID-19 Pandemic: Exploring the Role of Household Size and Virtual Social Contact Among Midlife and Older Black South African Adults

Nigel Walsh Harriman, MPH,[1,*] Daniel Ohene-Kwofie, PhD,[2] Sun Jae Jung, MD, PhD,[1,3] Sabrina Hermosilla, PhD,[4] Francesc Xavier Gómez-Olivé, MD, PhD,[2] and Elyse A. Jennings, PhD[1]

[1]Harvard Center for Population and Development Studies, Harvard T.H. Chan School of Public Health, Cambridge, Massachusetts, USA.
[2]MRC/Wits Rural Public Health and Health Transitions Research Unit (Agincourt), School of Public Health, Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, Gauteng, South Africa.
[3]Department of Preventive Medicine, Yonsei University College of Medicine, Seoul, South Korea.
[4]Heilbrunn Department of Population and Family Health, Mailman School of Public Health, Columbia University, New York City, New York, USA.

*Address correspondence to: Nigel Walsh Harriman, MPH. E-mail: nharriman@hsph.harvard.edu

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Abstract

Objectives: The current study investigates how physical distancing during the coronavirus disease 2019 (COVID-19) pandemic was associated with increased anxiety among a cohort of midlife older Black South African adults and the extent to which household size and virtual social contact modify this association for men and women.

Methods: We analyze data from a phone survey conducted from July 2021 to March 2022 as part of Health and Aging in Africa: A Longitudinal Study of an INDEPTH Community in South Africa (n = 2,080). We employ logistic regression to estimate the association between changes in in-person social interactions and anxiety symptoms and examine whether the association is modified by household size and changes in virtual social contact. We perform analyses separately for women and men.

Results: Declines in in-person social interactions were associated with increased anxiety for women and men (odds ratios [OR] = 2.52, $p < .001$). For women only, declines were greater for those living in larger households (OR = 1.11, $p = .032$). Declines were buffered by increased virtual social contact for both women (OR = 0.55, $p = .025$) and men (OR = 0.45, $p = .019$).

Discussion: Although the anxiety symptoms of women and men were similarly affected by declines in in-person social interaction, the modifying influence of household size is unique to women, likely due to gender-specific social roles. For women, living in larger households may mean greater caregiving burden, exacerbating the detrimental association between physical distancing and anxiety. On the other hand, both women and men may have used virtual means to connect with friends and family living outside their homes, buffering against increased anxiety.

Keywords: Caregiving, COVID-19, Living arrangements, Mental health, Social support

The global onset of the coronavirus disease 2019 (COVID-19) pandemic in March 2020 exerted an important and lasting influence on the lives of people around the world, extending beyond the significant effects on physical health and mortality to also affect mental health. Physical distancing, whether government-enforced or by personal choice, meant that individuals experienced a reduction in their in-person activities with friends and family living outside of their homes. Research has established that social isolation can lead to a substantial burden of mental health symptoms (Gyasi et al., 2019; Rohde et al., 2016). Recent research has further documented that the restrictions on in-person social life and fear surrounding the COVID-19 virus can exacerbate mental health disorders among populations in a wide variety of contexts (Marroquín et al., 2020; Santomauro et al., 2021; Williams et al., 2020), including increasing anxiety (Benke et al., 2020; Hoffart et al., 2021; Xiao et al., 2020). Older adults may have felt these impacts most acutely, as they already faced heightened risks of loneliness and social isolation, and, upon the onset of COVID-19, were held to especially high standards of physical distancing (Choi et al., 2022; Hwang et al., 2020). In settings with fewer resources and greater poverty, the impacts of COVID-19 may be especially harmful (Alkire et al., 2020; Santomauro et al., 2021), and older adults in these settings may have felt some of the worst consequences of physical distancing. It is therefore imperative to understand how declines in in-person social interaction during COVID-19 may have

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affected the mental health outcomes of older adults in low- and middle-income settings.

South Africa was one of the hardest-hit countries during the COVID-19 pandemic, with stringent lockdowns early in the pandemic and high death rates (Harling et al., 2021). The strictest level of lockdown was put in place in late March through late April 2020, involving the closing of schools, restriction of travel and transport, and limitation of nonessential activities. Although restrictions did not reach this strict level again, restrictions tightened up again in December 2020–February 2021 during the Beta wave, June–July 2021 during the Delta wave, and during the Omicron wave (November–December 2021; Al Hasan et al., 2022).

Much of the population of South Africa lives in poverty (Abrahams et al., 2022), and resources for both physical and mental healthcare are limited (Folb et al., 2015; Nguse & Wassenaar, 2021). We focus on a midlife and older adult Black population in a rural setting, using data from a longitudinal cohort study, to understand how declines in extra-household in-person social interactions since the start of the COVID-19 pandemic were related to increased anxiety. This population faces a heightened risk of physical health problems (Nojilana et al., 2016; Wade et al., 2021), which could increase the fear of contracting COVID-19. At the same time, the older members of this population have faced other adversities in their lives, especially under apartheid (dismantled in 1994), which may position them with greater resilience to cope with the hardships brought by COVID-19 (Payne et al., 2020). Additionally, households in this region often consist of numerous members across multiple generations (Abrahams et al., 2022; Amoateng et al., 2007), possibly offering protection from some of the negative impacts on mental health that can result from declines in social interactions with friends and family living outside of their home.

Despite the recognition that the COVID-19 pandemic has placed older adults, especially those in low-resource settings, at an increased risk for mental health problems, there is a paucity of studies that investigate phenomena that may exacerbate or reduce this risk. To fill this gap in the literature, we use data from a longitudinal study of a cohort of Black South Africans aged 40 or older at baseline (i.e., in 2014) and examine how declines in extra-household in-person social interactions since the start of the COVID-19 pandemic were related to increased anxiety. We test three key hypotheses. First, we expect that declines in in-person social interactions during the COVID-19 pandemic were associated with increased anxiety. Past research has documented similar associations across settings (Benke et al., 2020; Santomauro et al., 2021). Second, we expect that living in larger households modifies the impact of the decline in in-person social interaction on increased anxiety. This modification could operate in either direction: Older adults living in larger households may benefit from social interactions with household members, which may buffer the impact of declining in-person interaction, with people outside the home, on anxiety (Crowell et al., 2014). On the other hand, larger households may present more opportunities for stress (Arokkiaraj et al., 2021), especially as household members stay confined to the home together. Staying home together can increase turmoil or conflict in the household, and this may exacerbate the impact of declining in-person interactions, with people outside the home, on anxiety. Third, we expect that increased social contact by phone, email, or social media (hereafter referred to as "virtual social contact") will protect against the negative impacts of declines in in-person social interactions on anxiety. Older adults may receive social support, especially emotional support, through conversations with friends and family living outside the home, even when those conversations are not in person.

In order to empirically address these hypotheses, we investigate key concepts that differ greatly by gender and, therefore, perform analyses separately for men and women. For example, recent work has indicated that women have reported higher levels of anxiety than men during the COVID-19 pandemic (Zwar et al., 2023). Moreover, the moderating influence of household size on associations between declining extra-household in-person interactions and anxiety may differ by gender: Women are known to have faced the greatest caregiving burdens during the pandemic (Farré et al., 2022), and this can be exacerbated by living in larger households as women often assumed additional responsibilities for caregiving of household members. In this South African setting, women are often the heads of their households (Schatz et al., 2011), and lockdown restrictions may have substantially increased their caregiving burden as well as concerns about meeting the basic needs of the household. Anxiety symptoms of women who face restricted interactions with friends and relatives living outside of their homes are likely to be exacerbated if they live in large households: A greater number of household members is expected to increase their caregiving burden and burden of meeting others' needs. This moderating effect, if present, may be reversed for men, as men living in larger households do not face the same caregiving burden as women and may be more likely than women to feel the benefit of having more people at home with whom to interact. Lastly, the impacts of engaging in virtual social contact on anxiety may be unique for men and women, as the use of virtual forms of contact can differ by gender, with women more often using virtual social contact for social and emotional connection (Krasnova et al., 2017; Li, 2021).

Our findings will offer important new insight into the risks faced by midlife and older, Black South African adults during the COVID-19 pandemic. Shedding light on the possible buffering effects of virtual social contact is an important contribution to the literature and the understanding of possible routes to improve mental health outcomes among the socially isolated.

Method

Data

We use data from Health and Aging in Africa: A Longitudinal Study of an INDEPTH Community in South Africa (HAALSI), described in detail elsewhere (Gómez-Olivé et al., 2018). The HAALSI study is a population-based survey that examines and characterizes a population of midlife and older people in rural South Africa with respect to health, physical and cognitive function, aging, and well-being. The baseline sample was drawn in 2014 for enrollment in the first wave of data collection, from the existing framework of the Agincourt Health and Socio-Demographic Surveillance System (Agincourt HDSS) site in Mpumalanga province. Individuals 40 years and older as of July 1, 2014 and permanently living in the study site were eligible to be sampled. The HAALSI study is focused on Black South African adults ages 40 and older because this population is considered to be "older" in this setting. Although adults in Western settings are typically

considered "older" when they reach age 60 or so, men and women in South Africa experience about 16 years shorter life expectancy than in "more developed" countries (PRB, 2022). This suggests that the processes associated with aging may begin at younger ages in South Africa, and we expect this to particularly be the case in rural contexts and among Black South Africans.

Using gender-specific sampling fractions to ensure a gender-balanced sample, 6,281 individuals were randomly selected to participate in the baseline (Wave 1) survey. A total of 5,059 individuals completed a Wave 1 interview, conducted using computer-assisted personal interviewing (CAPI) in the local language, Shangaan. The following two waves of the CAPI survey sampled all the living members of this original 5,059 HAALSI cohort. Wave 2 was conducted between October 2018 and November 2019, with a response rate of 94%. Wave 3 was conducted between July 2021 and March 2022, with a response rate of 94%.

Approximately concurrent with the Wave 3 CAPI survey—both were conducted from July 2021 to March 2022 capturing the end of the Delta (May 2021–November 2021) and the beginning of the Omicron (November 2021–December 2022) waves—a ~20-min survey was conducted using computer-assisted telephone interview (CATI) to gather information about the experiences of this cohort during the COVID-19 pandemic (hereafter referred to as the COVID-19 Survey). The COVID-19 survey sampled all living members of the original 5,059 HAALSI cohort as of June 2021 (n = 4,247). Excluding the 309 individuals who were confirmed to be deceased when they were contacted for the survey, the response rate for this survey was lower than the CAPI surveys, at 69% (2,698/(4,247–309)). Our analytic sample includes members of the original cohort who completed the COVID-19 Survey and excludes: (1) respondents who are missing any of the measures used in our models (n = 489), and those who reported that someone moved in with them due to the COVID-19 pandemic (n = 129). The latter observations were removed to ensure that we had a temporally stable exposure. This leaves us with an analytic sample of 1,213 women and 867 men across 1,945 households.

Measures

Dependent variable

We used a modified version of the Generalized Anxiety Disorder 2-item assessment to indicate an increase in anxiety symptoms during the COVID-19 pandemic (Wild et al., 2014). Existing work in South Africa has utilized the GAD-2 to assess anxiety symptoms, indicating its cultural suitability for the population under study (Bhana et al., 2019; van Heyningen et al., 2018; Visser & Law-van Wyk, 2021). The original items ask about anxiety symptoms during the past 2 weeks, and our modified items in the COVID-19 Survey ask about these symptoms since the beginning of the pandemic in March 2020 (approximately an 18-month recall). The items read, first, "Since March 2020, relative to before the pandemic, have you felt nervous, anxious, or on edge more often, less often, or about the same?" The second item reads "Since March 2020, relative to before the pandemic, how often have you felt you were not able to stop or control worrying? Would you say more often, less often, or about the same?" The Spearman-Brown Reliability Coefficient for increased anxiety symptoms was 0.854 for the entire sample (Cronbach's alpha = 0.853), 0.805 for men (Cronbach's alpha = 0.804), and 0.881 for women (Cronbach's alpha = 0.879), indicating good internal consistency. A principal-component factor analysis on the two items retained one factor with an eigenvalue of 1.75, explaining 87.26% of the observed variance. We coded each of these measures as −1 for "less often," 0 for "about the same," and 1 for "more often." We then averaged the values of these two measures and created a dichotomous variable reflecting increased anxiety (1) and less or the same level of anxiety (0).

Independent variable

Our measure of extra-household in-person contact comes from a series of questions in the COVID-19 Survey that asked, "Has the amount of in-person contact with your children living outside the household increased, decreased, or remained about the same since the COVID-19 pandemic began, relative to before the pandemic?" Items with the same language were also asked about "grandchildren," "other family members who live outside the household," and "friends and neighbors." We coded each of these four variables as −1 if an increase in contact was reported, 0 for "remained about the same," and 1 if a decrease was reported. If participants indicated they did not have children or grandchildren who lived outside the household, they were coded as missing for those interactions. We then created an average score for these four types of extra-household in-person interactions, excluding only those missing responses on more than half (i.e., three or more) of the interactions (n = 57). Our final variable was dichotomous; respondents received a 1 if they reported an average decline across the four in-person interactions respondents. Those who reported an average increase in in-person social interactions or reported no differences were coded as a 0.

Modifiers

The first of our modifiers is a continuous measure that reflects the number of permanent residents in a household at Wave 2, top-coded at 10 or more permanent residents. Box-Tidwell tests supported the assumption that the distribution of permanent household residents was linear to the log odds of increased anxiety symptoms ($p > .05$).

To operationalize increases in virtual social contact since the start of the COVID-19 pandemic, we use the responses to four questions that asked: "Has the amount of contact by phone, email, or social media with your children increased, decreased, or remained about the same since the COVID-19 pandemic began, relative to before the pandemic?" Like our measure of decline in extra-household in-person interactions, there were three other items with the same wording asked about grandchildren, other family members outside the house, and friends and neighbors. However, unlike our measure for a decline in in-person interaction, we coded each of these variables as −1 if a *decrease* in contact was reported, 0 if contact remained about the same, and 1 if an *increase* in contact was reported. Following, we created an average score across these variables, excluding those missing responses on more than half the variables (n = 73), and dichotomized the values such that individuals received a 1 if they reported an average increase in virtual social contact and a 0 if they reported an average decrease or no change.

Covariates

We account for several covariates in our analyses. Most of these covariates reflect participants' responses to questions collected during Wave 2, which was conducted the year before the onset of the COVID-19 pandemic. Only education status and the number of living children were reflective of responses at Wave 1, which were not collected at Wave 2 under the rationale that these characteristics were unlikely to have changed since Wave 1 given the older age of the sample.

Our models control for a continuous measure of respondent's age (top coded at 100 or older). Regarding our measures of socioeconomic status, we included a nominal variable of education (no formal, primary [1–7 years], secondary or higher [8+ years]) and a dichotomous measure of employment (employed or household manager vs not working or retired). Household wealth was measured using weighted scores created from a principal components analysis of household ownership of consumer durables (e.g., television, refrigerators, and vehicles), livestock, and housing characteristics (e.g., sanitation facilities and access to water). The distribution of these weighted scores was then divided into quintiles (Riumallo-Herl et al., 2019). We also included a continuous measure of the number of children alive (top coded at eight or more); a nominal measure of marital status (married or living with a partner, never married, separated or deserted or divorced, widowed); a dichotomous variable assessing whether the respondent had limitations in their activities of daily living (ADLs); and a nominal variable for the month of the interview. Due to low cell counts, we collapsed interviews from November 2021 to March 2022 into one category. Our final covariates include a continuous measure for the respondent's reported Center for Epidemiologic Studies-Depression scale (CES-D) score at wave 2 (Adams et al., 2020); a dichotomous variable for COVID-19 vaccination status at Wave 3; and a dichotomous variable reflecting whether the respondent had been previously diagnosed with any of the following comorbidities: hypertension, diabetes, or HIV. Other information regarding the measures in HAALSI is provided in detail elsewhere (Gómez-Olivé et al., 2018).

Analyses

First, we calculated the descriptive statistics (percentage, means, standard deviations, medians, and ranges) of our sample. We then assessed the presence of univariate gender differences for our variables using *t* tests for continuous variables, and chi-squared tests for categorical variables. Following, we used logistic regression to estimate the association between a decline in extra-household in-person social interactions and an increase in anxiety symptoms during the COVID-19 pandemic. We tested this first hypothesis in three models. Model 1 was conducted on the entire sample, controlled for covariates described above, and included a dichotomous variable for the participant's gender. Models 2 and 3 contained the same parameters as model 1 but were conducted on women (model 2) and men (model 3), rather than including a fixed effect for gender. The remaining models were stratified by gender, because household composition and virtual social contact may have differing impacts on anxiety for women and men.

We tested our second hypothesis, that household size would modify the association between declines in extra-household in-person social interactions and increased anxiety symptoms in models 4 (women) and 5 (men). These models included the covariates from models 2 and 3 and added an interaction term between a decline in in-person social interactions and the number of permanent household members, with the main effects included for both.

We evaluated our final hypothesis, that increased virtual social contact would buffer against the association between declines in extra-household in-person social interactions and increased anxiety, in models 6 (women) and 7 (men). In these models, we removed the interaction term from models 4 and 5, keeping the main effects, and fit an interaction between a decline in in-person social interactions and an increase in virtual social contact.

We assessed potential model misspecification using Pregibon's Goodness-of-Link Test (Pregibon, 2018). The alpha value for significance for all analyses was set to .05.

Results

The descriptive statistics for our sample are displayed in Table 1.

Dependent Variable

On average, both women (36.4%) and men (28.7%) experienced an increase in anxiety symptoms since the start of the pandemic, and significantly more women than men reported such an increase ($p < .001$).

Independent Variable

Both women and men experienced declines in in-person social interactions during the COVID-19 pandemic. Differences in these declines by gender were significant ($p = .011$); 62.8% of women reported declines in contrast to 57.3% of men.

Modifiers

On average, women lived in households with more permanent residents than men (5.62 vs 5.28; $p = .01$). Increases in virtual social contact since the beginning of the pandemic did not significantly vary between women (44.3%) and men (41.2%).

Covariates

In univariate analyses, we observed variation in some of our covariates by gender. In terms of socioeconomic status, no formal education was more common among women than men (45.7% vs 35.3%; $p < .001$), and a higher proportion of men were employed than women (23.2% vs 15.7%; $p < .001$). Women were more often widowed than men (48.1% vs 10.5%; $p < .001$) and had higher mean CES-D depression scores (14.53 vs 13.56; $p = .02$). Finally, women had a higher prevalence of at least one comorbidity than men, which includes HIV, hypertension, and diabetes, (79.4% vs 70.5%; $p < .001$).

Logistic Regression Models for Increased Anxiety Symptoms and Decreased In-Person Interactions

Table 2 presents the results of the logistic regression models for increased anxiety symptoms among our entire sample (model 1), women (model 2), and men (model 3). In model 1, compared to those who reported no change or increases, individuals who reported a decline in in-person social interactions relative to before March 2020 had 2.52 times the odds of increased anxiety symptoms (odds ratios [OR] = 2.52, $SE = 0.264$, $p < .001$). We observed that women had 47% higher odds of increased anxiety symptoms compared to men

Table 1. Sample Description

Variable	Women (n = 1,213)		Men (n = 867)		p Value
	n (%)	Mean (*SD*); [Median, Range]	n (%)	Mean (*SD*); [Median, Range]	
No change/decrease in anxiety symptoms since March 2020	772 (63.6)		618 (71.3)		<.001
Increase in anxiety symptoms since March 2020	441 (36.4)		249 (28.7)		
No change/increase in in-person social interactions since March 2020	451 (37.2)		370 (42.7)		.011
Decline in in-person social interactions since March 2020	762 (62.8)		497 (57.3)		
Number of permanent household members		5.62 (2.81); [5, 1–10]		5.28 (2.94); [5, 1–10]	.010
No change/decrease in virtual social contact since March 2020	676 (55.7)		510 (58.8)		.160
Increase in virtual social contact since March 2020	537 (44.3)		357 (41.2)		
Age		63.12 (11.37); [62, 43–100]		63.89 (11.2); [64, 44–100]	.121
Education					
No formal education	554 (45.7)		306 (35.3)		<.001
Some or complete primary education (1–7 years)	432 (35.6)		338 (38.9)		
Some or complete secondary education (8+ years)	227 (18.7)		223 (25.7)		
Employed (includes home manager)	190 (15.7)		201 (23.2)		<.001
Not working (includes retired)	1,023 (84.3)		666 (76.8)		
Marital status					
Never married	58 (4.8)		76 (8.8)		<.001
Currently married or living with partner	432 (35.6)		601 (69.3)		
Separated/deserted/divorced	140 (11.5)		99 (11.4)		
Widowed	583 (48.1)		91 (10.5)		
Number of living children		4.53 (2.18); [5, 0–8]		4.73 (2.44); [5, 0–8]	.055
Wealth index					
Q1—Poorest	229 (18.9)		174 (20.1)		.605
Q2—Poor	231 (19.0)		148 (17.1)		
Q3—Middle	227 (18.7)		170 (19.6)		
Q4—Less poor	244 (20.1)		187 (21.6)		
Q5—Least poor	282 (23.3)		188 (21.7)		
No ADLs	1,157 (95.4)		821 (94.7)		.473
Reported ADLs	56 (4.6)		46 (5.3)		
Month of data collection during COVID supplement					
July 2021	86 (7.1)		71 (8.2)		.867
August 2021	249 (20.5)		178 (20.5)		
September 2021	327 (27.0)		239 (27.6)		
October 2021	454 (37.4)		310 (35.8)		
November 2021–March 2022	97 (8.0)		69 (8.0)		
CES-D score		14.53 (9.25); [13, 0–44]		13.56 (9.43); [12, 0–43]	.020
No comorbidities	250 (20.6)		256 (29.5)		<.001
At least 1 comorbidity	963 (79.4)		611 (70.5)		
Unvaccinated against COVID-19	499 (41.1)		368 (42.5)		.551
Vaccinated	714 (58.9)		499 (57.6)		

Note: ADL = activities of daily living; CES-D = Center for Epidemiologic Studies-Depression scale; COVID = coronavirus disease; COVID-19 = coronavirus disease 2019; Q = quintile; *SD* = standard deviation.

Table 2. Logistic Regression Models for Increased Anxiety Symptoms and Decreased In-Person Social Interactions

Variable	Model 1—Overall (N = 2,080)			Model 2—Women (n = 1,213)			Model 3—Men (n = 867)		
	OR	*SE*	*p* Value	OR	*SE*	*p* Value	OR	*SE*	*p* Value
No change/increase in in-person social interactions since March 2020		*ref*			*ref*			*ref*	
Decline in in-person social interactions since March 2020	**2.521**	**0.264**	**<.001**	**2.292**	**0.310**	**<.001**	**2.917**	**0.498**	**<.001**
Men		*ref*							
Women	**1.470**	**0.164**	**.001**						
Age	0.999	0.005	.798	1.003	0.007	.711	0.994	0.009	.489
No formal education		*ref*			*ref*			*ref*	
Some primary (1–7 years)	1.072	0.122	.544	1.070	0.156	.645	1.097	0.207	.622
Some secondary or more (8+ years)	1.000	0.150	.999	1.107	0.221	.610	0.874	0.207	.569
Not working/retired		*ref*			*ref*			*ref*	
Employed/home manager	1.136	0.150	.333	1.367	0.241	.077	0.978	0.200	.915
Currently married or living with partner		*ref*			*ref*			*ref*	
Never married	0.944	0.195	.780	0.612	0.188	.109	1.362	0.385	.274
Separated/deserted/divorced	0.998	0.160	.991	0.996	0.206	.985	0.979	0.262	.938
Widowed	0.805	0.101	.083	0.761	0.113	.067	0.786	0.213	.373
Number of children	0.994	0.023	.797	1.002	0.030	.952	1.001	0.037	.976
Wealth Index Q1 (poorest)		*ref*			*ref*			*ref*	
Q2	0.939	0.151	.696	0.831	0.171	.368	1.148	0.306	.606
Q3	1.067	0.169	.683	0.915	0.187	.663	1.319	0.339	.281
Q4	1.218	0.189	.204	1.166	0.234	.445	1.291	0.327	.315
Wealth Index Q5 (least poor)	1.020	0.161	.899	0.873	0.177	.504	1.222	0.317	.441
No ADLs		*ref*			*ref*			*ref*	
Has ADLs	1.296	0.301	.263	0.792	0.251	.462	**2.295**	**0.790**	**.016**
July 2021		*ref*			*ref*			*ref*	
August 2021	1.368	0.288	.137	1.481	0.414	.160	1.146	0.368	.672
September 2021	1.096	0.225	.656	1.099	0.302	.731	1.136	0.352	.682
October 2021	1.477	0.294	.050	1.658	0.442	.058	1.245	0.375	.468
November 2021 to March 2022	**2.769**	**0.670**	**<.001**	**3.537**	**1.150**	**<.001**	1.970	0.744	.073
CES-D score	1.008	0.005	.124	1.014	0.007	.051	1.000	0.009	.991
No comorbidities		*ref*			*ref*			*ref*	
At least 1 comorbidity	1.247	0.146	.059	1.117	0.174	.480	**1.472**	**0.264**	**.031**
Unvaccinated against COVID-19		*ref*			*ref*			*ref*	
Vaccinated	0.977	0.098	.814	0.966	0.124	.786	0.996	0.162	.982

Notes: ADL = activities of daily living; CES-D = Center for Epidemiologic Studies-Depression scale; COVID-19 = coronavirus disease 2019; OR = Odds Ratio; Q = quintile; *ref* = reference; *SE* = standard error.
Bold indicates significance at the .05 alpha level.

(OR = 1.47, *SE* = 1.64, $p < .001$). In models 2 and 3, declines in in-person social interactions remained associated with elevated odds of increased anxiety for both women (OR = 2.29, *SE* = 0.31, $p < .001$) and men (OR = 2.92, *SE* = 0.5, $p < .001$), respectively.

Modification by Household Size for Women and Men

The results of models 4 (women) and 5 (men) are displayed in Table 3. We found evidence that the association between declines in in-person social interactions and increased anxiety was modified by the number of permanent household members for women, but not men. Specifically, for each additional permanent resident in the respondent's household, the magnitude of association between declines in in-person social interactions and increased anxiety increased by 11.1% (OR = 1.11, *SE* = 0.054, $p = .032$).

Modification by Increased Virtual Social Contact for Women and Men

The results of models 6 (women) and 7 (men) can be found in Table 4. In these models, the association between declines in in-person social interactions and increased anxiety was modified by an increase in virtual social contact for both women and men. For women, the magnitude of association between a decline in in-person interaction and increased anxiety was reduced by 46.5% among those who reported increases in virtual social contact (OR = 0.535, *SE* = 0.149, $p = .025$). We observed that this association was buffered for men who reported increases in virtual social contact as well. Specifically, the magnitude of association between a decline in

Table 3. Modification by Household Size for Women and Men

Variable	Model 4—Women (n = 1,213)			Model 5—Men (n = 867)		
	OR	*SE*	*p* Value	OR	*SE*	*p* Value
No change/increase in in-person social interactions since March 2020		*ref*			*ref*	
Decline in in-person social interactions since March 2020	1.279	0.386	.415	**3.038**	**1.083**	**.002**
Number of permanent household members	0.952	0.040	.242	1.018	0.052	.722
Number of permanent household members × decline in in-person social interaction since March 2020	**1.111**	**0.054**	**.032**	0.993	0.058	.904
Age	1.003	0.007	.682	0.994	0.009	.520
No formal education		*ref*			*ref*	
Some primary (1–7 years)	1.093	0.161	.548	1.099	0.208	.618
Some secondary or more (8+ years)	1.129	0.226	.545	0.879	0.209	.588
Not working/retired		*ref*			*ref*	
Employed/home manager	1.380	0.246	.071	0.977	0.200	.909
Currently married or living with partner		*ref*			*ref*	
Never married	0.599	0.185	.098	1.380	0.392	.258
Separated/deserted/divorced	0.982	0.203	.932	1.015	0.284	.958
Widowed	0.762	0.114	.070	0.806	0.223	.436
Number of children	0.992	0.033	.803	0.995	0.039	.899
Wealth Index Q1 (poorest)		*ref*			*ref*	
Q2	0.821	0.169	.338	1.141	0.305	.621
Q3	0.913	0.187	.656	1.322	0.339	.276
Q4	1.156	0.234	.475	1.283	0.326	.327
Wealth Index Q5 (least poor)	0.881	0.181	.539	1.212	0.316	.461
No ADLs		*ref*			*ref*	
Has ADLs	0.762	0.241	.391	**2.283**	**0.786**	**.017**
July 2021		*ref*			*ref*	
August 2021	1.534	0.429	.126	1.143	0.368	.677
September 2021	1.134	0.312	.648	1.136	0.353	.682
October 2021	**1.704**	**0.454**	**.046**	1.247	0.376	.465
November 2021 to March 2022	**3.748**	**1.216**	**<.001**	1.986	0.754	.071
CES-D score	1.013	0.007	.058	1.000	0.009	.995
No comorbidities		*ref*			*ref*	
At least 1 comorbidity	1.123	0.176	.460	**1.477**	**0.266**	**.030**
Unvaccinated against COVID-19		*ref*			*ref*	
Vaccinated	0.979	0.127	.871	1.000	0.163	.999

Notes: ADL = activities of daily living; CES-D = Center for Epidemiologic Studies-Depression scale; COVID-19 = coronavirus disease 2019; OR = odds ratio; Q = quintile; *ref* = reference; *SE* = standard error.
Bold indicates significance at the .05 alpha level.

in-person interaction and increased anxiety was reduced by 56.5% among men who reported increases in virtual social contact (OR = 0.445, *SE* = 0.153, $p = .019$).

Pregibon's Goodness-of-Link Test did not indicate model misspecification across any of our models ($\hat{y}$ $p < .05$, $\hat{y}^2$ $p > .05$).

Discussion

In this investigation, we sought to understand how anxiety within a cohort of midlife and older Black South African adults in a rural setting may have been affected by physical distancing during the COVID-19 pandemic, and the extent to which household size and virtual social contact (including by phone, social media, and email) may modify this association. Findings suggest that declines in extra-household in-person social interactions were associated with worsening anxiety symptoms for both men and women. Moreover, we found evidence that living in larger households may put women who experienced a decline in extra-household in-person social interaction at greater risk for anxiety symptoms. Finally, we found that the association between declining in-person interactions and increased anxiety symptoms was attenuated for both women and men who increased their virtual social contact since the start of the COVID-19 pandemic.

Our findings offer important insight into the mental health implications of the COVID-19 pandemic in this setting. Since the beginning of the pandemic, researchers have noted South

Table 4. Modification by Increased Social Contact for Women and Men

Variable	Model 6—Women (n = 1,213)			Model 7—Men (n = 867)		
	OR	*SE*	*p* Value	OR	*SE*	*p* Value
No change/increase in in-person social interactions since March 2020		*ref*			*ref*	
Decline in in-person social interactions since March 2020	**2.783**	**0.504**	**<.001**	**3.926**	**0.888**	**<.001**
Number of permanent household members	1.022	0.026	.376	1.011	0.032	.716
No change/decrease in virtual social contact since March 2020		*ref*			*ref*	
Increase in virtual social contact since March 2020	**2.196**	**0.503**	**.001**	**2.144**	**0.615**	**.008**
Increase in virtual social contact since March 2020 × decline in in-person social interaction since March 2020	**0.535**	**0.149**	**.025**	**0.445**	**0.153**	**.019**
Age	1.001	0.007	.854	0.992	0.009	.357
No formal education		*ref*			*ref*	
Some primary (1–7 years)	1.067	0.156	.661	1.084	0.206	.671
Some secondary or more (8+ years)	1.127	0.227	.553	0.859	0.205	.525
Not working/retired		*ref*			*ref*	
Employed/home manager	1.386	0.247	.068	0.961	0.197	.846
Currently married or living with partner		*ref*			*ref*	
Never married	0.623	0.192	.124	1.403	0.410	.246
Separated/deserted/divorced	1.021	0.213	.920	1.030	0.294	.916
Widowed	0.762	0.114	.070	0.813	0.223	.449
Number of children	0.991	0.033	.781	0.997	0.039	.937
Wealth Index Q1 (poorest)		*ref*			*ref*	
Q2	0.776	0.162	.225	1.173	0.315	.552
Q3	0.863	0.178	.473	1.341	0.346	.255
Q4	1.102	0.224	.632	1.318	0.335	.276
Wealth Index Q5 (wealthiest)	0.805	0.167	.295	1.219	0.318	.447
No ADLs		*ref*			*ref*	
Has ADLs	0.803	0.258	.496	**2.228**	**0.769**	**.020**
July 2021		*ref*			*ref*	
August 2021	1.539	0.434	.127	1.175	0.381	.618
September 2021	1.080	0.300	.781	1.152	0.359	.651
October 2021	1.662	0.446	.058	1.261	0.381	.443
November 2021 to March 2022	**3.564**	**1.179**	**<.001**	1.997	0.758	.068
CES-D score	1.013	0.007	.057	1.000	0.009	.998
No comorbidities		*ref*			*ref*	
At least 1 comorbidity	1.139	0.178	.405	**1.501**	**0.271**	**.024**
Unvaccinated against COVID-19		*ref*			*ref*	
Vaccinated	0.980	0.127	.875	0.993	0.162	.964

Notes: ADL = activities of daily living; CES-D = Center for Epidemiologic Studies-Depression scale; OR = odds ratio; Q = quintile; *ref* = reference; *SE* = standard error.
Bold indicates significance at the .05 alpha level.

Africa's high burden of mental health problems, including posttraumatic stress disorder, anxiety, and depression—all of which cannot be disentangled from its history of racial trauma and current social and economic inequality (Naidu, 2020; Nguse & Wassenaar, 2021). Our finding that declines in extra-household in-person social interaction were associated with increased anxiety symptoms is consistent with prior research among a younger sample of adults in South Africa, which found that, as in-person interactions increased in Spring/Summer 2020, anxiety symptoms declined (Harling et al., 2021). The implications for older adults are likely even more dire, as they face increased risk of COVID-19 infection, hospitalization, and mortality (Dadras et al., 2022). Moreover, the increased risk of COVID-19 infection and the resultant burden on mental health (Kim et al., 2022) were accompanied by declines in in-person social interactions by formal stay-at-home orders and informal decisions to avoid others, physically isolating older adults from their support systems and challenging the behaviors and routines they had in place to access them (Kim & Jung, 2020; Vrach & Tomar, 2020). The confluence of these factors placed this population at increased risk for mental health disorders, including

anxiety, depression, and psychological distress (Fontes et al., 2020).

Our results revealed that for women, but not men, the association between declines in extra-household in-person social interaction and increases in anxiety symptoms was exacerbated by the number of permanent household members in one's home. Critically examining the historic and contemporary distribution of caregiving in South African households can provide insight into this observed moderation. Globally, scholars have described what is termed the "care economy" to refer to the unpaid care that women provide to members of their households (Power, 2020). In South Africa, available estimates suggest that women dedicate up to tenfold more time to unpaid care work than men (Oosthuizen, 2018). This burden primarily falls on older women as the heads of households, due to disruptive apartheid-era labor and housing policies that led men to migrate to cities for employment opportunities, whereas women stayed at home to care for the family (Budlender & Lund, 2011). Moreover, the mortality of the middle generation due to HIV has further added to the caregiving burden for many midlife and older women, who take on the primary care of their grandchildren (Schatz & Ogunmefun, 2007).

Women, globally, experienced a heightened caregiving burden during the COVID-19 pandemic. In its 2020 report on COVID-19 and Universal Health Coverage, the United Nations highlighted the disproportionate impact the pandemic has had on women, especially those who are faced with unpaid care work at home (UNSDG, 2020). Stay-at-home orders and informal social distancing practices increased the demand on mothers and grandmothers to care for members of their households as schools and workplaces closed, while also isolating these women from some of the in-person social connections and support they may rely on to fulfill this role. With this study's context in mind, it may be that for women, rather than replacing the lost in-person social interactions with people outside of the home, household members represent an additional source of stress because of their caregiving needs, exacerbating the stress and anxiety associated with that lost in-person contact.

Finally, our paper explored whether increased virtual social contact modified the association between declining extra-household in-person social interaction and increasing anxiety symptoms for men and women. Unlike our findings for household size, we observed that this association was modified for both women and men; increased virtual social contact buffered the association between declining in-person social interaction and increased anxiety symptoms. Although unexpected, these findings are consistent with existing literature on the potential mental health benefits of virtual social contact during the COVID-19 pandemic (Semo & Frissa, 2020). Most published analyses in South Africa have focused on how online platforms can reduce the social and emotional impacts of pandemic-induced social isolation in adolescents and young adults, a population in which the use of online communication is near universal (Visser & Law-van Wyk, 2021; Wegner et al., 2022). However, work conducted in the early stages of the pandemic has recommended extending online resources to aging populations, including telehealth services and social media platforms (Gyasi, 2020). Online media can assist in reducing disruptions to individuals' routines, cultivate social support through interactions with family and friends, and be an avenue to access mental and physical healthcare.

Observational studies conducted prior to the COVID-19 pandemic have revealed similar associations between virtual social interactions and mental health. A scoping review of articles published between 2008 and 2018 revealed that online social contact assisted older adults in alleviating loneliness, social isolation, and depression by enhancing communication with friends and family and fostering independence and self-efficacy (Chen et al., 2022). In addition to these benefits, existing experimental research has indicated that virtual social support can buffer the stress response from social stressors as effectively as in-person social support (Kothgassner et al., 2019). This work utilized the Buffering Model of social support, which posits social support has the potential to alleviate the stress associated with adverse events that provided that the support addresses the needs resulting from the event (Cohen & Wills, 1985). In the context of our study, it may be that increased virtual social contact buffers against the stress resulting from physical distancing by replacing the loss of in-person interaction with virtual contact. However, plausible this explanation may be, further research is required to determine if this is the underlying, causal, mechanism for our observed association.

Existing work has also linked social media use to the receipt of emotional support among caregivers. A systematic review by Wan et al., which included research from low-middle-income countries, found that social media helped caregivers fulfill their emotional and informational needs across a variety of studies (Wan et al., 2020). A meta-analysis of studies done in high-income settings found that social media-based interventions helped improve caregivers' perceived social support and self-efficacy (Parker Oliver et al., 2017). Given this evidence, it is plausible that women in our sample were using virtual communication platforms (including interactions by phone) in response to the lack of support for their care activities, thereby receiving emotional support that buffered their anxiety. Virtual communication platforms, which encompass tools for both social interactions and healthcare services, have demonstrated the potential to improve mental health and redress inequities, underscoring their suitability as a potential means of public health intervention for middle and older adults.

Findings presented in this paper should be viewed considering some limitations of the study. First, although our analyses included a temporal component in the wording of our questions, our exposure, modifying variables, and outcome were measured simultaneously, preventing our ability to make causal claims and rule out reverse causation (i.e., anxious individuals may reduce their extra-household social contact). Future research in South Africa should examine the relationships reported in this analysis longitudinally to better elucidate the pathways through which physical distancing may result in worse mental health for both men and women, and specifically for women in larger households. Second, survey items used to operationalize our dependent and independent measures relied on the memory of respondents, in reporting changes in anxiety symptoms and in in-person social interactions over the previous 18 or more months. As such, these measures may suffer from error due to recall bias. Moreover, our dependent variable reflects subjective changes in anxiety; we are therefore limited in our capacity to make inferences about the association between declines in in-person contact and

absolute increases in anxiety. Likewise, there are unobservable or unmeasured factors that could be linked with changes in anxiety, but that we were unable to account for in our models (e.g., job-related concerns, fear of mortality, and so on). Finally, our sample is not representative of all aging Black South Africans, which limits the generalizability of our findings to those outside our analytic sample.

Our study is one of the first to explore the association between declines in extra-household in-person social interactions and increases in anxiety during the COVID-19 pandemic among middle and older Black South African adults. Our findings can inform the development of policies and interventions aimed at improving mental health and redressing health inequities within this population. We found that for both women and men, declines in in-person social interactions were associated with increases in anxiety symptoms, but were weaker for those who reported increases in virtual social contact. However, for women only, these declines were stronger for those living in larger households and weaker for those who reported increases in virtual social contact. Existing literature on the mental health of older adult populations in Sub-Saharan Africa during the COVID-19 pandemic has recommended expanding access to online culturally sensitive psychological counseling services, including reducing electricity charges or offering subsidies to allow for increased internet/phone use (Gyasi, 2020). Other research has recommended the development of person-centered applications to allow these populations to stay socially connected with friends and family (Wu, 2020). Given South Africa's historical context and apartheid's legacy on contemporary household composition and gendered caregiving norms, multifaceted, transformational policies and interventions should be considered to redress mental health challenges and gender inequities, especially in the face of changes to social life brought by the COVID-19 pandemic. Extant literature from South Africa suggests several evidence-based policies to address these challenges, including the introduction of paternity leave, provision of private and/or public financial support for female heads of households, and increasing access to affordable childcare (Smout, 2021). Such interventions—designed to improve population health and redress inequities—are necessary to maintaining mental wellness even as societies move past lockdowns and social distancing as the primary means of responding to COVID-19. Future research should continue to catalog the unique stressors middle and older adults experienced during the pandemic and investigate the pathways by which they affect their mental health.

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Conflict of Interest

None.

Author Contributions

N. W. Harriman performed all statistical analyses, drafted the methods, results, and discussion, and revised the introduction. D. Ohene-Kwofie led the data collection along with F. X. Gómez-Olivé, who provided guidance on the statistical analysis, and revised all sections of the paper. S. J. Jung and S. Hermosilla provided feedback on the statistical analysis and revised all sections of the paper. F. X. Gómez-Olivé led the data collection along with D. Ohene-Kwofie and revised all sections of the paper. E. A. Jennings conceptualized the study, supervised the statistical analyses, drafted the introduction, and revised all sections of the paper.

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