The Effect of Medicaid Home and Community- Based Services on Health Outcomes

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February 2022

Abstract

The Medicaid Home and Community- Based Services (HCBS) program in the United States subsidizes the long-term care provided at home or in community-based settings for older adults. Little is known about how HCBS affects the well-being of the aging population. Using detailed information about health from the Health and Retirement Study (HRS) linked with state-level HCBS policy expenditures, we show that HCBS indeed helps older people avoid institutionalization and stay at home longer. Furthermore, the program is positively associated with the probability of older individuals reporting better mental health, especially among people with limited resources.

Keywords: Medicaid HCBS, Long-Term Care, HRS, Health

Introduction

As the country's population ages, the need for long-term care (LTC) in the United States has increased dramatically (Kemper et al. 2005; Brown & Finkelstein 2008; National Center for Health Statistics 2009; Hagen 2013; Johnson 2017). In order to meet the increased demand for LTC while reducing the financial burden on the government of covering the high costs of nursing home care, Medicaid implemented the Home and Community-Based Services (HCBS) program in the mid-1980s, and has been rapidly expanding the program since the early 1990s (Kaye et al. 2009; Ng et al. 2010).[1] Moreover, the HCBS program helps to satisfy the increasing preference of older people to age in their own homes and communities, as it is designed to make it easier for older people to delay or avoid nursing home care (Aguila et al. 2020; Wilmoth & Chen 2003). A large body of literature has demonstrated that aging-in-place can improve people's sense of belonging; reduce their feelings of loneliness; facilitate their social relationships with their family, friends, and neighbors; and help them maintain a sense of control over their life (Nair 2004; Oswald & Wahl 2004; Wiles 2005; Grabowski 2006; Rojo-Pérez et al. 2007; Stancliffe et al. 2009; Prieto-Flores et al. 2011; Sereny & Gu 2011). However, compared to care provided in a nursing home, there is typically less oversight of the quality and quantity of the home-based care provided (Kane et al. 2007; Dick et al. 2019), which may lead to negative health outcomes for affected population. Thus, the question of how the HCBS program affects the health outcomes of the older people has not been fully answered. In this paper, we provide empirical evidence to address this question by estimating the effect of HCBS expenditures at the state level on the physical and mental health outcomes of older Americans.

HCBS may have contradictory effects on the health outcomes of older people. To the extent that the program provides individuals who previously lacked access to care with home-based professional help (Borsani et al. 2006; Grabowski 2006; Houser et al. 2012;

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[1]Many OECD countries have shifted resources toward providing more affordable home-based care to reduce the costs of providing long-term institutional care (Landers et al. 2016).

Wagner et al. 2020), the HCBS may improve health outcomes. The beneficiaries now receive affordable care from home health aides and professionals, which might prevent some unexpected health problems from occurring. For example, HCBS might provide older individuals with more check-ups, thus improving the chances that health conditions like heart disease will be detected. However, if increased contact with service providers results in additional diagnoses of illnesses, more instances of diagnosed illness among HCBS enrollees may be reported, even if their underlying health is better. To the extent that HCBS expenditures move older people out of nursing home care and into home-based care (Wang et al. 2020), the program could have beneficial effects on their underlying health. Aging at home in a familiar environment with family nearby could have mental health benefits, such as increased satisfaction with social interactions with family and reduced feelings of loneliness. On the other hand, the quality of care provided at home might be worse than that provided in nursing homes (Kane et al. 2007; Dick et al. 2019). As one of the goals of the program is to limit costs, the quality of the HCBS service providers might be compromised: i.e., because Medicaid payments are relatively low, the program may attract less qualified home health aides and providers.[2] There is, for example, evidence that the training and skills of HCBS staff are inadequate for particular groups such as for people with dementia, who are at risk of being inaccurately evaluated and given unsuitable care (Sands et al. 2008; Cherry 2012). Thus, the physical health of older people who participate in the program might deteriorate. Furthermore, if older people who receive home-based care have less contact with medical professionals than they would in a nursing home setting, some of their illnesses may go undiagnosed, even if their underlying health has deteriorated. Thus, the overall effect of Medicaid HCBS on the health outcomes of older people is ambiguous.

This paper empirically estimates the relationship between Medicaid HCBS and the

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[2]Among the most common quality problems are intentional physical injury to patients; and workers' tardiness or failure to spend the specified time with clients, poor attitudes, abuse of clients, and exploitation of the clients' financial resources.

health outcomes of older individuals. Using restricted data of the Health and Retirement Study (HRS), merged with data on state-level expenditures from 1998 to 2014, we estimate the relationship between per capita HCBS expenditures and a broad range of health outcomes. First, we show that HCBS increases the probability of older people who are medically needy to stay at home longer. The positive effect is more significant for older people with limited financial resources who are more likely to be enrolled in HCBS. Then, we evaluate how HCBS affects the well-being of this older population on physical and mental health, separately. Our findings show that an increase in HCBS expenditures is weakly associated with an increase in the number of physical difficulties in instrumental activities of daily life (IADL). The estimates also show that more generous HCBS expenditures seem to improve the mental health of the aging population, especially among poor older population.

This paper is related to several branches of the literature. First, the results are related to the research on how HCBS affects the likelihood of older people with LTC needs being placed in a nursing home or a home-setting, and on levels of health deterioration in this population. Wang et al. (2020) showed that higher HCBS expenditures are associated with a lower likelihood of nursing home placement among people with dementia. For those at risk of entering a nursing home, the increase in HCBS expenditures is correlated with a greater likelihood of remaining at home with higher levels of limitations in physical activities. Muramatsu et al. (2007) and Miller (2011) both found that as investments in HCBS have increased, the use of nursing home care has decreased among older people aged 65 and above. Similarly, Guo et al. (2015) estimated that with every $1,000 increase in Medicaid home care expenditures, 2.75 days in nursing facilities are avoided. Konetzka et al. (2020) found that HCBS users are more likely to be hospitalized than their nursing home counterparts, after controlling for selection bias. Wysocki et al. (2014) showed that individuals who transition from a nursing home into home-based care are at higher risk of hospitalization. Sands et al. (2008) observed that HCBS clients are more likely than

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nursing home residents to have an inpatient admission. In line with our results, Kane et al. (2013) found that increased HCBS expenditures are associated with more cases of patients with functional and cognitive impairments remaining at home. Radke et al. (2006) showed that higher HCBS spending leads to increases in the functional impairment levels of newly admitted nursing home residents, and in the percentage of nursing home residents returning to the community. Also in line with our findings, Wang et al. (2020) presented evidence that increases in HCBS expenditures allow more oldest old individuals (aged 85 and older) to return to their homes after being discharged from nursing homes; and Alecxih et al. (2006) showed that HCBS use is associated with increases in inpatient discharges. Miller et al. (1998) found that unmarried individuals with dementia living in states with more generous HCBS spending stay in the community longer than their counterparts in states with lower HCBS spending.

Second, the study is related to the branch of literature that evaluates the cost-effectiveness of HCBS programs. Many studies have reported that the HCBS program actually increases, rather than reduces, overall Medicaid expenditures on LTC (Kemper 1988; Levine & Barry 2003; Grabowski 2006; Kane et al. 2013). However, the reasons for this seemingly counterintuitive observation are unclear, and have not been fully explored. The findings presented in this paper might shed some light on this issue. The expansion of the HCBS program has enabled older people who wish to remain at home despite having disabilities to avoid having to enter a nursing home, provided their health problems are not very serious. However, if the health of older people deteriorates to the point that they have to be placed in a nursing home, the costs of their care increase dramatically, which can offset the savings associated with providing them with home-based care through HCBS. Therefore, the total amount paid by Medicaid for the care of an older individual could easily higher with the HCBS program than without it.

Third, the study is broadly connected to the branch of literature that estimates the effects of public policy on the health and well-being of the older population. Our results

are similar to the findings of studies like McMorrow et al. (2017), which indicated that the psychological health outcomes of low-income parents improved following the Medicaid expansion under the Affordable Care Act (ACA). Simon et al. (2017) also showed that the implementation of the ACA mildly improved self-assessed health. Research on the effects of Medicare has shown that Medicare benefits are associated with slight improvements in health status and in self-reported health among older people (Khwaja 2006; Card et al. 2008). The evidence that HCBS helps older people live at home or in the community longer is related to the literature that discusses how public policies such as the Earned Income Tax Credit (EITC) affect living arrangements (Pilkauskas & Michelmore 2019).

This paper makes several contributions. First, to our knowledge, this paper is the first to present estimates of how the HCBS program affects the physical and mental health status of the older population. Second, we provide more convincing estimates than previous research by using a large representative sample of aging people in the United States and longitudinal data from HRS that control for individual time-varying unobservable factors. Third, we explore heterogeneous effects, and present evidence that the HCBS program has the largest impact on low-income older people by enabling these vulnerable individuals to avoid going to a nursing home, and to remain at home with more physical difficulties. Our findings can provide useful information to policymakers about how LTC services can be targeted to specific populations, and about how total LTC spending can be reduced.

Institutional Background

Medicaid Home and Community-Based Services (HCBS)

Historically, Medicaid funded LTC only in institutional settings, such as in nursing homes for older people. Because nursing home care is costly, Medicaid's LTC expenditures increased significantly over the years. In an effort to contain the massive growth in LTC expenditures, and to satisfy older people's expressed preferences to receive LTC at home or

in their community, Medicaid implemented the HCBS program starting in the early 1980s. The mission of HCBS is to provide LTC for older adults at home, as well as to improve their quality of life by allowing them to age in place. HCBS expenditures rose sharply from 1995 to 2013, as shown in Appendix Figure A1.

Medicaid HCBS funds three main programs that comprise the majority of its enrollment and spending: a mandatory home health state plan, an optional personal care state plan, and optional waivers.[3] The Medicaid HCBS state plans are available to every Medicaid-eligible person with limited resources. In general, the eligibility limit for older applicants is around $2,313 per month in income and $2,000 in assets.[4]

The Medicaid optional waivers allow states to waive the general requirements of the regular Medicaid programs, such as Medicaid state plan programs. States can use waivers to target and serve different sub-groups, such as people aged 65 and older, the blind or the disabled, children with intellectual or developmental disabilities, children with mental illnesses, people with HIV/AIDS, and people with brain injuries. In this study, we focus on aging waivers that target adults aged 65 and older. The waivers are optional, and states need to apply for approval if they intend to implement one. More details of aging waivers can be found in Liu & Zai (2022). In 2017, total expenditures on aging waivers came to approximately $40 billion, making up 65 percent of Medicaid's total waiver expenditures.

The HCBS waivers have several unique features. First, each state has flexibility in determining the scope of the subsidized services, and can limit the coverage of each service offered to participants through waivers. Second, the waiver needs to be cost-neutral. This means that the expenditures on home-based care per participant covered through the waiver cannot exceed the costs per participant of nursing facility care. Each state must show that

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[3]Medicaid HCBS also includes other state plan programs, such as Community First Choice, which provides supplementary services for people who prefer to stay at home; and Section 1915(i), which supports intellectually or developmentally disabled people. In 2018, about $62.5 billion was spent on waivers, accounting for 58 percent of total Medicaid expenditures; another $20.6 billion was spent on state plans, representing 23 percent of total Medicaid expenditures; while the Community First Choice program was much smaller, accounting for around nine percent of total Medicaid expenditures.

[4]For details about the eligibility rules in each state, see: https://www.medicaidplanningassistance.org/medicaid-eligibility/.

it is meeting this requirement in its waiver application, and the federal Centers for Medicare and Medicaid Services (CMS) determine whether the requirement is or is not met. Third, the final realized expenditures on waivers in each state depend largely on the development of the service delivery system and the supply of qualified care providers. Liu & Zai (2022) offer a detailed discussion of the qualifications of providers.

In 2018, approximately three million people were enrolled in Medicaid HCBS, and 2.5 million beneficiaries received waivers (85 percent). As Appendix Table A1 shows, home health state plans mainly cover services provided by nurses and professionals; while personal care state plans cover services such as personal care and assistance with household activities provided at home, in the workplace, in foster care, or in an assisted living facility. Some of the services covered by these programs and waivers overlap.
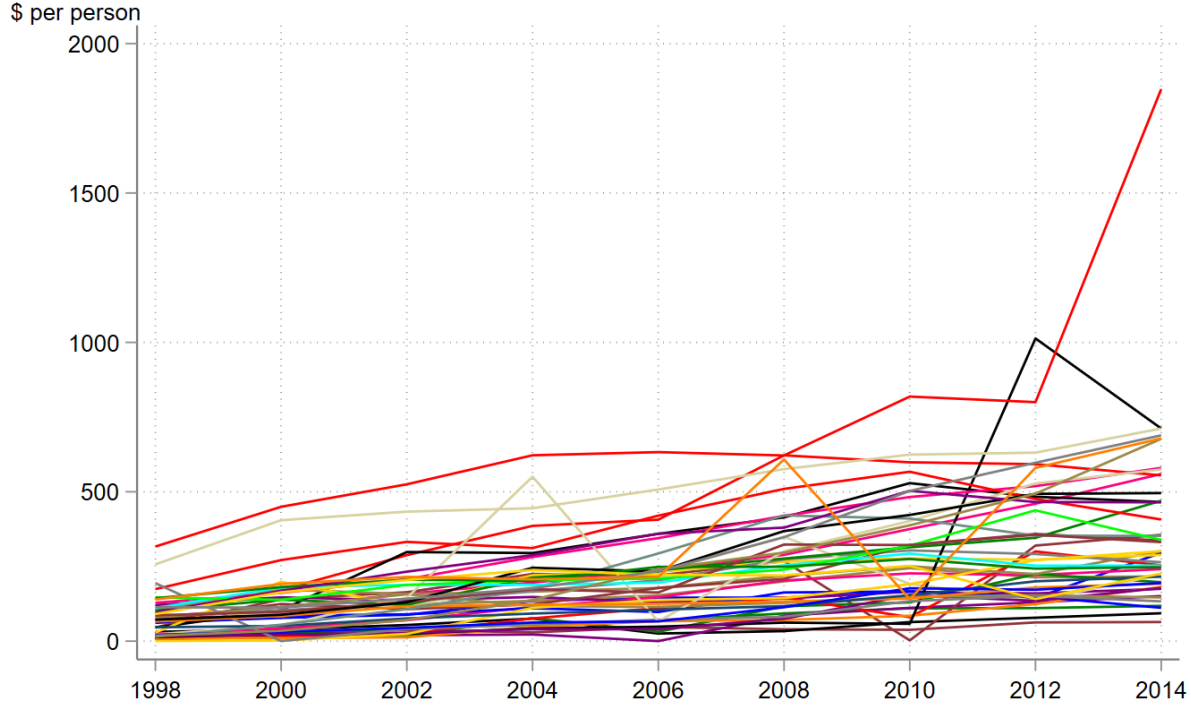
Data

Medicaid HCBS Data

Our first data source is the Medicaid HCBS policy information of each state from 1995 to 2014. This publicly available information includes data on expenditures on home health state plans, on personal care state plans, and on aging waivers for older people.[5] The level of HCBS expenditures per capita, which is our main independent variable, is calculated using the population of individuals aged 65 and older. Figure 1 shows the variation in HCBS expenditures over time and across states. The expenditure levels vary considerably across states. Moreover, within each state, the variation in spending over time is also large. Figure 2 splits the 50 states into four sub-graphs to make the variation more noticeable. More details on the variation in each state can be found in Liu & Zai (2022).

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[5]https://www.medicaid.gov/

Figure 1: State Level Variation in HCBS Expenditures 1998 to 2014

Notes: The plot shows the HCBS expenditures per older person across 50 states from 1998 to 2014. Each line corresponds to one state.

HRS Data

Our second data source is the Health and Retirement Study (HRS), a longitudinal dataset that begins in 1992. Respondents are surveyed every other year. The HRS is representative of Americans aged 51 and older. The survey includes different cohorts who enter the study as they become eligible. The core cohort, the HRS cohort, has been followed and interviewed since 1992. Since 1993, the HRS has included the Study of Assets and Health Dynamics Among the Oldest Old (AHEAD) cohort of individuals born before 1924; the Children of the Depression Age (CODA) cohort of people born between 1924 and 1930; and the War Babies cohort (WB) of individuals born between 1942 and 1947. An additional Early Baby Boomers (EBB) cohort of people born between 1948 and 1953 was added to the sample in 2004, and the Mid-Baby Boomers cohort of individuals born

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Figure 2: State Level Variation in HCBS Expenditures 1998 to 2014
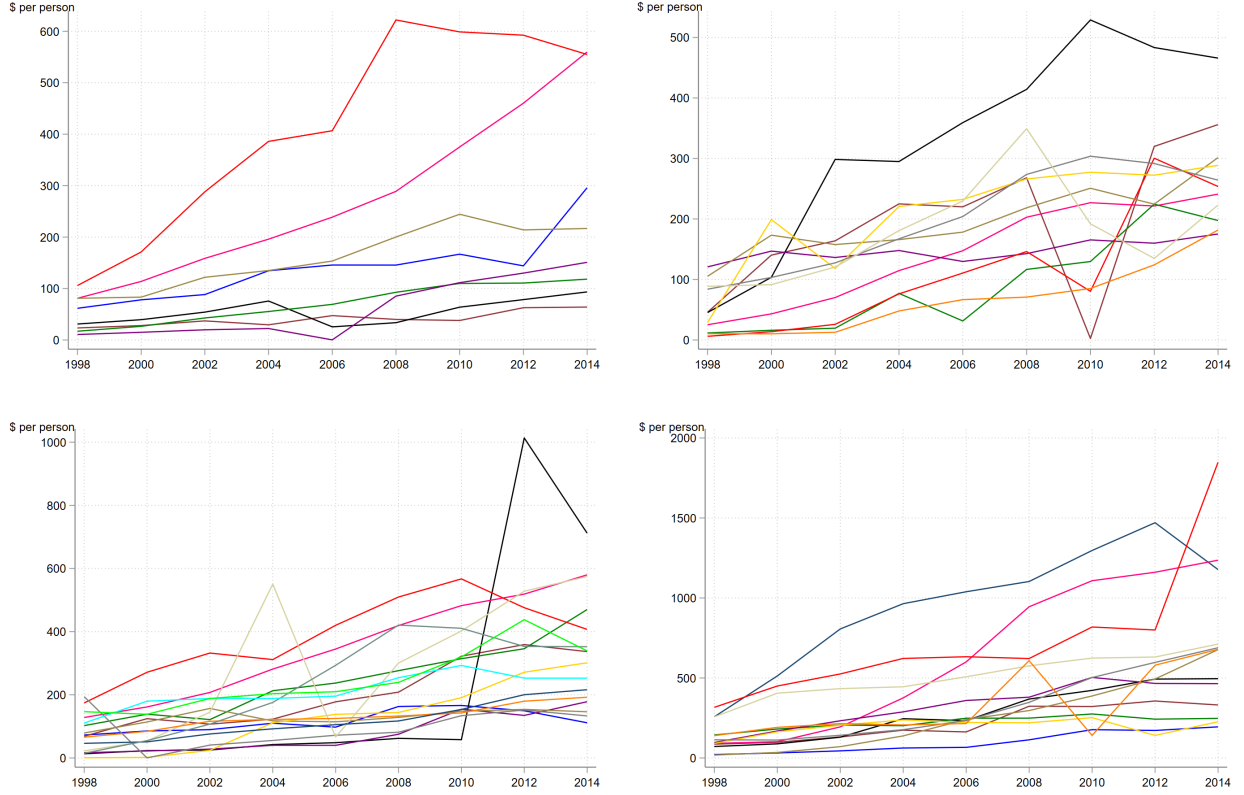
Notes: The four graphs display the HCBS expenditures per person from 1998 to 2014 across states. The lines of the sub-graph on the top-left correspond to Delaware, Nevada, North Dakota, South Dakota, Utah, and Wyoming; the lines of the sub-graph on the top-right correspond to Alaska, Hawaii, Idaho, Indiana, Iowa, Louisiana, Maine, Montana, Nebraska, New Hampshire, New Mexico, Rhode Island, and Vermont; the lines of the sub-graph on the bottom-left correspond to Alabama, Arizona, Arkansas, Connecticut, Kansas, Kentucky, Maryland, Massachusetts, Michigan, Mississippi, Missouri, New Jersey, New York, Oklahoma, South Carolina, Tennessee, and West Virginia; the lines of the sub-graph on the bottom-right correspond to California, Colorado, Florida, Georgia, Illinois, Minnesota, North Carolina, Ohio, Oregon, Pennsylvania, Texas, Virginia, Washington, and Wisconsin.

between 1954 and 1959 was added in 2010. A detailed questionnaire that asks respondents about their demographic characteristics, health outcomes, employment status, financial situation, and intergenerational transfers is administered in person or via telephone. We use restricted access data that include the state of residence for each respondent, and merge these data with the policy information of our first data source.

We restrict the main sample to respondents who are over age 65, because in all states, only people in this age group are eligible for the HCBS aging waivers.[6]

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[6]Details of HCBS aging waiver introduction can be referred to Liu & Zai (2022).

We merge the HRS data with the HCBS expenditure data based on the state of residence of the respondents. The resulting dataset includes 21,421 unique individuals, and 98,116 observations from 1998 to 2014.

Key Variables

First, we use information about difficulties with activities of daily living (ADLs) to explore whether HCBS helps older people stay at home longer. The HRS provides an index ranging from zero to five that measures difficulties of ADLs with bathing, eating, dressing, getting in or out of bed, and walking across a room. For example, an ADL difficulty index with a value of five means that an individual has difficulties with all of the ADLs, while a value of zero means that the individual has no difficulties with the ADLs.

Second, we use information about health outcomes to estimate how HCBS affect the well-being of older people. The HRS asks respondents to self-report their general health status, ranging from one for excellent, to two for very good, three for good, four for fair, and five for poor. We create a poor health indicator, which is one if self-reported health is poor, and is zero otherwise. The self-reported poor health indicator is commonly used in similar datasets, such as in the Survey of Health, Aging, and Retirement in Europe (SHARE) dataset and the Household, Income, and Labor Dynamics in Australia (HILDA) dataset (Coe & Zamarro 2011; Zhu 2016).

Third, we further use health information about physical limitations: i.e. difficulties with instrumental activities of daily living (IADLs) and about psychological health. The IADL difficulty index assesses the difficulties people have in performing daily activities such as using the phone, managing money, taking medications, shopping for groceries, and preparing hot meals. The value of the IADL difficulty index ranges from zero to five, and its values can be interpreted similarly to those of the ADL difficulty index. More details on the construction of these measures can be found in Chien et al. (2015). In addition, the HRS asks respondents about their mental health using the Center for Epidemiologic Studies Depression (CESD)

score. The CESD score captures the number of adverse sentiments a respondent experienced all or most of the time in the past two years, including whether an individual was depressed, felt alone, felt sad, had restless sleep, felt everything was an effort, could not get going, felt unhappy, and did not enjoy life. The CESD scale has been validated in the research as an instrument to identify major depression in older adults (Irwin et al. 1999). Besides, the cognition summary score calculates an individual's total scores on word recall and mental status tests, with outcomes ranging from zero to 35. The word recall test, which is widely used to measure cognitive skills, asks respondents to listen to a list of words, and then to recall them immediately and with a delay (Bonsang et al. 2012; Mazzonna & Peracchi 2012). The mental status test score includes an individual's scores on serial sevens, counting backwards from 20, naming objects, recalling dates, and naming the president and the vice-president. These cognitive tests are important measures of the mental health of older adults, as the aging process is strongly associated with a decline in the ability to perform cognitive tasks (Souchay et al. 2000; Anderson & Craik 2000; Prull et al. 2000; Dixon 2004; Hertzog et al. 2008).

Fourth, we use information about event diagnosis. HRS asks respondents if they have ever had a diagnosis of cancer, lung disease, heart disease, or stroke. These dichotomous indicators are used to measure the morbidity events of individuals.

Sample Statistics

Table 1 presents the summary statistics of the sample of HRS respondents who are aged 65 and older in each survey year. About 58 percent of the sample are female. The average educational attainment of the respondents is around 12 years. On average, each individual has about two siblings. The majority of the respondents are white, and 13 percent are black. The average age of the respondents is about 75 years. While 58 percent of the respondents are married or are living with a partner, approximately 30 percent have lost their spouse or partner.

The average ADL limitation index score is close to one, which indicates that the individual is having difficulties with one of the activities of daily living. The average self-reported health status of the respondents is good. The average IADL limitation index score is similar to the average of ADL limitation score. The average CESD depression score is 1.5 out of eight. The average cognition score is close to 21. In addition, around 19 percent of the respondents report ever having a cancer diagnosis, 15 percent report ever having a lung disease diagnosis, and 39 percent report ever having a heart disease-related diagnosis. In terms of the behavioral health variables, about 57 percent of individuals report ever smoking, and about nine percent report currently smoking. Forty-three percent of the respondents report ever drinking alcohol, and of those who say they currently drink alcohol, the average consumption is about one drink per week, and about one half of a standard drink per sitting. The detailed definitions of these variables can be found in Table A2 in the Appendix.

Estimation Model

We use an individual fixed effects model to account for individual heterogeneity in longitudinal data. The model is as follows:

$$Y_{ist} = \alpha_i + \delta_{hcbs} HCBS_{s\bar{t}} + \mu_t + \eta_s + \eta_s * t + \beta_x X_{it} + \epsilon_{ist} \tag{1}$$

where i indicates the individual, s is the state where the individual lives, and t is the survey year an individual is observed. Y_{ist} is the health outcome for an individual i in state s and year t. $HCBS_{s\bar{t}}$ is the average expenditures of Medicaid HCBS per older person over age 65 living in the state s and averaged in year t and $t-1$. For example, the health outcome in survey year 2000 is regressed on HCBS expenditures averaged between 2000 and 1999. The model controls for the individual fixed effect, α_i, the year fixed effect, μ_t, the state fixed effect, η_s, and the state year trend $\eta_s * t$. The individual fixed effect controls for the

Table 1: Summary Statistics of the Sample

Variable	Mean	S.D.	Unique individuals	Obs.
Time-invariant demographics				
Female	0.58	0.49	21,421	98,116
Education	11.97	3.40	21,406	98,087
Siblings	2.31	2.23	21,199	97,776
Race/ethnicity				
White	0.83	0.37	21,409	98,091
Black/African	0.13	0.34	21,409	98,091
Other	0.03	0.18	21,409	98,091
Time-varying demographics				
Age	75.33	7.51	21,421	98,116
Marital status				
Married/partnered	0.58	0.49	21,420	98,060
Separated/divorced	0.09	0.28	21,420	98,060
Widowed	0.31	0.46	21,420	98,060
Never married	0.03	0.16	21,420	98,060
Heath variables				
ADL limitation	0.51	1.16	21,409	98,040
Self-reported health	3.00	1.11	21,417	98,027
IADL limitation	0.50	1.19	21,406	98,023
CESD scores	1.47	1.90	19,975	88,184
Cognition scores	21.28	5.39	19,951	87,999
Cancer diagnosis	0.19	0.45	21,418	98,035
Lung disease diagnosis	0.15	0.49	21,413	98,028
Heart disease diagnosis	0.39	0.73	21,416	98,004
Stroke	0.13	0.41	21,414	98,029
Smoke now	0.09	0.29	21,363	97,510
Smoke ever	0.57	0.49	21,237	97,250
Drink ever	0.43	0.50	21,421	98,098
Drink days	1.00	2.05	21,410	97,915
Drink number	0.50	1.10	21,403	97,889

Notes: The data used are from the HRS for 1998 to 2014 on individuals aged 65 and older. The definitions of these variables can be found in Appendix Table A2.

unobservable factors that are constant within individuals, such as protective health behavior like exercise, and preferences for health care providers. η_s is the state fixed effect, which controls for unobserved time-invariant state characteristics, such as the political environment for promoting health and the basic infrastructure that facilitates entertainment activities among older people. μ_t is the year fixed effect that controls for common shocks across states that could affect health outcomes. $\eta_s * t$ is the state-specific linear time trend, which controls for the heterogeneous trends in outcomes that might be spuriously correlated with policy expenditures across states. X is a set of time-varying characteristics of individuals, such as age, marital status, and number of living siblings. The standard errors are clustered at the individual level.

Results

Effect of HBCS on Staying at Home

Per the design of HCBS, older people who are medically needy are encouraged to stay at home or community-based settings. First, we estimate whether HCBS indeed helps old people stay at home longer. Table 2 displays the results for the effect of HCBS on ADL limitations. The number of ADL limitations is commonly used to indicate the severity of medical condition of old population. The outcomes in each column correspond to the indicators with different levels of ADL limitations. For example, column 1 shows the outcomes for the ADL indicator with at least one ADL limitation; column 2 reports the outcomes for the ADL indicator with at least two ADL limitations, etc. The effect of HCBS on ADL limitations concentrates on the indicator with at least four or five ADL limitations. All models include individual fixed effects, state fixed effects, year fixed effects, state year trends, demographic characteristics of respondents such as age and marital status, and state characteristics.

Specifically, the HCBS program seems to be effective in reducing the probability of having light physical limitations; i.e., of having one ADL limitation. However, an increase in

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HCBS expenditures per older person is associated with a significant increase in the likelihood of an individual having more serious ADL limitations, as shown in columns 4 and 5. The magnitude of the coefficient on four limitations in ADL is around two percentage points, and the magnitude of the coefficient on five limitations in ADL is around one percentage point. A $1,000 per capita increase in HCBS expenditures is associated with an approximately 41 percent increase in the chances of reporting at least four ADL limitations, with a mean of 0.05; and a 45 percent increase in reporting five ADL limitations, with a mean of 0.03. Table A3 shows the estimates of the effect of aging waiver and state plan expenditures on ADL limitations separately. The effect of aging waivers is larger than that of state plan expenditures: an increase in aging waiver expenditures increases the probability of having four ADL limitations by approximately three percentage points, while an increase in state plan expenditures increases the probability of having four ADL limitations by two percentage points. The effect of aging waivers on the ADL indicator with at least three limitations is also statistically significant, at around two percentage points.

As we discussed in Section , HCBS targets older people who have limited resources and are at risk of needing LTC. To give supportive evidence, Table 3 reports the effect of HCBS on ADL limitations by education. Panel A shows the findings on individuals who have education below the college level; panel B shows the effect on individuals without a high school degree; and panel C shows the effect on individuals who did not finish junior high school. Education can be seen as a proxy for financial resources. The positive association between HCBS expenditures and ADL limitations increases among older individuals with lower education. Among individuals who did not attend college, an increase in HCBS expenditures significantly increases their probability of having at least three, four, or five limitations in ADL. The magnitude of these coefficients is slightly larger than that shown in Table 2. Among individuals without a high school degree, the positive relationship between HCBS expenditures and ADL limitations still holds for higher levels of ADL difficulties. The magnitude of the coefficient of five ADL limitations is much larger,

Table 2: Effect of HCBS on ADL Limitations

	(1)	(2)	(3)	(4)	(5)
	ADL indicator_one limitation	ADL indicator_two	ADL indicator_three	ADL indicator_four	ADL indicator_five
HCBS expenditures per older person ($1,000)	-0.0081	0.0043	0.0161	0.0212**	0.0122*
	(0.0141)	(0.0112)	(0.0100)	(0.0083)	(0.0065)
Mean of ADL indicator	0.2217	0.1251	0.0801	0.0513	0.0272
Number of individuals	21,125	21,125	21,125	21,125	21,125
Observations	96,860	96,860	96,860	96,860	96,860
Controls	Y	Y	Y	Y	Y
Adjusted R-squared	0.103	0.104	0.090	0.077	0.053

Notes: The data used are from HRS 1998 to 2014 on individuals who are 65 aged and older. The ADL index of difficulties in Activities of Daily Living (ADL) ranges from zero to five, indicating whether respondents are having difficulties in bathing, eating, dressing, getting in/out of bed, and walking across a room. The ADL indicator with one limitation means an individual has at least one ADL limitation; the ADL indicator with two limitations means an individual has at least two ADL limitations, etc. All models include individual fixed effects, state fixed effects, year fixed effects, state year trends, demographic characteristics of respondents such as age and marital status, and state characteristics. The definitions of these variables can be found in Appendix Table A2.

at two percentage points, versus one percentage point in Table 2. Among individuals with very low education, shown in panel C, the effect of HCBS on ADL limitations is almost three times as large as that shown in Table 2. Specifically, a $1,000 increase in HCBS expenditures per older person increases the probability of individuals having at least three ADL limitations by approximately seven percentage points, while the magnitude is around two percentage points in Table 2. The magnitude of the effect on the probability of individuals having at least four ADL limitations is around six percentage points, and the magnitude of the effect on the probability of individuals having at least five ADL limitations increases to about four percentage points.

Appendix Table A4 further shows the results of the effect of HCBS on nursing home variables in columns 1 and 3, and on hospital use variables in column 4. The program seems to reduce the expectation of moving into a nursing home in the next five years, as shown in column 1. The coefficient on the predicted probability of moving is, however, statistically insignificant. As shown in column 2, a $1,000 increase in HCBS expenditures per older person significantly decreases the number of days a person who has ever been institutionalized spends in a nursing home, by around 180 days. Compared to the average stay, which is 480 days among a small sample of individuals who have ever stayed in a nursing home, this decrease is relatively large, at approximately 35 percent. Column 3 also provides evidence of the effect of HCBS on the frequency of nursing home stays. If the HCBS program indeed affects the willingness of older people who need intensive LTC care to stay in a nursing home, such individuals might have to be transferred to nursing facilities more frequently if there were no HCBS support. The results displayed in column 3 confirm this assumption. Older people in more generous states have more incidents of nursing home stays, while the coefficient is statistically insignificant. Column 4 shows that HCBS reduces the probability of placement in other settings, such as hospital stays. The magnitude of the coefficient is economically small, which suggests that HCBS affects health outcomes mainly through the channels of avoiding nursing home placement and staying at home longer.

Table 3: Effects of HCBS on ADL by Education

	(1)	(2)	(3)	(4)	(5)
	ADL indicator_one	ADL indicator_two	ADL indicator_three	ADL indicator_four	ADL indicator_five

Panel A: Low Education (Below College)[0.91]

HCBS expenditures					
per older person ($1,000)	-0.0083	0.0072	0.0183*	0.0271***	0.0171**
	(0.0152)	(0.0121)	(0.0108)	(0.0089)	(0.0069)
Mean	0.2303	0.1308	0.0840	0.0539	0.0284
Number of individuals	19,151	19,151	19,151	19,151	19,151
Observations	87,714	87,714	87,714	87,714	87,714
Adjusted R-squared	0.1027	0.1035	0.0904	0.0778	0.0539

Panel B: Low Education (Below High School)[0.64]

HCBS expenditures					
per older person ($1,000)	-0.0141	0.0058	0.0135	0.0259**	0.0201**
	(0.0196)	(0.0163)	(0.0147)	(0.0119)	(0.0094)
Mean	0.2553	0.1489	0.0968	0.0621	0.0325
Number of individuals	13,443	13,443	13,443	13,443	13,443
Observations	61,310	61,310	61,310	61,310	61,310
Adjusted R-squared	0.1062	0.1063	0.0949	0.0829	0.0573

Panel C: Low Education (Below Junior High School)[0.15]

HCBS expenditures					
per older person ($1,000)	0.0050	0.0329	0.0711*	0.0636**	0.0436*
	(0.0480)	(0.0425)	(0.0393)	(0.0321)	(0.0262)
Mean	0.3714	0.2429	0.1698	0.1123	0.0586
Number of individuals	3,323	3,323	3,323	3,323	3,323
Observations	14,137	14,137	14,137	14,137	14,137
Adjusted R-squared	0.1159	0.1263	0.1171	0.1176	0.0869

Notes: The data used are from HRS 1998 to 2014 on individuals who are aged 65 and older. The ADL index of difficulties in Activities of Daily Living (ADL) ranges from zero to five, indicating whether respondents are having difficulties in bathing, eating, dressing, getting in/out of bed, and walking across a room. The ADL indicator with one limitation means an individual has at least one ADL limitation; the ADL indicator with two limitations means an individual has at least two ADL limitations, etc. Panel A uses the sample of respondents with fewer than 16 years of education; Panel B uses the sample of respondents with fewer than 12 years of education; and Panel C uses the sample of respondents with fewer than eight years of education. All models include individual fixed effects, state fixed effects, year fixed effects, state year trends, demographic characteristics of respondents such as age and marital status, and state characteristics. The definitions of these variables can be found in Appendix Table A2.

In summary, an increase in HCBS expenditures increases the probability of older people who are at risk of being institutionalized to stay at home longer. The effect is much significant among the population with limited financial resources and who are more likely to be participants of HCBS.

Effect of HCBS on Health Outcomes

Since HCBS encourages older people to stay at home longer, we now explore how HCBS affects the well-being of older people aging-in-place. First, Table 4 shows the effect of HCBS on self-reported poor health using different model specifications. Model 1 does not control for individual fixed effects. Model 2 adds the individual fixed effects. Model 3 adds controls of the time-variant demographic characteristics of HRS respondents; model 4 adds controls of health behavior, such as drinking and smoking; and model 5 further adds state characteristics, such as the unemployment rate, poverty level, percentage married, and percentage white. All models control for state fixed effects, year fixed effects, and state year trends. The scale of the independent variable, HCBS expenditures per older person, is in increments of $1,000. Without controlling for individual fixed effects, the estimate in the first column shows that an increase in HCBS expenditures has a negative effect on the probability of an individual reporting poor health. The models that include individual fixed effects, displayed from column 2 to column 5, show a positive and statistically insignificant estimate of the impact of the program on self-reported poor health. Specifically, a $1,000 increase in HCBS expenditures per older person is associated with a decrease of 0.2 percentage points in the probability of reporting poor health in model 1; though the magnitude of the effect increases to 0.7 percentage points after controlling for individual fixed effects. On a baseline poor health rate of 0.10, the estimated effect size corresponds to an increase of approximately seven percent in the probability of reporting poor health. The magnitude of the estimate decreases to 0.5 percentage points after further controlling for the health behavioral variables of smoking and drinking. Overall, the estimated effect of

HCBS on the probability of reporting poor health is relatively stable and consistent across models with individual fixed effects. The following estimates of the effect of HCBS on other health outcomes use the preferred model of individual fixed effects with full controls.

Table 4: Results on the Effect of Medicaid HCBS on Self-Reported Poor Health

	(1)	(2)	(3)	(4)	(5)
HCBS expenditures per older person ($1,000)	-0.0017	0.0066	0.0067	0.0047	0.0064
	(0.0096)	(0.0104)	(0.0104)	(0.0103)	(0.0105)
Mean of poor health	0.105	0.105	0.104	0.104	0.104
Number of individuals		21,417	21,195	21,126	21,126
Observations	98,027	98,027	97,632	96,841	96,841
Adjusted R-squared	0.000	0.019	0.020	0.023	0.023
Individual FE	N	Y	Y	Y	Y
Demographics	N	N	Y	Y	Y
Health behavior	N	N	N	Y	Y
State characteristics	N	N	N	N	Y

Notes: The data used are from HRS 1998 to 2014 on individuals who are aged 65 and older. Self-reported health is based on the general health status of the HRS respondent: one for excellent, two for very good, three for good, four for fair, and five for poor. Self-reported poor health is an indicator showing that an individual self-assesses his or her general health status as poor. The mean of HCBS expenditures per older person is around $500. All models include state fixed effects, year fixed effects, and state year trends. The definition of these variables can be found in Appendix Table A2.

Second, we explore the health effect of HCBS on physical limitations and mental health, separately. Appendix Table A5 reports the estimates on IADL limitations. Similar to Table 2, each column reports the effect on one IADL indicator with different levels of IADL limitations. An increase in HCBS expenditures is correlated with an increase in the likelihood of having at least two IADL limitations. The coefficients are not statistically significant. Table 5 reports the effect of HCBS on mental health using the CESD scale. We have created a series of indicators to show how HCBS affects individuals' psychological outcomes. The HCBS expenditures are negatively correlated with individuals reporting depressive feelings. The coefficients on all indicators across the columns are negative but

statistically insignificant. Overall, HCBS seems to improve the probability of older people reporting more positive psychological outcomes.

To further explore the mental health effect of HCBS on different populations, Table 6 reports the results on mental health by education. Column 1 shows the estimates for the original depression scores using the CESD scale. Similar to the results shown in Table 5, HCBS decreases the chances of older people experiencing negative feelings. The effect of HCBS expenditures is much stronger among older people with education below junior high school level, as shown in panel B; and among older people without primary school education, as shown in panel C. The magnitude of the coefficient on high depression outcomes, as shown in column 3 of panel C, is especially large: i.e., there is a decrease of approximately six percentage points with an increase in HCBS expenditures per older person.

In addition, Appendix Table A6 reports the estimates of the effect of HCBS on cognitive scores and morbidity outcomes. An increase in HCBS expenditures is associated with an deterioration in cognitive skills, but the coefficient is not statistically significant, and it is economically small relative to the average of 21. In addition, an increase in HCBS expenditures is correlated with an older individual being more likely to be diagnosed with cancer, lung disease, or stroke; but less likely to be diagnosed with a heart-related disease. These coefficients on morbidity outcomes are not statistically significant.

Conclusion

In this paper, we explored how Medicaid HCBS affects health outcomes among people aged 65 and older. We found evidence that HCBS helps older people stay in their homes longer when their physical health deteriorates. The HCBS program significantly increases the probability that individuals who have limitations in activities of daily living, such as eating, bathing, dressing, walking around, and toileting, can avoid going to a nursing home. This effect was found to be especially large among older people with low levels of education. The finding

Table 5: Effects of HCBS on Mental Health

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Depression_one	Depression_two	Depression_three	Depression_four	Depression_five	Depression_six	Depression_seven	Depression_eight
HCBS expenditures								
per older person ($1,000)	-0.0051	-0.0069	-0.0071	-0.0170	-0.0096	-0.0053	-0.0014	-0.0014
	(0.0180)	(0.0170)	(0.0160)	(0.0130)	(0.0120)	(0.0094)	(0.0069)	(0.0043)
Mean of depression	0.5665	0.3447	0.2222	0.1460	0.0967	0.0593	0.0305	0.0102
21, Number of individuals	19,746	19,746	19,746	19,746	19,746	19,746	19,746	19,746
Observations	87,265	87,265	87,265	87,265	87,265	87,265	87,265	87,265
Controls	Y	Y	Y	Y	Y	Y	Y	Y
Adjusted R-squared	0.007	0.010	0.009	0.007	0.006	0.004	0.002	0.002

Notes: The data used are from HRS 1998 to 2014 on individuals who are aged 65 and older. Depression scores are based on the Center for Epidemiologic Studies Depression (CESD) scale: i.e., the sum of five negative indicators minus two positive indicators. The negative indicators measure whether respondents have the following sentiments all or most of the time: depression, everything is an effort, restless sleep, feeling alone, sad, and cannot get going. The positive indicators measure whether respondents feel happy and enjoy life. All models include individual fixed effects, state fixed effects, year fixed effects, state year trends, demographic characteristics of respondents, and state characteristics. The definitions of these variables can be found in Appendix Table A2.

Table 6: Effects of HCBS on Mental Health by Education

	(1)	(2)	(3)
	Depression score_original	Depression indicator_seven items	Depression indicator_eight items
	Panel A: Low Education (Below College)[0.91]		
HCBS expenditures			
per older person ($1,000)	-0.0840	-0.0018	0.0001
	(0.0715)	(0.0075)	(0.0047)
Mean	1.5433	0.0327	0.011
Number of individuals	17,825	17,825	17,825
Observations	78,535	78,535	78,535
Adjusted R-squared	0.0149	0.0041	0.0024
	Panel B: Low Education (Below Junior High School)[0.15]		
HCBS expenditures			
per older person ($1,000)	-0.4569*	-0.0031	-0.0130
	(0.2400)	(0.0270)	(0.0160)
Mean	2.2837	0.0562	0.0171
Number of individuals	2,823	2,823	2,823
Observations	11,102	11,102	11,102
Adjusted R-squared	0.0093	(0.0002)	0.0010
	Panel C: Low Education (Below Primary School)[0.05]		
HCBS expenditures			
per older person ($1,000)	-0.4700	-0.0350	-0.0587*
	(0.5300)	(0.0630)	(0.0280)
Mean	2.5849	0.0748	0.0194
Number of individuals	937	937	937
Observations	3,556	3,556	3,556
Adjusted R-squared	0.0254	0.0040	0.0116

Notes: The data used are from HRS 1998 to 2014 on individuals who are aged 65 and older. Depression scores are based on the Center for Epidemiologic Studies Depression (CESD) scale: i.e., the sum of five negative indicators minus two positive indicators. The negative indicators measure whether respondents have the following sentiments all or most of the time: depression, everything is an effort, restless sleep, feeling alone, sad, and cannot get going. The positive indicators measure whether respondents feel happy and enjoy life. The total cognition score sums the total word recall and mental status test scores ranging from zero to 35. The word recall index sums the immediate and delayed word recall scores. The mental status index includes the scores for serial sevens, counting backwards from 20, naming objects, recalling dates, and naming the president and the vice-president. Panel A uses the sample of respondents with fewer than 16 years of education; Panel B uses the sample of respondents with fewer than eight years of education; and Panel C uses the sample of respondent with fewer than five years of education. The mean of low education is in brackets. All models include individual fixed effects, state fixed effects, year fixed effects, state year trends, demographic characteristics of respondents, and state characteristics. The definitions of these variables can be found in Appendix Table A2.

is in line with the theoretical framework presented in Liu & Zai (2022). Furthermore, we estimate how HCBS affects the well-being of older people aging-in-place. HCBS is weakly weakly positively associated with having physical limitations in instrumental activities of daily living. In addition, individuals in states with more generous HCBS benefits were found to be less likely to report depressive feelings, and to feel more positive about life. The improvements in mental health were shown to be much more significant for older people with low resources. We also found that HCBS was associated with improvements in older people's cognitive skills. It is possible that the HCBS program allowed older people to age in place, and thus in a relatively relaxing and comfortable environment that was beneficial for their cognitive and psychological health.

The findings of this study are informative for the development of long-term care policy. During the 2020 pandemic, CMS changed the implementation rules for the aging waiver program. States were permitted to loosen quality requirements for home health care providers in order to ensure that services would continue to be provided to HCBS clients. In addition, some states increased pay rates in order to attract more providers and to compensate providers for the increased risk of entering homes during the pandemic. Understanding the detailed effects of the program on health outcomes is essential, as the federal government is planning for the eventual return to regular operations after the public health emergency ends. The results of this study can inform policy debates about what share of home health services should be covered, and about what types of care are more efficient in improving the quality of life of older people aging in place. Moreover, strategies aimed at better coordinating the incentives of home care providers, patients, family caregivers, and social workers can further increase the efficiency of care delivery.

To realize the goal of reducing costs by shifting resources to home- or community-based settings, improving the quality of care provided by home health agencies is a leading priority of CMS. While each state HCBS program has minimum requirements for the certification of service providers that are guided by the federal government, these requirements vary across

states. In addition, states are responsible for surveying and monitoring home health agencies to ensure that they are providing a high standard of care. However, with so many individuals being served by thousands of agencies, it is difficult to monitor their activities, and to ensure that all patients are treated fairly. The findings in this paper provide direct evidence on the health outcomes of HCBS clients, which can be discussed in depth, and be used to create better quality indicators to regulate home health care providers.

References

Aguila, E., Park, J. H., & Vega, A. (2020). Living arrangements and supplemental income programs for older adults in Mexico. *Demography*, *57*(4), 1345–1368.

Alecxih, L. M. B., Radke, S., Wiener, J. M., Anderson, W. L., Khatutsky, G., & Shinogle, J. (2006). Medicaid Home and Community-Based Services for older people and persons with physical disabilities: Beneficiary satisfaction, service use and expenditures.

Anderson, N. D. & Craik, F. I. (2000). Memory in the aging brain. *The Oxford Handbook of Memory*, 411–425.

Bonsang, E., Adam, S., & Perelman, S. (2012). Does retirement affect cognitive functioning? *Journal of Health Economics*, *31*(3), 490–501.

Borsani, V., Matta, A., Beschi, G., & Sommaruga, F. (2006). A home care scheduling model for human resources. In *2006 International conference on service systems and service management*, volume 1, (pp. 449–454). IEEE.

Brown, J. R. & Finkelstein, A. (2008). The interaction of public and private insurance: Medicaid and the long-term care insurance market. *American Economic Review*, *98*(3), 1083–1102.

Card, D., Dobkin, C., & Maestas, N. (2008). The impact of nearly universal insurance coverage on health care utilization: evidence from Medicare. *American Economic Review*, *98*(5), 2242–58.

Cherry, D. (2012). HCBS can keep people with dementia at home. *Generations*, *36*(1), 83–90.

Chien, S., Campbell, N., Hayden, O., Hurd, M., Main, R., Mallett, J., Martin, C., Meijer, E., Miu, A., Moldoff, M., et al. (2015). RAND HRS data documentation, version N. *RAND Corporation*.

Coe, N. B. & Zamarro, G. (2011). Retirement effects on health in Europe. *Journal of Health Economics*, *30*(1), 77–86.

Dick, A. W., Murray, M. T., Chastain, A. M., Madigan, E. A., Sorbero, M., Stone, P. W., & Shang, J. (2019). Measuring quality in home healthcare. *Journal of the American Geriatrics Society*, *67*(9), 1859–1865.

Dixon, R. A. (2004). *New frontiers in cognitive aging.* Oxford univ. press.

Grabowski, D. C. (2006). The cost-effectiveness of noninstitutional long-term care services: Review and synthesis of the most recent evidence. *Medical Care Research and Review*, *63*(1), 3–28.

Guo, J., Konetzka, R. T., & Manning, W. G. (2015). The causal effects of home care use on institutional long-term care utilization and expenditures. *Health Economics*, *24*, 4–17.

Hagen, S. A. (2013). *Rising demand for long-term services and supports for elderly people.* Congressional Budget Office.

Hertzog, C., Kramer, A. F., Wilson, R. S., & Lindenberger, U. (2008). Enrichment effects on adult cognitive development: Can the functional capacity of older adults be preserved and enhanced? *Psychological Science in the Public Interest*, *9*(1), 1–65.

Houser, A. N., Fox-Grage, W., & Ujvari, K. (2012). *Across the states: Profiles of long-term services and supports.* AARP Public Policy Institute.

Irwin, M., Artin, K. H., & Oxman, M. N. (1999). Screening for depression in the older adult: Criterion validity of the 10-item Center for Epidemiological Studies Depression Scale (CESD). *Archives of Internal Medicine*, *159*(15), 1701–1704.

Johnson, R. W. (2017). What is the lifetime risk of needing and receiving long-term services and supports? *Washington, DC: The Urban Institute.*

Kane, R. L., Lum, T. Y., Kane, R. A., Homyak, P., Parashuram, S., & Wysocki, A. (2013). Does home-and community-based care affect nursing home use? *Journal of Aging & Social Policy*, *25*(2), 146–160.

Kane, R. L., Shamliyan, T., Mueller, C., Duval, S., & Wilt, T. J. (2007). Nurse staffing and quality of patient care. *Evidence Report/Technology Assessment*, (151), 1–115.

Kaye, H. S., LaPlante, M. P., & Harrington, C. (2009). Do noninstitutional long-term care services reduce Medicaid spending? *Health Affairs*, *28*(1), 262–272.

Kemper, P. (1988). The evaluation of the national long term care demonstration. *Health Services Research*, *23*(1), 161.

Kemper, P., Komisar, H. L., & Alecxih, L. (2005). Long-term care over an uncertain future: What can current retirees expect? *INQUIRY: Journal of Health Care Organization, Provision, and Financing*, *42*(4), 335–350.

Khwaja, A. (2006). A life cycle analysis of the effects of medicare on individual health incentives and health outcomes. *Journal of Econometrics*.

Konetzka, R. T., Jung, D. H., Gorges, R. J., & Sanghavi, P. (2020). Outcomes of Medicaid home-and community-based long-term services relative to nursing home care among dual eligibles. *Health Services Research*, *55*(6), 973–982.

Landers, S., Madigan, E., Leff, B., Rosati, R. J., McCann, B. A., Hornbake, R., MacMillan, R., Jones, K., Bowles, K., Dowding, D., et al. (2016). The future of home health care: a strategic framework for optimizing value. *Home Health Care Management & practice*, *28*(4), 262–278.

Levine, S. A. & Barry, P. P. (2003). Home care. In *Geriatric Medicine* (pp. 121–131). Springer.

Liu, Y. & Zai, X. (2022). The unintended effect of Medicaid aging waivers on informal caregiving. *Working Paper*.

Mazzonna, F. & Peracchi, F. (2012). Ageing, cognitive abilities and retirement. *European Economic Review, 56*(4), 691–710.

McMorrow, S., Gates, J. A., Long, S. K., & Kenney, G. M. (2017). Medicaid expansion increased coverage, improved affordability, and reduced psychological distress for low-income parents. *Health Affairs, 36*(5), 808–818.

Miller, N. A. (2011). Relations among home-and community-based services investment and nursing home rates of use for working-age and older adults: A state-level analysis. *American Journal of Public Health, 101*(9), 1735–1741.

Miller, S. C., Prohaska, T. R., Furner, S. E., Freels, S., Brody, J. A., & Levy, P. S. (1998). Time to nursing home admission for persons with Alzheimer's disease: the effect of health care system characteristics. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences, 53*(6), S341–S353.

Muramatsu, N., Yin, H., Campbell, R. T., Hoyem, R. L., Jacob, M. A., & Ross, C. O. (2007). Risk of nursing home admission among older americans: does states' spending on home-and community-based services matter? *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences, 62*(3), S169–S178.

Nair, K. (2004). The physically ageing body and the use of space. In *Ageing and Place* (pp. 126–133). Routledge.

National Center for Health Statistics (2009). *Health, United States, 2008: With special feature on the health of young adults.* Number 2009. US Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics.

Ng, T., Harrington, C., & Kitchener, M. (2010). Medicare and Medicaid in long-term care. *Health Affairs*, *29*(1), 22–28.

Oswald, F. & Wahl, H.-W. (2004). Housing and health in later life. *Reviews on Environmental Health*, *19*(3-4), 223–252.

Pilkauskas, N. & Michelmore, K. (2019). The effect of the earned income tax credit on housing and living arrangements. *Demography*, *56*(4), 1303–1326.

Prieto-Flores, M.-E., Fernandez-Mayoralas, G., Forjaz, M. J., Rojo-Perez, F., & Martinez-Martin, P. (2011). Residential satisfaction, sense of belonging and loneliness among older adults living in the community and in care facilities. *Health & Place*, *17*(6), 1183–1190.

Prull, M. W., Gabrieli, J. D., & Bunge, S. A. (2000). Age-related changes in memory: A cognitive neuroscience perspective.

Radke, S., Walsh, E. G., Greene, A. M., & Kaganova, Y. (2006). Design of evaluation options of the system change grants.

Rojo-Pérez, F., Fernández-Mayoralas, G., Rodríguez-Rodríguez, V., & Rojo-Abuín, J.-M. (2007). The environments of ageing in the context of the global quality of life among older people living in family housing. In *Quality of Life in Old Age* (pp. 123–150). Springer.

Sands, L. P., Xu, H., Weiner, M., Rosenman, M. B., Craig, B. A., & Thomas III, J. (2008). Comparison of resource utilization for medicaid dementia patients using nursing homes versus home and community based waivers for long-term care. *Medical Care*, *46*(4), 449–453.

Sereny, M. D. & Gu, D. (2011). Living arrangement concordance and its association with self-rated health among institutionalized and community-residing older adults in China. *Journal of Cross-Cultural Gerontology*, *26*(3), 239–259.

Simon, K., Soni, A., & Cawley, J. (2017). The impact of health insurance on preventive care and health behaviors: evidence from the first two years of the ACA Medicaid expansions. *Journal of Policy Analysis and Management, 36*(2), 390–417.

Souchay, C., Isingrini, M., & Espagnet, L. (2000). Aging, episodic memory feeling-of-knowing, and frontal functioning. *Neuropsychology, 14*(2), 299.

Stancliffe, R. J., Lakin, K. C., Taub, S., Chiri, G., & Byun, S.-y. (2009). Satisfaction and sense of well being among Medicaid ICF/MR and HCBS recipients in six states. *Intellectual and Developmental Disabilities, 47*(2), 63–83.

Wagner, A., Schaffert, R., Möckli, N., Zúñiga, F., & Dratva, J. (2020). Home care quality indicators based on the Resident Assessment Instrument-Home Care (RAI-HC): A systematic review. *BMC Health Services Research, 20*, 1–12.

Wang, S., Temkin-Greener, H., Simning, A., Tamara Konetzka, R., & Cai, S. (2020). Is the generosity of Medicaid Home and Community-Based Services associated with community discharge from skilled nursing facilities? *Health Services Research, 55*, 24–25.

Wang, S., Yan, D., Temkin-Greener, H., & Cai, S. (2020). Does Medicaid HCBS generosity influence nursing home placement for dually eligible ADRD patients? *Health Services Research, 55*, 23–24.

Wiles, J. (2005). Conceptualizing place in the care of older people: the contributions of geographical gerontology. *Journal of Clinical Nursing, 14*, 100–108.

Wilmoth, J. M. & Chen, P.-C. (2003). Immigrant status, living arrangements, and depressive symptoms among middle-aged and older adults. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences, 58*(5), S305–S313.

Wysocki, A., Kane, R. L., Dowd, B., Golberstein, E., Lum, T., & Shippee, T. (2014).

Hospitalization of elderly Medicaid long-term care users who transition from nursing homes. *Journal of the American Geriatrics Society, 62*(1), 71–78.

Zhu, R. (2016). Retirement and its consequences for women's health in Australia. *Social Science & Medicine, 163*, 117–125.

Figure A1: Medicaid LTC Spending by Service Settings
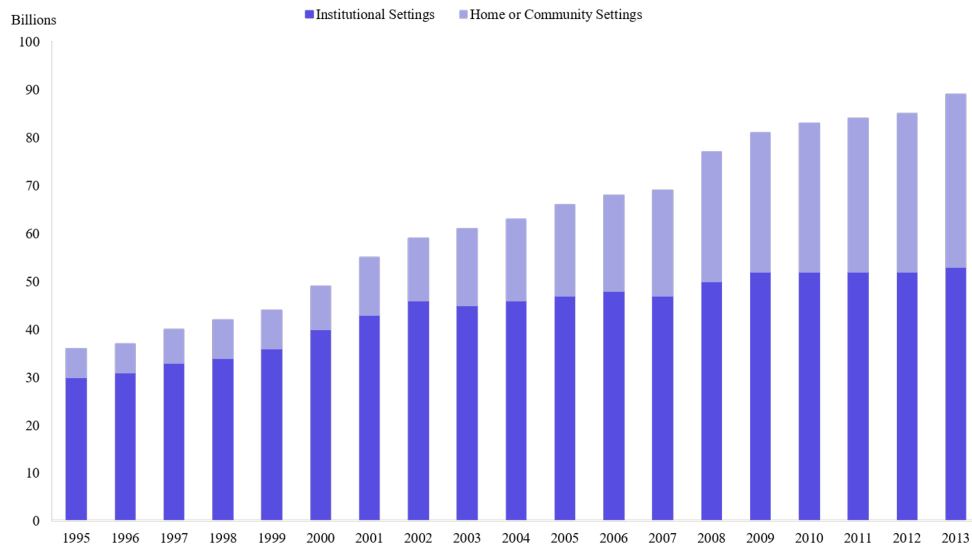
Notes: The graph shows Medicaid LTC spending by service settings, i.e., institutional settings and home or community-based settings, between 1995 and 2013. While spending on institutional settings dominated for much of this period, spending on home or community-based settings rose dramatically in later years. The data source is annual CMS 64 forms

Table A1: Medicaid HCBS Programs

Home Health State Plan (every resident is eligible)

Nursing services

Home health aide services

Medical supplies, equipment and appliances

Optional therapy services like physical, occupational and speech pathology therapy

Personal Care State Plan (every resident is eligible)

Assistance with self-care (e.g., bathing, dressing)

Household activities (e.g., preparing meals)

Cueing or monitoring

Injections by nurses

Work sites, foster care or assisted living facilities

Aging Waivers

Round-the-clock services (in-home residential rehabilitation)

Home-based services like personal care, assistance with household chores, and respite care

Day services (day rehabilitation and adult day care services)

Case management services

Notes: The table shows in detail the services covered under each Medicaid HCBS authority. Mandatory home health state plans mainly cover home-based aide services and professional services for all Medicaid-qualified participants. Personal care state plans mainly provide assistance to eligible people with ADL and IADL limitations. Aging waivers provide intensive round-the-clock services, as well as assistance to individuals with ADL and IADL limitations. The information is adjusted from the annual Kaiser Family Foundation Waiver Program Survey.

Table A2: Definitions of Variables

Variable	Definition
Heath variables	
Self-reported health	Respondent's self-reported general health status, one for excellent, two for very good, three for good, four for fair, and five for poor.
ADL difficulty	Index of difficulties in Activities of Daily Living (ADL) ranging from zero to five, indicating whether respondents are having any difficulties in bathing, eating, getting dressed, getting in/out of bed, and walking across a room
IADL difficulty	Index of difficulties in Instrumental Activities of Daily Living (IADL) ranging from zero to five, indicating whether respondents having any difficulties in using the phone, managing money, taking medications, shopping for groceries, and preparing hot meals
Depression scores	Index of mental health ranging from zero to eight based on the score on the Center for Epidemiological Studies Depression (CESD) scale, which represents the sum of five negative indicators minus two positive indicators. The negative indicators measure sentiments all or most of the time: depression, everything is an effort, restless sleep, feeling alone, sad, and cannot get going. The positive indicators measure whether respondents feel happy and enjoy life
Cognition scores	The total cognition score is the sum of the total word recall and mental status test scores ranging from zero to 35. The word recall index sums the immediate and delayed word recall test scores. The mental status index includes the scores for serial 7's, counting backwards from 20, naming objects, recalling dates, and naming the president/vice-president
Cancer diagnosis	Dichotomous indicator of whether respondents have ever been diagnosed with a cancer or a malignant tumor of any kind
Lung diagnosis	Dichotomous indicator of whether respondents have ever been had a lung-related disease
Heart diagnosis	Dichotomous indicator of whether respondents have ever been told by a doctor that they have had a heart attack, coronary heart disease, angina, congestive heart failure, or other heart problems
Stroke	Dichotomous indicator of whether respondents have ever had a stroke
Smoke now	Dichotomous indicator of whether respondents were smoking at the time of being surveyed
Smoke ever	Dichotomous indicator of whether respondents have ever smoked
Drink ever	Dichotomous indicator of whether respondents have ever drank alcohol
Drink days	The number of days per week respondents have had any alcohol to drink in the last three months, for example, beer, wine, or any drink containing liquor
Drink number	The number of drinks per day respondents have consumed in the last three months on the days they have been drinking

Table A3: Effects of Aging Waiver and State Plan Expenditures on ADL Limitations

	(1)	(2)	(3)	(4)	(5)
	ADL indicator_one limitation	ADL indicator_two	ADL indicator_three	ADL indicator_four	ADL indicator_five
Aging expenditures per older person ($1,000)	0.0009	0.0191	0.0252*	0.0328***	0.0222**
	(0.0210)	(0.0160)	(0.0150)	(0.0130)	(0.0091)
State plan expenditures per older person	0.0089	0.0030	0.0153	0.0202**	0.0113*
	(0.0140)	(0.0110)	(0.0100)	(0.0083)	(0.0066)
Number of individuals	21,125	21,125	21,125	21,125	21,125
Observations	96,860	96,860	96,860	96,860	96,860
Controls	Y	Y	Y	Y	Y
Adjusted R-squared	0.103	0.104	0.090	0.077	0.053

Notes: The data used are from HRS 1998 to 2014 on individuals who are aged 65 and older. The ADL index of difficulties in Activities of Daily Living (ADL) ranges from zero to five, indicating whether respondents are having difficulties in bathing, eating, dressing, getting in/out of bed, and walking across a room. The ADL indicator with one limitation means an individual has at least one ADL limitation; the ADL indicator with two limitations means an individual has at least two ADL limitations, etc. State plan expenditures include home health care and personal care state plan expenditures. The mean of state plan expenditures per older person is around $300. The mean of aging waiver expenditures per older person is around $200. All models include individual fixed effects, state fixed effects, year fixed effects, state year trends, demographic characteristics of respondents such as age and marital status, and state characteristics.

Table A4: The Effect of HCBS on Nursing Variables

VARIABLES	(1) Move to nursing homes	(2) Days in nursing homes	(3) Number of nursing home stays	(4) Number of hospital stays
HCBS expenditures				
per older person ($1,000)	-0.84	180.96*	0.52	-0.0059
	(0.91)	(100.49)	(0.60)	(0.019)
Mean	0.146	482.61	0.104	0.326
Number of individuals	18,963	2,259	21,108	21,118
Observations	78,137	3,630	96,433	96,573
Adjusted R-squared	0.0332	0.242	0.0094	0.0316
Individual FE	Y	Y	Y	Y
Demographics	Y	Y	Y	Y
Health behavior	Y	Y	Y	Y
State characteristics	Y	Y	Y	Y

Notes: The data used are from HRS 1998 to 2014 on individuals who are aged 65 and older. The probability of moving is measured for five years in the future depending on whether the HRS respondent is willing to move to a nursing home. Days spent in nursing homes indicates the number of days the respondent stayed in a nursing home in the last two years. The number of nursing home stays indicates the number of times an individual moved into a nursing home in the last two years. The number of hospital stays indicates the number of times an individual stayed in a hospital in the last two years. All models include individual fixed effects, state fixed effects, year fixed effects, state year trends, demographic characteristics, and state characteristics.

Table A5: Effects of HCBS on IADL Limitations

	(1)	(2)	(3)	(4)	(5)
	IADL indicator_one limitation	IADL indicator_two	IADL indicator_three	IADL indicator_four	IADL indicator_five
HCBS expenditures per older person ($1,000)	-0.0103	0.0088	0.0111	0.0077	0.0066
	(0.0138)	(0.0114)	(0.0102)	(0.0092)	(0.0074)
Mean of IADL indicator	0.2073	0.1219	0.0804	0.0562	0.032
Number of individuals	21,122	21,122	21,122	21,122	21,122
Observations	96,845	96,845	96,845	96,845	96,845
Controls	Y	Y	Y	Y	Y
Adjusted R-squared	0.136	0.138	0.122	0.105	0.061

Notes: The data used are from HRS 1998 to 2014 on individuals who are aged 65 and older. The IADL index of difficulties in Instrumental Activities of Daily Living (IADL) ranges from zero to five. The IADL indicator with one limitation means that an individual has at least one IADL limitation; the IADL indicator with two limitations means that an individual has at least two IADL limitations, etc. All models include individual fixed effects, state fixed effects, year fixed effects, state year trend, demographic characteristics of respondents such as age and marital status, and state characteristics. The definitions of these variables can be found in Appendix Table A2.

Table A6: Effects of HCBS on Cognitive Scores and Event Diagnosis

	(1)	(2)	(3)	(4)	(5)
	Cognition Scores	Cancer	Lung	Heart	Stroke
HCBS expenditures					
per older person ($1,000)	-0.0057	0.0043	0.0056	-0.0331	0.0185
	(0.1476)	(0.0125)	(0.0165)	(0.0222)	(0.0147)
Mean	21.3492	0.1955	0.1495	0.3864	0.1243
Number of individuals	19,722	21,129	21,125	21,126	21,124
Observations	87,084	96,852	96,843	96,819	96,844
Adjusted R-squared	0.223	0.028	0.006	0.024	0.023
Controls	Y	Y	Y	Y	Y

Notes: The data used are from HRS 1998 to 2014 on individuals who are aged 65 and older. The total cognition score sums the respondent's total word recall and mental status test scores ranging from zero to 35. The word recall index sums the immediate and delayed word recall scores. The mental status index includes the scores for serial sevens, counting backwards from 20, naming objects, recalling dates, and naming the president and the vice-president. Columns 2 to 5 are dichotomous dependent variables indicating whether individuals have been diagnosed with cancer, lung disease, heart disease, and stroke. All models include individual fixed effects, state fixed effects, year fixed effects, state year trends, demographic characteristics of respondents, and state characteristics. The definitions of these variables can be found in Appendix Table A2.