# Income, Cognition, and Cardiovascular Disease: Spillovers from Cash Transfers

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INCOMPLETE DRAFT - NOT FOR CIRCULATION

**Abstract**

I analyze the effect of a large, unconditional cash transfer from a non-contributory pension on adult cognitive functioning. Cognitive health is a critical concern in low-/middle- income countries, which will carry 70% of the world's dementia burden by 2040. Investments in early life inputs (e.g., education) can improve later-life cognitive health, but little is known about whether and which policies can substitute for (or compliment) human capital investment to improve contemporaneous outcomes. Cash transfers are a popular policy option in these settings, but there is evidence that such programs can actually worsen adult health, increasing risk for chronic diseases like hypertension and obesity. These factors in particular are known to negatively affect cognition. In this paper, I show that large transfers do have the potential to worsen cognitive health, and I argue this is most likely because of dramatic income effects on cardiovascular diseases and obesogenic food consumption. The effect sizes are large enough to counter any benefit to cognition from modest investments in early life education. The findings have important implications for public policy and are the first to document such effects on cognitive health from cash transfer programs.

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# 1 Introduction

An increasingly common policy approach to ensure the economic security of aging populations in low- and middle- income settings is a non-contributory pension: an unconditional cash transfer to age-qualifying recipients close to retirement age. These programs are widespread and varied, but there exists little rigorous research to guide their implementation, particularly relative to the research on cash transfer programs that target children and young mothers. These income transfer programs may have important health and economic benefits for aging demographics, for whom chronic diseases are an increasingly heavy burden and financial security is tenuous.[1]

Cognitive functioning is a health domain of particular interest for populations targeted by non-contributory pension programs: by 2040, over 70% of the world's dementia burden will come from low- and middle- income settings.[20] This may be in large part attributable to improvements in life expectancy, as age is one of the most important risk factors for poor cognitive health. However, these populations are by definition low-income, have low educational attainment, and face a growing chronic and cardiovascular disease burden, all of which heighten the risk for dementia and poor cognitive health. Dementia is also costly, and a significant portion of the economic burden comes from indirect costs like caregiving. This is particularly salient to LMICs where access to medical care is unreliable and care for older individuals is often provided by younger household members.[25][31]

Little is known about whether (public policy) interventions outside of clinical settings can improve cognitive functioning in LMICs. As such, this study represents one of only a small handful of studies that analyzes the impact of (unconditional) cash transfers on adult cognitive health.[2][14][5] While the extant studies find positive effects of income transfers on cognitive health, there is evidence to suggest that this finding may not be universal. On one hand, income transfers may improve cognitive status by decreasing stress, improving nutrition and food security, and increasing access to healthcare to better manage cardiovascular diseases (an important determinant of cognition). On the other, large cash transfers may have adverse impacts as well. In particular, individuals may adopt unhealthy behaviors that correlate with poor cognitive health. Studies have shown large income effects on diet can explain rapid increases in obesity and hypertension observed among beneficiaries.[19][21] These cardiovascular diseases and risk factors are known to negatively impact brain health and cognition, but to date no studies have examined the "spillover" effects to cognition from these other health domains affected by income transfers.

In this paper, I examine the effects of a large, unconditional cash transfer from a non-contributory pension in Mexico and find evidence suggesting income transfers lead to a decline in cognitive functioning. My primary identification strategy exploits age-eligibility cutoffs for the program in order to implement a regression discontinuity design. I show that the decline in cognitive health correlates with large increases in hypertension and body mass index: risk factors for cardiovascular diseases known to affect cognition among older adults. These findings are likely the result of dramatic income effects on obesogenic food consumption. I also show that the decline in cognitive health is largest among individuals who have more limited access to healthcare, compared to those who have access to formal social security systems. This finding potentially suggests that individuals with more reliable access to health services may be able to offset the harmful effects of chronic, cardiovascular diseases on cognitive functioning.

These findings make contributions to both our understanding of public policy in low-income settings, as well as our knowledge of socio-economic determinants of health more generally. The results highlight one source of additional and unforeseen costs associated with the expansion of non-contributory pension/cash transfer programs, and future work could investigate what changes to program administration and benefit structure (if any) will yield different results. Quasi-experimental variation in diet, cardiovascular diseases, and cognition has also been difficult to analyze outside of a laboratory setting, so my results - which rely on household surveys - also contribute to our understanding of the determinants of cognitive health. More generally, the findings are notable as they link income, cardiovascular diseases, and cognitive health to challenge more linear conceptions of socioeconomic gradients in health.

The remainder of the paper proceeds as follows: in Section 2, I describe non-contributory pensions and discuss in more detail the specific program I study in Mexico. In Section 3, I draw on literature from economics, medicine, and public health to formulate two hypothesis about the way cash transfers affect cognition. In section 4, I describe my data and empirical strategy to test for income effects on cognitive health. Section 5 discusses the results, and in Section 6 I explore mechanisms that may explain why eligibility for the cash transfer is linked to declines in cognitive functioning. In Section 7, I discuss an important source of heterogeneity - differences in the effect by insurance status - in order to further link the decline in cognitive functioning to cardiovascular diseases. Finally, in Section 8, I discuss the contributions, limitations, and future work for this paper.

## 2 Non-Contributory Pension Programs

Many developing and developed countries face aging populations. Compounding these demographic shifts are epidemiologic transitions: infectious disease burdens fall and chronic, cardiovascular disease burdens rise. Aging individuals are at the crux of these transitions, but often lack access to institutions to provide financial security or healthcare services. A popular policy to address these disparities has been a type of unconditional cash transfer called a non-contributory pension. It is non-contributory in the sense that recipients do not contribute to any fund during their working lives; it is simply a cash transfer from the government to age-qualifying individuals. Examples of these programs exist around the world, and are particularly prevalent in Latin America. Other countries with non-contributory pension programs include Paraguay, Peru, Bolivia, South Africa, Namibia, and China to name only a few. These policies are popular where participation in informal labor markets is high and poor individuals have difficulty accessing health services and saving for retirement.

Comparable to many of these countries, Mexico has a rapidly aging population, but social security institutions (e.g., IMSS and ISSSTE) typically provide benefits only to workers in the formal labor market, often excluding older adults in poor, rural areas who have worked informally most of their lives. In light of these disparities, Mexico implemented one of the largest non-contributory pension programs (*Programa Pension para Adultos Mayores*). The program is colloquially referred to as "70 y Más" since only individuals 70 years of age and older were initially eligible. The pension consists of an unconditional cash transfer equivalent to MX$ 500/month, representing roughly 30% of household income for the eligible demographic (about US$ 40/month during the study period). In practice, the transfer was delivered every two months in installments of MX$ 1,000.

The "70 y Más" program began in 2007 in localities with populations of 2,500 individuals or fewer, and rapidly expanded to larger localities in subsequent years.[1] In 2008, localities with populations up to 20,000 persons became eligible; and in 2009, localities with populations up to 30,000 became eligible. Most localities in Mexico would have been eligible in 2007, and by 2009 approximately half of the country's 4 million individuals 70 and over were covered by the program. In the initial roll out of the program, there was no means testing: eligibility was based only on age and locality of residence. The program was well publicized and take-up was high: SEDESOL, the ministry responsible for the administration of the program, cites take-up north of 90%, although in my own analysis I construct more conservative estimates.

The effects of cash transfers in general on (older) adults have received limited attention despite their policy relevance; this is particularly true of non-contributory pension programs (including "70 y Más"). The findings are critical to understanding how large income transfers impact health and wellbeing, yet the relatively few extant studies do not present any convincing conclusion about the direction or magnitude of these income effects. For example, studies from Mexico's *Progresa/Oportunidades* program find improvements in (cardiovascular disease-related) mortality and self reported health, but other evidence from the same program finds concurrent increases in health conditions like obesity and hypertension.[21][19][7][6]

Whether the results from *Progresa/Oportunidades* program are applicable to the "70 y Más" eligible population is not immediately clear given the unconditional nature of the cash transfer. However, studies of the effects on health and wellbeing from the first phase of the "70 y Más" program (expansion to localities with populations up to 2,500) similarly suggest both positive and negative health effects. Recipients reported better quality of life and subjective wellbeing, fewer depressive symptoms, but also experienced increases in blood pressure.[23][22][40] In my own work, I find that the transfer leads to increases in mortality (in contrast to findings from Barham and Rowberry 2012), driven by income effects on cardiovascular disease.[17] To the best of my knowledge, no study has examined the impact of the "70 y Más" program on cognitive health, and only three other studies (including only two from LMICs) have addressed the impact of cash transfers on cognition directly.

[1] Locality is the tertiary geographic strata in Mexico following state and municipality.

# 3 Cash Transfers and Cognitive Health

How will large income transfers affect adult cognitive health? While there is little direct evidence about these effects (particularly in low- and middle- income countries where the dementia burden is rising rapidly), I synthesize various literature on cash transfer programs from economics, public health, and medicine to explore two hypotheses.

## 3.1 Improvements in Cognition from Healthcare Utilization and Cognitive Reserve

The first hypothesis is that the cash transfers improve cognitive functioning. This may happen one of two ways: via (1) improvements in "cognitive reserve" attributable to less stress, depression, and better subjective wellbeing, or (2) via "spillover" effects from improved healthcare utilization and better management of cardiovascular diseases. Cognitive reserve refers to the brain's ability to efficiently utilize existing neurological networks or to recruit alternate brain networks for better cognitive functioning.[44] Improvements in stress, depression, and other measures of subjective wellbeing allow the brain to function more optimally, improving cognitive reserve and improving cognitive functions related to memory (for example). Income effects on healthcare utilization are particularly salient if they improve the management of cardiovascular diseases like hypertension and diabetes, which negatively affect the brain and are both prevalent and poorly managed in LMICs like Mexico.

There is some support for this first hypothesis (improvements in cognitive health resulting from improved cognitive reserve) in the economics and public health literature. Ayyagari and Frisvold (2016) find increases in Social Security payments in the United States improve cognitive health for recipients benefiting from the Social Security "Notch."[5] The authors exploit a quasi-experimental change in benefit calculation that leads to large, statistically significant improvements in cognition and declines in the probability of dementia. The authors back-out that a US$ 1,000 increase in income per year (US$ 83/month) leads to a 2 percentage point decrease in the likelihood of dementia. The effects are likely attributable to improvements in cognitive reserve: individuals report being less stressed and more financially secure with the larger payments. Since the study population has access to healthcare through Medicare and this access is not differential across the "Notch," improvements in cognitive health through better management of cardiovascular diseases is a not a convincing explanation. However, Pak and Kim (2017) find that expansion of Medicare Part D lead to improvements in cognitive functioning through the program's impact on the management of cardiovascular conditions.[33]

Whether these results are replicable or applicable outside of the U.S. (or other high-income countries) is unclear. To the best of my knowledge, there are only two studies that measure directly income effects on cognition in LMICs, and both find positive effects. However, the results of these studies mostly support the idea that improvements in cognition are driven by increases in healthcare utilization, rather than improvements in cognitive reserve. Aguila, Kapteyn, Smith (2015) and Aguila, Casanova (2018) use random, experimental variation in pension eligibility among quasi-urban localities in the Yucatan state in Mexico to test for income effects on cognitive health (and several other health outcomes).[3][2] The authors find the income transfers improve cognitive performance, and attribute this result to greater healthcare utilization. However, they do not link income effects on healthcare utilization specifically to better management of cardiovascular diseases. Pre-treatment differences between the control and treated localities in certain demographic characteristics, such as literacy, may also require more caution when interpreting the effects, and it is not known how the results may generalize outside of the specific study context.

One other study outside of Mexico finds beneficial effects of income on cognitive health. Cheng et al (2016) analyze the health effects of a non-contributory pension program in China and find that income transfers lead to improvements in cognition, among other beneficial health outcomes.[14] The authors show that these effects correlate with decreased levels of stress and depressive symptoms, increased food security and nutrition, as well as better managements of chronic conditions like hypertension. It is not clear, however, which of these results (if any) drives improvements in cognitive health.

## 3.2 Declines in Cognition from Retirement and Cardiovascular Disease

A second hypothesis is that cash transfers worsen cognitive health. Two ways in which this can happen are via (1) "mental retirement" and via (2) worse cardiovascular disease outcomes due to income effects on poor health behaviors (increased consumption of obesogenic foods, for example). "Mental retirement" refers to the process in which individuals experience worse mental health (cognitive health, depression, etc.) and worse health outcomes in general (cardiovascular disease, mortality, and health behaviors) following exit from the labor market. The phenomenon was notably explored by Rohwedder and Willis (2010), who find retirement leads to significantly lower cognitive functioning in the United States, the UK, and 12 other countries in Western Europe.[37] Such retirement effects may be relevant to the "70 y Mas" eligible population, who are receiving a pension for the first time. Whether retirement categorically leads to worse heath is not well established in higher income countries, where research has found null - as well as positive - effects on a variety of health outcomes. Moreover, retirement effects in LMICs are poorly understood and research on retirement pathways among aging individuals in these economies is generally lacking.

Aside from retirement, large income transfers may lead to worse cognitive health through negative impacts on health behaviors. For example, in Mexico and Colombia, cash transfer recipients have experienced dramatic increases in weight, obesity, and high blood pressure.[21][19][18] These health conditions are key risk factors for poor cognitive health among aging adults. The likely explanation for these physiological changes is a large income effect on obesogenic food consumption. That is, individuals spend the cash transfers on foods rich in processed starches, carbohydrates, sugars, cholesterols, fats, and trans fats.

Studies from both humans and mice have shown that cognition responds quickly - within a matter of months - to changes in diet. Medical and laboratory-based studies generally rely on small samples and specific interventions to document how changes in diet can rapidly affect brain structure (e.g., white and grey matter, brain volume) and/or performance on cognitive assessments. This includes continuous measures of cognitive functioning and impairment, as well as clinical assessments of dementia and Alzheimer's Disease.[34][15][47][9][8][43][41][28][32] Larger, prospective cohort and cross sectional studies document positive associations throughout the lifecourse between obesity, diabetes, hypertension, and poor cognitive performance. Generally, these studies suggest obesity and other cardiovascular, circulatory, and metabolic diseases or disruptions can have large negative effects on cognition and greatly increase risk for dementia, Alzheimer's, and quicken the pace of cognitive decline in older adults. These studies sample from a variety of non-institutionalized populations and include both non-Hispanic demographics from the United States and Europe, as well as a few studies specifically focusing on Hispanic adults in the US and aging populations in Mexico.[16][42][39][46][38]

# 4 Data and Empirical Strategy

## 4.1 ENSANUT Household Survey

The main data source for this study is the *Encuesta Nacional de Salud y Nutricion* (ENSANUT), a nationally- and state-representative survey for community-residing Mexican individuals. The 2012 data set includes rich health and socioeconomic data and a cognitive assessment screener administered by the survey enumerator. I limit my study sample to those individuals living in localities eligible for "70 y Más" in 2007 (locality population of 2,500 or fewer), 2008 (locality population of 20,000 or fewer), or 2009 (locality populations of 30,000 or fewer). Sample statistics are presented in Table 1. In general, the population has low education and a high chronic disease burden. The table also includes means and standard deviations for each of the various cognitive assessments in ENSANUT, which I describe in further detail in the next section.

## 4.2 Measures of Cognitive Functioning

There are four cognitive assessments included in ENSANUT, which are only administered to individuals ages 60 and over. The first is immediate word recall, scored 0-3, in which individuals are read aloud three words (*arbol, perro, casa*) and are asked to repeat as many of them as they can. The second is a measure of verbal fluency, in which respondents are asked to name as many animals as possible within a minute time span (scores range from 0 to 60, although it is possible to score even higher). At the conclusion of the cognitive battery, the respondents are asked again to name as many of the original three words from the immediate recall measure. This is the delayed word recall assessment, and I sum immediate and delayed word recall measures together for a "recall summary score" (in addition to analyzing them separately). ENSANUT also includes a fourth cognitive measure, commonly referred to as the "clock test" (or "clock drawing test"), for a subset of respondents. Respondents are asked to draw a clock face with a specific time indicated by the hour and minute hands (11:10). In ENSANUT, the exam is scored on a scale of 0 to 3. Respondents are given a point for each of the following tasks that are completed correctly: (1) all 12 numbers in their proper positions and sequence on the clock face, (2) spacing the numbers on the clock face correctly so that each quadrant of the clock contains roughly 3 numbers, and (3) that the time indicated by the clock hands is about 11:10.

These measures are common components to many standard cognitive batteries, including the "Mini Mental State Examination" (MMSE) and the "Montreal Cognitive Assessment" (MoCA). They are used in the studies cited above from China, the Yucatán, and the United States, which allows for more direct comparisons between various countries and institutional settings. They have also been shown to be effective measures of cognitive health for low-income and low-literacy populations. However, the measures are limited in that they are not diagnostic of dementia, Alzheimer's Diseases, or any type of cognitive impairment. Further, the ENSANUT word recall assessments differ from those in other cognitive batteries, in that there are only three words to remember, instead of eight, ten, or even twenty words. As such, there may be ceiling effects to these measures. In practice, this does not seem to limit the empirical approach for this paper.

### 4.3 Identification

To identify the effects of the large, unconditional income transfers on cognitive health, I exploit the age-eligibility cutoff for the non-contributory pension program with a regression discontinuity design.[27] Ineligible individuals who are too young to qualify for the program serve as a counterfactual for age-eligible individuals who are old enough to qualify. This identification strategy tests for changes in cognitive functioning that accrue over a relatively short time frame, and cannot measure cumulative effects of the cash transfer or interactions between older ages and income transfers. Said differently, the study design has limited external validity to explore more dynamic interactions between income and health outside of the neighborhood of age-eligibility. Other empirical approaches are theoretically possible, but not feasible due to data limitations. For example, a differences-in-differences (-in-differences) approach could exploit differences in eligibility across time, locality population size, and age to more thoroughly explore effects of the income transfer. However, the data needed for this approach is not available: ENSANUT has only one wave of cognitive measures, and this is true for other household surveys in Mexico as well, making it impossible to test the assumptions ("parallel trends") needed for double (triple) differences approaches.

For the running variable, I use the age of the oldest household member to determine which individuals are exposed to the income transfer. In the current analysis, I rely on estimation procedures using global polynomial regressions estimated over various bandwidths and various functional form specifications of the running variable. Future work will more carefully weigh the bias-variance trade-off present for regression discontinuity designs with local linear regression estimates and more sophisticated methods for selecting the optimal bandwidth.[26][11][30] The estimating equation to identy the intent-to-treat (ITT) effect of the program is:

$$Y_{ih} = g(Age_h - c) + \delta \mathbb{1}(Age_h \geq c) + g(Age_h - c) \times \mathbb{1}(Age_h \geq c) + \mu_{ih}$$

for outcome $Y_{ih}$ for individual $i$ in household $h$. The coefficient of interest is $\delta$ which identifies the effect of the program within the neighborhood of eligibility. $g(Age_h - c)$ is a flexible polynomial function of the maximum age of all household members $Age_h$, centered at the eligibility cut off, $c$. $\mathbb{1}(Age_h \geq c)$ is a dummy variable for any household with a member above the age eligibility cut off. $\mu_{ih}$ is a heteroskedastic-robust error term, clustered by age.[29] The results are also robust to two-way clustering on both age and locality (standard errors are near identical).[13]

In practice, I set the discontinuity in eligibility at age 71 instead of age 70. There are several ways to motivate this decision, but it is largely driven by the fact that take up does not immediately increase at age 70 as seen in Appendix Figure A1. Setting the eligibility at age 71 (rather than 70) yields the largest and most statistically significant change in take-up that best fits patterns in the observed data. This specification measures income effects on cognition within one year of becoming eligible, which may allow us to better detect changes in health outcomes in response to the transfer. On average, individuals only participate in the program for one third of the year between ages 70 and 71, so the ITT estimates can be inflated by 3 to back out LATE estimates. The same estimates can be estimated using an instrumental variables approach and future empirical work will also include these IV estimates.

Estimates from regression discontinuity designs can be sensitive to the bandwidth and the functional form of $g(Age_h - c)$, so I include estimates from two specifications: (1) a bandwidth of 5 years and a linear specification of the running variable, and (2) a bandwidth of ten years and a quadratic specification of the running variable. Across all specifications, only individuals between ages 60 and 80 are included. Higher order terms are possible, but these can often bias the results, so I limite the polynomials to degree two. [24]

I include additional robustness checks common to regression discontinuity designs. The first is to test for smoothness or manipulation in the running variable (the maximum age of household members). Individuals may manipulate their age to qualify for the program, pretending that they are 70 years or older to receive the transfer. Since individuals need to validate their birthday and address with government issued identification, this seems improbable. More likely, individuals may manipulate co-residency arrangements so that households have a "70 y Más" eligible member. However, I find no evidence of this manipulation.[2] Second, I test for smoothness in other covariates that could confound the discontinuity we observe ("balance test"). For example, changes in educational attainment at age 70 could lead to discontinuities in cognition as well. Results presented in the Appendix Figure A3 and Appendix Table A2 for select covariates. I find no economically or statistically significant discontinuity in the covariates. I discuss the results in more detail in Section 6.

# 5 Results: Income Effects on Cognitive Health

Figure 1 and Table 2 display regression discontinuity results for measures of cognitive functioning: recall summary score (immediate + delayed word recall), verbal fluency, and the clock drawing test. Both depict significant declines in the cognition for individuals (ages 60-80) residing in households with a "70 y Más" eligible member. For verbal fluency, individuals recall 1 word/animal less on average, which is about 0.2 standard deviations. For the recall summary score, individual recall one fifth (0.18) fewer words on average, which is again about 0.2 standard deviations. In Appendix Figure A2 and Appendix Table A1, I include the regression discontinuity estimates for immediate and delayed word recall separately. Despite the potential for ceiling effects with immediate word recall, I see statistically significant declines in both measures, although the decline is much larger in absolute magnitude for delayed word recall. I see no statistically or economically significant changes in the clock drawing test. The results are robust to different bandwidths and polynomial specifications.

To improve inference for each of the three cognition measures, I "randomly" assign the eligibility cutoff at other ages and re-estimate the regression discontinuity ITT estimate and corresponding T-statistic at these "placebo ages" with a bootstrapped confidence interval. These results are displayed in Appendix Figure A4. These results show that I am unlikely to estimate comparable treatment effects of the pension program at other ages for measures of word recall and verbal fluency. In other words, the magnitude and statistical significance of the true regression discontinuity estimates are likely not attributable to random variation in the data. However, for the clock drawing score, we see that this is not the case, consistent with the null finding in Table 2 and Figure 1.

# 6 Mechanisms

The findings described above are consistent with the second hypothesis that income effects lead to worse cognitive functioning. In this section, I explore potential mechanisms to explain this result. I focus on the two mentioned earlier: (1) increases in cardiovascular diseases driven by income effects on obesogenic food consumption, and

[2] Following Cattaneo et al (2016) I test formally for statistically significant discontinuities in the distribution of the running variable. I do not observe any statistically significant break in the distribution. The p-value associated with Cattaneo's density test is p=0.6209.

(2) labor market transitions that contribute to "mental retirement."

## 6.1 Income Effects on Cardiovascular Diseases

### 6.1.1 Hypertension and Body Mass Index (BMI)

I focus on two key markers of cardiovascular disease known to negatively affect cognition: blood pressure and body mass index.[3] Since the sample of respondents with complete biomarker measurements is small in ENSANUT, I combine the data with biomarker surveys from the Mexican Family Life Survey (MxFLS) administered from 2009 to 2012. Both surveys include measures of height and weight, which I use to calculate BMI, and systolic and diastolic blood pressure (measured at the time of the interview), which I use to examine hypertension outcomes.[4]

For BMI, I pool height and weight data together and construct a z-score to ease interpretation. For hypertension, I construct two measures. First, I create a measure for hypertension using only the blood pressure measurements from the survey. This is a dummy variable equal to 1 if systolic/diastolic is greater than 140/90 mmHg. However, since the biomarker samples are only fielded to a subset of respondents, I create a second measure of hypertension that uses the blood pressure measurement combined with self report of ever having been diagnosed with high blood pressure by a doctor. Aside from more precise estimates, this allows me to identify individuals who have high blood pressure, but are able to manage it (so that at the time of the survey they do not register as hypertensive). One concern is that this may measure income effects on health care utilization, biasing the estimates upwards, which I address in the discussion of the results.

I use the same regression discontinuity approach to measure changes in BMI and hypertension. The results are displayed in Figure 2 and Table 3. The results suggest the income transfer leads to a significant increase in the cardiovascular disease burden of pension eligible individuals. Within one year of becoming eligible for the pension program, individuals experience a 0.20 standard deviation increase in BMI. This likely reflects the increase in caloric intake from income effects on obesogenic food consumption that I explore in the next section. Across both measures of hypertension, I find an increases of 10 percentage points, but estimates using any hypertension (measured or self reported) are more precisely estimated. This represents a significant increase in blood pressure that potentially has detrimental effects on cognitive functioning.

The results are robust to various bandwidths and polynomial specifications of the running variable. To improve inference, I repeat the placebo regression discontinuity exercise described at the end of the previous section for both the ITT estimates and corresponding T-statistics. These results are displayed in Appendix

[3] These are not the only circulatory/cardiovascular diseases or conditions known to affect cognitive functioning. In fact, one of the most important is diabetes, but this is difficult to measure in ENSANUT and MxFLS. While both surveys ask about diabetes diagnosis from a doctor, they contain only very small samples of respondents with HbA1c measures, a biomarker typically used to determine risk for diabetes that will not be biased by self-report.

[4] MxFLS does not include cognitive measures for individuals ages 60 and over.

Figure A5. These results show that I am unlikely to estimate comparable treatment effects of the pension program on hypertension and BMI at other ages and that the regression estimates are not attributable to random variation in the data.

#### 6.1.2 Obesogenic Food Consumption

The changes in cardiovascular disease markers I observe above are likely the result of income effects on obesogenic food consumption. To measure these changes, I use data on diet and consumption from a third household survey, the *Encuesta Nacional de Ingresos y Gastos de los Hogares* (ENIGH). This is a nationally representative household survey of income and expenditures, including detailed information on food consumption. I group household food expenditures into the following categories: carbohydrates, fruits and vegetables, dairy and meat, and sweets/fats/oils.[5] While these categories are fairly broad, they help identify consumption of foods likely to be rich in processed carbohydrates, refined sugars, fats and trans fats that contribute to poor cardiovascular health, and in particular lead to increases in BMI and blood pressure.

In Appendix Figure A6 and Appendix Table A3, I display the regression discontinuity estimates for changes in (natural) log per capita household food expenditure for each food group. However, the ENIGH survey does not have the exact date of birth, so I bin data by year of birth of the oldest household member. This presents some challenges for estimation. Namely, the standard errors may not be correct since we cluster on age (in years) rather than exact age. To address the small number of clusters, I include the Wild bootstrap p-value in the tables as well.[12] I find large increases in food consumption driven by consumption of carbohydrates, meat and diary, and sugars, fats, and oils. These specific foods groups are likely to contribute most to cardiovascular conditions like hypertension.[6] I find no change in consumption of fruits and vegetables.

### 6.2 "Mental Retirement" and Potential Confounders

A second potential mechanism linking cash transfers to cognitive decline is withdrawal from the labor market. The large income transfers may induce individuals to retire from work, and the retirement transition may have detrimental impacts on (cognitive) health in particular. After retirement, individuals may become more sedentary or be exposed to less social stimulation, negatively impacting cognition. This process has been termed "mental retirement." However, using only a limited measure of labor supply (a binary indicator of currently working or not working in the past month), I do not find strong evidence for retirement effects. The results

[5] These categories do omit some types of expenditure, such as those on spices, coffee, alcohol, and tobacco, and food eaten outside of the household. These consumptions groups make up a small part of household expenditures. Of particular interest may be alcohol and tobacco which are known to exacerbate conditions like hypertension, but fewer than 5% of households report any expenditure on these goods.

[6] How quickly do changes in diet and consumption of compounds like trans fats impact cardiovascular health? While there is ample evidence from laboratory studies and the medical literature about the relationship between diet and cardiovascular disease, there are also a handful of studies from economics that exploit trans fat bans to identify these effects. Studies in the United States and Denmark find that trans fats have reduce hospitalizations and mortality attributable to stroke and heart attacks, and that these effects begin to accrue within a year.[10][35][36]

are shown in Appendix Figure A3 and Appendix Table A2. I find a precisely estimated zero for changes in this variable. Future work will consider richer measures of labor supply, such as hours worked, and place of work (work outside the home vs. family/unpaid work inside the home) that may be more sensitive to income.

Changes in household composition (living arrangements) could also drive the results I observe for cognitive functioning. Any significant income effects on household arrangements, whereby less healthy individuals move into eligible households or healthier individuals move out, could lead to spurious declines in the regression discontinuity estimates for cognitive functioning. However, I argue this not the case. First, I find no significant change in household size. Second, I find no statistically or economically significant change in education or height - two factors positively associated with health and cognitive functioning. I interpret these results to mean that there are no changes in the composition of households that would mechanically drive down scores on the cognitive measures. (Further, if this was this case, it seems slightly suspect that scores would be lower only for two of the three measures of cognitive functioning.) The results are shown in Appendix Figure A3 and Appendix Table A2.

## 7 Heterogenous Effects by Insurance Status

To more convincingly link income effects on cardiovascular disease to cognition, I exploit differences in insurance coverage within my sample. I hypothesize that individuals with insurance coverage through formal social security programs like IMSS have more reliable access to medical care and thus can offset the detrimental income effects of cardiovascular disease on cognition. Said differently, they are able to access prescription drugs or other types of medical care to treat hypertension and buffer the impacts of high blood pressure on the brain.[7]

To estimate the differential impact of the transfer across insurance status, I estimate a regression discontinuity model that includes interactions between the running variable, $\mathbb{1}(Age_h \geq c)$, and a dummy for formal insurance coverage. I display the coefficients for $\mathbb{1}(Age_h \geq c)$ and $\mathbb{1}(Age_h \geq c) \times Insurance$ in Table 4 (cognitive measures) and Table 5 (cardiovascular disease markers). Table 4 shows that individuals with insurance do not experience declines in cognitive functioning for word recall or verbal fluency (summing the two coefficients yields the regression discontinuity estimate for insured populations). Moreover, insured individuals seem to experience an increase in the clock drawing test score, although I find it unlikely that there would be such a dramatic, causal impact on this particular measure of cognitive health and not others.

Further, in Table 5, I show that those with insurance are largely able to buffer the income effects on

[7] Approximately 30% of the sample is covered by “formal” systems of social security in Mexico, mainly IMSS. IMSS is available to workers in the formal sector and is funded from both employee and employer contributions. It provides both pensions and healthcare services. The other portion of the sample would not have access to these services, but would likely qualify for *Seguro Popular* (SP), a large scale public insurance program. While SP in theory provides fee care for most conditions, recent evaluations have found that the program suffers from problems such as prescription drug stock-out and poor provider retention. Both formally insured/uninsured individuals were eligible for the “70 y Más” pension program as long as they were age 70 and over and resided in eligible localities.

cardiovascular diseases. This is true for both measures of BMI and to some extent hypertension. While there is no difference in the hypertension variable that includes self report and biomarkers, there are substantial differences in the hypertension variable using only measured systolic and diastolic blood pressure. One interpretation of these results is that both formally insured and uninsured individuals experience income effects on cardiovascular conditions like high blood pressure, but insured individuals are able to somehow buffer the impact and manage their high blood pressure. One potential challenge to this interpretation, however, are the results for BMI that indicate there may not be equivalent income effects on obesogenic food consumption for this group in the first place. Future drafts will explore differences in the consumption by insurance status as well.

# 8 Discussion

## 8.1 Contextualizing Study Results and Contributions

This paper analyzes the effects of a large unconditional cash transfer from a non-contributory pension program on cognitive health, an important component of the public health research agenda for many low- and middle-income countries ill-equipped to deal with the large burden of dementia in the coming decades. My results show that these cash transfers may worsen cognition through effects on cardiovascular diseases like hypertension and obesity, likely driven by income effects on obesogenic food consumption.

I find significant impacts on cognitive measures of word recall and verbal fluency, both showing a 0.2 standard deviation decline. To gage the magnitude of this effect, I compare it to existing gradients in cognitive functioning by education. For example, individuals with 2 to 3 years of education score 0.6 and 1.9 words higher respectively on verbal fluency, relative to those individuals with no education. Thus, the regression discontinuity estimate of 1 fewer point on the verbal fluency score largely removes any benefit from modest investments of education (the average educational attainment in the sample is 2.3 years). Similarly, individuals with three years of education score 0.2 words higher on the recall summary measure, which is again largely erased by the income effect. (Individuals with 2 years of education do not have higher scores on the recall summary measure relative to those without education). This exercise highlights the possibility of growing chronic disease burdens in low- and middle- income countries to erode investments in human capital that have been the focus of a host of anti-poverty programs.

While the magnitude of the effect is large, other studies of income on cognition in LMICs have also found large effects. The Yucatán experiment finds a 14-40% improvement over the mean for various cognitive measures. In China, the non-contributory pension program increased "good cognitive functioning" by 18 percentage points (27%). Studies analyzing other socio-economic determinants of cognition (retirement, air pollution, and early life health) also find large effects. For example, Rohwedder and Willis' seminal paper on "mental retirement" finds retirement leads to a 1.5 standard deviation decline in cognitive functioning.[37] (The authors' identification strategy, like mine, exploits discontinuities in age eligibility for pensions.) Ailshire and Crimmins (2014) show moving from census tracts at the lowest quartile of air pollution to the third higher quartile of pollution in the U.S. lowers cognitive functioning by about 0.6 standard deviations.[4] Venkataramani (2012) studies the effect of a malaria eradication program on later-life cognitive performance in Mexico, and finds that eliminating malaria improves cognitive performance by 0.22 standard deviations.[45]

My findings aim to make important contributions. Notably, they contrast with the small handful of other studies from Mexico, China, and the United States that find positive effects of cash transfers on cognitive health. As such, the results contribute to our understanding public policy in low- and middle- income settings, as well as to more general understanding about the relationship between income and (cognitive) health. Future research could explore to what extent changes in program administration could lead to better health outcomes and improve welfare. For example, heterogenous effects by insurance status potentially suggest that resources could be better allocated to strengthening existing health insurance programs if the objective is to maximize population health. Given the high potential costs of cognitive impairment and dementia, this does not seem misplaced. Future research could also consider the role of conditionalities to incentivize healthier behaviors.

## 8.2 Limitations and Future Analyses

The paper is not without key limitations. First, I estimate the effect of the cash transfers using a regression discontinuity design, which has high internal validity and low external validity. While the results are robust to bandwidth and functional form specifications, they do not tell us about the effect of the program at older ages, which is a notable limitation given that cognitive abilities decline with age, and this gradient may be especially steep as we move farther and farther away from age 70. Second, it is not clear to what extent the results are replicable outside of Mexico. Mexico has an especially high chronic and cardiovascular burden; beneficiaries in other countries where the prevalence/incidence of hypertension and diabetes is lower may not respond in the same way to the transfer (marginal propensity to consume food may be lower, or physiological responses to changes in diet may be different).

The ENSANUT cognitive assessment is also limiting: it is not diagnostic of cognitive impairment or any sort of dementia. Thus, it is difficult to determine whether the decline in cognitive functioning I document in the paper represents an increase in risk for these more serious conditions. In future work, I plan to study the distributional impacts of the transfer to determine whether the cash transfer negatively affects those more likely to have lower or higher scores on the cognitive functioning measures. (Those with lower scores are more likely at risk of dementia or cognitive impairment at older ages).

Future drafts of the paper should also more carefully address competing mechanisms. For example, I use the lack of a discontinuity in currently working to rule out "mental retirement." However, this variable may not sufficiently capture changes in labor supply or other behaviors that contribute to the "mental retirement" phenomenon. For example, individuals may transition from work outside the home to home production (work inside the home). While still "currently working," such a transition may contribute to mental retirement if work at home is more sedentary and otherwise less stimulating than work outside the home. Additionally, pension recipients may adjust labor supply on the intensive margin as well. Future empirical work will analyze changes in hours, and type and place of work to more fully account for labor market transitions.

Finally, this paper's central claim is that the decline in cognitive functioning is attributable to change in cardiovascular diseases, and a key component of the analysis is heterogeneity by insurance status. While consistent with the hypothesis that cardiovascular diseases contribute to poor cognitive health, different results by insurance status could simply reflect heterogeneity by socio-economic status. Individuals of higher socioeconomic status may respond to the cash transfer differently. For example, they may have a lower marginal propensity to consume (obesogenic food), a higher marginal propensity to save, or engage in different health behaviors that offset the detrimental income effects. Future empirical work will examine these outcomes more thoroughly.

## 9 Conclusion

This study finds that large, unconditional cash transfers worsen the cognitive functioning of older individuals through income effects cardiovascular diseases and obesogenic food consumption. These results contrast with the limited extant work on cash transfers and health (particularly cognition) that until now have largely suggested beneficial effects of such transfer programs. The results make important contributions to understanding the effect of cash-based welfare programs targeting adults, such as non-contributory pension programs and universal basic income schemes. These are both increasingly popular policy levers to improve economic wellbeing across low- and middle- income countries. While these programs are varied in their benefits and administration, future research should endeavor to understand how their administration can be adapted to better foster wellbeing and economic security in the presence of negative spillovers on health.

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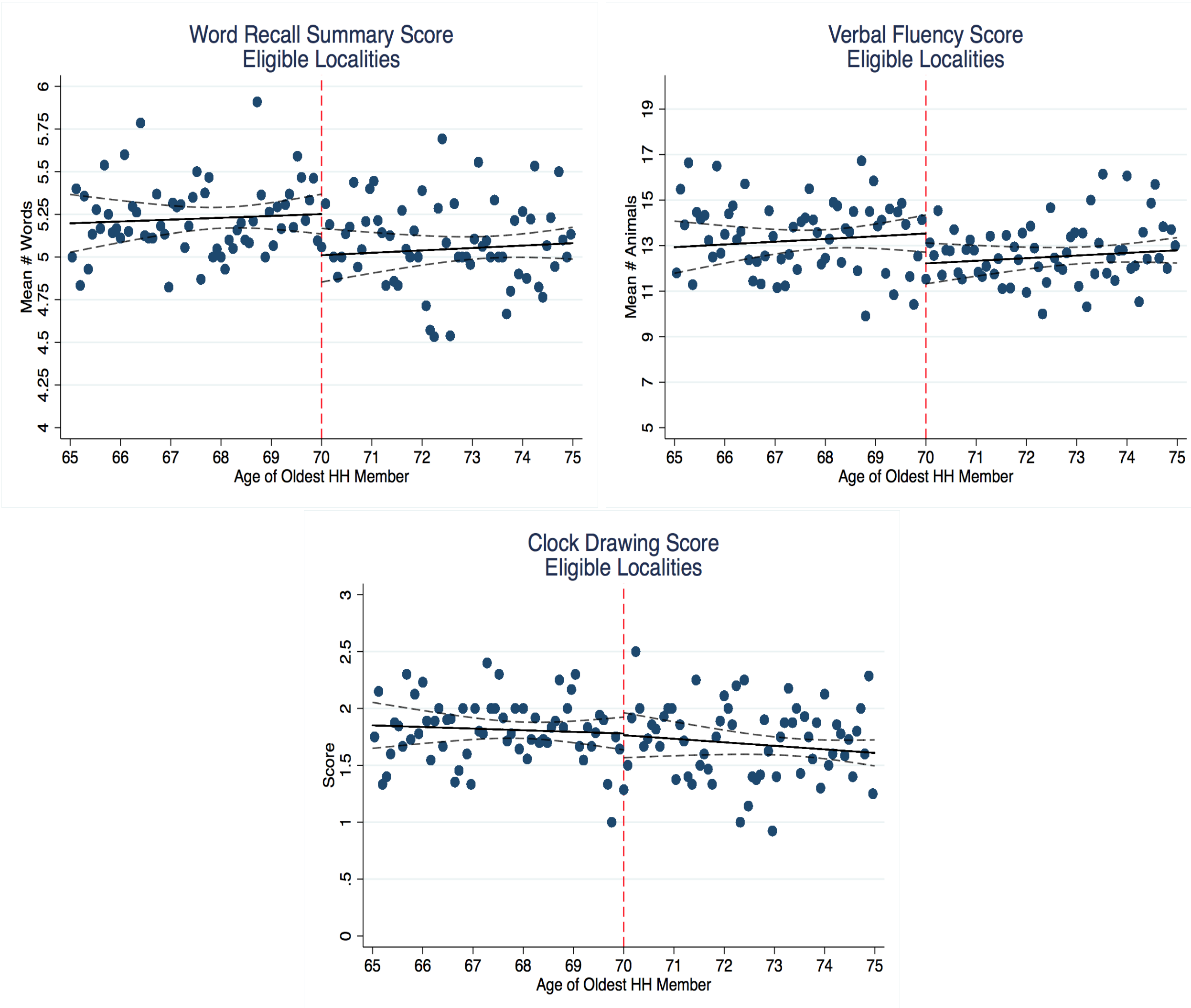
## 10 Tables and Graphs

Table 1: Sample Characteristics (ENSANUT)

| | Mean (Standard Deviation) |
|---|---|
| *Demographics* | |
| Age (years) | 77.0 |
| | (5.6) |
| Education (years) | 2.3 |
| | (3.0) |
| Female (0/1) | 0.52 |
| | (0.50) |
| Currently Working (0/1) | 0.28 |
| | (0.45) |
| Formally Insured | 0.31 |
| | (0.46) |
| 70 y Mas Pension (0/1) | 0.82 |
| | (0.38) |
| *Cognitive Measures* | |
| Immediate Word Recall (0-3) | 2.91 |
| | (0.41) |
| Delayed Word Recall (0-3) | 1.97 |
| | (0.97) |
| Word Recall Summary (0-6) | 4.89 |
| | (1.14) |
| Verbal Fluency (0-60) | 11.83 |
| | (5.69) |
| Clock Drawing Score (0-3) | 1.65 |
| | (0.85) |
| *Cardiovascular Disease Measures* | |
| Body Mass Index (kg/m2) | 27.04 |
| | (5.31) |
| Hypertension (Any) | 0.42 |
| | (0.49) |
| Hypertension (Measured) | 0.43 |
| | (0.47) |
| Observations | 2321 |

Data: ENSANUT (2012). Table displays descriptive statistics (means and standard deviations in parenthesis) for individuals ages 60-80 living in households with at least one member eligible for the “70 y Mas” pension program. Statistics are not weighted.

Figure 1. Regression Discontinuity Estimates for Cognitive Outcomes



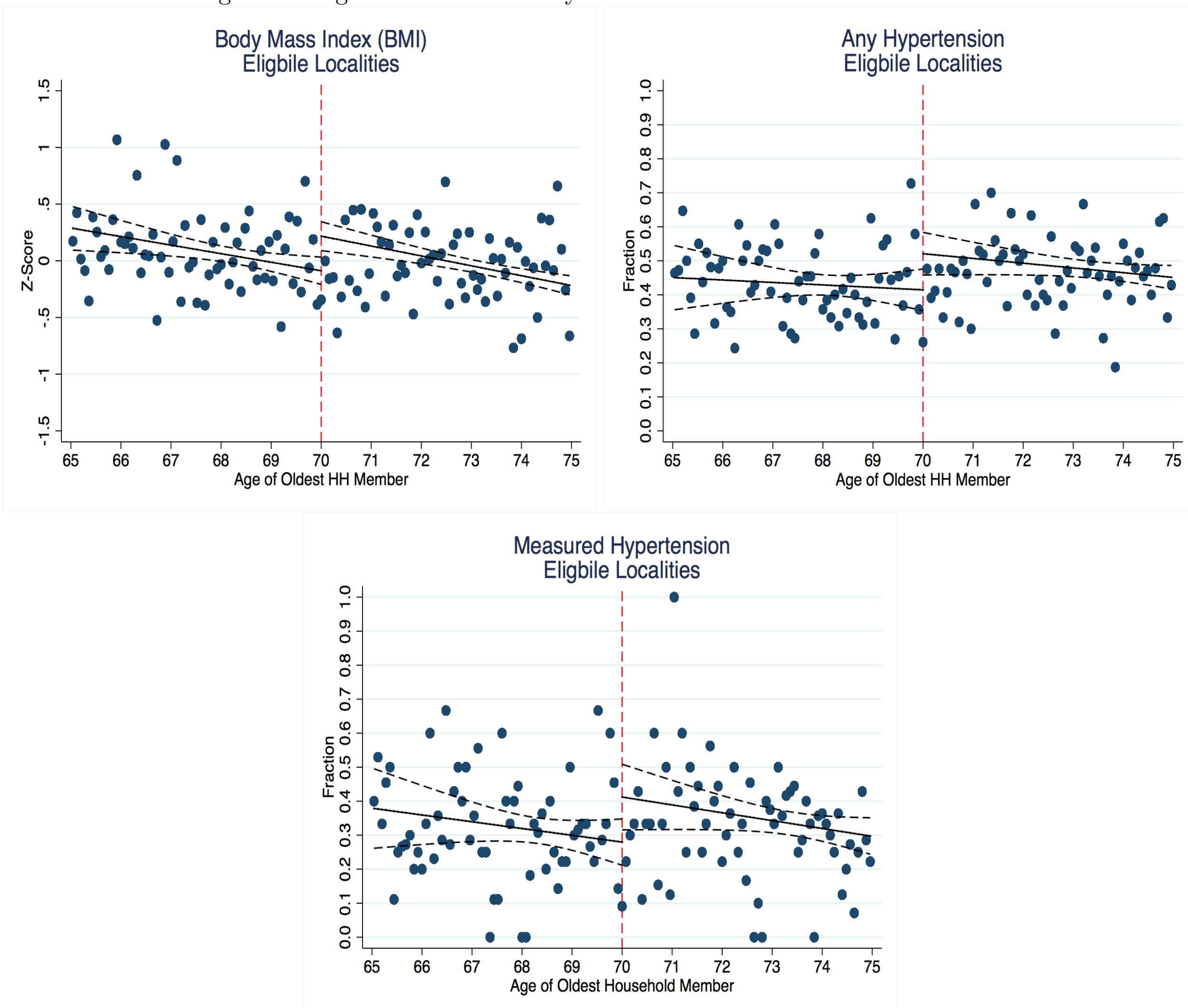

Data: ENSANUT (2012). Graph displays mean score by age of oldest household member for each cognitive measure. Solid lines are fitted values from linear specification of the running variable. Dashed lines are 95% confidence intervals, heteroskedastic and clustered robust.

Table 2: Regression Discontinuity Estimates for Cognitive Measures

| | Verbal Fluency Score | | Word Recall Summary Score | | Clock Drawing Score | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| $\mathbb{1}(Age_h \geq 70)$ | -1.019** | -0.880* | -0.181** | -0.181** | 0.0651 | 0.0811 |
| | (0.479) | (0.504) | (0.0802) | (0.0863) | (0.0990) | (0.106) |
| Observations | 2026 | 3638 | 2026 | 3638 | 1101 | 2014 |
| Bandwidth | 5 | 10 | 5 | 10 | 5 | 10 |
| Polynomial | Linear | Quadratic | Linear | Quadratic | Linear | Quadratic |
| Variable Mean | 12.60 | 12.77 | 5.13 | 5.14 | 1.74 | 1.77 |
| Variable SD | 5.37 | 5.44 | 0.97 | 0.98 | 0.82 | 0.83 |

Data: ENSANUT (2012). Table shows regression discontinuity estimates form global polynomial specifications. Standard errors (parenthesis) are heteroskedastic and cluster robust.
* p<0.1 ** p<0.05 *** p<0.01

Figure 2. Regression Discontinuity Estimates for Cardiovascular Diseases




Data: ENSANUT (2012), MxFLS (2009-2012). Graphs displays mean of dependent variable by age of oldest household member. Solid lines are fitted values from linear specification of the running variable. Dashed lines are 95% confidence intervals, heteroskedastic and clustered robust.

Table 3: Regression Discontinuity Estimates for Cardiovascular Diseases

| | Body Mass Index (BMI) | | Hypertenisve (Any) | | Hypertenisve (Measured) | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| $\mathbb{1}(Age_h \geq 70)$ | 0.253*** | 0.259*** | 0.106*** | 0.126*** | 0.0871* | 0.103* |
| | (0.0802) | (0.0880) | (0.0368) | (0.0390) | (0.0515) | (0.0557) |
| Observations | 2498 | 4515 | 2551 | 4670 | 1147 | 2065 |
| Bandwidth | 5 | 10 | 5 | 10 | 5 | 10 |
| Polynomial | Linear | Quadratic | Linear | Quadratic | Linear | Quadratic |
| Variable Mean | -0.02 | -0.00 | 0.42 | 0.41 | 0.34 | 0.33 |
| Variable SD | 1.16 | 1.17 | 0.49 | 0.49 | 0.47 | 0.47 |

Data: ENSANUT (2012), MxFLS (2009-2012). Table shows regression discontinuity estimates form global polynomial specifications. Standard errors (parenthesis) are heteroskedastic and cluster robust.
* p<0.1 ** p<0.05 *** p<0.01

Table 4: Regression Discontinuity Estimates for Cognitive Measures by Insurance Status

| | Verbal Fluency Score | | Word Recall Summary Score | | Clock Drawing Score | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| $\mathbb{1}(Age_h \geq 70)$ | -1.520*** | -1.247** | -0.218** | -0.172 | -0.122 | -0.120 |
| | (0.580) | (0.601) | (0.103) | (0.108) | (0.134) | (0.142) |
| $\mathbb{1}(Age_h \geq 70) \times Insured$ | 1.423 | 0.741 | 0.142 | -0.126 | 0.496** | 0.484** |
| | (1.084) | (1.149) | (0.168) | (0.180) | (0.208) | (0.220) |
| Observations | 2026 | 3638 | 2026 | 3638 | 1101 | 2014 |
| Bandwidth | 5 | 10 | 5 | 10 | 5 | 10 |
| Polynomial | Linear | Quadratic | Linear | Quadratic | Linear | Quadratic |
| Variable Mean | 12.63 | 12.72 | 5.13 | 5.12 | 1.74 | 1.76 |
| Variable SD | 5.37 | 5.44 | 0.97 | 0.99 | 0.82 | 0.83 |

Data: ENSANUT (2012). Table shows regression discontinuity estimates form various global polynomial regression specifications. Standard errors (parenthesis) are heteroskedastic and cluster robust.
* p<0.1 ** p<0.05 *** p<0.01

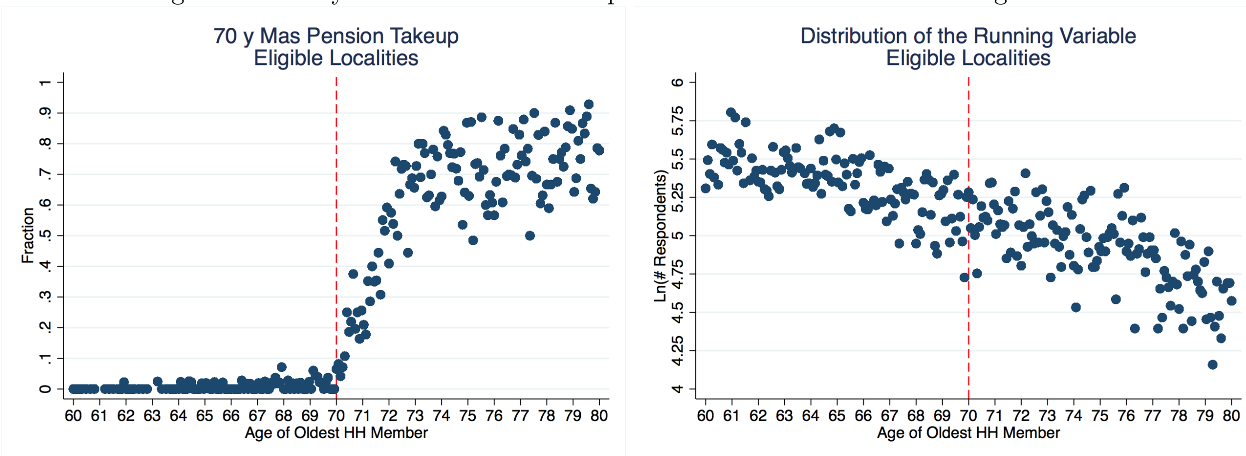
Table 5: Regression Discontinuity Estimates for Cardiovascular Disease by Insurance Status

| | Body Mass Index (BMI) | | Hypertenisve (Any) | | Hypertenisve (Measured) | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| $\mathbb{1}(Age_h \geq 70)$ | 0.322*** | 0.330*** | 0.111*** | 0.143*** | 0.113* | 0.143** |
| | (0.0912) | (0.0991) | (0.0418) | (0.0442) | (0.0590) | (0.0635) |
| $\mathbb{1}(Age_h \geq 70) \times Insured$ | -0.305 | -0.350 | -0.00492 | -0.0461 | -0.148 | -0.214 |
| | (0.213) | (0.229) | (0.112) | (0.120) | (0.165) | (0.176) |
| Observations | 2498 | 4515 | 2551 | 4670 | 1147 | 2065 |
| Bandwidth | 5 | 10 | 5 | 10 | 5 | 10 |
| Polynomial | Linear | Quadratic | Linear | Quadratic | Linear | Quadratic |
| Variable Mean | -0.04 | -0.04 | 0.42 | 0.41 | 0.34 | 0.33 |
| Variable SD | 1.17 | 1.19 | 0.49 | 0.49 | 0.47 | 0.47 |

Data: ENSANUT (2012), MxFLS(2009-2012). Table shows regression discontinuity estimates form various global polynomial regression specifications. Standard errors (parenthesis) are heteroskedastic and cluster robust.
* p<0.1 ** p<0.05 *** p<0.01

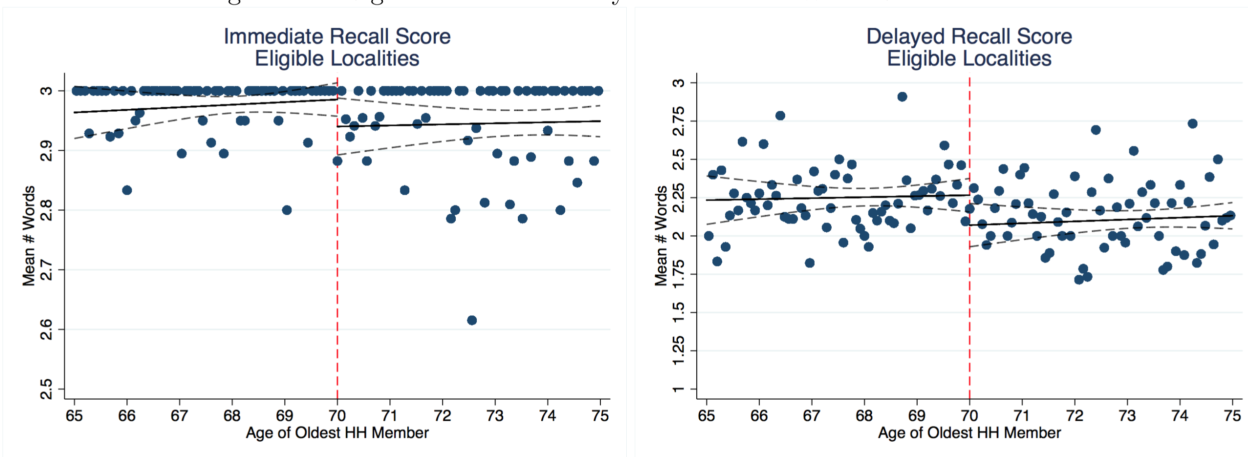
# 11 Appendix Tables and Figures

Figure A1. “70 y Más” Pension Take Up and Distribution of the Running Variable




Data: ENSANUT (2012), MxFLS(2009-2012). Graphs displayes mean takeup of “70 y Más” at the household level (left) and distribution of the running variable (right).

Figure A2. Regression Discontinuity Estimates for Word Recall Measures



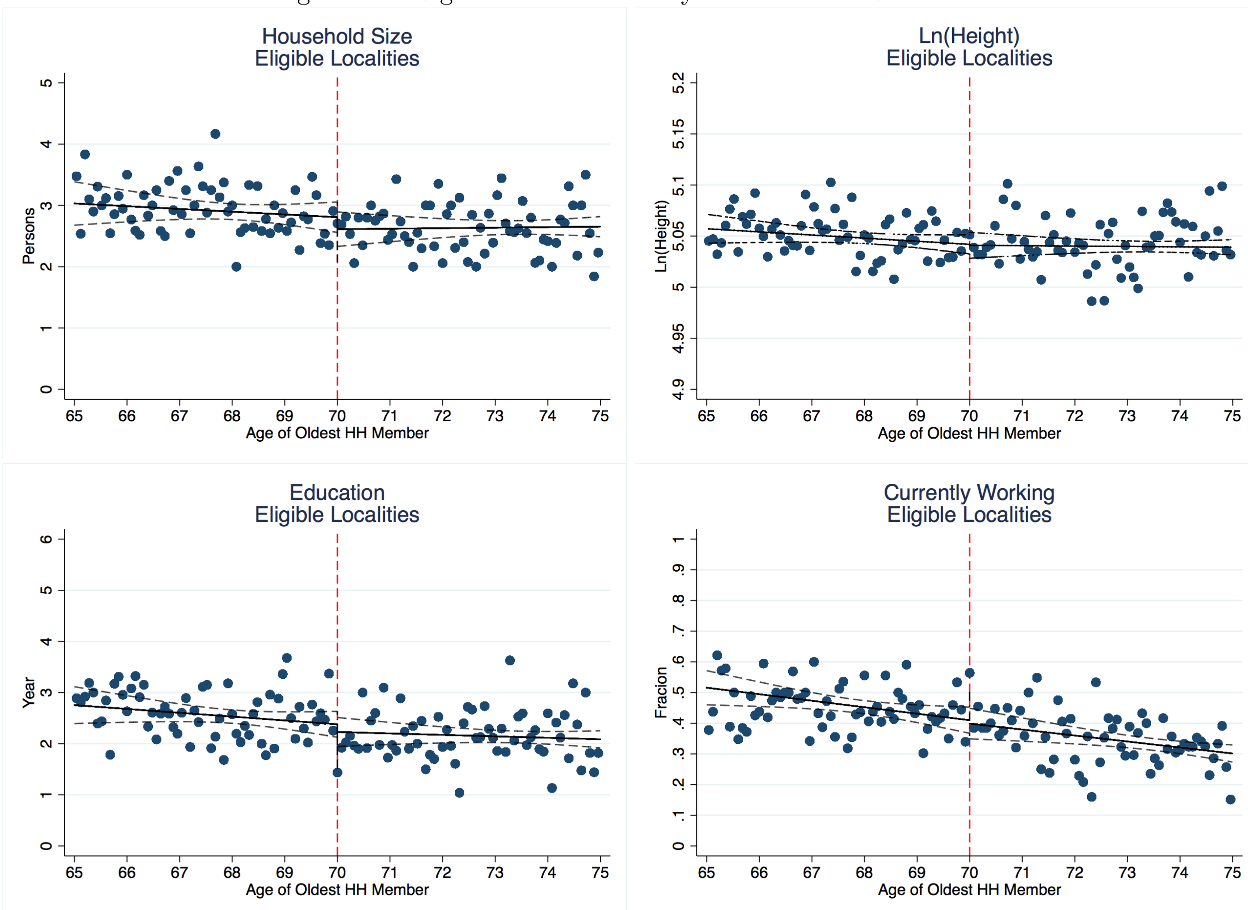

Data: ENSANUT (2012). Graphs shows scatter plot of mean dependent variable by age of oldest household member. Sample limited to individuals ages 60 to 80. Solid line is the fitted values from global polynomial regression with quadratic specification of the running variable. Dotted lines are 95% confidence intervals, heteroskedastic and clustered robust.

Table A1: Regression Discontinuity Estimates for Word Recall Measures

| | Immediate Recall Score | | Delayed Recall Score | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| $\mathbb{1}(Age_h \geq 70)$ | -0.0417** | -0.0424* | -0.133* | -0.132 |
| | (0.0206) | (0.0224) | (0.0748) | (0.0804) |
| Observations | 2026 | 3638 | 2026 | 3638 |
| Bandwidth | 5 | 10 | 5 | 10 |
| Polynomial | Linear | Quadratic | Linear | Quadratic |
| Variable Mean | 2.96 | 2.96 | 2.17 | 2.18 |
| Variable SD | 0.26 | 0.28 | 0.88 | 0.88 |

Data: ENSANUT (2012). Table shows regression discontinuity estimates form global polynomial specifications. Standard errors (parenthesis) are heteroskedastic and cluster robust.
* p<0.1 ** p<0.05 *** p<0.01

Figure A3. Regression Discontinuity Estimates for Covariates



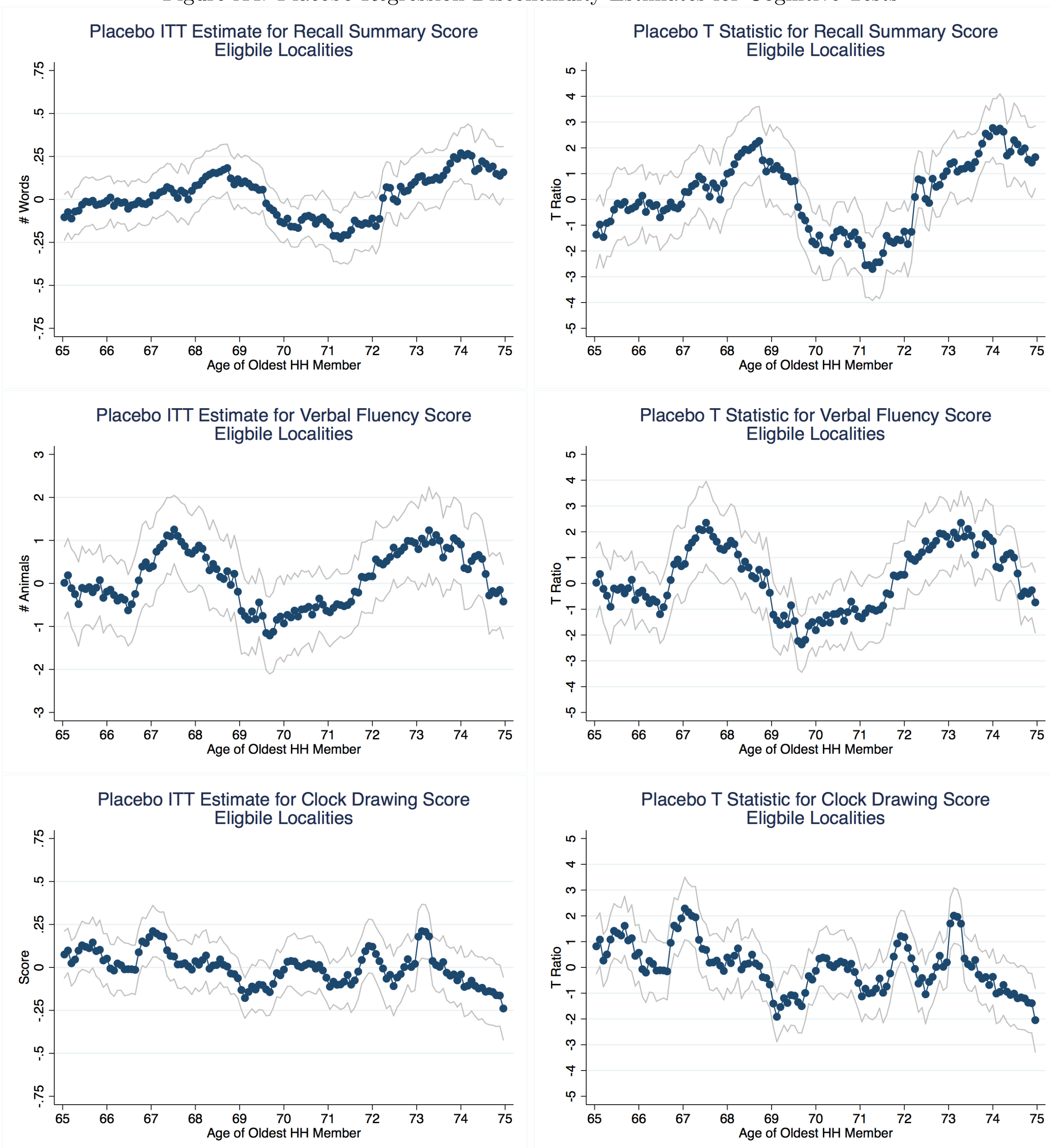

Data: ENSANUT (2012). Graphs shows scatter plot of mean dependent variable by age of oldest household member. Sample limited to individuals ages 60 to 80. Solid line is the fitted values from global polynomial regression with quadratic specification of the running variable. Dotted lines are 95% confidence intervals, heteroskedastic and clustered robust.

Table A2: Regression Discontinuity Estimates for Covariates

| | HH Size | | Education | | Ln(Height) | | Working | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| $\mathbb{1}(Age_h \geq 70)$ | -0.145 | -0.172 | -0.372 | -0.297 | 0.00731 | 0.0104 | -0.00705 | -0.00189 |
| | (0.164) | (0.173) | (0.326) | (0.339) | (0.00710) | (0.00797) | (0.0421) | (0.0451) |
| Observations | 2026 | 3628 | 2026 | 3628 | 2026 | 3628 | 2026 | 3628 |
| Bandwidth | 5 | 10 | 5 | 10 | 5 | 10 | 5 | 10 |
| Polynomial | Linear | Quadratic | Linear | Quadratic | Linear | Quadratic | Linear | Quadratic |
| Variable Mean | 2.69 | 2.72 | 2.67 | 2.87 | 5.04 | 5.04 | 0.40 | 0.41 |
| Variable SD | 1.69 | 1.71 | 3.24 | 3.38 | 0.08 | 0.08 | 0.49 | 0.49 |

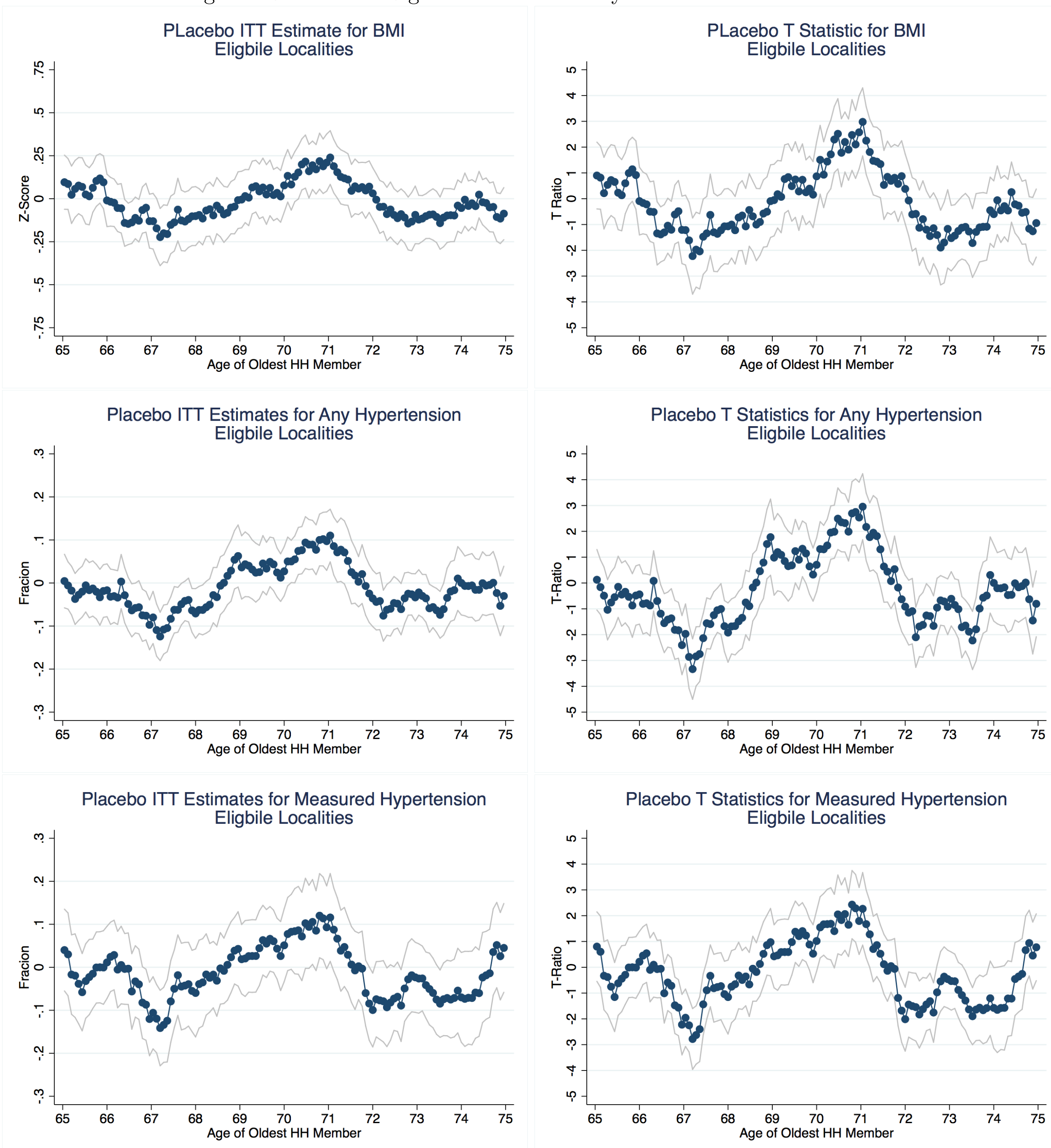
Data: ENSANUT (2012).Table shows RD (regression discontinuity) estimands form various local linear and global polynomial regression specifications. Local linear regressions estimated with various bandwidth selection procedures: (1) “CCT” - Cattaneo, Calonico, Titiunik (2014); (2) “IK” - Imbens, Kalyanaraman (2012); (3) “‘CV” - Cross validation approach used by Ludwig, Miller (2007).
* p<0.1 ** p<0.05 *** p<0.01

Figure A4. Placebo Regression Discontinuity Estimates for Cognitive Tests



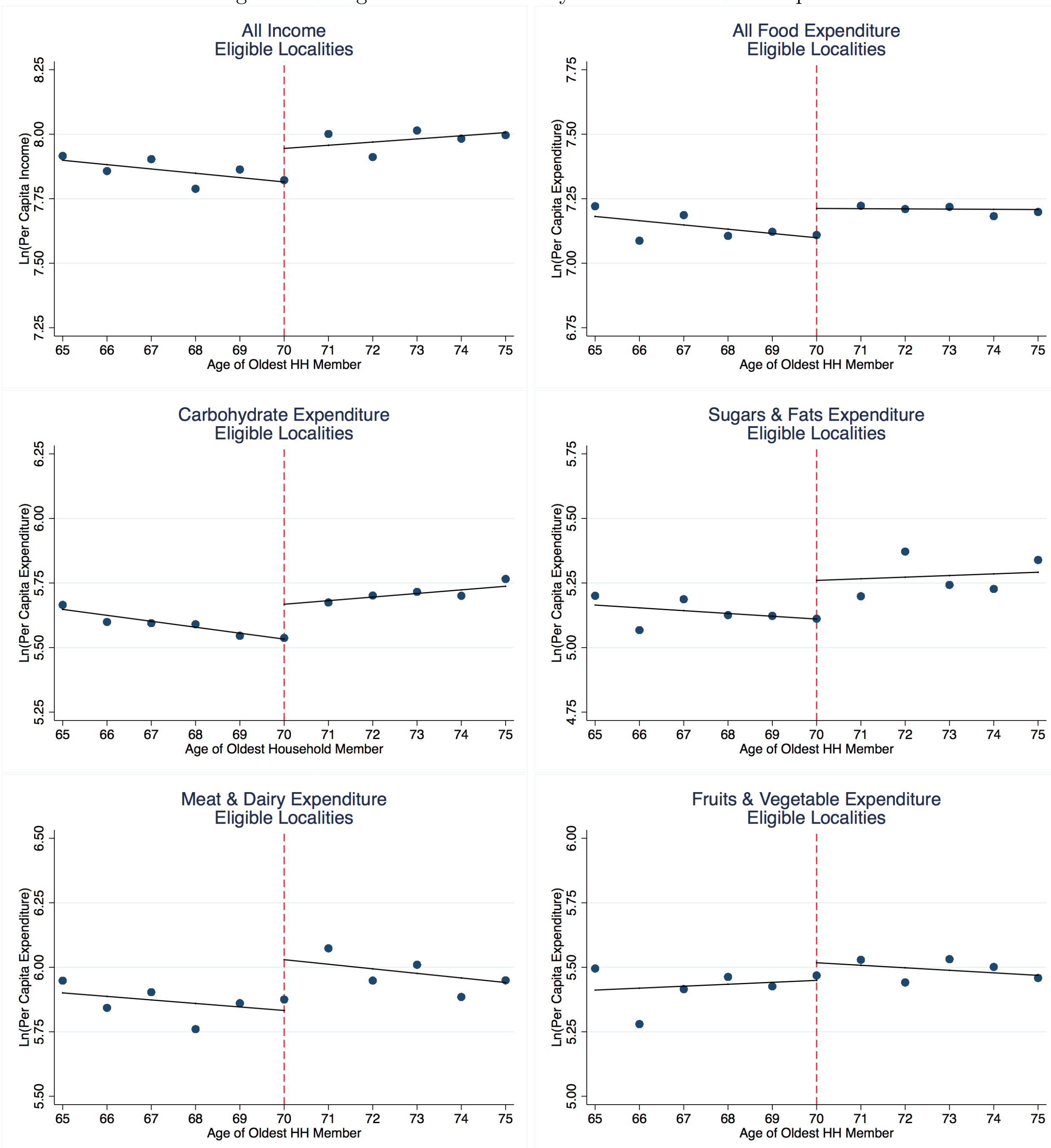

Data: ENSANUT (2012). Graph displays the regression discontinuity estimate for placebo ages and bootstrapped confidence interval.

Figure A5. Placebo Regression Discontinuity Estimates for Biomarkers




Data: ENSANUT (2012), MxFLS (2009-2012). Graph displays the regression discontinuity estimate for placebo ages and bootstrapped confidence interval.

Figure. A6 Regression Discontinuity Estimates for Consumption




Data: ENIGH (2008-2012). Graphs displays mean dependent variable (food consumption by category) by age of oldest household member. Solid lines are fitted values from linear polynomial specification of the running variable.

Table A3: Regression Discontinuity Estimates for Income and Consumption

| | Income | All Food | Sugars/Fats | Meat/Dairy | Carbohydrates | Fruits/Vegetables |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| *Polynomial Specification* | | | | | | |
| Linear | 0.111** | 0.118*** | 0.163*** | 0.169*** | 0.166*** | 0.002 |
| | (0.042) | (0.041) | (0.059) | (0.044) | (0.056) | (0.054) |
| | [0.0400] | [0.039] | [0.023] | [0.002] | [0.068] | [0.964] |
| Observations | 3192 | 3132 | 2557 | 2847 | 2997 | 2845 |
| Bandwidth | 5 | 5 | 5 | 5 | 5 | 5 |
| Quadratic | 0.107** | 0.159*** | 0.136** | 0.217*** | 0.199*** | 0.069 |
| | (0.049) | (0.045) | (0.060) | (0.056) | (0.066) | (0.073) |
| | [0.064] | [0.004] | [0.055] | [0.001] | [0.064] | [0.402] |
| Observations | 5846 | 5752 | 4749 | 5280 | 5514 | 5266 |
| Bandwidth | 10 | 10 | 10 | 10 | 10 | 10 |

Data: ENIGH (2008, 2010, 2012). Table shows regression discontinuity estimates form global polynomial specifications. Dependent variable is log of per capita household income or expenditure for a given food group. Heteroskedastic- and cluster-robust standard errors in parenthesis. Wild bootstrap p-value in brackets.

* p<0.1 ** p<0.05 *** p<0.01