Can Long-Term Care Mitigate Cognitive Decline?

Heber Steven Davila Rivera

July 2026

1 Introduction

Frailty is a dynamic condition of vulnerability that is strongly associated with the need for long-term care (LTC). From an international perspective, both European countries and the United States determine eligibility for publicly financed LTC through heterogeneous care needs assessments (CNAs). Knapp et al. (2026) construct a harmonized Frailty Index for individuals aged 65 and older and apply harmonized CNA rules from the Gateway Policy Explorer. They show that, conditional on a given objective level of frailty, prospective eligibility for LTC varies substantially depending on the CNA rules implemented. Exploiting this institutional variation as an instrument for prospective eligibility raises important questions about the role of LTC systems as preventive and/or palliative policies (whether they help to maintain health or decelerate functional/cognitive decline) and it's intertemporal implications for health and economic outcomes. Specifically, this approach allows us to identify individuals who would be prospectively eligible for LTC and effectively receive formal care under their own country's rules, as well as under alternative country or state rules at different points in time.

This framework generates a quasi-experimental setting in which individuals with the same objective level of frailty may differ in their access to care solely due to differences in institutional generosity. As a result, some individuals may receive LTC at earlier, potentially modifiable stages of frailty, while others may only access care at more advanced stages. This variation enables us to examine the health and economic trajectories of individuals conditional on the timing of care receipt and to quantify the intertemporal costs associated with early versus late interventions. By doing so, we aim to evaluate whether access to LTC delays cognitive decline conditional on receiving a health shock, and, as a second step, to analyze whether the receipt of LTC at the moment of a health shock attenuates cognitive deterioration compared to not receiving it.

2 Theorethical framework

2.1 Health shocks and cognition

Schiele and Schmitz (2023) suggests that health shocks lead to an immediate and persistent decline in cognitive functioning. At the same time, the authors examined whether policy in-

terventions can mitigate these adverse effects. The findings indicate that neither compulsory education nor retirement regulations moderate the cognitive consequences of health shocks, underscoring the importance of maintaining good physical health in old age as a key protective factor. Several mechanisms help explain the relationship between health shocks and cognitive decline. Dominguez et al. (2021) identifies advanced age as the main risk factor for cognitive impairment and dementia, followed by genetic, socioeconomic, and environmental determinants, including nutrition and physical activity. Complementarily, Schiele and Schmitz (2023) shows that after a health shock, individuals tend to reduce physical activity, experience decreased social interaction, and report more sleep problems. In this framework, health shocks are defined as the onset of a serious illness between survey waves and declines in handgrip strength as an objective health measure.

While these definitions capture significant and disruptive health events, such shocks often involve hospitalization or specialized care and rapid functional deterioration. Severe illness onset or loss of grip strength may quickly lead to physical inactivity, social isolation, and sleep disturbances. However, declines in autonomy may also occur more gradually. Progressive limitations that reduce the ability to engage in physical activity or maintain social interactions can foster feelings of lack of purpose or depression, thereby contributing to cognitive decline through multiple pathways. In this regard, Lyu and Wolinsky (2017) finds that the onset of difficulties in Activities of Daily Living (ADLs) and Instrumental Activities of Daily Living (IADLs) significantly reduces health-related quality of life in both physical and mental dimensions, even after adjusting for baseline covariates. This evidence positions functional limitations as important factor influencing cognitive decline. Consequently, policies aimed at promoting independence and functional ability in older adults may exert protective effects not only on physical health but also on cognitive functioning. Specifically, long term care policies (LTC) could act as moderating mechanisms that mitigate the broader negative consequences of health shocks, with special attention to cognitive decline.

2.2 Theorethical mechanisms: Long-term care policies as a moderator to decelerate cognitive decline?

Conceptual Framework

Cognition. Let individual i at time t have a level of cognition CR_{it} defined as

$$CR_{it} = f(E_i, L_i, S_{it}, F_{it}, PA_{it}) + \varepsilon_{it}, \tag{1}$$

where E_i denotes educational attainment, L_i occupational complexity, S_{it} social network, F_{it} frailty, PA_{it} physical activity, and ε_{it} captures unobserved factors affecting cognitive reserve. Frailty is defined as a condition of increased vulnerability to stressors, arising from the decline in the body's physiological reserves.

Health shocks and frailty dynamics. Suppose the individual experiences a health shock HS_{it} in period t, which negatively affects frailty. The evolution of frailty is given by

$$F_{i,t+1} = F_{it} - \delta HS_{it} + \gamma LTC_{it}, \tag{2}$$

where $\delta > 0$ captures deterioration due to the shock and γ represents the effect of long-term care (LTC), which may be positive or negative depending on care quality and intensity.

Types and timing of long-term care. Long-term care may be implemented before or after a health shock:

$$LTC_{it} \in \{LTC_p,\, LTC_c\}, \tag{3}$$

where LTC_p denotes preventive care (implemented before the shock) and LTC_c corrective care (implemented after the shock).

Long-term care may also be provided through different arrangements:

$$LTC_{it} = LTC_{it}^{pub} + LTC_{it}^{priv} + IC_{it}, \tag{4}$$

where LTC_{it}^{pub} denotes public formal care, LTC_{it}^{priv} private formal care, and IC_{it} informal care provided by the household.

Physical activity and social engagement. Physical activity and social interaction depend on frailty and long-term care:

$$PA_{i,t+1} = g(F_{i,t+1}, LTC_{it}), \tag{5}$$

$$S_{i,t+1} = h(F_{i,t+1}, LTC_{it}). \tag{6}$$

Household decision on private and informal care. The provision of private formal care and informal care is an endogenous household decision. The household chooses LTC_{it}^{pub} and IC_{it} subject to income, assets, time allocation, and caregiving capacity:

$$LTC_{it}^{public} = \phi(I_t, A_t, T_t, IC_{it}), \tag{7}$$

where I_t denotes household income, A_t assets, T_t available time, and IC_i the household's capacity to provide informal care.

Eligibility for public long-term care. Eligibility for public formal long-term care is determined by a social planner through a care allocation mechanism Γ, which evaluates the individual based on frailty and a Care Needs Assessment (CNA) under fiscal constraints:

$$Elig_{it}^{pub} = \mathbf{1}\left[\Gamma(F_{it}, CNA_t) \geq \tau_t\right], \tag{8}$$

where CNA_t reflects the generosity and criteria of the care needs assessment, and τ_t is the eligibility threshold.

Take-up of public long-term care. Conditional on eligibility, the probability of taking up public long-term care depends on individual characteristics, information, administrative barriers, and family support:

$$\Pr(LTC_{it}^{pub} = 1 \mid Elig_{it}^{pub} = 1) = F(E_i, F_{it}, FS_i, LTC_{it}^{priv}), \tag{9}$$

where FS_i denotes family support.

2.3 Life-cycle trajectories of cognitive outcomes.

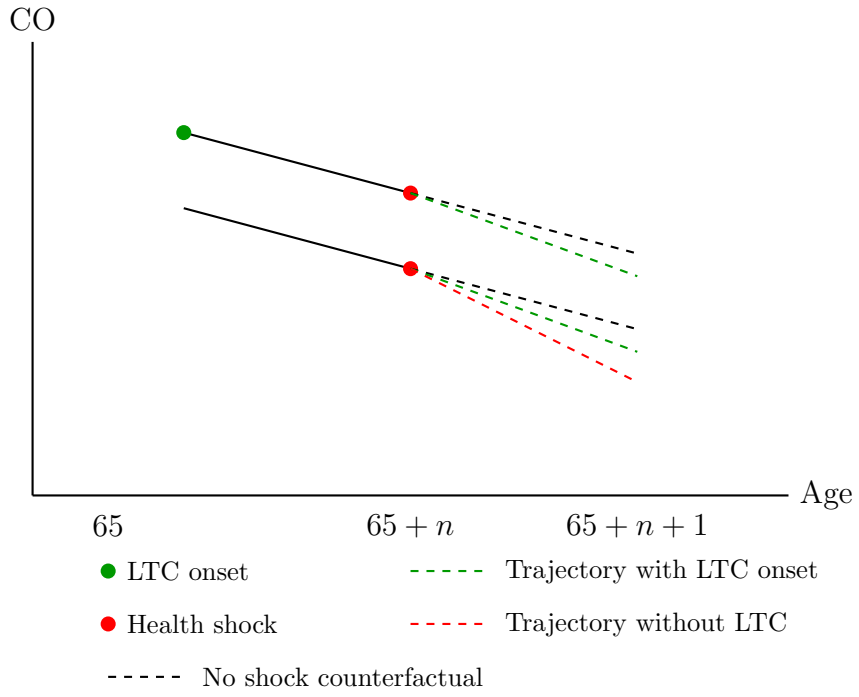


Figure 1: Conceptual trajectories of CO under LTC timing and health shocks.

Figure 1 illustrates life-cycle trajectories of cognitive outcomes for two individuals with comparable observable characteristics at baseline, including frailty and socioeconomic status (e.g., education and income), prior to receiving any long-term care (LTC). The figure is intended to illustrate potential mechanisms. Individual I_1 receives preventive long-term care (LTC_p) n periods before experiencing a health shock at time t. Preventive care is assumed to slow the rate of decline in cognitive reserve by supporting physical health, activity, and social engagement. Consequently, I_1 may enter the shock period with a higher level of cognitive reserve relative to otherwise similar individuals who did not receive preventive care. When the health shock occurs, its negative effect on cognitive reserve may be partially mitigated due to greater resilience associated with better pre-shock health and functioning (dashed trajectory). Nevertheless, the post-shock level of cognitive reserve remains below the counterfactual trajectory in which no health shock occurred (black dashed line). This counterfactual path abstracts from behavioral responses and assumes survival. In contrast,

individual I_2 does not receive preventive care prior to the health shock at time t. Following the shock, two scenarios may arise: (i) I_2 receives corrective long-term care, which may partially mitigate the decline in cognitive reserve by supporting recovery and adaptation (green dashed line), or (ii) I_2 does not receive corrective or palliative intervention (red dashed line). In both cases, the resulting cognitive reserve remains below the counterfactual trajectory without a health shock (black dashed line for I_2). The magnitude of decline and recovery may vary with shock severity, care quality, and individual resilience, and observed trajectories are conditional on survival.

3 Empirical applications by regions

We test the theorethical framework developed in the previous section by examining the effects of corrective (on time) access to long-term care (LTC) given a negative health shock on a set of health and economic outcomes. To this end, we exploit policy-driven variation in individuals' exposure to LTC eligibility within the United States. We begin by providing a brief overview of the United States LTC system, and then describe in detail the empirical strategy used to identify the causal effects of early access to LTC.

3.1 United States LTC system

LTC benefits in the United States are primarily provided through Medicaid, a public health insurance program for low-income individuals administered at the state level by a designated state agency. Enrollment in Medicaid is voluntary Gateway to Global Aging Data (2025). Eligibility for LTC services under Medicaid is determined based on two main criteria: care needs and financial eligibility. Care needs are assessed through state-specific Care Needs Assessments (CNAs), which apply algorithms and eligibility thresholds defined within each state's regulatory framework. Financial eligibility is determined through means testing based on income and asset limits. Individuals requiring LTC services may qualify for Medicaid through five primary eligibility pathways:

- Eligibility track 1: Mandatory Categorically Needy
  - 1a. Supplemental Security Income (SSI) recipients
  - 1b. Section 209b aged, blind and disabled
- Eligibility track 2: Optional Categorically Needy
  - 2a. Institutional rules
  - 2b. Federal Poverty Level (FPL) aged and disabled
- Eligibility track 3: Medically Needy

Empirical Strategy

[11pt]article

[margin=1in]geometry amsmath,amssymb,mathtools,bm booktabs setspace

4 Data and Identification Strategy

4.1 Data

We use the Health and Retirement Study (HRS), waves 5–13, a nationally representative biennial panel of older U.S. adults. We restrict the sample to individuals aged 65 and older who are classified as not demented according to the Langa–Weir cognition scale, so that measured cognitive change reflects variation within the non-demented range rather than the onset of dementia itself. We further restrict attention to the 35 U.S. states for which state-specific long-term care (LTC) eligibility rules can be constructed from the LTC Policy Explorer of the Gateway to Global Aging Data. Throughout, we incorporate HRS sample weights so that estimates are representative of the target population of community-dwelling older adults.

Cognition. The outcome is a continuous latent measure of cognition, C_{it}^{*}, constructed following Hudomiet et al. (2022). The latent index is modeled as

$$C_{it}^{*} = \beta\, X_{it} + \eta_{i0} + \eta_{i1}\, a_{it} + \epsilon_{it}^{c}, \tag{10}$$

where X_{it} is a vector of individual characteristics, a_{it} is age, η_{i0} and η_{i1} are individual-specific intercept and age-slope terms capturing person-level heterogeneity in the level and trajectory of cognition, and ϵ_{it}^{c} is a measurement error term. We denote the resulting index by $Y_{it} \equiv C_{it}^{*}$ in the estimating equations below.

Gradual health shock. We focus on *gradual* functional decline rather than acute events. A health shock is defined as a one-unit increase in the count of limitations in activities of daily living (ADLs) between consecutive waves:

$$HS_{it} = \mathbf{1}[\,\mathrm{ADL}_{it} - \mathrm{ADL}_{i,t-1} = 1\,]\,. \tag{11}$$

Let hs_i denote the wave at which individual i first experiences such a shock. This gradual definition isolates the marginal transition into greater dependency, which is the margin at which LTC eligibility rules are most likely to become behaviorally and financially relevant.

Eligibility. Eligibility $Elig_{i,s,t}$ is a binary indicator equal to one when individual i, residing in state s at wave t, satisfies that state's Care Needs Assessment (CNA) rules for LTC eligibility. Because CNA rules differ across states and are applied to individual-level functional and health status, $Elig_{i,s,t}$ varies across individuals, states, and time.

4.2 Treatment Definition

We test two related hypotheses. First (prospective eligibility), whether receiving LTC benefits shapes the subsequent trajectory of cognition. Second (timing), whether, conditional on a health shock, the speed of LTC receipt relative to the shock decelerates cognitive decline, on the intuition that early eligibility helps restore or maintain physical functioning, offering more support than late care.

We first focus on hypothesis one. In our initial specification, we therefore compare two groups. The treated group consists of individuals who were granted eligibility *contemporaneously with or before* their gradual health shock; the comparison group consists of individuals who *never* attained eligibility over the observation window. Formally,

$$T_i = \begin{cases} 1 & \text{if } Elig_{i,s,t} = 1 \text{ for some } t \leq hs_i, \\ 0 & \text{if } Elig_{i,s,t} = 0 \text{ for all } t, \end{cases} \tag{12}$$

where hs_i denotes the wave of the (gradual) health shock. By construction the treatment is a function of the individual's realized eligibility path and therefore varies by individual and time. Individuals who become eligible only *after* their health shock are excluded from this first specification, so that the contrast is sharply between prospective eligibility and its complete absence; we plan to relax this restriction in subsequent specifications that exploit the full timing of eligibility relative to the shock.

4.3 Estimating Equation

To trace the dynamics of the effect of prospective eligibility on cognition around the health shock, we estimate an event-study specification with individual, wave, and age fixed effects:

$$Y_{it} = \alpha_i + \lambda_t + \tau_{it} + \sum_g \sum_{e \neq -1} \delta_{g,e} \, 1\{G_i = g\} \cdot 1\{t - g = e\} + \varepsilon_{it}, \tag{13}$$

where α_i are individual fixed effects absorbing time-invariant heterogeneity, λ_t are wave fixed effects capturing common shocks and survey-timing effects, and τ_{it} denotes age fixed effects controlling flexibly for the mechanical decline of cognition with age. Because treatment timing varies across cohorts, we therefore estimate the dynamic treatment effects using the doubly robust estimator of Callaway and Sant'Anna (2021). This approach estimates group–time average treatment effects on the treated, $ATT(g, e)$, using never-treated (or not-yet-treated) units as the comparison group, and combines outcome-regression and inverse-probability-weighting components so that the estimator remains consistent if either the outcome model

or the propensity model is correctly specified. We incorporate HRS sample weights throughout and aggregate the $ATT(g, e)$ into event-study parameters that summarize the average dynamic effect of prospective LTC eligibility on cognition at each event time.

5 Preliminary Results

The estimates reported here were obtained by linking our state-specific long-term care (LTC) eligibility measures, derived from the Care Needs Assessment (CNA) rules in the LTC Policy Explorer of the Gateway to Global Aging Data, to the restricted-access Health and Retirement Study (HRS) microdata. This linkage assigns each respondent an individual-, state-, and time-specific eligibility status, which we use to define prospective eligibility relative to a gradual health shock. We stress that these results are *preliminary*.

5.1 Descriptive patterns

Figure 2 summarizes the two central inputs to the analysis. The left panel plots the expected value of the Hudomiet (2023) latent cognitive index by age; as anticipated, cognition declines steadily over the 65–90 age range. The right panel plots the mean probability of a gradual health shock, by age, which rises monotonically and accelerates at older ages. Together these patterns confirm that both the outcome and the shock behave as expected across the age distribution and motivate the age fixed effects included in the estimating equation.

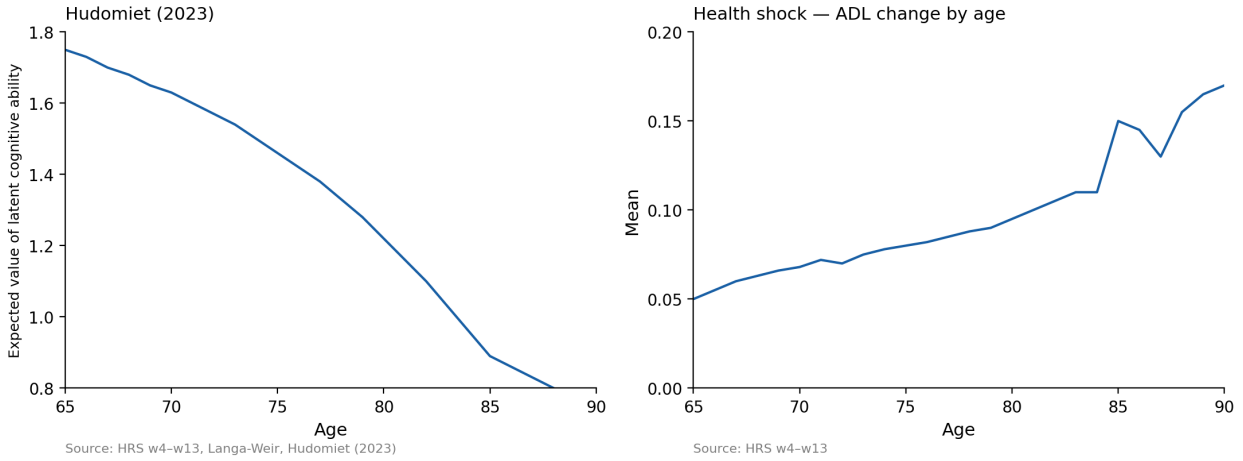


Figure 2: Latent cognitive ability and gradual health-shock probability by age. Left: expected value of the Hudomiet (2023) latent cognitive index. Right: mean probability of a gradual (one-unit ADL) health shock.

Source: HRS w4–w13; Hudomiet (2023).

5.2 Event-study estimates

Figures 3 and 4 report the group–time ATT estimates from the Callaway and Sant'Anna (2021) doubly robust estimator, aggregated to event time and incorporating HRS sample weights. In both specifications the pre-treatment coefficients (event time $e < 0$) are small, statistically indistinguishable from zero, and display no systematic trend, providing support for the parallel-trends assumption underlying the design.

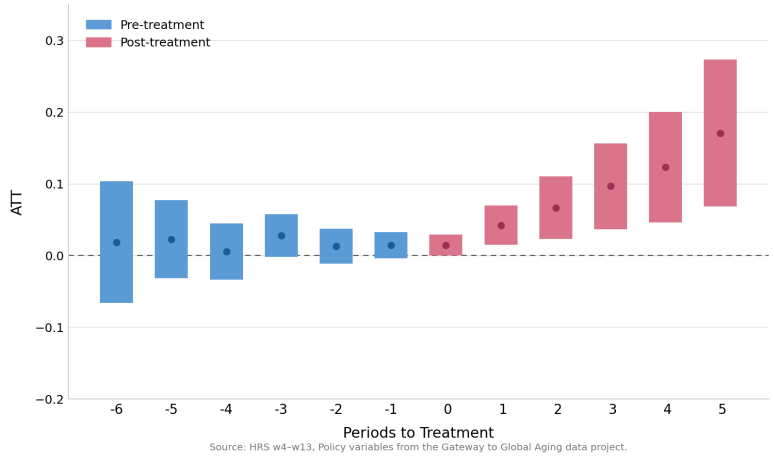


Figure 3: Event-study estimates of the effect of prospective LTC eligibility on latent cognition. Control group = never eligible; treatment group = eligible before or at the moment of the health shock. Points are aggregated group–time ATT estimates; bars denote 95% confidence intervals. Blue: pre-treatment; red: post-treatment. Event time is normalized to $e = -1$.

Source: HRS w4–w13; policy variables from the Gateway to Global Aging Data project.

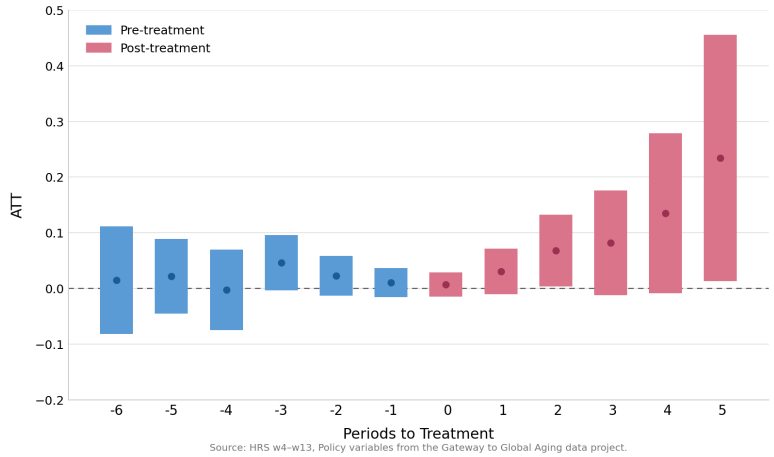


Figure 4: Event-study estimates, alternative specification. Control group = never eligible; treatment group = eligible at the moment of the health shock. Points are aggregated group–time ATT estimates; bars denote 95% confidence intervals. Blue: pre-treatment; red: post-treatment. Event time is normalized to $e = -1$.

Source: HRS w4–w13; policy variables from the Gateway to Global Aging Data project.

Following the onset of prospective eligibility, the post-treatment estimates ($e \geq 0$) rise monotonically with event time and become statistically significant at longer horizons. Inter-

preting the sign of these estimates requires care. Latent cognition declines with age for the entire sample, so both the treated and the never-eligible comparison group follow downward trajectories over the post-treatment horizon. The ATT is therefore the difference between two declines rather than a contrast between an increase and a decline. A *positive* ATT indicates that cognition declines *more slowly* among individuals with prospective LTC eligibility than among those who never attained eligibility; equivalently, the deterioration in cognition is steeper in the never-eligible comparison group. The results thus point to prospective eligibility *attenuating*, rather than reversing cognitive decline conditional on receiving a gradual health shock. The magnitude and precision of the estimates differ across the two specifications, and the confidence intervals widen at longer horizons, where fewer cohorts contribute to identification; these differences should be interpreted with caution given the preliminary nature of the analysis.

Two extensions are of first-order importance. First, we will assess how well our eligibility measures perform as instruments by testing their ability to predict actual take-up of formal LTC. Second, we will conduct further analysis to understand if timing of care receival has a role in mitigating cognitive decline, additionally we will run heterogeneity analysis to examine whether the estimated effects vary across policy-relevant subgroups, for example, by sex, baseline functional status, state LTC generosity, or socioeconomic status, since average effects may mask meaningful variation across the population. Additional robustness checks on the treatment definition, the composition of the never-eligible comparison group, and the sensitivity of the estimates to alternative event-time windows are also warranted.

References

Dominguez, L. J., Veronese, N., Vernuccio, L., Catanese, G., Inzerillo, F., Salemi, G., and Barbagallo, M. (2021). Nutrition, physical activity, and other lifestyle factors in the prevention of cognitive decline and dementia. *Nutrients*, 13(11):4080.

Gateway to Global Aging Data (2025). Gateway policy explorer: United states, long-term care in-kind benefit plan details, 1992–2025. Version 1.1 (December 2025), University of Southern California, Los Angeles.

Lyu, W. and Wolinsky, F. D. (2017). The onset of adl difficulties and changes in health-related quality of life. *Health and quality of life outcomes*, 15(1):217.

Schiele, V. and Schmitz, H. (2023). Understanding cognitive decline in older ages: The role of health shocks. *European Economic Review*, 151:104320.