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Volunteering during early retirement reduces depression

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Abstract

As individuals age, they often face deteriorating health and significant lifestyle changes, including retirement. While retirement can alter individuals' economic and social roles, potentially increasing the risk of depression, involvement in volunteer activities has been found to be beneficial for retirees. Using data from the Health and Retirement Study, we apply the parametric g-formula to simulate an intervention aimed at estimating the effect of volunteering on depression and its heterogeneity, and to assess the mediating role of limitations in activities of daily living. Our results show that engagement in volunteering reduces the probability of depression by approximately 5% in the whole population, with larger gains among early retirees. The results hold irrespective of gender, and indicate that the benefits are greater for women and racial minorities. Our findings show that about 10% of the positive impact of volunteering on depression operates via a reduction in the likelihood of experiencing limitations in activities of daily living. Therefore, we conclude that the benefits of volunteering extend to improving the overall health of both individuals and the population. Our simulated intervention targeting early retirees may be a viable public health strategy for protecting individuals against depression, while also enabling them to contribute to the public good.

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Introduction

In 2021 in the U.S., more than 60 million individuals were formally volunteering (about 23.2% of the U.S. population), and were generating services with an estimated economic value of more than $120 billion (AmeriCorps.gov 2023). In contrast to spontaneous acts of kindness, formal volunteering is an organized and deliberate means of enhancing the social good (Morrow-Howell 2010). Volunteering generates substantial social and economic value, as in addition to helping nonprofit organizations function (Sheard 1995), volunteering promotes social cohesion in society (Ackermann et al. 2023). The benefits of volunteering are not limited to the society and the recipients, but extend to the volunteers themselves.

Engaging in social activities has been found to be beneficial for volunteers, especially as they grow old. Volunteering has been associated with increased survival (Rogers et al. 2016), better physical and mental health (Carr et al. 2018; Greenfield and Marks 2004; Lim et al. 2023; Musick and Wilson 2003; Thoits and Hewitt 2001), improved self-perception of aging (Huo et al. 2021), higher perceived autonomy (Jiang et al. 2021), and a reduced risk of developing limitations in activities of daily living (ADLs) (Weziak-Bialowolska et al. 2024). Overall, volunteering contributes to increased well-being and life satisfaction, and may thus play a crucial role in mitigating depression in older adults (Greenfield and Marks 2004; Thoits and Hewitt 2001; Weziak-Bialowolska et al. 2024).

Depression is among the leading causes of the global health-related burden (Vos et al. 2020). In the United States, 21.0 million adults, or 8.4% of all adults, had at least one major depressive episode in 2020. Women (10.5%) were more likely than men (6.2%) to experience a major depressive episode (NIH, 2022). Depression is primarily a mood disorder that negatively affects an individual's emotional state, which influences their ability to perform daily tasks such as eating, sleeping, thinking, and working. More generally, depression is associated with role impairment (Kessler et al. 2003).

A substantial body of literature indicates that depression may result from the interplay of individuals' levels of life stress and their genetic and personality vulnerability. Indeed, studies have shown that when individuals face adverse circumstances, major life changes, stress, illnesses, and medication use throughout their life course, their risk of depression increases (Lupien et al. 2009). Medical conditions that are more common in older age, such as diabetes, cancer, heart disease, and Parkinson's disease, often co-occur with depression (Agustini et al. 2020; Maier et al. 2021) and exacerbate each other's consequences. The increased risk of depression at older ages is not solely due to declining health, but also relates

to significant life stage changes. Retirement is a major transition later in life that brings significant changes in individuals' economic and social roles (Carter and Cook 1995; M. Wang et al. 2011), potentially exposing new retirees to an increased risk of depression.

The resource-based dynamic perspective is a theoretical framework (M. Wang et al. 2011) that can be used to study the impact of early retirement on mental health. Within this framework, individual and contextual resources, such as financial, social, and emotional resources, as well as knowledge and abilities, can change over time, affecting individuals' mental health. On the one hand, retirees lose their daily routine and contact with the working environment. The loss of the work role may lead to an identity crisis and a loss of purpose, increasing the risk of depression. On the other hand, being free of work commitments may allow individuals to spend more time with family and friends, provide childcare (Eibich and Siedler 2020), do physical exercise (Kämpfen and Maurer 2016), enjoy leisure activities (Eibich 2015), or contribute to society through beneficial activities (Eibich et al. 2022; Hämäläinen et al. 2024; Zhu 2021). Nonetheless, depression itself is a significant risk factor for early retirement (Lee and Smith 2009).

The retirement process is heterogeneous and its effects on health are contingent on individual and contextual circumstances, which are themselves part of the transition process (Garrouste and Perdrix 2022). In particular, an early exit from the workforce resembles a job loss more than a planned retirement, which is detrimental to mental health (Abrams et al. 2021). Gender differences exist, with women who experience an involuntary job loss being more likely than men to suffer from depression (Gallo et al. 2000). A wife's depression might be aggravated by her husband's retirement (Xiong et al. 2024), especially if the wife anticipates having to care for her husband in retirement (Szinovacz and Davey 2004).

Retiring without health insurance can make it difficult to access necessary medical care, especially for those with ongoing health issues (Kail 2016). The impact of an early or a late exit from the workforce on an individual's risk of depression may be influenced by their level of education. For example, retirees with higher education might have better financial stability, and may thus experience less stress when exiting the workforce early or late (J. E. Kim and Moen 2002). Furthermore, they might not be working solely for monetary reasons, but also for reasons of personal fulfillment, which could change the impact of a labor force exit on their mental well-being (J. E. Kim and Moen 2002). Low-educated individuals, by contrast, are disproportionately affected by involuntary early retirement, which is linked to a significant increase in depressive symptoms (W. Li et al. 2021). In sum, the consequences of retirement and individual circumstances interact to manifest as health problems that contribute to

increasing disparities (J. E. Kim and Moen 2002; Xiong et al. 2024), with individuals who retire early and involuntarily being at a substantial disadvantage (Atalay and Barrett 2022).

The same resource-based dynamic framework suggests that volunteering can help retirees cope better with the mental health challenges of early retirement. Engaging in volunteer activities can benefit early retirees in various ways, including by offering them access to social opportunities; encouraging them to maintain and learn new skills; and improving their well-being by providing them with a sense of achievement, purpose, and community. Some volunteer activities require physical exertion, which can be beneficial for retirees' physical health. Moreover, volunteering might improve retirees' well-being by enabling them to maintain their role in society (Chambré 1984) and to find continuity after retirement (Atchley 1989).

Volunteering and activity limitations

Volunteering can reduce the risk of depression through its effects on physical health. Staying active and engaged has been found to be beneficial for maintaining physical health (Choi et al. 2016; Kail and Carr 2016), which reduces the risk of developing limitations in activities of daily living (ADLs) (Weziak-Bialowolska et al. 2024), which can, in turn, reduce symptoms of depression (Gayman et al. 2008). E. S. Kim and Konrath (2016) found that older adults who volunteer are more likely to engage in preventive health measures such as getting flu vaccines, cholesterol tests, and cancer screenings. More generally, research findings suggest that volunteering may promote behaviors that support good health.

Volunteering can protect older adults from the debilitating effects of chronic conditions, such as heart disease, diabetes, or arthritis, which usually have a significant impact an individual's ability to perform activities of daily living (Kail and Carr 2016). Engaging in volunteer activities in later life can slow the progression of physical disability (Carr et al. 2018). Moreover, volunteering in midlife has long-term benefits for health and physical activity (Pillemer et al. 2010). The positive effects of participating in volunteer activities are amplified by the community network. Initiatives led by volunteers, like walking groups, can encourage physical activity in communities with poor health profiles (Hanson et al. 2016). Volunteering seems to help older adults maintain a regular cortisol pattern, potentially preventing disruptions caused by stress related to functional disabilities (Huo et al. 2021).

More generally, volunteering is associated with a more positive perspective and more positive attitudes toward growing older (Huo et al. 2021). Such attitudes can buffer the stress and fear associated with aging by motivating elderly individuals to take better care of

themselves and encouraging healthy behaviors such as maintaining a balanced diet or regular exercise, which can, in turn, lead to improved physical and mental health (Ohrnberger et al. 2017). The magnitude of the positive impact of volunteering on health varies across sociodemographic and health circumstances (Matthews and Nazroo 2021), which are themselves predictors of participation in volunteering among elderly individuals (Erlinghagen 2010; Hämäläinen et al. 2024).

Activity limitations and depression

A vast body of literature has focused on the impact on depression of activity limitations, particularly those related to activities of daily living (ADLs). Most studies suggest that individuals with limitations in ADLs suffer from depression more often (Gayman et al. 2008; Y. Li and Ferraro 2005), with the patterns varying by race, gender, and socioeconomic status (Schieman and Plickert 2007). Physical limitations can lead to increased depressive symptoms by affecting the ability of individuals to meet their own expectations and to fulfill their social, family, and occupational responsibilities (Gayman et al. 2008).

Among older couples, having a partner who suffers from limitations in ADLs increases the likelihood of depression in the other partner (Monserud and Peek 2014), with wives who provide care being at higher risk (Han et al. 2021). Further evidence indicates that having depression can increase the likelihood of developing limitations in ADLs, with accelerating effects due to depression (van Gool et al. 2005). Overall, the available evidence suggests that there is a bi-directional association between limitations in activities of daily living (ADLs) and depression, with the two conditions affecting each other and potentially sharing common factors (Dapp et al. 2021; Gayman et al. 2008; Hirvensalo et al. 2007).

The current study

The evidence from previous studies regarding the impact of volunteering on reducing depression in old age is inconclusive. Our study takes a new approach to investigating whether volunteering reduces depression among early retirees. This is especially important as the labor force in Western countries is aging and shrinking. Volunteering could be seen as an alternative for older individuals who do not want to or are unable to re-enter the labor market after retirement. We aim to provide new insights into the relationship between volunteering and depression, and to advance our knowledge on this relationship by examining limitations in ADLs as a potential causal mediator. Limitations in ADLs may mediate the relationship between volunteering (the exposure) and depression (the outcome), but might also confound

the relationship between subsequent volunteering, depression, and time-varying covariates, such as comorbidities or labor market outcomes. As this intermediate confounding makes it difficult to determine the indirect effect of volunteering via limitations in ADLs on depression, it is important to address it in causal analyses.

Using a counterfactual approach by applying the parametric g-formula to data from the Health and Retirement Study (HRS), we simulate scenarios that allow us to contribute to the literature by addressing the following research questions: 1) Does volunteering during early retirement years reduce the risk of depression? 2) Do gender, race/ethnicity, and education play moderating roles in the effect of volunteering on depression? 3) To what extent does the effect of volunteering operate through limitations in ADLs?

Data & Methods

Analytical sample and variables

Outcome

Our outcome is derived from a binary translation of the widely-used eight-item Center for Epidemiological Studies Depression Scale (CES-D 8) for evaluating depression. This scale scores from zero to eight, with a score of three or above indicating high depressive symptoms (Steffick 2000), and establishing the threshold for our binary indicator[5].

Primary exposure(s)

The primary exposure is a binary indicator that is equal to one when individuals participate in formal volunteer activities (through religious, educational, health-related, or other charitable organizations) for at least 100 hours per year, and that is equal to zero otherwise.

Main covariates

We model and account for time-varying variables, including age, labor force status (employment, unemployment, retirement, not in a labor force), the number of people in the household (one, two, three or more), partnership status (partnered/married, separated/divorced, widowed, never married), income quartile, the number of limitations in ADLs (none, one, two or more), and the number of comorbidities (none, one, two or more) the respondent ever had. These comorbidities include stroke, diabetes, heart problems, psychological problems, cancer,

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[5] In an alternative specification, we utilized an indicator of depression, specifically feelings of depression occurring much of the time during the week prior to the interview, as the outcome. This indicator comes from a single item on the CESD-8 scale. We found that the results we obtained were qualitatively similar.

arthritis, and respiratory diseases. We also account for "non-paid help activity" via a binary variable indicating whether the respondent has dedicated at least 100 hours in the last year to unpaid assistance to friends, neighbors, or out-of-household relatives (zero for "no").

Time-constant characteristics

We take into account gender (men, women); race/ethnicity (non-Hispanic White, non-Hispanic Black, Hispanic, other), birth cohort (AHEAD – CODA – HRS, WB – EBB, MBB-LBB, EGENX), educational attainment (less than high school/GED, high school, some college, college and above), childlessness, baseline occupation (professional, manual, service), family socioeconomic status during childhood (poor, average, well-off), census region (Northeast, Midwest, West, South, other), and religious preference (Catholic, Jewish, Protestant, other, none).

Analytical strategy

We use a counterfactual approach based on the longitudinal parametric g-formula (Robins 1986) to create a simulated scenario (often referred to as an "intervention") in which individuals in early retirement, i.e., individuals who retire at an age younger than age 65, volunteer until they turn age 70[6]. Through this simulated scenario, we aim to examine the impact volunteer activities might have on depression among early retirees.

The relationship between volunteering and depression is dynamic and complex. There might be feedback effects between volunteering and depression, that is, they might affect each other, which creates estimation problems in standard regression settings (Imai and Kim 2019). Modeling this relationship is further complicated when more variables are involved. For example, volunteering may induce early retirement through limitations in ADLs that can indirectly contribute to depression, thereby mediating the effect of volunteering on depression. However, volunteering may also be affected by depression and retirement status. Furthermore, at different points in time the outcome can also play the role of a confounder, as well as the role of a mediator. In other words, while depression may influence other variables over time, acting as a "confounder" of the relationship between volunteering and limitations in ADLs, depression might act as a "mediator" at other points in time. Therefore, standard regression

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[6] We chose this age threshold based on the idea that volunteering can serve as a substitute for employment. Labor force participation is typically almost null for individuals above this age.

models are not well-suited for this analysis, as they may yield biased results (Buckley et al. 2015; Picciotto and Hertz-Picciotto 2015).

We direct our analyses according to the direct acyclic graph (DAG) in Figure 1. The relationships in the DAG follow a set of cross-lagged models in which variables at age t affect variables at age t+1. The cross-lagged models allow us to introduce a temporal ordering that helps us reduce potential bias due to the endogeneity of volunteering and depression at ages around retirement. The algorithm description of the parametric g-formula that follows the DAG can be summarized in the following steps: 1) fit the multivariate models to the empirical data following the DAG; 2) define the intervention and mediation scenarios; 3) reproduce the observed data by keeping the baseline and the first time points and then simulate the follow-up times; 4) implement the interventions by simulating a scenario in which early retirees volunteer until age 70; and 5) contrast the natural course and the intervention scenario to assess the effect of volunteering on depression.

< Figure 1 about here >

In step 1, we model the categorical variables through either logistic regressions or multinomial models, and we model the continuous variable with linear regression models. We predict probabilities and conditional expectancies from these models, which we then use to simulate the value of the corresponding variables for each individual at each age, drawing from the appropriate probability distributions. The simulated data that resemble the observed data are called the "natural course." The intervention scenario is generated using the same procedure, but in the simulation, it is assumed that individuals who retire earlier than at age 65 volunteer until they reach age 70. The fixed value for volunteering has a cascading effect on the outcome, directly affecting depression and spreading its effects across all the simulated variables. We obtain confidence intervals using a non-parametric bootstrap by resampling the analytical sample 500 times (Hernan and Robins 2020; Keil et al. 2014). The resampling procedure preserves the longitudinal structure of the data. Within each bootstrap we conduct the simulation 50 times to decrease the variability due to the Monte Carlo simulations.

Contrasting the interventions to the natural course, we estimate the total effect (TE), which allows us to measure the impact of volunteering on depression. The TE is an unconditional estimate, a population-level measure. To assess the heterogeneity of the TE across different population subgroups, we estimate the TE by gender and educational attainment, and within racial/ethnic groups. Next, we perform mediation analysis to identify

the factors or "pathways" through which volunteering affects depression. In particular, we evaluate whether and the extent to which disability, measured as limitations in ADLs, mediates the effect of volunteering on depression. Specifically, we estimate the indirect effect (IE) of volunteering on depression through the pathway of limitations in ADLs, and the direct effect (DE) of volunteering on depression through pathways other than limitations in ADLs. The decomposition of the TE in the direct effect (DE) and the indirect effect (IE) follows the definition provided in Wang and Arah (2015).

Results

The analytical sample consists of over 80,000 individuals who entered the observation period while employed. Their main characteristics are described in Table 1. Among those who suffer from depression, only 7.4% volunteer for more than 100 hours per year, while the corresponding share for individuals not suffering from depression is 13.5%. The percentage of volunteers decreases as the number of limitations in ADLs increases. While 13% of individuals with no limitations in ADLs participate in volunteering, only 7% of those with two or more limitations in ADLs volunteer. People with higher education levels are more likely to volunteer, with over 21% of those with a college degree or higher participating in volunteer activities, compared to less than 5% of those with less than a high school degree. The share of volunteers is higher among retirees than among individuals who are participating in the labor force or who have left the labor market due to disability. Volunteering is also more common among individuals who help more frequently. There are no significant gender differences among volunteers, but the frequency of volunteering is higher among White and Black individuals than among Hispanics.

< Table 1 about here >

Figure 2 shows the results from the natural course with 95% confidence intervals plotted against the observed prevalence of depression by age in the analytical sample from the HRS data. Overall, the simulated natural course scenario appears to adequately approximate the age distribution of the outcome, as despite the irregular observed distribution, the simulated distribution almost always contains the observed data within the 95% bands. Moreover, most importantly, the simulated data appropriately describe the observed depression patterns by age and gender. The share of the sample who report having depression is 17% at age 50, declines to below 15% at age 65, and then increases to 18% at around age 80. Figure 2 also suggests that around the statutory retirement ages there are no discontinuities in the depression pattern,

with depression actually declining until age 70. The age pattern of depression is similar for men and women, although the level is (about 5 percentage points) higher for women.

< Figure 2 about here >

Social engagement as an alternative to early retirement

We assess the effect of volunteering on depression among early retirees. That is, we evaluate the effect of a hypothetical intervention that makes retirees younger than age 65 engage in formal volunteering (100+ hours per year). Assuming individuals volunteer until they reach age 70 affects all the related time-varying variables in a cascading fashion. That is, unlike in standard regression models, the volunteering intervention is not implemented by keeping "everything else equal," but rather by simulating what would happen to depression levels if individuals in early retirement volunteered, which also has implications for physical health as well as for all of the other characteristics that vary with time and are related to volunteering and depression. The results of the intervention are plotted by age in Figure 3. In the upper panel, the age trajectory resulting from the intervention scenario is compared to the corresponding trajectory in the natural course, by gender. The lower panel displays the age trajectory, by gender, of the difference in depression prevalence between the natural course and the intervention, that is, the total effect (TE) of the intervention.

< Figure 3 about here >

Despite the variation by age and gender, the results indicate that volunteering reduces depression. Averaging across the age trajectories, the intervention causes a reduction in the prevalence of depression in the population of about 5% (- 0.009 percentage points), with a 4.2% reduction among men (- 0.006 percentage points) and a 5.5% reduction among women (- 0.011 percentage points). While the beneficial effects of volunteering appear to be modest, it is important to emphasize that these estimates refer to the entire population. This intervention, however, is aimed specifically at early retirees, which make up a small subgroup of the overall population.

Figure 4 shows the age and gender trajectories of the difference in the probability of having depression between the natural course and the simulated intervention, that is, the treatment effect on the treated (ATT – the effect of volunteering on depression among individuals who retired earlier than at age 65).

< Figure 4 about here >

As in the case of the ATE, volunteering until reaching age 70 has beneficial effects on depression for both men and women, and carries over until ages above 76-77; at older ages, the effect is still beneficial but with higher variability. Averaging across ages, the intervention causes a reduction in the prevalence of depression of about 10.6% (- 0.02 percentage points) among the treated, with a 9.2% reduction among men (- 0.015 percentage points) and an 11.6% reduction among women (- 0.025 percentage points).

Heterogeneity

The effect of the simulated intervention is heterogeneous across subpopulations. This is expected considering the known differences by race/ethnicity and education in depression and volunteering rates, as well as in retirement timing. Figure 5 shows that the effects of volunteering on depression are consistently beneficial among early retirees of different racial/ethnic groups. The effects seem to be larger among Blacks and Hispanics than among Whites (-0.026 and -0.027 compared to -0.017 percentage points, respectively), but the estimates are more uncertain for men in particular; complete results are available in Table 3a in the appendix.

< Figure 5 about here >

Figure 6 shows the effect of volunteering on the depression trajectories of early retirees by level of education. The findings suggest that volunteering reduces depression among early retirees, especially among those with lower levels of education, and among women in particular. The ATT among individuals with less than a high school degree is about twice the effect among those with at least some college (the reduction varies from -0.038 percentage points for early retirees with less than a high school degree to -0.014 percentage points for those with a college degree or higher); complete results are available in Table 4a in the appendix.

< Figure 6 about here >

Given that racial minorities are more prevalent among the less educated population, volunteering could significantly reduce depression among early retirees who are less educated and belong to racial minority groups.

Mediation

To better understand how volunteering reduces depression, we explored the role of limitations in ADLs as a mediating factor in this relationship. Our findings indicate that limitations in ADLs account for 11% of the TE of volunteering on depressive symptoms, with no large gender differences. In other words, 11% of the TE of volunteering on depression is attributable to a reduced likelihood of developing limitations in ADLs until early retirees age 70; complete results are available in Table 5a in the appendix. Therefore, while limitations in ADLs represent just one contributing factor, they still play a meaningful role in the relationship between volunteering and depression, even though most of the impact is due to other factors.

Dynamic intervention

Engaging in volunteer activities at older ages is feasible if people are healthy enough to participate in such activities. To reflect this prerequisite and to make the simulated intervention more realistic, we simulated a different intervention scenario. In this simulation, retirees younger than age 65 engage in volunteer activities until they reach age 70, but only if they are physically capable of participating; that is, we assume that only individuals with no limitations in ADLs volunteer, and make the intervention dynamic, as people's disability levels may change over time. The results show a reduction in depression of about 4.2% (-0.007 percentage points) in the total population, with a 3.5% reduction among men (-0.005 percentage points) and a 4.7% reduction among women (-0.09 percentage points); complete results are available in Table 6a in the appendix. The results obtained from the dynamic intervention are very similar to those from the volunteering intervention, regardless of the presence of limitations in ADLs. This indicates that volunteering during early retirement is not only feasible and effective in reducing depression, but is also beneficial for physical health, lowering the likelihood of developing limitations in ADLs and delaying their onset.

Discussion

Participating in volunteer activities is a powerful way to build social connections and to strengthen community bonds, and can thus have a positive impact on individuals and on communities as a whole. Volunteers enjoy better health and have a lower risk of depression than people who do not engage in such activities. Moreover, volunteers contribute to the production of free public goods, which have significant economic value. Therefore, early retirees who engage in volunteering are continuing to contribute society, and tend to remain in

good health longer. Nevertheless, given the lack of policies promoting volunteering as a replacement for early retirement, the potential effects of such an intervention are unknown.

The main question that arises in this context is whether volunteering reduces depression among early retirees, or is just the result of selection. The resource-based dynamic framework (M. Wang et al. 2011) and continuity and activity theories (Atchley 1989; Chambré 1984) suggest that volunteering enhances individual life satisfaction and increases well-being. Large differentials in depression by gender, race/ethnicity, and educational attainment have been observed. Women and the most disadvantaged individuals are at higher risk of depression (Hudson et al. 2013; Platt et al. 2020). These population subgroups are also more likely to retire early and to be in poor health (Brown et al. 2023; Brown and Warner 2008). Our results show that volunteering reduces depression among early retirees and among the general population. To put the results in perspective, given that the absolute reduction in the probability of depression we found is approximately 0.009, our results imply that out of the around 11 million elderly individuals (6.5 million of whom are women) suffering from depression in the U.S. in 2020, there are approximately 900,000 fewer depressed individuals (two out of three of whom are women). These benefits are even more significant for the subgroup of early retirees. Additionally, given that volunteering is a "social" intervention that does not involve medication, and the indirect benefits of reduced limitations in ADLs, it is clear the effects of volunteering are largely beneficial.

At the macro level, the benefits of volunteering are well known. In 2021, the more than 60 million formal volunteers generated economic value of more than $120 billion (AmeriCorps.gov 2023). Most Western governments have raised the statutory retirement age. In the U.S., the federal government increased the full statutory retirement age to 67 for individuals born in 1960 or later with the goal of counteracting the threat of population aging to the sustainability of the welfare system – despite evidence indicating that incentivizing individuals to retire at older ages does not always translate into longer working lives (Dudel and Myrskylä 2017). If people start to retire at older ages, the availability of volunteers may be reduced (Zhu 2021), because participation in formal volunteering increases after retirement (Eibich et al. 2022). Volunteering supports nonprofit organizations (Sheard 1995) and fosters social cohesion (Ackermann et al. 2023), and thus contributes to a more united and supportive society. The consequences of decreased participation in formal volunteering might be significant, as volunteering in the U.S. generates considerable social and economic value.

We also found that the positive effects of volunteering on depression are mediated via limitations in ADLs, thereby demonstrating that volunteering has broader health benefits

beyond reducing depression levels. Our results indicate that volunteering is beneficial for postponing and lowering the risk of developing limitations in ADLs, in line with previous literature (e.g., Carr et al. 2018; Hanson et al. 2016; Kail and Carr 2016; Weziak-Bialowolska et al. 2024). Our findings add to these previous studies, which showed that volunteering is associated with reductions in depression in both Europe and the U.S. It is important to note that those studies did not explicitly address intermediate confounding, or the possibility of reverse causation. However, given that the studies were conducted in different social, economic, and policy environments, their findings, when taken together, suggest that there is a causal relationship between volunteering and depression. Our study expanded on this evidence by demonstrating a reduction in depression through a simulated intervention involving volunteering. This analysis accounted for potential influencing factors and clarified the mediating role of limitations in ADLs.

Our findings lend support to the idea of implementing a policy to encourage volunteering during the early retirement years. It may be hard to imagine a policy that targets the entire population, and the benefits of a forced intervention may be uncertain. However, encouraging volunteering among early retirees who have not developed limitations in ADLs can bring similar benefits to the entire population. This approach seems more realistic, and reduces the potential for spillover effects.

We conclude that encouraging volunteering is a viable approach to promoting active aging and contributing to the greater good. Even if the effect of volunteering on depression appears to be small, the overall impact remains highly beneficial considering the indirect effect through the reduced risk of developing limitations in ADLs, and the larger impact on women and the most vulnerable individuals in the population. The individual benefits of volunteering are paired with the benefits to the community, the social and economic value of which is undebatable.

In addition to the standard assumption of correct model specification, our analytical approach relied on three key assumptions to ensure the accurate identification of causal effects: namely, positivity, consistency, and exchangeability. Positivity implies that every participant in our research had a non-zero probability of receiving the intervention, which was to volunteer. In our analytical sample, this was not particularly problematic. We also simulated an intervention specifically for "healthy" individuals to ensure that the intervention was feasible, and we obtained similar results. There are various factors that might influence why individuals choose to volunteer. These factors can include personal motivations or individual factors, family influence or family ties, as well as the influence of the larger community or community

characteristics. The consistency assumption states that the intervention must be clearly and consistently defined to accurately reflect the study's object, the effect of volunteering on depression. Our simulated intervention was based on an observational experiment, not a policy measure. As such, the simulated scenario tried to mimic societal conditions using a simplified model of volunteering behavior that captured its observed distribution in society. Thus, our simulation is likely to be of major interest to policymakers, social scientists, and community organizers (VanderWeele and Hernan 2013), as it can help them in shaping more effective social policies, promoting societal engagement, and developing strategies aligned with people's natural tendencies to volunteer. The exchangeability assumption required us to control for all relevant confounders so that volunteers and non-volunteers could be compared conditional on measured covariates. Our study, like all observational studies, is not free from potential problems due to residual confounding, that is, due to unobserved or inaccurately measured variables. Therefore, when trying to estimate causal effects, we cannot be entirely certain that bias has been eliminated. However, to enhance the credibility of our results, we conducted a dynamic intervention and used a different variable to measure depression in an alternative model. This alternative approach yielded similar results, which further supports the validity of our findings.

In summary, our findings indicate that supporting workers who are leaving the workforce early and encouraging them to engage in volunteering is an important strategy for promoting well-being among Americans of retirement age.

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Tables and Figures

Table 1 – Key descriptive statistics of the analytical sample by volunteer hours[7]

		Volunteer hours >= 100+ (%)	Volunteer hours < 100+ (%)	n
Total		12.5	87.5	81,462
Depression (CESD-8 >=3)				
	Not depressed	13.5	86.5	67,516
	Depressed	7.4	92.6	13,946
Age				
	Mean	53.3	52.5	
Gender				
	Men	12.3	87.7	36,236
	Women	12.6	87.4	45,226
Race/ethnicity				
	Whites	13.3	86.7	54,437
	Blacks	13.6	86.4	14,300
	Hispanics	6.4	93.6	9,948
	Other	11.1	88.9	2,777
Education				
	LTHS/GED	4.4	95.6	14,480
	HS	8.6	91.4	22,996
	Some college	12.9	87.1	21,616
	College+	21.3	78.7	22,370
Labor force status				
	Employed	11.1	88.9	46,575
	Retired	14.8	85.2	31,422
	Unemployed	11.6	88.3	1,628
	NILF or disabled	8.6	91.4	1,837
Help to friends, relatives, neighbors, 100+ hours				
	No	10.4	89.6	72,668
	Yes	29.8	70.2	8,794
Comorbidities				
	0	12.4	87.6	26,282
	1	12.6	87.4	28,599
	2+	12.4	87.6	26,581
Limitations in ADLs				
	0	12.8	87.2	74,080
	1	10.1	89.9	4,260
	2+	6.8	93.2	3,122

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[7] This table is limited to the key variables in our sample. The full table is available in the appendix.

Figure 1 - Simplified directed acyclic graph (DAG) showing the age to age cross-lagged structure, whereby depression (D), labor force participation (L), and time-varying confounders and mediators (X) are associated across ages (a) 50 to 80
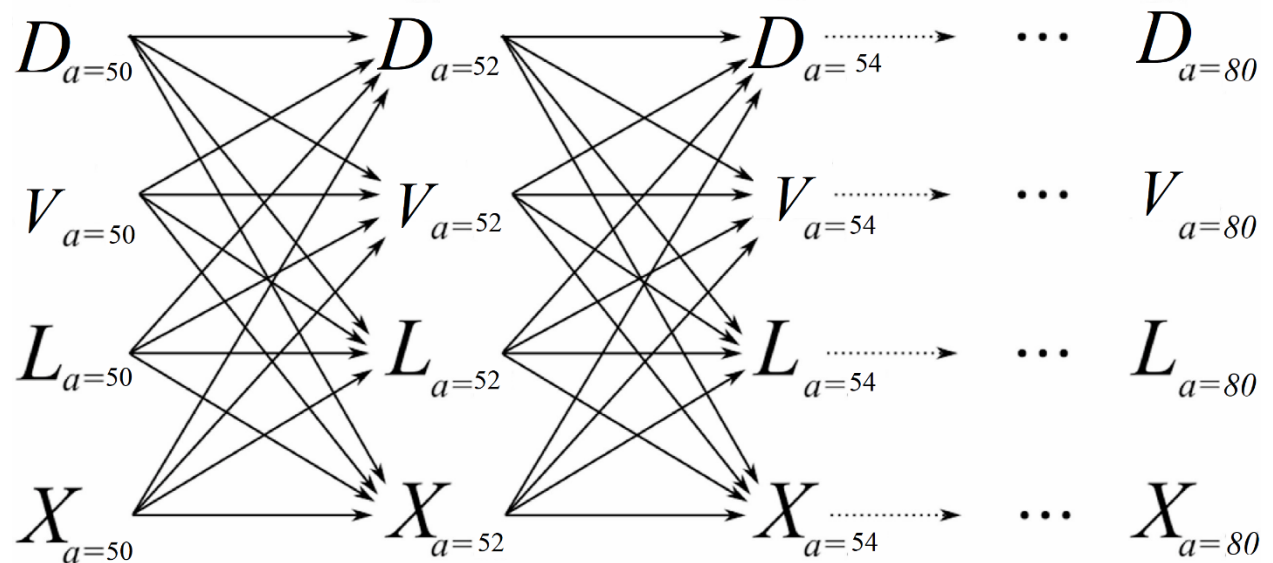
Figure 2 - Age pattern of depression - natural course (simulated) vs. observed depression
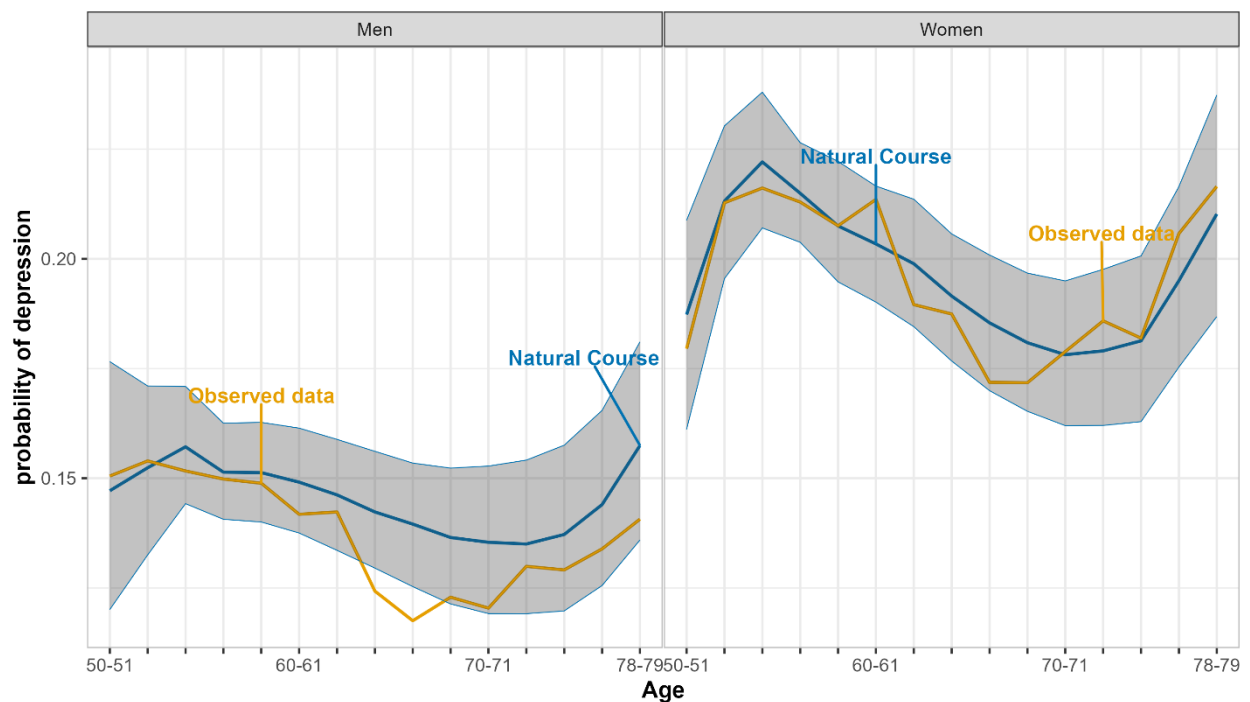
Figure 3 - Natural course vs. intervention scenario (upper panel) and their difference by age (lower panel)
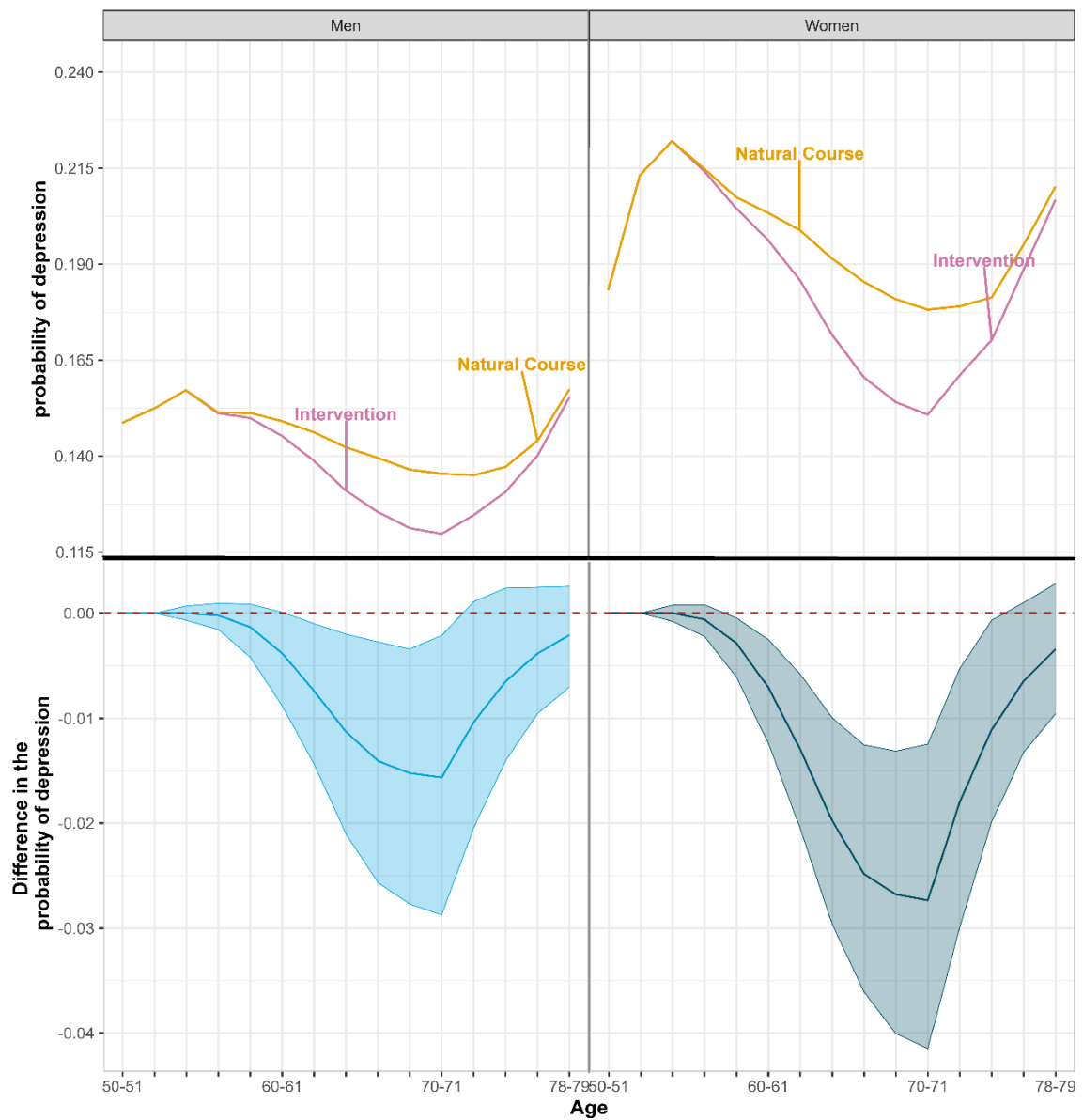
Figure 4 - Difference in the probability of depression between the natural course and the simulated intervention among the treated (ATT), by gender
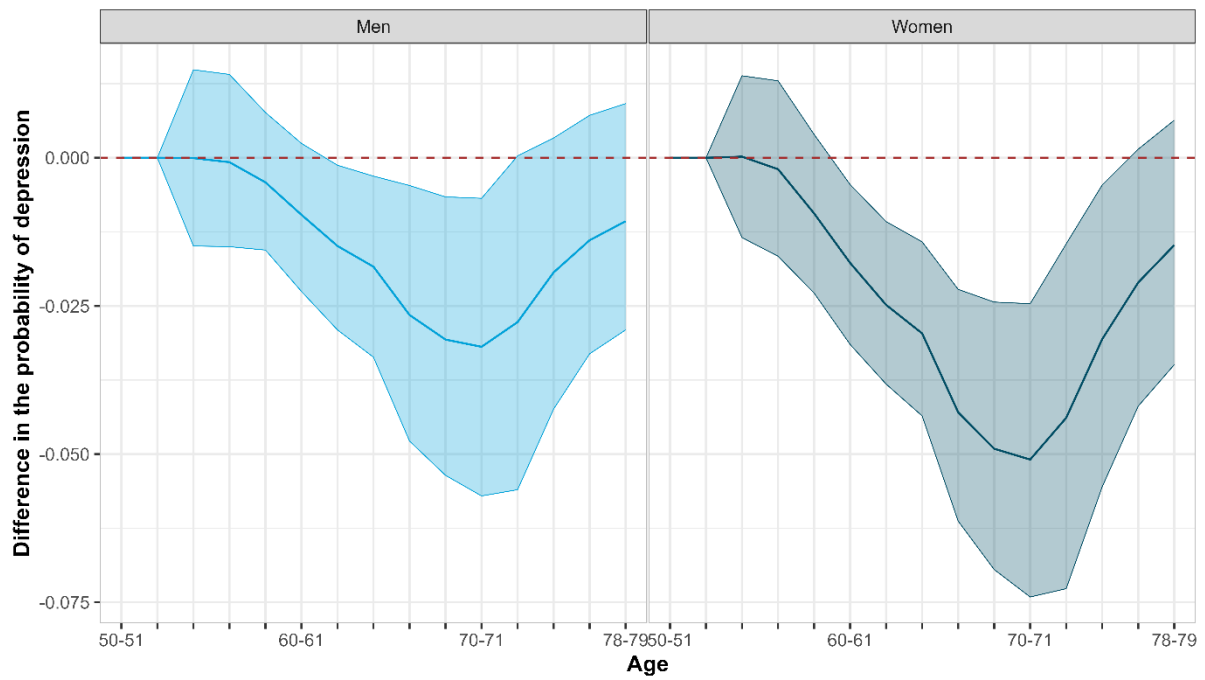
Figure 5 - Difference in the probability of depression between the natural course and the simulated intervention among the treated (ATT), by gender and race/ethnicity

Figure 6 – Difference in the probability of depression between the natural course and the simulated intervention among the treated (ATT), by gender and education
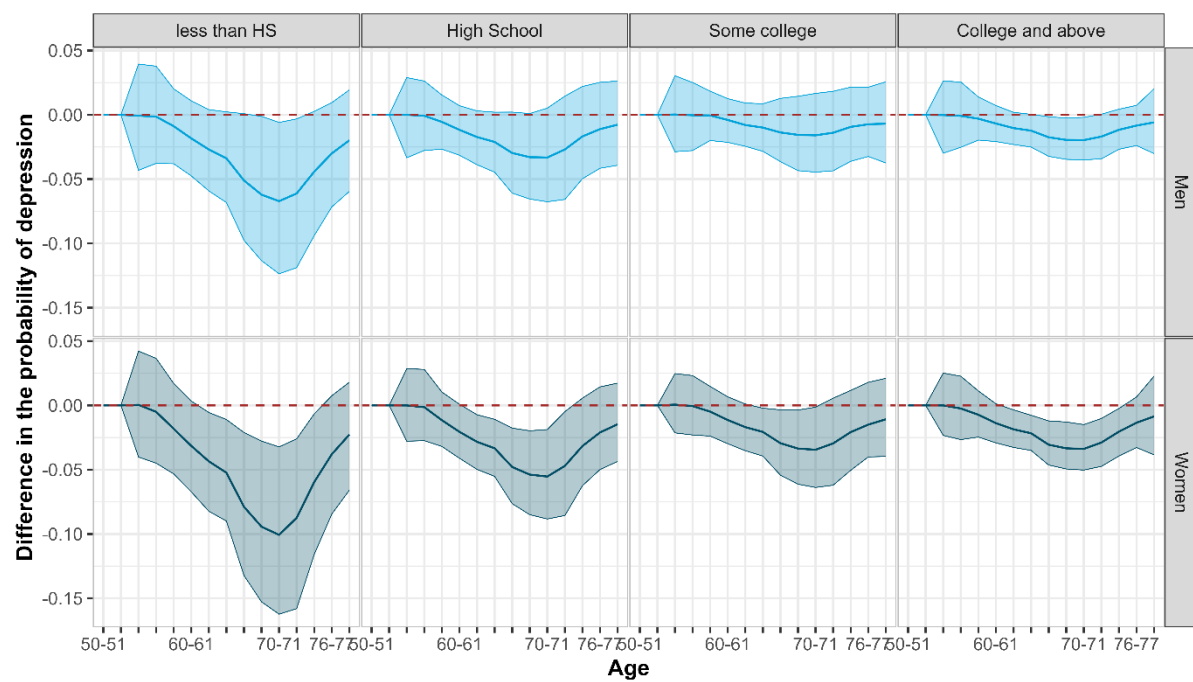
Table 2a - Descriptive statistics of the analytical sample by volunteer hours

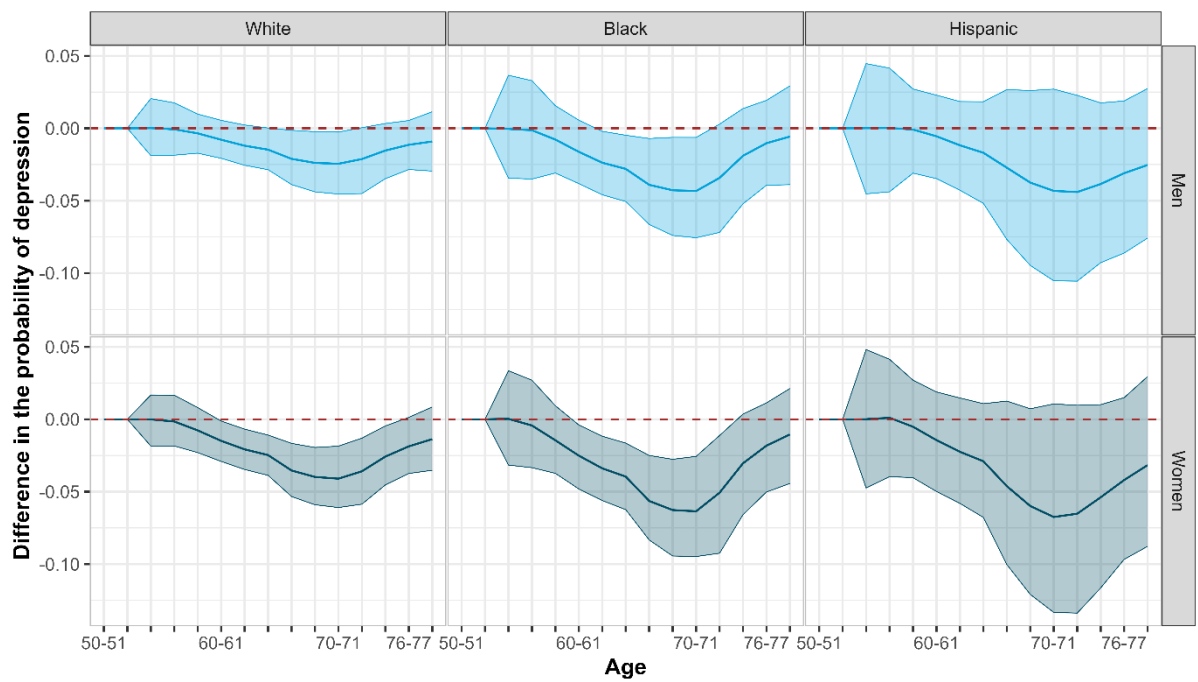|		Volunteer hours >= 100+ (%)	Volunteer hours < 100+ (%)	n
Total		12.5	87.5	81,462
Depression (CESD-8 >=3)				
	Not depressed	13.5	86.5	67,516
	Depressed	7.4	92.6	13,946
Age				
	Mean	53.3	52.5	
Gender				
	Men	87.7	12.3	36,236
	Women	87.4	12.6	45,226
Race/ethnicity				
	Whites	13.3	86.7	54,437
	Blacks	13.6	86.4	14,300
	Hispanics	6.4	93.6	9,948
	Other	11.1	88.9	2,777
Education				
	LTHS/GED	4.4	95.6	14,480
	HS	8.6	91.4	22,996
	Some college	12.9	87.1	21,616
	College+	21.3	78.7	22,370
Family wealth during childhood				
	Poor	11.3	88.7	21,968
	Average	12.5	87.5	52,872
	Well-off	15.9	84.1	6,622
Cohort				
	AHEAD-CODA-HRS	12.2	87.8	24,960
	EGENX	13.7	86.3	387
	MBB-LBB	12.1	87.9	20,414
	WB-EBB	12.8	87.2	35,701
Region				
	Northeast	12.0	88.0	12,112
	Midwest	12.9	87.1	19,133
	South	12.0	88.0	33,724
	West	13.1	86.9	16,381
	Other region	16.1	83.9	112
Baseline Occupation				
	Professional	19.5	80.5	27,070
	Services	10.0	90.0	35,671
	Manual	6.9	93.1	18,721

Religion				
	Protestant	14.4	85.6	48,060
	Catholic	9.3	90.7	21,882
	Jewish	13.8	86.3	1,520
	None/no pref.	8.5	91.5	8,049
	Other	16.0	84.0	1,951
Childless				
	No	12.4	87.6	75,341
	Yes	13.8	86.2	6,121
Married / in a partnership				
	No	10.8	89.2	25,010
	Yes	13.2	86.8	56,452
Labor force status				
	Employed	11.1	88.9	46,575
	Retired	14.8	85.2	31,422
	Unemployed	11.6	88.3	1,628
	NILF or disabled	8.6	91.4	1,837
Income quartiles				
	q1	6.8	93.2	11,740
	q2	10.0	90.0	17,192
	q3	13.0	87.0	23,170
	q4	15.8	84.2	29,360
Number of people in HH				
	1	11.9	88.1	14,976
	2	13.2	86.7	41,631
	3+	11.5	88.5	24,855
Help to friends, relatives, neighbors, 100+ hours				
	no	10.4	89.6	72,668
	yes	29.8	70.2	8,794
Comorbidities				
	0	12.4	87.6	26,282
	1	12.6	87.4	28,599
	2+	12.4	87.6	26,581
Limitations in ADLs				
	0	12.8	87.2	74,080
	1	10.1	89.9	4,260
	2+	6.8	93.2	3,122

Table 3a- TE and ATT with 2.5 and 97.5 CI, by gender

set	gender	Theta	2.5%	97.5%
TE	Total	-0.009	-0.012	-0.004
TE	Men	-0.006	-0.011	-0.002
TE	Women	-0.011	-0.015	-0.006
ATT	Total	-0.02	-0.03	-0.011

ATT	Men		-0.015	-0.027	-0.004
ATT	Women		-0.025	-0.034	-0.013

Table 4a - TE and ATT with 2.5 and 97.5 CI, by gender and race/ethnicity

SET	Gender	Race/Ethnicity	Theta	2.5%	97.5%
TE	Total	white	-0.007	-0.011	-0.003
TE	Total	black	-0.012	-0.019	-0.004
TE	Total	hispanx	-0.010	-0.022	0.002
TE	Total	other	-0.007	-0.026	0.013
TE	Men	white	-0.005	-0.009	0.000
TE	Men	black	-0.008	-0.015	-0.002
TE	Men	hispanx	-0.008	-0.019	0.004
TE	Men	other	-0.005	-0.023	0.014
TE	Women	white	-0.009	-0.013	-0.004
TE	Women	black	-0.014	-0.022	-0.005
TE	Women	hispanx	-0.013	-0.027	0.001
TE	Women	other	-0.009	-0.031	0.012
ATT	Total	white	-0.017	-0.025	-0.008
ATT	Total	black	-0.026	-0.040	-0.009
ATT	Total	hispanx	-0.027	-0.056	0.007
ATT	Total	other	-0.019	-0.061	0.033
ATT	Men	white	-0.012	-0.023	-0.001
ATT	Men	black	-0.020	-0.036	-0.003
ATT	Men	hispanx	-0.021	-0.052	0.013
ATT	Men	other	-0.014	-0.059	0.040
ATT	Women	white	-0.020	-0.030	-0.010
ATT	Women	black	-0.030	-0.046	-0.012
ATT	Women	hispanx	-0.032	-0.064	0.003
ATT	Women	other	-0.023	-0.068	0.032

Table 5a - TE and ATT with 2.5 and 97.5 CI, by gender and education

SET	Gender	Education	Theta	2.5%	97.5%
TE	Total	<HS-GED	-0.016	-0.027	-0.005
TE	Total	HS	-0.010	-0.017	-0.003
TE	Total	college+	-0.005	-0.008	-0.002
TE	Total	some-college	-0.006	-0.011	0.000
TE	Men	<HS-GED	-0.013	-0.023	-0.001
TE	Men	HS	-0.007	-0.014	0.001
TE	Men	college+	-0.004	-0.006	-0.001
TE	Men	some-college	-0.003	-0.009	0.003
TE	Women	<HS-GED	-0.020	-0.033	-0.006
TE	Women	HS	-0.012	-0.020	-0.004
TE	Women	college+	-0.007	-0.011	-0.003
TE	Women	some-college	-0.007	-0.014	0.000
ATT	Total	<HS-GED	-0.038	-0.065	-0.010
ATT	Total	HS	-0.022	-0.036	-0.005
ATT	Total	college+	-0.014	-0.021	-0.006
ATT	Total	some-college	-0.013	-0.026	0.001
ATT	Men	<HS-GED	-0.031	-0.058	-0.001
ATT	Men	HS	-0.016	-0.033	0.004
ATT	Men	college+	-0.010	-0.017	-0.001
ATT	Men	some-college	-0.008	-0.021	0.007
ATT	Women	<HS-GED	-0.046	-0.075	-0.013
ATT	Women	HS	-0.027	-0.042	-0.009
ATT	Women	college+	-0.017	-0.025	-0.007
ATT	Women	some-college	-0.017	-0.031	0.000

Table 6a- Decomposition of TE in DE and IE through ADLs with CI, by gender

gender	TE	2.5%	97.5%	DE	2.5%	97.5%	IE	2.5%	97.5%
Total	-0.0086	-0.0125	-0.0044	-0.0076	-0.0112	-0.0040	-0.0009	-0.0028	0.0012
Men	-0.0061	-0.0109	-0.0016	-0.0055	-0.0096	-0.0013	-0.0006	-0.0026	0.0019
Women	-0.0108	-0.0153	-0.0056	-0.0095	-0.0136	-0.0051	-0.0012	-0.0034	0.0015

Table 7a - TE obtained contrasting the natural course with the scenario with early retirees volunteering until age 70 irrespective of the presence of limitations in ADLs vs. TE obtained contrasting the natural course with the dynamic intervention scenario in which retirees volunteer only when they have no limitations in ADLs, with 2.5 and 97.5 CI, by gender

gender	SET	Theta	2.50%	97.50%
Total	TE	-0.009	-0.012	-0.004
	TE in the dynamic intervention	-0.007	-0.010	-0.004
Men	TE	-0.006	-0.011	-0.002
	TE in the dynamic intervention	-0.005	-0.009	-0.001
Women	TE	-0.011	-0.015	-0.006
	TE in the dynamic intervention	-0.009	-0.013	-0.005

Figure 7a – Pattern of time-varying variables by age: household composition, limitations in ADLs, marital status (in a partnership), comorbidities, depression, labor force status, help to friends (or relatives or neighbors), income quartile, and volunteering for women – observed data vs. simulated data (natural course)
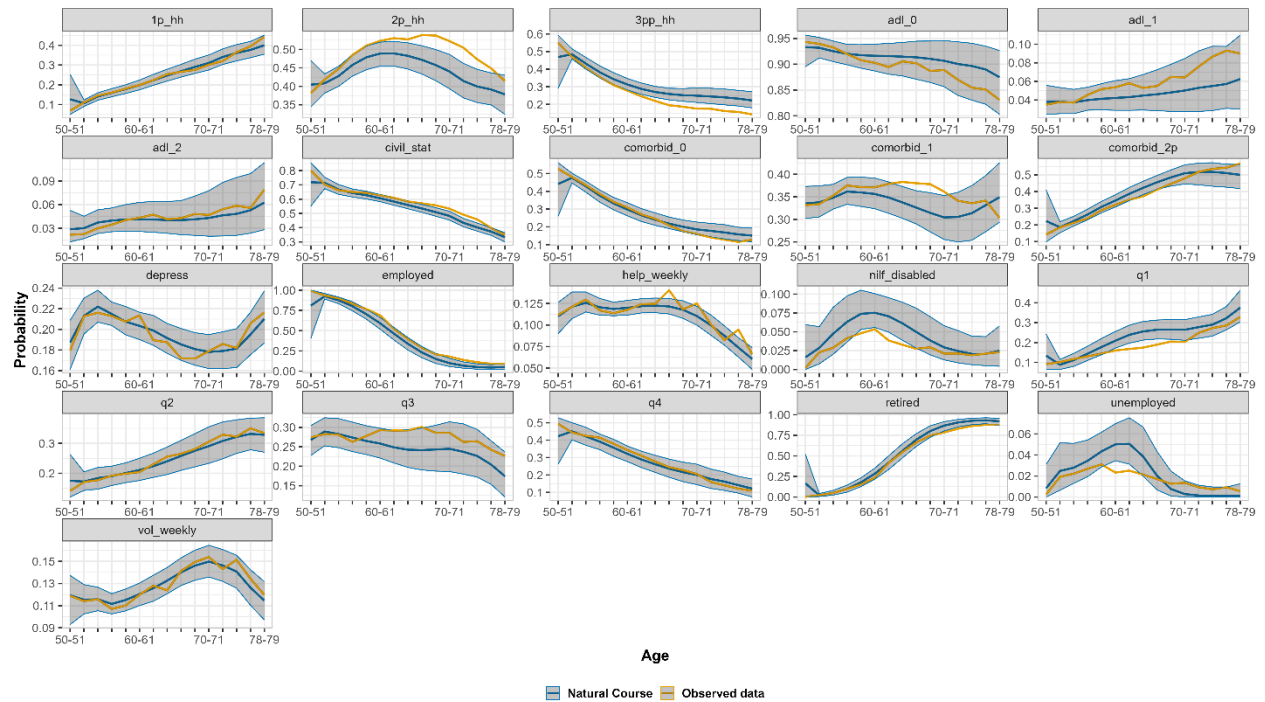
Figure 8a – Pattern of time-varying variables by age: household composition, limitations in ADLs, marital status (in a partnership), comorbidities, depression, labor force status, help to friends (or relatives or neighbors), income quartile, and volunteering for men – observed data vs. simulated data (natural course)