

Changes in activity levels, physical functioning, and fall risk during the COVID-19 pandemic

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Funding information

AARP Foundation; Michigan Medicine; U. S. Department of Veterans Affairs

Abstract

Background: Physical function worsens with older age, particularly for sedentary and socially isolated individuals, and this often leads to injuries. Through reductions in physical activity, the COVID-19 pandemic may have worsened physical function and led to higher fall-related risks.

Methods: A nationally representative online survey of 2006 U.S. adults aged 50–80 was conducted in January 2021 to assess changes in health behaviors (worsened physical activity and less daily time spent on feet), social isolation (lack of companionship and perceived isolation), physical function (mobility and physical conditioning), and falls (falls and fear of falling) since March 2020. Multivariable logistic regression was used to assess relationships among physical activity, social isolation, physical function, falls, and fear of falling.

Results: Among respondents, 740 (36.9%) reported reduced physical activity levels, 704 (35.1%) reported reduced daily time spent on their feet since March 2020, 712 (37.1%) reported lack of companionship, and 914 (45.9%) social isolation. In multivariable models, decreased physical activity (adjusted risk ratio, ARR: 2.92, 95% CI: 2.38, 3.61), less time spent on one's feet (ARR: 1.95, 95% CI: 1.62, 2.34), and social isolation (ARR: 1.51, 95% CI: 1.30, 1.74) were associated with greater risks of worsened physical conditioning. Decreased physical activity, time spent daily on one's feet, and social isolation were similarly associated with worsened mobility. Worsened mobility was associated with both greater risk of falling (ARR: 1.70, 95% CI: 1.35, 2.15) and worsened fear of falling (ARR: 2.02, 95% CI: 1.30, 3.13). Worsened physical conditioning and social isolation were also associated with greater risk of worsened fear of falling.

Conclusion: The COVID-19 pandemic was associated with worsened physical functioning and fall outcomes, with the greatest effect on individuals with reduced physical activity and social isolation. Public health actions to address reduced physical activity and social isolation among older adults are needed.

KEYWORDS

activity, conditioning, falls, fear of falling, loneliness, mobility

INTRODUCTION

Sedentary behavior and social isolation increase risks of functional impairment and injury among older adults, threatening their independence and safety.¹⁻⁵ During extended periods of reduced physical activity or isolation, such disablement may accelerate, causing a progressive loss of mobility and physical conditioning, and greater need for assistance from others for daily activities.⁶⁻⁹

Although disability and functional trajectories have been extensively examined,¹⁰⁻¹³ it is less well understood how physical functioning of older adults has been affected by the COVID-19 pandemic. Some older adults may have maintained functional capacity through continued exercise, despite restrictions on physical and social engagement.¹⁴ For others, mobility and physical conditioning may have declined due to increased social isolation and sedentary behaviors, leading to higher risk for injuries such as falls.¹⁻⁵

Limited prior research has described decreases in physical activity among older adults during the COVID-19 pandemic.¹⁵ The current study adds to this literature by examining self-reported changes in physical function and fall-related injury, and whether these changes are influenced by sedentary behavior and social isolation. Specifically, it assesses whether physical activity and social isolation influenced physical functioning, and how activity levels and social isolation influenced fall injuries and the fear of falling. These findings can improve understanding of how older adults' levels of physical disability and injury risk change under rapid shifts in opportunities for physical and social engagement.

METHODS

Data for this study came from the January 2021 National Poll on Healthy Aging (NPHA), a nationally representative survey of U.S. adults aged 50–80 ($n = 2023$, completion rate = 78%). Respondents were selected from the Ipsos web-enabled KnowledgePanel[®] in which panel participants are randomly recruited through address-based sampling, and households are provided with access to the internet and laptop computers if needed to complete surveys. The poll asked older adults about their experiences related to activities, function, and falls since March 2020 (i.e., the start of the United States coronavirus pandemic).

Our main outcomes of interest were measures capturing physical function and falls. Two indicators of physical function were assessed: worsened mobility and physical conditioning. Mobility was defined for respondents as “a person's ability to move around on one's own – by walking, using assistive devices such as a cane or walker, or

Key Points

- The COVID-19 pandemic was associated with worsened physical functioning and fall outcomes.
- Poor fall outcomes reflected worsened physical functioning and reduced physical activity levels.

Why Does this Paper Matter?

Rapid deconditioning from the pandemic requires prompt policy responses.

by using transportation.” Physical conditioning was defined for respondents as “a person's flexibility, muscle strength, endurance, and ability to do physical activity.” Respondents were asked whether, since March 2020, each of mobility and physical conditioning had changed, if at all, with three response options: improved, worsened, and no change. Binary indicators for each of worsened mobility and worsened physical conditioning were developed from respondent answers.

Additionally, two fall-related outcomes were assessed: (1) falls, defined for respondents as “where a person ends up on the ground or a lower level due to a loss of balance, slip, or trip” and (2) worsened fear of falling. For the first measure, respondents were asked, “Since March 2020, how many times have you fallen?” with response options of 0, 1, 2–3, and ≥ 4 times. A binary indicator was created to categorize individuals as having fallen (≥ 1 fall) or not fallen (0 falls). For the second measure, respondents were asked, “Are you afraid of falling?” with response options of yes, very afraid of falling; yes, somewhat afraid of falling; and no, not afraid of falling. For those who answered yes (either very or somewhat afraid of falling), an additional question was asked: “How has your fear of falling changed since March 2020?” with response options of more fearful of falling, less fearful of falling, and no change in fear of falling.

Several measures of health behaviors and physical function (hereafter, “function”) were also assessed. Respondents were asked “Since March 2020, how often have you done moderate or more vigorous physical activity for at least 30 minutes?” Response options were as follows: every day or nearly every day, several times a week, about once a week, every 2–3 weeks, once a month or less, and never. Examples of moderate physical activities included brisk walking, housework, or mowing the lawn. Participants were then asked, “How has the amount of

moderate or more vigorous physical activity you do changed since March 2020, if at all?” Respondents were also asked “How has the amount of time you spend on your feet standing or walking on a typical day changed since March 2020, if at all?” Response options for both questions were as follows: more active, less active, or no change. Two dichotomous indicators were created to categorize individuals into those with reduced versus not reduced physical activity and with reduced versus not reduced daily time spent on their feet. To assess social isolation, respondents were asked “In the past year, how often have you felt isolated from others?” Response options were as follows: hardly ever, some of the time, often. A dichotomous indicator was created to categorize individuals into those who felt frequent social isolation (some of the time or often) versus hardly ever.

Sociodemographic and health characteristics included age (continuous), gender, race/ethnicity (non-Hispanic White, non-Hispanic Black, Hispanic, and non-Hispanic Other), education (high school or less, some college, bachelor’s degree or higher), total annual household income (<\$30,000, \$30,000–\$59,999, \$60,000–\$99,999, ≥\$100,000), marital status (married/partnered, not married/not partnered), and health status (poor, fair, good, very good, or excellent).

In analyses, overall sociodemographic and health characteristics were first described. Next, *t*-tests for continuous and chi-square tests for binary or categorical variables were used to compare these measures by physical activity (hereafter, “activity”) levels, daily time spent on one’s feet, mobility, and physical conditioning (hereafter, “conditioning”).

Given conceptual and empirical understandings of disablement and injury (Figure 1), we hypothesized that reduced activity and greater social isolation would be associated with worsened function. In turn, we expected that decreased function would increase injury risk and fear of injury. To test these hypotheses, four logistic regression models were estimated. For the first and second models, logistic regression models were separately estimated, regressing each of worsened mobility and worsened conditioning on reduced activity, less daily time spent on one’s feet, and social isolation. For the third and fourth models, logistic regression models were separately estimated, regressing each of having a fall and worsened fear of falling on worsened mobility, worsened conditioning, and social isolation. All models were adjusted for sociodemographic and health characteristics. Results for adults aged 65–80 are provided in Tables S1–S3.

The first three models had an analytic sample of 2006, whereas the fourth model included a smaller sample of 737 respondents (because of the change in fear of falling after March 2020 only being asked of those

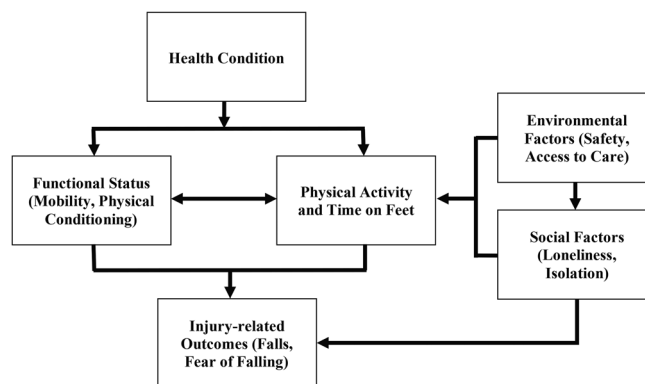


FIGURE 1 Conceptual model of relationships among physical activity, time on feet, social isolation, physical function, and falls outcomes. The figure illustrates how the pandemic may have directly influenced older individuals’ social lives (by reducing the sense of safety in social interactions at home or in the community) and their physical activity levels, by affecting the safety of daily physical activity (such as errands in the community, recreational activities). The pandemic may have also affected older individuals’ health, which in turn reduced activity levels. Through these pathways, the pandemic may have indirectly influenced older individuals’ functional status and fall-related outcomes. If individuals reduced their physical activity levels or time on their feet, they may have had worsened mobility and physical conditioning, which in turn could lead to increased falls and fear of falling. Or loneliness and isolation could directly affect fall outcomes through the mechanism of depression, which is strongly correlated with fall and fall injury risk

reporting any fear of falling). Because odds ratios produced in logistic regression models can overstate magnitudes of associations of interest for non-rare outcomes, we computed adjusted risk ratios and delta method standard errors.¹⁶ Survey weights were used for all descriptive data and in regression models.

This study was reviewed and deemed exempt by the University of Michigan Institutional Review Board.

RESULTS

A total of 2006 respondents to the survey provided complete information for all model variables. Of these respondents, 59.5% were aged 50–64 and 52.6% were female (Table 1). The sample was comprised of non-Hispanic Whites (71.1%), Hispanics (11.6%), non-Hispanic Blacks (10.5%), and Other racial/ethnic backgrounds (6.8%). Four in 10 individuals had high school or less education (40.1%) and 39.0% had household incomes of less than \$60,000. Approximately one in 6 individuals (15.5%) reported being in fair or poor health, and 45.9% felt isolated (some of the time or often) from others.

TABLE 1 Characteristics of respondents, overall and by changes in activity level and physical function after the start of the COVID-19 pandemic

	Overall	Changes in activity level ^a		Changes in physical function ^a	
		Less physical activity	Less time on feet	Worsened physical conditioning	Worsened mobility
Total (<i>n</i> = 2006)	100.0	36.9	35.1	26.9	20.9
Age			*		
50–64 (<i>n</i> = 993)	59.5	35.1	33.2	26.4	20.8
65–80 (<i>n</i> = 1013)	40.5	39.5	38.0	27.7	21.1
Gender		**	*		
Male (<i>n</i> = 943)	47.4	32.8	32.2	26.0	19.2
Female (<i>n</i> = 1063)	52.6	40.5	37.8	27.7	22.4
Race/Ethnicity					
White, non-Hispanic (<i>n</i> = 1519)	71.1	35.5	34.3	27.5	20.5
Black, non-Hispanic (<i>n</i> = 183)	10.5	45.0	39.8	25.8	25.4
Hispanic (<i>n</i> = 181)	11.6	35.3	32.7	22.9	18.3
Other, non-Hispanic (<i>n</i> = 123)	6.8	41.8	40.9	29.8	22.6
Education			*	*	
High school or less (<i>n</i> = 661)	40.1	35.2	32.9	23.6	20.9
Some college (<i>n</i> = 664)	29.1	39.4	33.2	28.1	23.7
Bachelor's degree or higher (<i>n</i> = 681)	30.8	36.7	39.8	30.1	18.3
Total annual household income					*
Less than \$30,000 (<i>n</i> = 239)	17.2	38.8	36.9	29.1	27.5
\$30,000–\$59,999 (<i>n</i> = 431)	21.8	40.5	37.4	27.2	22.1
\$60,000–\$99,999 (<i>n</i> = 509)	23.9	34.7	30.6	24.2	19.4
\$100,000 or more (<i>n</i> = 827)	37.2	35.2	35.9	27.5	18.2
Marital status		**	*	**	***
Married or partnered (<i>n</i> = 1424)	69.0	34.5	33.5	24.7	18.0
Not married or partnered (<i>n</i> = 582)	31.0	42.1	38.8	31.9	27.4
Lives alone					
Yes (<i>n</i> = 417)	21.0	35.2	39.5	28.0	21.4
No (<i>n</i> = 1589)	79.0	37.3	34.0	26.6	20.8
Physical health		**	***	***	***
Excellent/very good/good (<i>n</i> = 1716)	84.5	35.1	33.1	22.8	16.1
Fair or Poor (<i>n</i> = 290)	15.5	46.4	46.3	49.0	47.2
Felt isolated from others		***	***	***	***
Hardly ever (<i>n</i> = 1092)	54.1	26.5	26.3	16.2	12.2
Some of the time/often (<i>n</i> = 914)	45.9	49.1	45.5	39.5	31.1

^aChanges measured since the start of the pandemic in March 2020.

Note: Significance based on Pearson's Chi-squared. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. For columns 2 and 3, differences according to respondent characteristics are compared among those with reduced physical activity levels to those with no change or increased physical activity levels since the start of the pandemic. For instance, in column 3, characteristics such as age and gender are compared among those who since the start of the pandemic spent less time on their feet compared with those who had no change or spent more time on their feet. Similarly, for columns 4 and 5, differences in respondent characteristics are similarly compared among those with worsened physical function compared with those with no change or improvements in physical function since the start of the pandemic.

Changes in activity levels

A greater proportion of older (ages 65–80) compared with younger adults (ages 50–64) reported reductions in activity (39.5% vs. 35.1%) and daily time spent on their feet (38.0% vs. 33.2%) after the start of the pandemic (Table 1). Women also reported greater reductions than men for these respective activities (physical activity: 40.5% vs. 32.8%; time on feet: 37.8% vs. 32.2%). A greater proportion of non-Hispanic Blacks and non-Hispanic Other individuals, compared with non-Hispanic Whites, reported greater reductions in activity (45.0% and 41.8% vs. 35.5%) and daily time on feet (39.8% and 40.9% vs. 34.3%). Those with lower household income more often reported reductions in activity levels. Individuals who reported some of the time or often feeling socially isolated reported less activity (49.1%) and less time on their feet (45.5%), compared with 26.5% and 26.3% of those who hardly ever felt isolated.

Changes in physical function (physical conditioning and mobility)

A greater proportion of older (aged 65–80) compared with younger adults (aged 50–64) spent less daily time on their feet (38.0% vs. 33.2%), whereas similar proportions

of older and younger adults reported worsened conditioning (27.7% vs. 26.4%) and worsened mobility (21.1% and 20.8%) (Table 1). Those with higher (Bachelor's degree or higher) compared with lower (High school or less) education levels more often reported worsened conditioning (30.1% vs. 23.6%) (Table 1). Individuals in lower-income households (<\$30,000) compared with those in higher-income households (\geq \$100,000) also more often reported worsened conditioning (29.1% vs. 27.5%) and mobility (27.5% vs. 18.2%). More than twice as many individuals who were socially isolated, compared with those who hardly ever felt socially isolated, reported worsened conditioning (39.5% vs. 16.2%) and mobility (31.1% vs. 12.2%).

Those who became less, compared with more, active (55.2% vs. 9.2%, $p < 0.001$) and who spent less, compared with more, daily time on their feet (53.5% vs. 14.3%, $p < 0.001$) more often reported worsened conditioning (Table 2). Similar results were observed among adults aged 65–80 (Table S1).

Falls and fear of falling

Roughly one-quarter of respondents reported one or more falls since March 2020 (Table 3). Those who spent less compared with more daily time on their feet more

TABLE 2 Changes in physical conditioning and mobility since the start of the COVID-19 pandemic, by physical activity and daily time spent on feet

	Physical conditioning change ^a			<i>p</i>	Mobility change ^a			<i>p</i>
	Improved	Worsened	No change		Improved	Worsened	No change	
Total (<i>n</i> = 2006)	11.2	27.1	67.1		9.5	21.0	69.5	
Physical activity ^b				***				***
More active (<i>n</i> = 264)	52.7	9.2	38.2		43.3	7.3	49.4	
Less active (<i>n</i> = 753)	3.4	55.2	41.4		3.0	41.4	55.6	
No change (<i>n</i> = 1003)	6.3	10.9	82.9		5.6	9.3	85.1	
Time spent on feet ^c				***				***
More time (<i>n</i> = 241)	46.7	14.3	39.0		39.4	12.6	48.0	
Less time (<i>n</i> = 715)	5.4	53.5	41.2		4.7	40.8	54.5	
No change (<i>n</i> = 1062)	7.1	12.2	80.7		6.1	9.4	84.5	
Physical activity or time on feet decreased				***				***
Yes (<i>n</i> = 938)	5.5	49.8	44.7		4.8	37.2	58.0	
No (<i>n</i> = 1082)	16.1	7.5	76.4		13.6	6.9	79.5	

^aChanges measured since the start of the pandemic in March 2020.

^bModerate or vigorous physical activity.

^cTime spent on feet standing or walking.

Note: Significance based on Pearson's Chi-squared. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

often reported one or more falls (27.9% vs. 25.8%, $p = 0.02$). Overall, 22.9% of respondents became more fearful, and 4.7% became less fearful, of falling since the start of the pandemic. Increases in fear of falling were more common for those who became less active, compared with more active, after the pandemic began (32% vs. 22%, $p < 0.001$); for those who spent less, compared with more, time on their feet (32% vs. 25%, $p < 0.001$); and for those with worsened, compared with improved, conditioning (42% vs. 16%, $p < 0.001$) or mobility (45% vs. 21%, $p < 0.001$). Increased fear of falling was also greater among those who felt a lack of companionship (30% vs. 16%, $p < 0.001$) or isolation from others (28% vs. 15%, $p < 0.001$). Similar results were observed among adults aged 65–80, with slightly higher percentages reporting one or more falls (28.3%) (Table S2).

Adjusted findings: changes in function

The risk of worsened conditioning was higher for individuals who reduced, compared with did not reduce, regular activity (adjusted risk ratio, ARR = 2.92, 95% CI: 2.38, 3.61); for those who spent less, compared with no change

in, time on their feet (ARR = 1.95, 95% CI: 1.62, 2.34); and for socially isolated, compared with other, individuals (ARR = 1.51, 95% CI: 1.30, 1.74) (Figure 2A). For the worsened mobility outcome, increased risks were observed for each of reductions in regular activity (ARR = 2.49, 95% CI: 1.96, 3.16), less time on feet (ARR = 2.00, 95% CI: 1.60, 2.50), and social isolation (ARR = 1.53, 95% CI: 1.28, 1.84).

Adjusted findings: changes in fall-related outcomes

The risk of having one or more falls was greater (ARR = 1.70, 95% CI: 1.35, 2.15) for individuals with worsened, compared with not worsened, mobility and those who were socially isolated, compared with those hardly ever socially isolated (ARR = 1.23, 95% CI: 1.05, 1.45) (Figure 2B). Worsened conditioning was not associated with changes in the risk of a fall (ARR = 1.13, 95% CI: 0.90, 1.43).

Among individuals who reported fear of falling, each of worsened conditioning (ARR = 1.94, 95% CI: 1.26, 3.01) and worsened mobility (ARR = 2.02, 95% CI: 1.30,

TABLE 3 Falls and changes in fear of falling since the start of the COVID-19 pandemic, by respondent characteristics

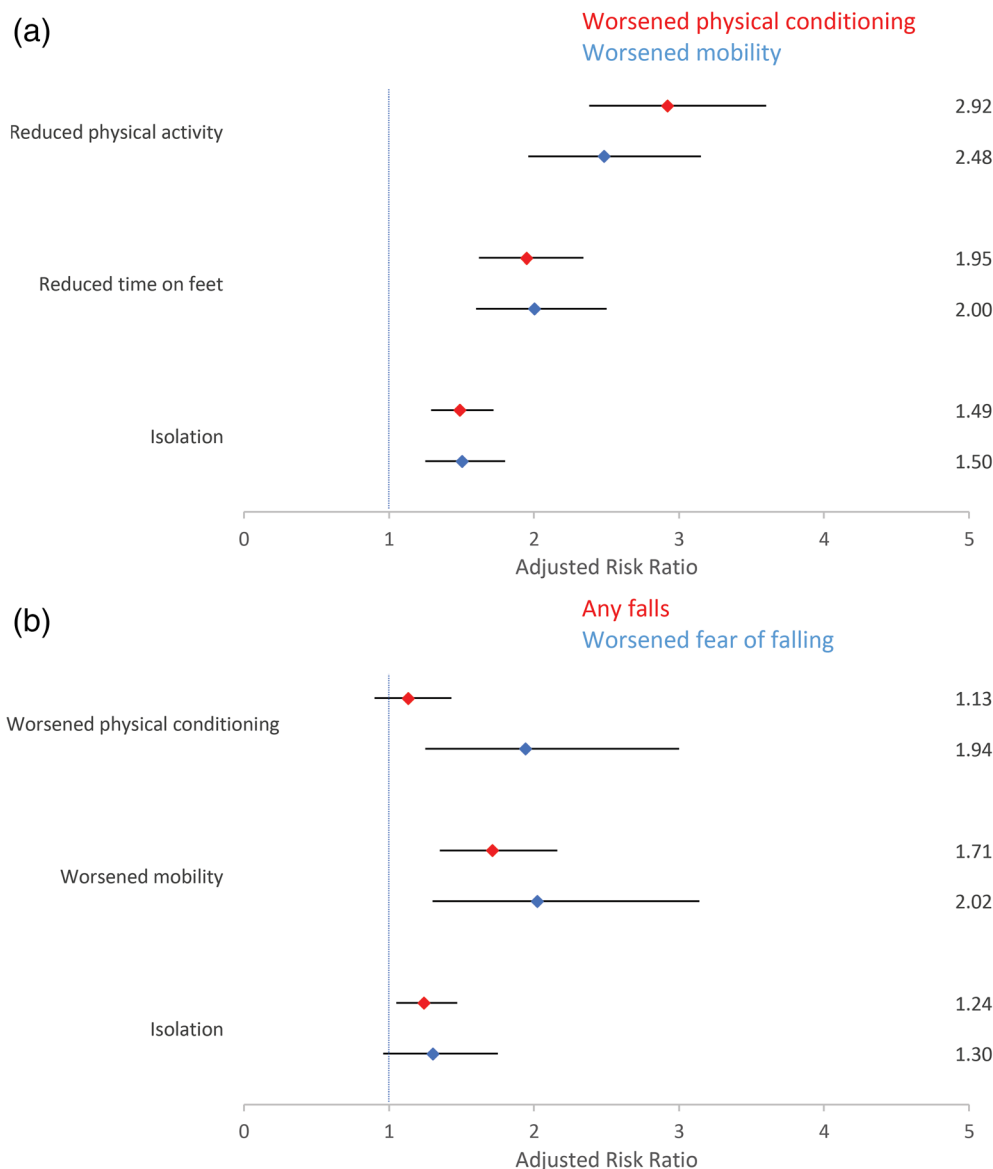
	n	Fall history			n	Fear of falling change			
		0 times	≥1 time	p		More fearful	Less fearful	No change	p
Total	2006	75.2	24.8		741	22.9	4.7	72.4	
Physical activity ^a (n, %)									***
More active	263	74.6	25.4	*	92	22.3	15.4	62.3	
Less active	746	72.0	28.0		334	31.5	4.2	64.2	
No change	997	77.6	22.4		315	14.0	2.2	83.8	
Time spent on feet ^b (n, %)				*					***
More time	240	70.9	18.8		92	24.9	14.0	61.1	
Less time	709	72.0	15.5		318	31.6	4.6	63.8	
No change	1057	78.2	13.5		330	13.9	2.2	84.0	
Physical conditioning (n, %)				***					***
Improved	221	74.5	25.5		65	15.8	23.6	60.6	
Worsened	552	63.1	36.9		279	41.7	3.2	55.2	
No change	1233	80.5	19.5		396	11.1	2.8	86.0	
Mobility (n, %)				***					***
Improved	184	73.9	26.1		56	21.3	23.0	55.7	
Worsened	416	57.4	42.6		240	45.1	4.2	50.7	
No change	1406	80.7	19.3		443	10.8	2.8	86.5	

^aModerate or vigorous physical activity.

^bTime spent on feet standing or walking.

Note: Changes measured since the start of the pandemic in March 2020. Significance based on Pearson's Chi-squared. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Sample sizes for fall history and fear of falling change differ because only those 741 individuals who indicated any fear of falling were asked if their fear of falling changed since March 2020, the start of the pandemic.

FIGURE 2 Associations between physical activity, time on feet, and social isolation and measures of physical function and fall outcomes. Models were adjusted for sociodemographic (age, gender, race/ethnicity, education, total annual household income, marital status, and health status)



3.13), but not social isolation (ARR = 1.29, 95% CI: 0.96, 1.74), were associated with increased fear of falling. For adults aged 65–80, the results were generally similar when compared with those for all participants, with several exceptions (Table S3). For adults aged 65–80, worsened mobility (ARR = 3.78, 95% CI: 1.89, 7.55) but neither of worsened conditioning (ARR = 1.28, 95% CI: 0.67, 2.44) and social isolation (ARR = 1.17, 95% CI: 0.84, 1.64) was associated with increased fear of falling (Table S3).

DISCUSSION

Since the start of the COVID-19 pandemic in the United States, one-third of older adults reported reduced activity levels. Declines in activity were associated with two to three-fold worsening of several self-reported

measures of physical function. In turn, poorer function was associated with increases in the risk of falls and fear of falling. Social isolation was also associated with an increased risk of poorer function and worse fall-related outcomes. Together, the results suggest the pandemic was associated with changes in health and social activities among older adults, and that these changes appear to have led to physical deconditioning and increased risk of fall-related injuries.

Beyond infection rates, hospitalizations, and mortality, recent literature on the COVID-19 pandemic has observed excess mortality that likely reflects clinically under-addressed or untreated acute and long-term health issues.¹⁷ This study illustrates another concern, that of pronounced physical functioning decline among older adults, potentially associated with sustained periods of reduced physical and social activity during the pandemic. Beyond previously measured excess death and morbidity,

this may presage worrisome population health disability and injury cascades in which deconditioning, functional loss, and injury created more disablement.

Observed changes could reflect common disability trends rather than effects from the pandemic. However, prior work observed that from 2019 to 2020 the proportions of adults aged 70 and older with mobility difficulties decreased only slightly, from 19.3% to 18.5%.¹⁸ Therefore, the findings are likely to reflect pandemic-related declines.

Risks for falls increase both with a history of previous falls and in the presence of fear of falling, as each can produce avoidant strategies such as using excessive caution getting around or avoidance of activity that can harm conditioning and mobility.^{19–21} These behaviors could increase short-term fall risk; they could also reduce risk by limiting opportunities for falls. In either case, fall risk may increase once regular activities resume, with important implications for older adults' health and health care costs.²² To the extent reduced activity levels mask shorter-term fall risk, and because falls are predictors for future disability, our study and others may understate the pandemic's longer-term impacts on older adults' functioning and safety.

Sedentary behavior and social isolation are strong predictors of morbidity and mortality, and short-term deconditioning due to these factors can lead to functional decline and injury risk.^{10,11,23,24} The current findings suggest critical, if distinct, roles for these risk factors and confirm that short-term exposures to these risks (in the approximately year-long pandemic period we assessed) can be associated with sizeable impacts on conditioning and mobility. Reversing these deficits will, therefore, require interventions on a broad range of individual and environmental factors that require support from public health agencies, clinicians, and policy makers.⁶

Limitations

The study was subject to several potential limitations. First, it used a cross-sectional design. Although we could assess the retrospective evolution of specific factors, such as physical activity levels or mobility, when estimating relationships among factors, our study may be vulnerable to reverse causality bias. For instance, although reduced mobility was estimated to increase fall risk by 70%, it is plausible that individuals who reported having one or more falls subsequently experienced limited mobility. Still, the absolute levels of change toward poorer mobility and fall-related outcomes are reason for concern. Second, the results may reflect recall bias involving reports of activity levels, function, and falls. Survey respondents underreport falls, for instance.²⁵ Third, measurement bias could be present if respondents at differing levels of social isolation or activity

differentially reported key outcomes. However, reporting bias is diminished with shorter recall intervals anchored by a notable event, such as with the historic pandemic.²⁶ Also, a roughly 1-year recall interval was used in contrast to other studies that used longer recall windows.²⁷ Fourth, internet-based surveys are subject to bias if participants vary from nonrespondents in characteristics unaccounted for in model risk adjustment. However, survey participants without access to the internet were provided free internet service and a web-enabled device and were recruited using a probability-based methodology designed to be nationally representative. Therefore, findings should be broadly generalizable to the U.S. older adult population. Fifth, the results are not generalizable to the cognitively impaired older adult population, as individuals unable to complete the survey on their own or with the help of a caregiver due to cognitive impairment were unlikely to participate in the survey panel. Finally, the survey did not include individuals over the age of 80. Given greater disability and fall risks in this subpopulation, results may understate the proportion of U.S. older adults experiencing activity declines, deconditioning, and falls. An examination of such pandemic-related risks in this “oldest old” group is an important area for future research.

These limitations notwithstanding, these findings have important clinical and policy implications. First, reversing observed trends in older adults' health and social behaviors will require extraordinary efforts beyond routine clinical care. For example, clinicians may lack awareness, training, or adequate resources to address such behaviors. Gerontological models on disablement and injury prevention advise harnessing multisectoral resources in the community and healthcare organizations, and from policy makers.^{8,28} Clinical assessments of function and fall risk are needed, but so are outreach and interventions from senior centers, public health nurses, and community-based care providers, including home health aides, physical and occupational therapists, social workers (for assessing home safety), and long-term care sites.

Policy makers should use the opportunity to address long-standing disincentives to address physical function and fall-related risks. One proposal entails a targeted Medicare falls benefit, including a detailed assessment by a physician to evaluate fall risk and tailored multifactorial fall prevention recommendations, an exercise program referral if requested by the physician, plus reimbursement for an additional follow-up visit.²⁹

This proposal would expand care options beyond a “medically necessary services” policy that prioritizes care after, as opposed to before, an injury. For instance, Medicare will reimburse surgery and rehabilitation for a broken hip, but not routine geriatric assessments or timely

replacement of durable medical equipment, such as a grab bar or bathing chair.³⁰ Similarly, Medicare contractors are likely to reject payment for an occupational therapy evaluation if the therapist makes recommendations regarding non-covered equipment or for an assessment by a physiotherapist of balance issues not covered by a diagnosis code.³⁰ Such determinations may discourage therapists from evaluating non-covered equipment and symptoms, and undermine the benefits of occupational and physical therapy for functioning and falls.^{31–33}

A targeted benefit could also improve care integration across settings. Medicare reimburses hospital, rehabilitation, skilled nursing, and certain home health services through Part A, but reimburses outpatient physician and rehabilitation and some health services under Part B. Each Medicare Part has different incentives for providers (prospective versus fee-for-service payment) and beneficiary cost-sharing arrangements that pose challenges for care coordination. Moreover, to manage payments for these services, Medicare uses separate fiscal intermediaries, which have discretion in making local coverage determinations. Such complexity for providers and patients can hamstring prevention efforts to access needed interdisciplinary care (e.g., occupational therapists for home modifications,^{31–33} physiotherapists and physiologists for exercise programs and tests of functional mobility,^{34,35} geriatricians and nurse practitioners for outpatient medical assessments,³⁶ and pharmacists for medication regimen assessments^{37,38}).

Integrating Medicare services through dedicated payment streams and addressing regulatory barriers to service provision could follow prior work done in the Program for All-Inclusive Care for the Elderly (PACE) and Money Follows the Person models,^{39,40} which combined funding sources to improve care coordination for Medicaid beneficiaries. Such program reforms have been long overdue and are particularly critical following a pandemic when millions of older adults' physical functioning and safety may have been compromised.

Private insurers might also consider coverage for falls prevention for adults less than 65 years old. Given heightened risks among the sample, including individuals aged 50–64, preventive efforts targeting occupational and physical pre-habilitation, durable medical equipment, and home safety modifications might prove cost-beneficial for insurers and beneficial to enrollees.

Absent such efforts, the scope of long-term care needs may largely fall on underfunded public programs and public health agencies as well as unpaid family caregivers, while policy efforts are instead directed to “headline” measures captured in the news media or health systems. Although mortality, excess deaths, and hospitalizations are critical measures of the pandemic's effects, longer-term effects on older adults' functioning and

injury, including risks for disability and loss of independence, are also critical to the nation's health.

Conclusion

In a national survey, substantial decreases in activity levels, physical conditioning, and mobility from March 2020 to January 2021 were observed among U.S. older adults aged 50–80 years. An increase in population-wide fall risk was observed along with worsened physical functioning brought on by reduced physical activity levels. In all, the findings could imply rapid deconditioning associated with restricted physical and social activities during the pandemic and should be more closely examined and addressed through innovative clinical and policy changes that can help integrate interdisciplinary preventive care for at-risk older adults. Community interventions that facilitate physical activity, including safe areas for walking in parks and neighborhoods, and efforts to manage safety risks at home, particularly in lower-income areas, can help address threats to mobility among the most vulnerable older adults.

ACKNOWLEDGMENTS

I have listed everyone who contributed significantly to the work.

CONFLICT OF INTEREST

The National Poll on Healthy Aging is sponsored by AARP and Michigan Medicine, the academic medical center for the University of Michigan. Dr. Kullgren received support from the Department of Veterans Affairs, Veterans Health Administration, Health Services Research and Development Service. The other authors have no conflicts to report.

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Study concept and design: Geoffrey J. Hoffman, Erica Solway, Dianne C. Singer, Jeffrey T. Kullgren, Preeti N. Malani. *Acquisition of subjects and/or data:* Dianne C. Singer, Matthias Kirch. *Analysis and interpretation of data:* Geoffrey J. Hoffman, Matthias Kirch.

SPONSOR'S ROLE

The funders had no role in the study design, data collection, management, and analysis, nor any participation in the preparation, review, and approval of the manuscript. The views expressed in this article are those of the authors and do not necessarily reflect the position or policy of the Department of Veterans Affairs or the United States government.

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REFERENCES

- Cornwell EY, Waite LJ. Social disconnectedness, perceived isolation, and health among older adults. *J Health Soc Behav.* 2009;50(1):31-48.
- Litwin H, Shaul A. The effect of social network on the physical activity-cognitive function nexus in late life. *Int Psychogeriatr.* 2019;31(5):713-722.
- Luo Y, Hawkey LC, Waite LJ, Cacioppo JT. Loneliness, health, and mortality in old age: a National Longitudinal Study. *Soc Sci Med.* 2012;74(6):907-914.
- Yamashita T, Noe DA, Bailer AJ. Risk factors of falls in community-dwelling older adults: logistic regression tree analysis. *Gerontologist.* 2012;52(6):822-832.
- Deandrea S, Lucenteforte E, Bravi F, Foschi R, La Vecchia C, Negri E. Risk factors for falls in community-dwelling older people: a systematic review and meta-analysis. *Epidemiology.* 2010; 21(5):658-668.
- Hoffman GJ, Webster NJ, Bynum JPW. A framework for aging-friendly services and supports in the age of COVID-19. *J Aging Soc Policy.* 2020;32:1-10.
- Gale CR, Westbury L, Cooper C. Social isolation and loneliness as risk factors for the progression of frailty: the English Longitudinal Study of Ageing. *Age Ageing.* 2018;47(3):392-397.
- Verbrugge LM, Jette AM. The disablement process. *Soc Sci Med.* 1994;38(1):1-14.
- Lord S, Chastin SF, McInnes L, Little L, Briggs P, Rochester L. Exploring patterns of daily physical and sedentary behaviour in community-dwelling older adults. *Age Ageing.* 2011;40(2):205-210.
- Ferrante LE, Pisani MA, Murphy TE, Gahbauer EA, Leo-Summers LS, Gill TM. Functional trajectories among older persons before and after critical illness. *JAMA Intern Med.* 2015; 175(4):523-529.
- Gill TM, Allore HG, Gahbauer EA, Murphy TE. Change in disability after hospitalization or restricted activity in older persons. *JAMA.* 2010;304(17):1919-1928.
- Gill TM, Guo Z, Allore HG. Subtypes of disability in older persons over the course of nearly 8 years. *J Am Geriatr Soc.* 2008; 56(3):436-443.
- Gill TM, Murphy TE, Gahbauer EA, Allore HG. The course of disability before and after a serious fall injury. *JAMA Intern Med.* 2013;173(19):1780-1786.
- Klasa K, Galaitsi S, Wister A, Linkov I. System models for resilience in gerontology: application to the COVID-19 pandemic. *BMC Geriatr.* 2021;21(1):51.
- Tilson GH, Avram R, Kuhar P, et al. Worldwide effect of COVID-19 on physical activity: a descriptive study. *Ann Intern Med.* 2020;173(9):767-770.
- Norton EC, Dowd BE, Maciejewski ML. Odds ratios-current best practice and use. *JAMA.* 2018;320(1):84-85.
- Ayanian JZ. Tallying the toll of excess deaths from COVID-19. *JAMA Health Forum.* 2020;1(7):e200832.
- Freedman VA, Cornman JC, Kasper JD. *National Health and Aging Trends Study Trends Chart Book: Key Trends, Measures and Detailed Tables.* National Health and Aging Trends Survey; 2021.
- Delbaere K, Crombez G, Vanderstraeten G, Willems T, Cambier D. Fear-related avoidance of activities, falls and physical frailty. A prospective community-based cohort study. *Age Ageing.* 2004;33(4):368-373.
- Growdon ME, Shorr RI, Inouye SK. The tension between promoting mobility and preventing falls in the hospital. *JAMA Intern Med.* 2017;177(6):759-760.
- Boyd R, Stevens JA. Falls and fear of falling: burden, beliefs and behaviours. *Age Ageing.* 2009;38(4):423-428.
- Hoffman GJ, Hays RD, Shapiro MF, Wallace SP, Ettner SL. The costs of fall-related injuries among older adults: annual per-faller, service component, and patient out-of-pocket costs. *Health Serv Res.* 2017;52(5):1794-1816.
- Brownlee SA, Blackwell RH, Blanco BA, et al. Impact of post-hospital syndrome on outcomes following elective, ambulatory surgery. *Ann Surg.* 2017;266(2):274-279.
- Krumholz HM. Post-hospital syndrome—an acquired, transient condition of generalized risk. *N Engl J Med.* 2013;368(2): 100-102.
- Hoffman GJ, Ha J, Alexander NB, Langa K, Tinetti M, Min LC. *Underreporting of Fall Injuries by Older Americans: Implications for Fall Risk Screening during the Medicare Annual Wellness Visit.* 2018;66(6):1195-1200.
- Ganz DA, Higashi T, Rubenstein LZ. Monitoring falls in cohort studies of community-dwelling older people: effect of the recall interval. *J Am Geriatr Soc.* 2005;53(12):2190-2194.
- Sonnega A, Faul JD, Ofstedal MB, Langa KM, Phillips JW, Weir DR. Cohort profile: the health and retirement study (HRS). *Int J Epidemiol.* 2014;43(2):576-585.
- Jette AM. Toward a common language for function, disability, and health. *Phys Ther.* 2006;86(5):726-734.
- Wu S, Keeler EB, Rubenstein LZ, Maglione MA, Shekelle PG. A cost-effectiveness analysis of a proposed national falls prevention program. *Clin Geriatr Med.* 2010;26(4):751-766.
- AOTA. *Medicare Policy and Falls Prevention.* American Occupational Therapy Association; 2010.
- Pighills AC, Torgerson DJ, Sheldon TA, Drummond AE, Bland JM. Environmental assessment and modification to prevent falls in older people. *J Am Geriatr Soc.* 2011;59(1):26-33.
- Cumming RG, Thomas M, Szonyi G, et al. Home visits by an occupational therapist for assessment and modification of environmental hazards: a randomized trial of falls prevention. *J Am Geriatr Soc.* 1999;47(12):1397-1402.
- Clemson L, Mackenzie L, Ballinger C, Close JC, Cumming RG. Environmental interventions to prevent falls in community-dwelling older people: a meta-analysis of randomized trials. *J Aging Health.* 2008;20(8):954-971.
- Robertson MC, Campbell AJ, Gardner MM, Devlin N. Preventing injuries in older people by preventing falls: a meta-analysis of individual-level data. *J Am Geriatr Soc.* 2002;50(5):905-911.
- Lord SR, Menz HB, Tiedemann A. A physiological profile approach to falls risk assessment and prevention. *Phys Ther.* 2003;83(3):237-252.
- Perell KL, Nelson A, Goldman RL, Luther SL, Prieto-Lewis N, Rubenstein LZ. Fall risk assessment measures: an analytic review. *J Gerontol A Biol Sci Med Sci.* 2001;56(12):M761-M766.
- Gillespie LD, Robertson MC, Gillespie WJ, et al. Interventions for preventing falls in older people living in the community. *Cochrane Database Syst Rev.* 2012;9:CD007146.
- Tinetti ME, Gordon C, Sogolow E, Lapin P, Bradley EH. Fall-risk evaluation and management: challenges in adopting geriatric care practices. *Gerontologist.* 2006;46(6):717-725.

39. Robison J, Shugrue N, Porter M, Baker K. Challenges to community transitions through Money Follows the Person. *Health Serv Res.* 2020;55(3):357-366.
40. Coughlin R, Ward JA, Denny-Brown N, et al. *Money Follows the Person Demonstration: Overview of State Grantee Progress, January to December 2016.* Mathematica; 2017.

SUPPORTING INFORMATION

Additional supporting information may be found in the online version of the article at the publisher's website.

Table S1. Changes in physical conditioning and mobility since the start of the COVID-19 pandemic among respondent ages 65–80, by physical activity and daily time spent on feet.

Table S2. Falls and changes in fear of falling since the start of the COVID-19 pandemic among respondent ages 65–80, by respondent characteristics.

Table S3. Associations between physical activity, time on feet, and social isolation and measures of physical function and fall outcomes for adults ages 65 and older.

How to cite this article: Hoffman GJ, Malani PN, Solway E, Kirch M, Singer DC, Kullgren JT. Changes in activity levels, physical functioning, and fall risk during the COVID-19 pandemic. *J Am Geriatr Soc.* 2022;70(1):49-59. doi:10.1111/jgs.17477