# Causal Effects of Mental Health Conditions on Food Insecurity and the Mitigating Role of SNAP

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# Motivation

Mental health conditions affect many individuals:

- 18% of U.S. adults have suffered from mental illness

Studies find association between mental health and food security:

- Depressive symptoms and food insecurity
- Mother's mental health problems and food insecurity

No known research on **causal** impact of mental health on food security that accounts for:

- True mental health status as potentially misreported
- Mitigating role of SNAP in effects of mental illness

# Research Objectives

We study **causal effects** of adult mental health conditions on food security and mitigating role of SNAP:

- To what extent does mental health of low-income adults causally affect food security of their families? Do these effects vary across socioeconomic and demographic characteristics?

- Do estimated causal effects differ by whether family participates in SNAP? Does SNAP play a meaningful, mitigating role in these relationships?

# Methodological Challenge

Identifying **causal** effect of mental health is difficult:

- **Endogeneity**: same unobservables simultaneously affect food security and mental health
  - Simple regression methods produce **inconsistent** estimates of causal effects
- **Measurement error**: mental disorders are often misdiagnosed, survey instruments have flaws, stigma leads to underreporting
  - Treatment variables are binary → error is **nonclassical**
  - Standard IV methods produce **inconsistent** estimates

Assessing whether SNAP mitigates effect of mental illness on food security is challenging because SNAP participation is **endogenous** and **misreported**

We develop partial identification methodology to quantify **joint effect** on food security of **two** potentially mismeasured, endogenous treatments: mental illness and SNAP participation

# Main Data Source

National Health Interview Survey (**NHIS**):

- Principal source of info on health of U.S. civilian population
- Cross-sectional, nationally representative, 80% response rate
- Annual sample of 35,000 households containing 87,500 individuals

**Core** components of NHIS questionnaire:

- **Household**: basic demographics, geocodes (restricted access)
- **Family**: demographics, food security, program participation, health status, injuries, healthcare utilization, health insurance
- **Sample adult** (one randomly selected adult per family): psychological distress, selected mental health problem, other aspects of health status, health care services, health behaviors
- **Sample child** (one randomly selected child per family): health status, health care services, health behaviors

NHIS also provides imputed income, covers extra topics

# 2011–2014 Analytical Sample

We pool linked sample adult–family records, NHIS 2011–14:

- Sample adult is aged **18–64** years (working age)
- Every family member is U.S. citizen
- Income ≤ **130% of poverty** (gross income cutoff for SNAP)
- ***N* = 21,520**
- *Note 1:* NHIS started administering food security survey module in 2011
- *Note 2:* E.g., in 98% of cases in 2014, “household” is identical to “family”

Selected sample characteristics (weighted):

| Variable | Mean | (Std.Dev.) |
|---|---|---|
| **SNAP** participation (indicator) | 0.485 | (0.500) |
| **Income-to-poverty** ratio | 0.689 | (0.372) |
| **Child** (age < 18) present | 0.355 | (0.479) |
| Sample adult’s **age** (years) | 37.05 | (14.32) |
| Sample adult is **male** | 0.436 | (0.496) |

# Food Security Indicators

NHIS includes **10-item** food security survey module:

- Referenced to **last 30 days**
- Includes family- and adult-specific questions (no child questions)

We create two indicators of family's food security status:

1) **Food secure**: 1 if raw score ≤ 2 (high or marginal FS)
2) **Not very low food secure**: 1 if score ≤ 5 (absence of very low FS)

Selected descriptive statistics (weighted):

| Indicator | Mean | (Std.Dev.) |
|---|---|---|
| Family is **food secure** | 0.677 | (0.468) |
| Family is **not very low food secure** | 0.831 | (0.375) |

| | SNAP subsample | Non-SNAP subsample | Difference |
|---|---|---|---|
| **Food secure** | 0.574 | 0.775 | -0.201*** |

# Indicators of Psychological Distress

NHIS administers 6 questions underlying **Kessler (K-6) psychological distress scale**:

- How frequently in past 30 days one felt sad, nervous, restless, hopeless, that everything was an effort, worthless (5-point Likert scale for answers)
- K-6 is standardized and validated measure of **nonspecific psychological distress** (CDC, 2013)

We follow McMorrow et al. (2016) and create indicators for:

1) Sample adult in **severe distress**: 1 if K-6 scale ≥ 13 (max is 24)
2) Sample adult in **moderate or severe distress**: 1 if K-6 scale ≥ 8

Selected descriptive statistics (weighted):

| Indicator | Mean | (Std.Dev.) |
|---|---|---|
| Adult is in **severe distress** | 0.097 | (0.296) |
| Adult is in **moderate/severe distress** | 0.226 | (0.418) |

# Indicators of Mental Health Problems

NHIS asks sample adults about degree of **difficulty** with 12 daily activities (e.g., walking) and what health problem caused this

NHIS also asks whether adults are **limited** in performing 7 activities (e.g., personal care) and what health problem caused this

We create indicators for existence of:

1) **Mental health problem causing difficulty** with activities
2) **Mental health problem causing limitation** in activities

'Problem' includes depression, anxiety, ADD, bipolar, schizophrenia, etc.

Selected descriptive statistics (weighted):

| Indicator | Mean | (Std.Dev.) |
|---|---|---|
| Adult has mental health problem causing **difficulty** | 0.069 | (0.253) |
| Adult has mental health problem causing **limitation** | 0.083 | (0.275) |

# Food Security on Subsamples

**Prevalence of food security** (%, weighted) in subsamples by moderate/severe distress and SNAP participation:

| | | SNAP participation: No | SNAP participation: Yes | (SNAP=Yes,·) – (SNAP=No,·) |
|---|---|---|---|---|
| Moderate or severe distress | No | 83.03 | 65.46 | -17.56 |
| Moderate or severe distress | Yes | 49.43 | 39.11 | -10.32 |
| (Distress=Yes,·) – (Distress=No,·) | | -33.60 | -26.35 | |

Also, distress, mental health problem indicators are **positively associated** with SNAP participation

# Motivation for Our Methodology

Simple parametric approach:

$$Y_i = \gamma \cdot S_i + x_i \cdot \beta + \varepsilon_i$$

Outcome ($Y_i$), Treatment ($S_i$), Covariates ($x_i$), Error term ($\varepsilon_i$)

Treatment $S_i$ is **binary**. E.g., $S_i = 1$ if $i$ is in distress, 0 if not

If same unobservables affect $S_i$ and $Y_i$, then $cov(S_i, \varepsilon_i) \neq 0$ and OLS is inconsistent due to **endogeneity**

Measurement error in $S_i$ is **nonclassical** → standard IV estimation is inconsistent too

Our **nonparametric bounding** methodology handles endogeneity and misreporting. We also develop methods to handle multiple treatments (not just one binary $S_i$), e.g., treatment = {in distress, on SNAP}

# Basics of Our Approach

Define: $H^*$ = 1 if adult is truly in distress, = 0 otherwise; $H$ is self-reported measure of $H^*$

We assess **average treatment effect** (**ATE**) of distress on food security:

$$ATE(1,0 \mid X) = P[Y(H^* = 1) = 1 \mid X] - P[Y(H^* = 0) = 1 \mid X]$$

$Y$ = 1: family is food secure, $Y$ = 0: insecure

$Y(H^* = 1)$ indicates **potential** food security outcome if adult were to be in distress. $Y(H^* = 0)$ denotes potential outcome if adult were not in distress

$X$ specifies subpopulation of interest. Say, families with income ≤ 130% of poverty, containing U.S. citizens, sample adult aged 18–64

**Not a regression framework**: covariates $X$ are not regressors, no regression error term here, no orthogonality conditions to satisfy

# Decomposition Strategy

ATE cannot be point-identified without assumptions **even if** $H^* = H$

We decompose every formula into what is identified and what isn't

Let's simplify notation: $ATE = P[Y(1)=1] - P[Y(0)=1]$

Consider decomposition:

$$P[Y(1)=1] = \underbrace{P[Y(1)=1 \mid H^*=1]}_{\text{identified}}\underbrace{P(H^*=1)}_{\text{identified}} + \underbrace{P[Y(1)=1 \mid H^*=0]}_{\text{not identified}}\underbrace{P(H^*=0)}_{\text{identified}}$$

Data cannot identify $P[Y(1)=1 \mid H^*=0]$ because it refers to unobserved **counterfactual**. We only know $P[Y(1)=1 \mid H^*=0] \in [0,1]$

However, using methods of Manski (1995), we can still find worst-case bounds for $P[Y(1)=1]$, $P[Y(0)=1]$, and $ATE$

# Addressing Misreporting

$$P[Y(1)=1] = P(Y=1, H^*=1) + P[Y(1)=1 \mid H^*=0]P(H^*=0)$$

$$= P(Y=1, H=1) + \theta_1^- - \theta_1^+ + P[Y(1)=1 \mid H^*=0]P(H^*=0)$$

$$\theta_1^- \equiv P(Y=1, H=0, H^*=1),\ \ \theta_1^+ \equiv P(Y=1, H=1, H^*=0)$$

Sharp **bounds** on ATE:

$$P(Y=1, H=1) - P(Y=1, H=0) - P^* + 2(\theta_1^- - \theta_1^+)$$

$$\leq ATE \leq$$

$$P(Y=1, H=1) - P(Y=1, H=0) + (1-P^*) + 2(\theta_1^- - \theta_1^+)$$

where $P^* \equiv P(H^*=1)$

# Tightening Bounds

Without assumptions, ATE bounds are **wide** and **contain zero**

To tighten them, we can:

- Use logical constraints on probabilities and auxiliary (validation) data to restrict $\theta$'s
- Apply "**no false positives**" assumption $\rightarrow \theta_1^+ = \theta_0^+ = 0$
- Impose restrictions on selection process:
  - Monotone treatment selection (**MTS**)
  - Monotone instrumental variable (**MIV**)
  - Monotone treatment response (**MTR**)

By layering progressively stronger assumptions we show how they shape inference

# Monotonicity Assumptions

**Monotone treatment selection** (**MTS**):

$$P[Y(j)=1 \mid H^{*}=1] \leq P[Y(j)=1 \mid H^{*}=0],\ j=0,1$$

**Monotone instrumental variable** (**MIV**):

Let *v* be income-to-poverty ratio. Higher *v* would not harm food security:

$$u_1 \leq u \leq u_2 \Rightarrow$$
$$P[Y(j)=1 \mid v=u_1] \leq P[Y(j)=1 \mid v=u] \leq P[Y(j)=1 \mid v=u_2]$$

**Monotone treatment response** (**MTR**):

Poor mental health would not improve food security on average:

$$P[Y(1)=1 \mid H^{*}=h] \leq P[Y(0)=1 \mid H^{*}=h],\ h=0,1$$

# Bounds under Endogenous Selection

| | | Self-reported prevalence rate: $P^* = P = 0.235$ | | | 10% Underreporting of true prevalence rate: $P^* = 1.1P = 0.258$ | | |
|---|---|---|---|---|---|---|---|
| Endogenous selection | | LB | UB | width | LB | UB | width |
| (a) Arbitrary errors | p.e.† | [-0.912, | 0.558] | 1.469 | [-0.935, | 0.581] | 1.516 |
| | CI‡ | [-0.919 | 0.567] | | [-0.942 | 0.590] | |
| (b) No false positives | p.e. | [-0.710, | 0.290] | 1.000 | [-0.734, | 0.313] | 1.047 |
| | CI | [-0.716 | 0.296] | | [-0.739 | 0.319] | |

† Point estimates of the population bounds.

‡ Imbens-Manski 95% confidence intervals around the true ATE.

# Bounds under MTS+MIV+MTR

| | | Self-reported prevalence rate: $P^* = P = 0.235$ | | | 10% Underreporting of true prevalence rate: $P^* = 1.1P = 0.258$ | | |
|---|---|---|---|---|---|---|---|
| MTS + Income MIV + MTR: | | LB | UB | width | LB | UB | width |
| (a) Arbitrary errors | p.e. | **[-0.851,** | **-0.0956]** | 0.756 | **[-0.878,** | **-0.0956]** | 0.783 |
| | CI | [-0.878 | -0.0649] | | [-0.901 | -0.0649] | |
| | bias | +0.011 | -0.015 | | +0.016 | -0.015 | |
| (b) No false positives | p.e. | **[-0.210,** | **-0.0956]** | 0.115 | **[-0.290,** | **-0.0956]** | 0.194 |
| | CI | [-0.266 | -0.0649] | | [-0.331 | -0.0649] | |
| | bias | +0.020 | -0.015 | | +0.020 | -0.015 | |

Strictly positive average treatment effects in **bold.**

† Point estimates of the population bounds corrected for finite sample bias.

‡Imbens-Manski 95% confidence intervals around the true ATE.

*Estimated finite sample bias prior to correction.

# Bounds by Reported SNAP Status

| | | Self-reported prevalence rate: $P^* = P$ | | | 10% Underreporting of true prevalence rate: $P^* = 1.1P$ | | |
|---|---|---|---|---|---|---|---|
| SNAP participants (N = 10,918), MTS + MIV + MTR: | | | | | | | |
| | | LB | UB | width | LB | UB | width |
| (a) Arbitrary errors | p.e. | **[-0.788,** | **-0.0779]** | **0.710** | **[-0.824,** | **-0.0779]** | **0.747** |
| | CI | [-0.820 | -0.0364] | | [-0.857 | -0.0364] | |
| (b) No false positives | p.e. | **[-0.151,** | **-0.0779]** | **0.073** | **[-0.228,** | **-0.0779]** | **0.150** |
| | CI | [-0.228 | -0.0364] | | [-0.302 | -0.0364] | |
| Nonparticipants (N = 10,036), MTS + MIV + MTR: | | | | | | | |
| | | LB | UB | width | LB | UB | width |
| (a) Arbitrary errors | p.e. | **[-0.921,** | **-0.0904]** | 0.831 | **[-0.940,** | **-0.0904]** | 0.850 |
| | CI | [-0.934 | -0.0516] | | [-0.953 | -0.0516] | |
| (b) No false positives | p.e. | **[-0.251,** | **-0.0904]** | 0.161 | **[-0.336,** | **-0.0904]** | 0.245 |
| | CI | [-0.319 | -0.0516] | | [-0.387 | -0.0516] | |

Strictly negative average treatment effects in **bold**.

† Point estimates of the population bounds corrected for finite sample bias.

‡ Imbens-Manski 95% confidence intervals around the true ATE.

# Next Steps

We have fully developed methods to assess causal effects of mental health on food security and potentially mitigating role of SNAP, while allowing for **both mental health and SNAP to be endogenous and misreported**. Application is underway

To date, we only used income-to-poverty variable as MIV

Next, we will estimate causal effects and use location-specific variables as MIVs to narrow bounds. These include:

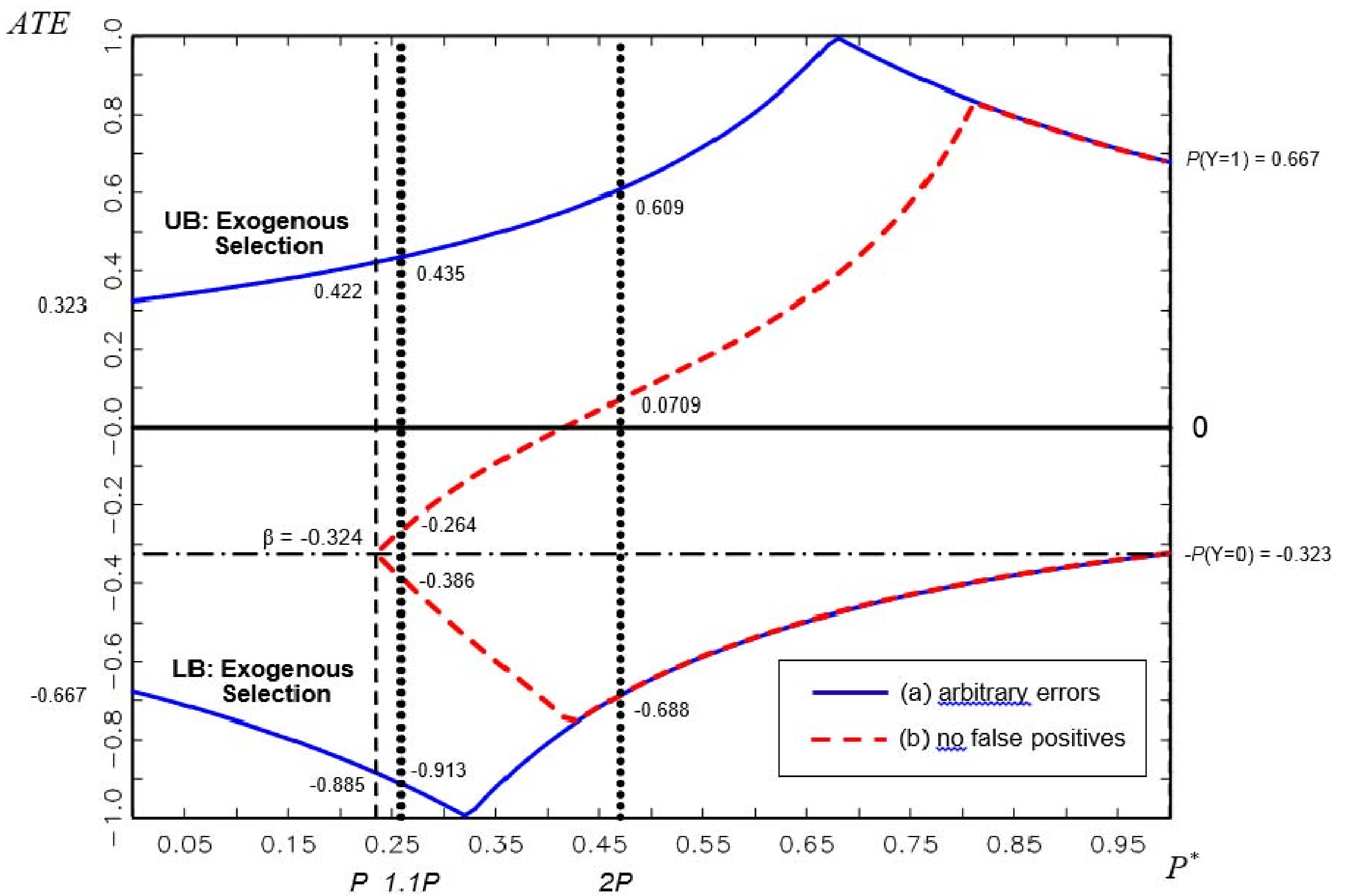
- Food store density
- Generosity of food bank and pantry system

Estimations using location-specific information will be performed within an RDC environment

Thank you!

# Appendix

# Bounds under Exogenous Selection (I)



# Bounds under Exogenous Selection (II)

| | | Self-reported prevalence rate: $P^* = P = 0.235$ | | | 10% Underreporting of true prevalence rate: $P^* = 1.1P = 0.258$ | | |
|---|---|---|---|---|---|---|---|
| Exogenous selection | | | | | | | |
| | | LB | UB | width | LB | UB | width |
| (a) Arbitrary errors | p.e.† | [-0.885, | 0.422] | 1.307 | [-0.913, | 0.435] | 1.348 |
| | CI‡ | [-0.894 | 0.431] | | [-0.922 | 0.445] | |
| (b) No false positives | p.e. | **[-0.324,** | **-0.324]** | 0.000 | [-0.386, | -0.264] | 0.123 |
| | CI | [-0.341 | -0.308] | | [-0.400 | -0.250] | |

Strictly negative average treatment effects in **bold**.

† Point estimates of the population bounds.

‡ Imbens-Manski 95% confidence intervals around the true ATE.

# Bounds under Endog. Selection: Graph