Changes in Nutrition at Retirement

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Motivation

Concerns over the adequacy of retirement savings

- Decline in the aggregate savings rate (e.g., Parker 1999)
- Shift from defined benefit to defined contribution pensions (e.g., Poterba 2014)
- Lack of retirement planning and financial sophistication (e.g., Lusardi and Mitchell 2007)

Multiple approaches for testing the adequacy of retirement savings based on the Life-Cycle/Permanent Income Hypothesis (LCPIH)

- Comparing pre-retirement income to post-retirement annuitized income (e.g., Moore and Mitchell 1997; Gustman and Steinmeier 1998)
- Comparing simulated and observed wealth levels (e.g., Engen, Gale, and Uccello 1999; Scholz, Seshadri, and Khitatrakun 2006)
- Examining changes in consumption at retirement (e.g., Banks, Blundell, and Tanner 1998; Bernheim, Skinner, and Weinberg 2001; Haider and Stephens 2007)

Evidence across all approaches that at least some households are inadequately prepared for retirement.

Motivation

Aguiar and Hurst (2005) question using retirement expenditure changes

- The LCPIH implies that households smooth the marginal utility of consumption, not necessarily expenditures, at retirement
- Large increase in available time for home production (à la Becker (1965)) at retirement can allow households to "smooth" with lower expenditures.
- They find evidence of an increase in time engaged in home production following retirement and a decrease in food expenditure at retirement.
- Caloric intake and their indices which relate reported food intake to permanent income do not fall at retirement.

Interestingly, their cross-sectional data spans the early 1990s when the drop in expenditure at retirement is smaller than in earlier years (Haider and Stephens 2007).

What We Do

We use multiple complementary empirical methods

1. Follow Aguiar and Hurst by using cross-sectional data but extend the time frame from 1989-1996 to 1971-2012.
2. Use longitudinal intake data which allows us to estimate specifications analogous to Euler Equations.

We consistently find that intake falls at retirement.

We attribute our differences with A&H in 1. to survey design and implementation issues that affected the data they use in their analysis.

Cross-Sectional Datasets

Continuing Survey of Food Intake of Individuals (CSFII)

- Data used by Aguiar and Hurst (2005)
- Fielded in 1989-1991 and 1994-96
- 1989-91: 24 hour recall for 1st day and recall for two more days
- 1994-96: 24 hour recall for two days

Nationwide Food Consumption Survey (NFCS)

- Fielded in 1977-78 and 1987-88
- 24 hour recall for 1st day and recall for two more days

These surveys collect a wide range of information including food expenditure, demographic, health, and labor market data.

- 1965-66 NFCS was the first survey to collect individual intake but labor market information is insufficient.

Cross-Sectional Datasets

National Health and Nutrition Examination Survey (NHANES)

- Fielded across many years: NHANES I (1971-75), NHANES II (1976-1980), NHANES III (1988-94)
- Combined with the CSFII to create Continuing NHANES (1999-2012)
- Well-known health survey that also collects food intake using 24 hour recall
- One day of food intake through 2003; since collect two days of intake
- Began collecting food expenditure information in 2007
- Also collect food demographic, health, and labor market data

Summary Statistics

Cross-Sectional Empirical Methodology

Using males ages 57-71, we estimate

$$y_i = \gamma R_i + \mathbf{X}_i \boldsymbol{\beta} + \epsilon_i \tag{1}$$

where

y_i is a measure food intake (calories or food expenditure),

R_i is an indicator for retirement status, and

$\mathbf{X}_i$ includes indicators for male, black, education, household size, self-reported health, and survey-specific calendar year effects

One concern is that ϵ_i may be correlated with R_i in (1)

- E.g., more impatient individuals accumulate less wealth and retire sooner yielding a spurious negative correlation between food intake and retirement

Following prior literature, we use the non-linear relationship between age and retirement driven by the early and normal Security retirement ages

$$R_i = \psi \mathbf{age_i} + \mathbf{X}_i \boldsymbol{\delta} + u_i \tag{2}$$

where $\mathbf{age_i}$ is a vector of age indicators

- Note that there is not a linear age term in (1)
- Applying 2SLS yields the effect of expected retirement on food intake

Table 2: Impact of Retirement on Caloric Intake

	A&H Result (1)	Adjusted Replication (2)	Pooling Studies (3)
B. 2SLS			
Retired	-0.02	-0.021	-0.175
	(0.03)	(0.047)	(0.031)
N	*2,052*	*1,654*	*9,610*

Replication using CSFII only yields similar findings to Aguiar and Hurst

However, pooling all cross-sectional datasets yields significant drop

Table 3: Impact of Retirement on Caloric Intake by Individual Survey

	NHANES I (1)	NHANES II (2)	NFCS 1977-78 (3)	NFCS 1987-88 (4)	NHANES III (5)	CSFII 1989-91 (6)	CSFII 1994-96 (7)	Continuous NHANES (8)
B. 2SLS								
Retired	-0.180	-0.237	-0.203	0.030	-0.221	0.034	-0.089	-0.205
	(0.087)	(0.050)	(0.035)	(0.088)	(0.077)	(0.073)	(0.059)	(0.055)
1st stage F-stat	24.2	28.1	30.3	13.2	19.5	13.0	23.5	18.5
N	*570*	*1,938*	*1,181*	*490*	*1,395*	*607*	*1,047*	*2,382*

Five of eight datasets yield point estimates comparable to pooled estimate

Two yield positive and insignificant effects: NFCS 87-88 and CSFII 89-91

One yields negative and insignificant effect: CSFII 84-96

Age Profiles of Caloric Intake

Intake Survey Methodological Issues

1991 GAO report raised concerns about 1987-88 NFCS

- Household response rate of 34 percent
- Three hour interview with very little compensation
- Contractor failed to follow sampling design + high interviewer turnover
- Expert panel subsequently convened: "does not recommend use of the data from the 1987-88 NFCS."

USDA subsequently implemented a major redesign

- From three to two days of intake (now all 24 hour recall)
- Restructured recall methodology
- Greatly reduced proxy reporting
- First implemented with 1994-96 CSFII:
  1989-91 CSFII used same intake methodology as 1987-88 NFCS
- Also changed contractors between 1989-91 CSFII and 1994-96 CSFII

Survey Response Rates

Cohort/Time Period Effect?

One alternative to the "data issues" rationalization is a cohort/time period story affecting estimates using the 1987-88 NFCS and 1989-91 CSFII

- S.S. notch? Not likely

NHANES III (1988-94) fielded contemporaneously

- Redesigned between NHANES II and NHANES III: Moved from paper and pencil to computer aided
- Yields a large and significant drop in intake at retirement

Table 4: Impact of Retirement on Nutrient Intake in Cross-Sectional Data

Surveys Used:	All Surveys Except NFCS 87-88 and CSFII 89-91		Both Waves of CSFII	
	(1)	(2)	(3)	(4)
Log Calories	-0.206		-0.021	
	(0.034)		(0.047)	
Log Vitamin A	0.068	0.215	0.366	0.383
	(0.082)	(0.080)	(0.130)	(0.117)
Log Vitamin C	0.122	0.276	0.328	0.348
	(0.099)	(0.097)	(0.120)	(0.105)
Log Vitamin E	-0.174	-0.009	0.108	0.131
	(0.078)	(0.072)	(0.090)	(0.072)
Log Calcium	-0.080	0.088	0.048	0.067
	(0.045)	(0.040)	(0.076)	(0.059)
Log Cholesterol	-0.192	-0.026	-0.061	-0.042
	(0.064)	(0.060)	(0.073)	(0.066)
Log Saturated Fat	-0.236	-0.043	-0.119	-0.094
	(0.059)	(0.039)	(0.064)	(0.044)
Log Protein	-0.189	-0.038	-0.082	-0.065
	(0.036)	(0.028)	(0.051)	(0.031)
Calories Control?	No	Yes	No	Yes

Longitudinal Data

Multiple Risk Factor Intervention Trial for the Prevention of Coronary Heart Disease (MRFIT)

- 13,000 men ages 35 to 58 in 1973 and interviewed over the next six to eight years.
- Collected demographic, labor market, and health data; also 24 hour recall
- Two observations with job and food intake data: baseline and six years later

MRFIT was a “bundled” treatment for coronary heart disease

- Treatment for hypertension, smoking cessation advice, and counseling on lowering cholesterol
- We use only the controls; roughly half of the sample
- Limit sample to those 47 to 58 at initial interview (53 to 64 six years later)
- Examine income (categorical) and caloric intake

Longitudinal Empirical Methodology

Based on the Euler Equation, we estimate

$$\Delta y_{it} = \gamma R_{it} + \Delta \mathbf{X}_{it} \boldsymbol{\beta} + e_{it} \tag{3}$$

where

Δy_i is the change in caloric intake between survey waves,
R_i is an indicator for retiring between survey waves, and
$\Delta \mathbf{X}_{it}$ includes an indicator for change in marital status

We account for endogenous retirement in two ways

- We include changes in health conditions in some specifications (high blood pressure, heart disease, stroke, diabetes, and cancer)
- We again instrument for retirement using age indicators

Longitudinal specification has multiple benefits.

- Accounts for fixed unobserved heterogeneity across individuals
- If there is a linear relationship between age and the level of caloric intake, it enters the constant term of the differenced equation
- Thus, the effect of retirement on caloric intake is from the non-linear age-retirement relationship

Table 5: The Impact of Retirement on Income and Caloric Intake in MRFIT

A. Cross-Sectional Analysis		
$y_i = \gamma R_i + \mathbf{X}_i \boldsymbol{\beta} + \epsilon_i$		
	OLS	2SLS
Outcome:		
Log Income	-0.212	-0.584
	(0.025)	(0.094)
Log Caloric Intake	-0.020	-0.389
	(0.025)	(0.084)
First Stage F-stat		23.3
B. Longitudinal Analysis		
$\Delta y_{it} = \gamma R_{it} + \Delta \mathbf{X}_{it} \boldsymbol{\beta} + e_{it}$		
	OLS	2SLS
Outcome:		
Log Income	-0.231	-0.492
	(0.028)	(0.107)
Log Caloric Intake	-0.016	-0.174
	(0.025)	(0.097)
First Stage F-stat		24.7

First Stage Estimates

Conclusions

We use complementary empirical methods to assess the change in intake at retirement

1. Expand cross-sectional data to 1971-2012
2. Use longitudinal data on caloric intake
   Across multiple methods, we find that intake falls at retirement

We can reconcile tour findings with those of Aguiar and Hurst (2005)

- Changes in data quality are quite important

Do our findings contradict the role of household production at retirement?

- Not at all; but these shifts may be a response to a failure to prepare for retirement rather than part of an optimal

Our findings are consistent literature showing widespread lack of financial literacy and retirement planning

An Index of Food Intake

- Our analysis until this point only examines caloric intake
  - Calories could remain constant even if quality of diet declined
  - Caloric needs may fall at retirement even if relative quality is unchanged
- Aguiar and Hurst link a food intake index to the optimization problem
  - C is an aggregator function of J home produced goods

    $$C = C(c_1, \ldots, c_J)$$

    where c_j depends upon market spending, s_j, and time, h_j, for each good
  - Assuming C and L are otherwise additively separable and

    $$u(C_t; \boldsymbol{\theta_t}) = \frac{C^{1-\sigma}}{1-\sigma} e^{\boldsymbol{\theta_t}} \tag{4}$$

    yields the expression (where S_t is total spending on market goods)

    $$\frac{C^{1-\sigma}}{S_t} e^{\boldsymbol{\theta_t}} = \lambda_t \tag{5}$$

An Index of Food Intake

$$\frac{C^{1-\sigma}}{S_t} e^{\boldsymbol{\theta_t}} = \lambda_t \tag{5}$$

- They approximate λ_t using permanent income, age, and hours of work

$$\ln(\lambda_t) \approx \psi_0 + \psi_1 \ln(y^{perm}) + \psi_2 age_t + \psi_3 age_t^2 + \psi_4 hours_t + \psi_5 hours_t^2 \tag{6}$$

  where y^{perm} is permanent income

- Inserting this expression into (5) and taking logs yields

$$\begin{aligned} \ln(y^{perm}) = {} & \beta_0 + \alpha_1 c_1 + \ldots + \alpha_J c_J + \beta_S \ln S_t + \boldsymbol{\beta_{\theta_t} \theta_t} \\ & + \beta_{age} age_t + \beta_{age^2} age_t^2 + \beta_{hours} hours_t + \beta_{hours^2} hours_t^2 + \varepsilon_t \end{aligned} \tag{7}$$

  where $\alpha_1 c_1 + \ldots + \alpha_J c_J$ is a linear approximation of $(\sigma - 1) \ln C$.

  Aguiar and Hurst use reported food intake as measures of the c_j.

  - Calories, seven nutrients, and nearly 80 food category indicators

An Index of Food Intake

$$\ln(y^{perm}) = \beta_0 + \alpha_1 c_1 + \ldots + \alpha_J c_J + \beta_S \ln S_t + \boldsymbol{\beta_{\theta_t} \theta_t}$$
$$+ \beta_{age}\, age_t + \beta_{age^2}\, age_t^2 + \beta_{hours}\, hours_t + \beta_{hours^2}\, hours_t^2 + \varepsilon_t \quad (7)$$

They estimate (7) using full-time workers ages 25 to 55

- Permanent income should be approximated by (6) for these workers
- The first order condition (5) should hold for these households

We use three alternative approaches for estimating (7)

1. Replace $\ln(y^{perm})$ with $\ln(y^{observed})$ in (7) since, theoretically, the regressors should only be correlated with the permanent component of income.
2. Predict $\ln(y^{perm})$ by regressing $\ln(y^{observed})$ on permanent income measures (occupation, education, their interactions, and sex and race interactions)
3. Replace $\ln(y^{perm})$ with $\ln(y^{observed})$ in (7) but then instrument for S_t using permanent income measures

Then estimate effect of retirement on $\ln \hat{C} = \hat{\alpha}_1 c_1 + \ldots + \hat{\alpha}_J c_J + \hat{\beta}_S \ln S_t$

Bonus Table 1: Impact of Retirement on Predicted Consumption Index

$\ln \hat{C} = \gamma R_i + \mathbf{X}_i \boldsymbol{\beta} + \epsilon_i$	OLS	2SLS
Method of Creating $\ln \hat{C}$:		
No Instruments	-0.028	-0.061
	(0.015)	(0.049)
Instrument for $\ln(y^{perm})$	0.002	0.007
	(0.007)	(0.019)
Instrument for S	-0.071	-0.175
	(0.030)	(0.084)

Notes - The estimation sample is restricted to heads of household ages 57 to 71 using male household heads. The sample consists of 4,382 observations from the Food Expenditure Surveys (CSFII 1989-91 and 1994-96, NFCS 1977-78 and 1987-88, and NHANES 2007-12). Estimates are generated using sampling weights. Huber/White/sandwich standard errors are clustered at the survey*PSU level.

Alternative Index

- As an alternative, we project expenditure on food intake

$$\begin{aligned}\ln(S) = {} & \beta_0 + \alpha_1 c_1 + \ldots + \alpha_J c_J + \beta_S \ln S_t + \boldsymbol{\beta_{\theta_t}} \boldsymbol{\theta_t} \\ & + \beta_{age}\, age_t + \beta_{age^2}\, age_t^2 + \beta_{hours}\, hours_t + \beta_{hours^2}\, hours_t^2 + \varepsilon_t\end{aligned}$$

- Then estimate effect of retirement on $\ln \hat{S} = \hat{\alpha}_1 c_1 + \ldots + \hat{\alpha}_J c_J + \hat{\boldsymbol{\beta}}_{\boldsymbol{\theta_t}} \boldsymbol{\theta_t}$

Bonus Table 2: Impact of Retirement on Predicted Expenditure Index

$$\ln \hat{S} = \gamma R_i + \mathbf{X}_i \boldsymbol{\beta} + \epsilon_i$$

	OLS	2SLS
Method of Creating $\ln \hat{S}$:		
No Instruments	-0.006	-0.049
	(0.008)	(0.017)

Notes - The estimation sample is restricted to heads of household ages 57 to 71 using male household heads. The sample consists of 3,704 observations from the Food Expenditure Surveys (CSFII 1989-91 and 1994-96, NFCS 1977-78 and 1987-88, and NHANES 2007-10). Estimates are generated using sampling weights. Huber/White/sandwich standard errors are clustered at the survey*PSU level.

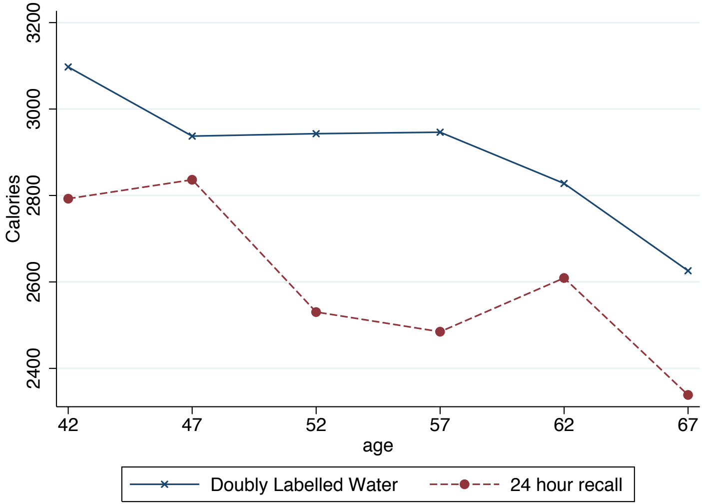
Underreporting in Food Intake Surveys

- Substantial evidence that food intake is underreported
- For calorie and protein intake, there are validated biomarkers for intake.
  - Collect biomarker samples and reported food intake over multiple weeks (Bingham 1994; Bingham 2003; Livingstone and Black 2003)
- Caloric intake biomarker is doubly labelled water
  - Subjects are given water with deuterium, which is excreted in water only, and oxygen 18 which is excreted in both water and carbon dioxide.
  - Urine samples collected over two weeks determine the loss of these items from the body which, in turn, can be used to determine calorie expenditure through information on carbon dioxide production.
  - "Gold standard" (Livingstone and Black 2003)
- Protein intake biomarker is total urinary nitrogen
  - Collect respondent's urine over a twenty-four hour period
  - Nitrogen content of urine yields a measure of protein intake (Isaksson 1980)

Underreporting in Food Intake Surveys

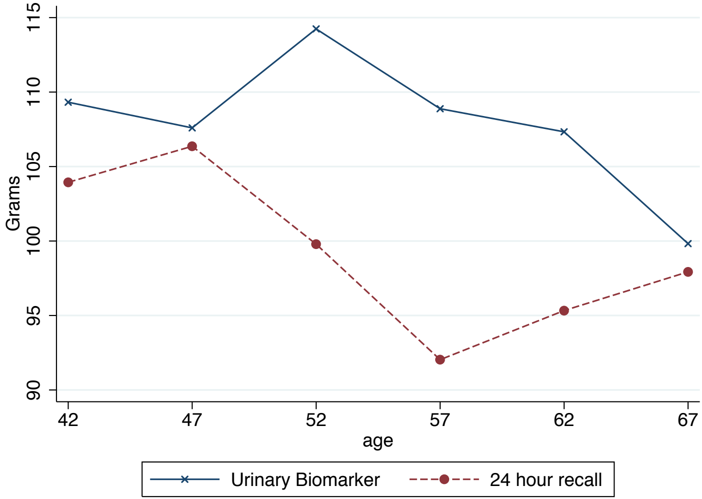
- Consistent finding: Underreporting is associated with BMI
- For our analysis, concern if age is systematically related to underreporting.
  - Age indicators are used to instrument for retirement
  - Additional time when retired may be used to more accurately report intake
  - If so, 2SLS estimates will underestimate drop in caloric intake at retirement
- We examine the relationship between underreporting and age
  - Use the Observing Protein and Energy Nutrition (OPEN) study which is one of the largest studies to collect intake biomarkers (Subar et al 2003)
  - Collected doubly labelled water and 24 hour urinary nitrogen from 484 individuals between the ages of 40 and 69, 261 of whom were male
  - Collected food intake using 24 hour recall
  - While OPEN did not collect labor force status information, we can examine the relationship between underreporting and age

Figure 2: Biomarker vs. Self-Reported Calories



Slope at ages 57-69: Self-report -17.1; Biomarker -44.4

Figure 3: Biomarker vs. Self-Reported Protein



Slope at ages 57-69: Self-report 0.3; Biomarker -1.6

Table 1: Cross-Sectional Data Summary Statistics

	Pooled Studies (1)	NHANES I (2)	NHANES II (3)	NFCS 1977-78 (4)	NFCS 1987-88 (5)	NHANES III (6)	CSFII 1989-91 (7)	CSFII 1994-96 (8)	Continuous NHANES (9)
Age	63.4	63.0	63.3	63.4	63.7	63.7	64.1	63.8	63.3
Black	0.09	0.08	0.08	0.09	0.05	0.08	0.11	0.09	0.09
Hhld Size	2.26	2.36	2.30	2.39	2.41	2.32	2.27	2.33	2.18
Education:									
HS Grad	0.26	0.24	0.24	0.29	0.35	0.29	0.35	0.35	0.23
Some College	0.20	0.09	0.12	0.13	0.13	0.14	0.13	0.17	0.26
College Grad	0.25	0.10	0.12	0.12	0.20	0.21	0.26	0.25	0.32
Self-Reported Health:									
Very Good	0.24	0.23	0.21	0.00	0.25	0.24	0.25	0.29	0.27
Good	0.34	0.32	0.30	0.48	0.33	0.33	0.34	0.34	0.32
Fair	0.18	0.23	0.23	0.23	0.20	0.19	0.19	0.15	0.17
Poor	0.06	0.08	0.12	0.09	0.04	0.07	0.05	0.05	0.05
Retired	0.40	0.36	0.34	0.41	0.37	0.45	0.49	0.55	0.38
Calories	2,127	1,925	1,990	2,064	1,926	2,180	1,892	2,059	2,239
N	*9,610*	*570*	*1,938*	*1,181*	*490*	*1,395*	*607*	*1,047*	*2,382*

Notes - The sample is restricted to male household heads from ages 57 to 71. Sample weights are used to compute the statistics shown in the table. The excluded education and health categories are high school dropout and excellent, respectively.

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Appendix Table A2: First Stage Estimates for MRFIT

	Cross-Sectional Analysis	Longitudinal Analysis
Age=54	0.014	0.016
	(0.014)	(0.014)
Age=55	0.027	0.029
	(0.012)	(0.013)
Age=56	0.060	0.059
	(0.015)	(0.015)
Age=57	0.040	0.043
	(0.016)	(0.016)
Age=58	0.085	0.092
	(0.028)	(0.029)
Age=59	0.115	0.120
	(0.020)	(0.020)
Age=60	0.150	0.155
	(0.032)	(0.031)
Age=61	0.161	0.165
	(0.038)	(0.037)
Age=62	0.254	0.257
	(0.042)	(0.041)
Age=63	0.312	0.320
	(0.039)	(0.041)
Age=64	0.391	0.406
	(0.096)	(0.095)
F statistic	23.3	24.7

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Appendix Table A1: Dietary Intake Survey Response Rates

Survey	Household Response Rate[a]	Individual Day 1 Response Rate[b]	Average Male Caloric Intake
HFCS 1965-66	85	81	2,536
NFCS 1977-78	61	57	2,280
NFCS 1987-88	34	31	2,119
CSFII 1989-91	67	58	2,202
CSFII 1994-96	85	80	2,445
NHANES I (1971-75)	99	74	2,308
NHANES II (1976-80)	91	73	2,371
NHANES III (1988-94)	86	78	2,654
Continuing NHANES (1999-2012)	73 to 84	70 to 80	2,593

[a] For NHANES, this column reports the response rate to the in-home interview.

[b] For NHANES, this column reports the response rate to mobile exam which includes the 24 hour recall interview.

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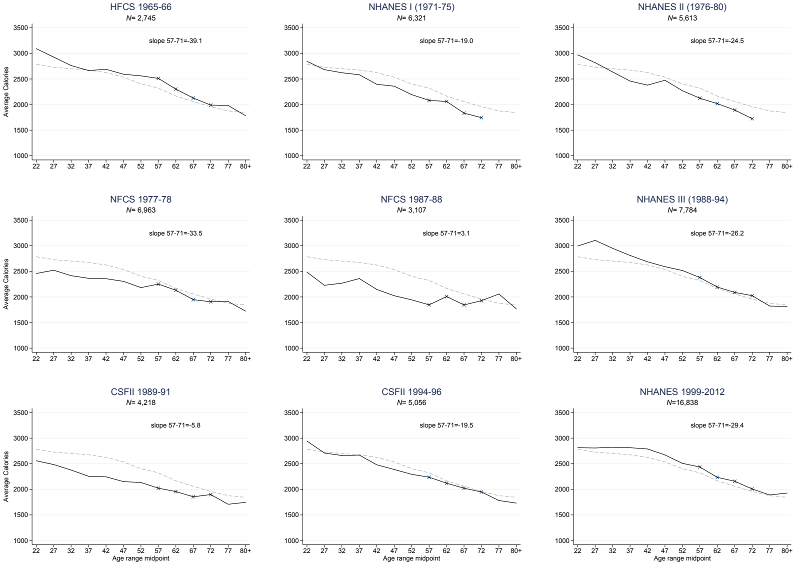
Figure 2: Age Profiles of Caloric Intake



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