Preplanned Studies

COVID-19 Stay-At-Home Orders and Older Adults' Cognitive Health — United States, June 2018–February 2022

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Summary

What is already known about this topic?

Lack of social activities is known to negatively impact cognitive functioning and increase risk of cognitive impairment, including dementia, among older adults.

What is added by this report?

Coronavirus disease 2019 (COVID-19) stay-at-home orders implemented in the U.S. early during the pandemic were not found to negatively affect cognitive functioning of older adults.

What are the implications for public health practice?

There may have been no severe, unintended consequences of the COVID-19 stay-at-home orders in terms of their impact on cognitive functioning and risk of dementia among older adults, lending further support to use of such orders.

The global prevalence of cognitive impairment is estimated to be 19% (*1*), with more than 55 million people living with dementia worldwide (*2*) and 6.5 million in the U.S. (*3*). While lack of social activities is known to negatively impact cognitive functioning and increase risk of cognitive impairment including dementia among older adults (*4*), little is known on the effect of coronavirus disease 2019 (COVID-19) related stay-at-home orders on older adults' cognitive health. This study examined the impact of the COVID-19 stay-at-home orders implemented in certain states of the U.S. and the cognitive health of older adults. Stay-at-home orders requested residents to stay at home as much as possible, and many public shops and venues to close down temporarily (*5*). This research used data from the U.S. Understanding America Study (UAS), a longitudinal internet survey representative of individuals aged 50 and above in the U.S., and the COVID-19 State Policies (CUSP) database. A difference-in-differences (DID) approach was used to compare trajectories of four cognitive scores before and after state-specific stay-at-home orders were implemented between states with and without COVID-19 stay-at-home orders. This study found no significant relationship between state-specific stay-at-home policies and cognitive health of U.S. older adults.

This study conducted an observational retrospective cohort study. The study population included U.S. adults aged 50 and older who participated in UAS and answered survey questions relevant to cognitive health between June 2018 and February 2022. UAS is a nationally representative longitudinal internet panel survey of more than 9,000 adults older than 18 years. Our outcome variables were four cognitive scores from numbers, picture vocabulary, verbal analogies, and serial seven subtraction tests. The tests were designed to measure the respondent's quantitative reasoning and lexical knowledge according to the Woodcock-Johnson Tests of Cognitive Abilities (*6*). Survey questionnaires containing these tests were fielded in two waves, one in June 2018, and the other in July 2020. The respondents could take a test in each wave any time after it became available; only those who participated in the first wave were eligible to participate in the second wave. We included in our analyses all individuals who participated in at least one wave to improve precision of estimates, although only those who participated in both waves contributed to DID coefficients. The independent variable was implementation of stay-at-home orders from the CUSP database. Implementation was treated as a binary variable that equals 1 if the state issued a stay-at-home order (treatment group) and 0 if the state did not issue any order or issued but did not specifically restrict movement of the general public during the study period (control group). Our control variables included gender, age, immigration status, marital status, education, ethnicity, race, presence of other household members, employment status, and household income. These variables were also obtained from UAS.

This research examined summary statistics of key variables, and *t*-tests for continuous variables and Chi-squared tests for categorical variables were used to

compare means between treatment and control groups. Our DID model specification was as follows:

$$y_{i,s,q} = \beta_0 + \beta_1 \left(d_s \times p_q\right) + X_{i,q}\gamma + \delta_q + \alpha_s + \varepsilon_{i,q,s} \quad (1)$$

where the dependent variable y is a cognitive test score for individual i, state s, and quarter q. d_s is an indicator for whether state s implemented strict stay-at-home orders. p_q is an indicator for whether quarter q is after the second quarter of 2020, since most states implemented stay-at-home orders between March and April 2020. $X_{i,q}$ contains individual-level sociodemographic control variables in quarter q. δ_q and α_s are quarter and state-fixed effects. $\varepsilon_{i,q,s}$ is the error term and is clustered at the state level. We conducted secondary analyses on subsamples stratified by age (65 or over *vs.* under 65), gender and whether the individual lived alone. All analyses were performed using Stata BE 17.0 (StataCorp, College Station, TX, U.S.A.).

Table 1 shows the numbers of state and person-wave observations for each of the four cognitive tests and the average test scores in states with stay-at-home orders (treatment group) and without stay-at-home orders (control group). Forty states out of 51 issued a stay-at-home order between March and April 2020. During the study period, the total number of observations per panel was about 8,000, of which over 80% were from the treatment group, with an average of approximately 170 observations per treatment state compared to approximately 100 per control state. The average cognitive test score was slightly higher in states with stay-at-home orders than in states without stay-at-home orders in all panels. Relative to the control states, treatment states had higher proportions of immigrants and unmarried people and higher average education levels and household incomes (Table 2). To assess selective attrition between Wave 1 and Wave 2, we compared summary statistics by the number of waves the respondent participated in (Supplementary Table S1, available in http://weekly.chinacdc.cn). Although we did not find large differences between those who participated in only one wave of cognitive assessment versus two, the former had somewhat higher socioeconomic status than the latter in terms of education and income. Table 3 shows the differential change in cognitive scores in states with stay-at-home orders relative to states without stay-at-home orders. None of the associations was statistically significant. In terms of coefficient magnitudes, stay-at-home orders were associated with lower numbers test and serial seven subtraction test scores compared to states without stay-at-home orders, by 0.184 points and 0.041 points, respectively. In contrast, stay-at-home orders were associated with increased picture vocabulary test and verbal analogies test scores by 0.221 and 0.757 points, respectively. Subgroup analyses yielded consistent results (not shown).

DISCUSSION

This study found no evidence that state-level COVID-19 stay-at-home orders in the U.S. led to significant changes in cognitive health of older adults. Previous studies of COVID-19 lockdown measures found adverse effects on mental health, such as

TABLE 1. Cognitive test score descriptive statistics, United States, June 2018–February 2022.

Variable	Numbers test	Picture vocabulary test	Verbal analogies test	Serial seven subtraction test
Number of states, N	51	51	51	51
With stay-at-home order	40	40	40	40
Without stay-at-home order	11	11	11	11
Number of observations (%)	8,090 (100.0)	7,974 (100.0)	7,861 (100.0)	7,684 (100.0)
With stay-at-home order (%)	6,985 (86.3)	6,884 (86.3)	6,783 (86.3)	6,653 (86.6)
Without stay-at-home order (%)	1,105 (13.7)	1,090 (13.7)	1,078 (13.7)	1,031 (13.4)
Cognitive score, Mean (SD)	51.17 (9.10)	54.26 (8.48)	51.33 (8.89)	4.494 (1.078)
With stay-at-home order	51.24 (9.13)	54.28 (8.55)	51.35 (8.93)	4.494 (1.081)
Without stay-at-home order	50.72 (8.88)	54.13 (7.99)	51.21 (8.63)	4.493 (1.063)

Note: The 51 States includes the 50 states and the District of Columbia. Numbers, picture vocabulary, and verbal analogies scores reported in the Understanding America Study were converted to standardized scores, where 50 is the mean and 10 is the standard deviation. A score of 50 means that the person's cognitive ability is equal to that of the average person in the general population, a score of 60 means that the person's ability is one standard deviation above average, and a score of 40 means that the person's ability is one standard deviation below average. The serial seven subtraction test scores range from 0 to 5.
Abbreviation: SD=standard deviations.

TABLE 2. Summary statistics of individual characteristics, United States, June 2018–February 2022.

Variable	Total	States with stay-at-home order	States without stay-at-home order	*P*-value
No. of observations (N)	8,090	6,985	1,105	
Age (Mean, SD)	63.1 (9.0)	63.2 (9.0)	62.6 (8.5)	0.036
Gender				0.19
Female (%)	4,389 (54.3)	3,762 (53.9)	627 (56.7)	
Male (%)	3,700 (45.7)	3,222 (46.1)	478 (43.3)	
Missing (%)	1 (0.0)	1 (0.0)	0 (0.0)	
Immigrant status				<0.001
Non-immigrant (%)	4,425 (54.7)	3,688 (52.8)	737 (66.7)	
First generation immigrant (%)	738 (9.1)	690 (9.9)	48 (4.3)	
Second or third generation immigrant (%)	2,757 (34.1)	2,462 (35.2)	295 (26.7)	
Missing (%)	170 (2.1)	145 (2.1)	25 (2.3)	
Marital status				<0.001
Never married (%)	782 (9.7)	720 (10.3)	62 (5.6)	
Married (%)	4,823 (59.6)	4,130 (59.1)	693 (62.7)	
Separated/divorced/widowed (%)	2,484 (30.7)	2,134 (30.6)	350 (31.7)	
Missing (%)	1 (0.0)	1 (0.0)	0 (0.0)	
Level of education				<0.001
High school graduate or under (%)	1,810 (22.4)	1,516 (21.7)	294 (26.6)	
Some college-no degree (%)	1,965 (24.3)	1,662 (23.8)	303 (27.4)	
Bachelor's degree (%)	2,935 (36.3)	2,578 (36.9)	357 (32.3)	
Master's degree and over (%)	1,380 (17.1)	1,229 (17.6)	151 (13.7)	
Hispanic ethnicity				0.59
No (%)	7,423 (91.8)	6,401 (91.6)	1,022 (92.5)	
Yes (%)	666 (8.2)	583 (8.3)	83 (7.5)	
Missing (%)	1 (0.0)	1 (0.0)	0 (0.0)	
Race				0.080
White only (%)	6,628 (81.9)	5,696 (81.5)	932 (84.3)	
Black only (%)	635 (7.8)	568 (8.1)	67 (6.1)	
Others (%)	798 (9.9)	695 (9.9)	103 (9.3)	
Missing (%)	29 (0.4)	26 (0.4)	3 (0.3)	
Employment status				0.20
Currently working (%)	3,293 (40.7)	2,825 (40.4)	468 (42.4)	
Retired (%)	2,798 (34.6)	2,443 (35.0)	355 (32.1)	
Others (%)	1,992 (24.6)	1,710 (24.5)	282 (25.5)	
Missing (%)	7 (0.1)	7 (0.1)	0 (0.0)	
Household income				0.001
Less than 30,000 USD	2,004 (24.8)	1,699 (24.3)	305 (27.6)	
30,000 to 59,999 USD	2,169 (26.8)	1,857 (26.6)	312 (28.2)	
60,000 to 99,999 USD	1,980 (24.5)	1,708 (24.5)	272 (24.6)	
100,000 USD or more	1,912 (23.6)	1,696 (24.3)	216 (19.5)	
Missing (%)	25 (0.3)	25 (0.4)	0 (0.0)	
Presence of other household members				0.071
No (%)	1,832 (22.6)	1,609 (23.0)	223 (20.2)	
Yes (%)	6,253 (77.3)	5,371 (76.9)	882 (79.8)	
Missing (%)	5 (0.1)	5 (0.1)	0 (0.0)	

Note: Values shown are numbers of individuals with percentages of individuals for each category in parentheses, unless otherwise indicated for continuous variables where means are shown with SD in parentheses.
Abbreviation: SD=standard deviations; USD=US dollar.

TABLE 3. DID estimates of stay-at-home order on cognitive health and loneliness, United States, June 2018–February 2022.

Parameter	Cognitive Test Score			
	Numbers test	PV test	VA test	SSS test
DID estimate	−0.184 (0.436) [−1.060, 0.691]	0.221 (0.250) [−0.281, 0.722]	0.757 (0.582) [−0.412, 1.926]	−0.041 (0.041) [−0.124, 0.041]
R^2	0.266	0.295	0.234	0.078
N	8,090	7,974	7,861	7,684
States	51	51	51	51

Note: Difference-in-differences models were estimated with least squares and include controls listed in Table 2, state-fixed effects and quarter-fixed effects. Each observation is an individual-quarter. State-clustered standard errors are in parentheses and 95% confidence intervals are in brackets. None of the coefficients reached statistical significance.
Abbreviation: PV=picture vocabulary; VA=verbal analogies; SSS=serial seven subtraction; DID=difference-in-differences.

depression and anxiety (*7*), and worsening cognitive ability among those with dementia, albeit not in the U.S. (*8*). To our knowledge, ours is the first study to examine the impact of state-level stay-at-home policies on cognitive health among the general, older population in the U.S. Results of our study may help rule out any drastic impact on the cognitive health of older adults subject to state-wide stay-at-home orders, at least in the U.S. context and during the short-term. It is possible that older adults had alternative means to remain socially active in the presence of stay-at-home orders, for example, by telephone or internet. It could also be that the relatively short time horizon and relaxed measures of stay-at-home orders without strict enforcement were simply not severe enough to impact cognition health of older adults. However, our findings should not be construed to mean that no COVID-19 related restrictions can negatively impact the cognitive health of older adults. Further research is needed to better understand the longer-term consequences of COVID-19 related restrictions in different contexts, and whether there are effective coping methods already adopted or to be adopted by older adults, their families, and public health policy makers to mitigate unintended consequences.

The study had several limitations. First, we were unable to observe the exact extent to which study participants adhered to stay-at-home orders. Second, there was heterogeneity in the specific nature of stay-at-home order rules across states. For instance, some states allowed limited movement to conduct essential activities and others allowed movement for outdoor exercise. We were unable to study each scenario separately due to insufficient sample size, and our results should be interpreted as an average effect of these policies. Third, due to the relatively short study period, we were unable to examine long-term impact of the COVID-19 stay-at-home orders on cognitive health. Fourth, though UAS participants were broadly representative of the U.S. population, participation in individual surveys was voluntary. To the extent that those completing questionnaires on cognition were relatively cognitively healthy individuals, selection bias could have impacted the external validity of our findings. A related issue is that it is possible that those who participated in Wave 1 of each survey and experienced a larger decline in cognitive ability may have been less likely to participate in Wave 2, causing our DID estimates to be biased towards the null, although our supplementary analysis provides no direct evidence that this is the case. Finally, it is possible that COVID-19 illness may independently affect cognition, although our study design was robust to any impact of the COVID-19 pandemic common to the treated and control groups.

Despite of these limitations, our study is one of the first to show that U.S. COVID-19 related stay-at-home order did not have severe negative consequences on the cognitive health of older adults in the general population. It lends further support for such measures to be viable public health options for combating the spread of communicable diseases like COVID-19.

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SUPPLEMENTARY MATERIAL

SUPPLEMENTARY TABLE S1. Summary statistics of UAS respondents by number of participating cognitive test survey waves, United States, June 2018–February 2022.

Variable n, %	One wave (N=2,102)	Both waves (N=2,994)	*P*-value of difference
Age, mean (SD)	61.8 (9.8)	62.6 (8.6)	<0.001
Score of Numbers Test, mean (SD)	50.9 (9.1)	51.4 (8.8)	0.11
Gender (n, %)			0.31
Female	1,168 (55.6)	1,609 (53.7)	
Male	934 (44.4)	1,384 (46.2)	
Missing	0 (0.0)	1 (0.0)	
Immigration status (n, %)			<0.001
Non-immigrant	1,117 (53.1)	1,654 (55.2)	
First generation immigrant	246 (11.7)	246 (8.2)	
Second or third generation immigrant	689 (32.8)	1,034 (34.5)	
Missing	50 (2.4)	60 (2.0)	
Marital status (n, %)			0.30
Never married	221 (10.5)	280 (9.4)	
Married	1,233 (58.7)	1,818 (60.7)	
Separated/divorced/widowed	648 (30.8)	895 (29.9)	
Missing	0 (0.0)	1 (0.0)	
Highest level of education (n, %)			0.034
High school graduate or under	437 (20.8)	683 (22.8)	
Some college-no degree	481 (22.9)	744 (24.8)	
Bachelor's degree	791 (37.6)	1,071 (35.8)	
Master's degree and over	393 (18.7)	496 (16.6)	
Hispanic ethnicity (n, %)			<0.001
No	1,886 (89.7)	2,769 (92.5)	
Yes	216 (10.3)	225 (7.5)	
Race (n, %)			0.62
White only	1,707 (81.2)	2,461 (82.2)	
Black only	167 (7.9)	234 (7.8)	
Others	218 (10.4)	290 (9.7)	
Missing	10 (0.5)	9 (0.3)	
Employment status (n, %)			0.020
Currently working	970 (46.1)	1,263 (42.2)	
Retired	683 (32.5)	998 (33.3)	
Others	447 (21.3)	730 (24.4)	
Missing	2 (0.1)	3 (0.1)	
Household income (n, %)			<0.001
Less than 30,000 USD	503 (23.9)	748 (25.0)	
30,000 to 59,999 USD	517 (24.6)	839 (28.0)	
60,000 to 99,999 USD	492 (23.4)	732 (24.4)	
100,000 USD or more	578 (27.5)	670 (22.4)	
Missing	12 (0.6)	5 (0.2)	
Other household members			0.090
No	514 (24.5)	654 (21.8)	
Yes	1,587 (75.5)	2,338 (78.1)	
Missing	1 (0.0)	2 (0.1)	

Note: Values shown are numbers of individuals with percentages of individuals for each category in parentheses, unless otherwise indicated for continuous variables where means are shown with SD in parentheses.
Abbreviation: UAS=Understanding America Study; SD=standard deviations; USD=US dollar.