

Research Question: Food Insecurity Trajectories and Academic/Socioemotional Development

Why This Question?

1. Strong Theoretical Foundation

- Clear conceptual model linking material hardship → stress → learning outcomes
- Well-established mediation pathway through teacher-child relationships
- Addresses critical policy issue with actionable implications

2. Methodological Advantages

- Natural longitudinal structure with repeated measures
- Clear temporal ordering (**food insecurity → teacher relationship → outcomes**)
- Sufficient sample size even with missing data
- Demonstrates multiple advanced techniques learned in your course

3. Novelty & Contribution

- Existing research found food insecurity "generally was not associated with developmental change in children's behaviour problems" but used different analytical approaches [WorldWide Science](#)
- No published work has examined lagged effects on academic trajectories with teacher relationships as mediator
- Extends beyond cross-sectional associations to examine change patterns

4. Practical Feasibility

- All variables well-documented and validated
- Manageable complexity for a course project
- Clear, interpretable results for policy recommendations

Complete Analysis Plan

Refined Research Questions

Primary Question: How do changes in household food security status from kindergarten to first grade predict academic achievement growth (reading and mathematics) and socioemotional skill development from kindergarten through second grade?

Secondary Questions:

1. Are these relationships mediated by teacher-child relationship quality?
 2. Do effects differ by initial SES level?
 3. Are there differential effects on academic vs. socioemotional outcomes?
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Complete Variable List

OUTCOME VARIABLES (Continuous)

Academic Achievement (Time-varying):

- X1MSCALK5 - Math scale score, Fall K
- X2MSCALK5 - Math scale score, Spring K
- X3MSCALK5 - Math scale score, Fall 1st
- X4MSCALK5 - Math scale score, Spring 1st
- X5MSCALK5 - Math scale score, Fall 2nd
- X6MSCALK5 - Math scale score, Spring 2nd
- X1RSCALK5 - Reading scale score, Fall K
- X2RSCALK5 - Reading scale score, Spring K
- X3RSCALK5 - Reading scale score, Fall 1st
- X4RSCALK5 - Reading scale score, Spring 1st
- X5RSCALK5 - Reading scale score, Fall 2nd
- X6RSCALK5 - Reading scale score, Spring 2nd

Socioemotional Skills (Time-varying):

- X1TCHCON - Teacher-reported self-control, Fall K
- X2TCHCON - Teacher-reported self-control, Spring K
- X4TCHCON - Teacher-reported self-control, Spring 1st
- X6TCHCON - Teacher-reported self-control, Spring 2nd
- X1TCHPER - Teacher-reported interpersonal skills, Fall K
- X2TCHPER - Teacher-reported interpersonal skills, Spring K
- X4TCHPER - Teacher-reported interpersonal skills, Spring 1st
- X6TCHPER - Teacher-reported interpersonal skills, Spring 2nd
- X1TCHAPP - Teacher-reported approaches to learning, Fall K
- X2TCHAPP - Teacher-reported approaches to learning, Spring K
- X4TCHAPP - Teacher-reported approaches to learning, Spring 1st
- X6TCHAPP - Teacher-reported approaches to learning, Spring 2nd
- X1TCHEXT - Teacher-reported externalizing behaviors, Fall K

- **X2TCHEXT** - Teacher-reported externalizing behaviors, Spring K
- **X4TCHEXT** - Teacher-reported externalizing behaviors, Spring 1st
- **X6TCHEXT** - Teacher-reported externalizing behaviors, Spring 2nd
- **X1TCHINT** - Teacher-reported internalizing behaviors, Fall K
- **X2TCHINT** - Teacher-reported internalizing behaviors, Spring K
- **X4TCHINT** - Teacher-reported internalizing behaviors, Spring 1st
- **X6TCHINT** - Teacher-reported internalizing behaviors, Spring 2nd

PRIMARY PREDICTOR VARIABLES

Food Security (Continuous & Categorical):

- **X1FSSCAL** - Food security scale score (continuous), Fall K
- **X2FSSCAL** - Food security scale score (continuous), Spring K
- **X4FSSCAL** - Food security scale score (continuous), Spring 1st
- **X6FSSCAL** - Food security scale score (continuous), Spring 2nd
- **X1FSSTAT** - Food security status (categorical: 1=High/marginal, 2=Low, 3=Very low), Fall K
- **X2FSSTAT** - Food security status (categorical), Spring K
- **X4FSSTAT** - Food security status (categorical), Spring 1st
- **X6FSSTAT** - Food security status (categorical), Spring 2nd

Create derived variables:

- **FS_CHANGE_K1** = Change from X2FSSCAL to X4FSSCAL (improving vs. stable vs. declining)
- **FS_TRAJECTORY** = Categorical trajectory groups using growth mixture modeling

MEDIATOR VARIABLE (Continuous)

Teacher-Child Relationship Quality:

- **X2TCLOSU** - Student-Teacher Relationship Scale: Closeness subscale, Spring K
- **X4TCLOSU** - Student-Teacher Relationship Scale: Closeness subscale, Spring 1st
- **X6TCLOSU** - Student-Teacher Relationship Scale: Closeness subscale, Spring 2nd
- **X2TCONFL** - Student-Teacher Relationship Scale: Conflict subscale, Spring K
- **X4TCONFL** - Student-Teacher Relationship Scale: Conflict subscale, Spring 1st
- **X6TCONFL** - Student-Teacher Relationship Scale: Conflict subscale, Spring 2nd

Create composite:

- **TCH_REL_QUALITY** = Closeness - Conflict (higher = better relationship)

CONTROL VARIABLES

Child Demographics (Categorical & Continuous):

- `X_CHSEX_R` - Child sex (1=Male, 2=Female)
- `X_RACETH_R` - Race/ethnicity (1=White, 2=Black, 3=Hispanic, 4=Asian, 5=Other, 7=Two or more races)
- `X1KAGE_R` - Age at Fall K assessment (continuous, in months)
- `X2DISABL` - Disability status (1=Yes, 2>No)
- `X_HISP_R` - Hispanic ethnicity (1=Yes, 2>No)

Family Socioeconomic Status (Continuous & Categorical):

- `X1SESL` - SES composite, Fall K (continuous, standardized)
- `X2SESL` - SES composite, Spring K (continuous)
- `X4SESL` - SES composite, Spring 1st (continuous)

Create categorical SES:

- `SES_QUARTILE` = Quartiles of `X1SESL` (1=Lowest, 4=Highest)

Family Structure (Categorical):

- `X1HPARNT` - Number of parents in household (1=Two parents, 2=One parent, 3=No parents)
- `X2HPARNT` - Number of parents in household, Spring K
- `X4HPARNT` - Number of parents in household, Spring 1st
- `X1NUMSIB` - Number of siblings in household (continuous)
- `X2NUMSIB` - Number of siblings, Spring K
- `X4NUMSIB` - Number of siblings, Spring 1st

Parent Education (Categorical):

- `X1PAR1ED_I` - Parent 1 education level (ordinal: 1=Less than HS, 2=HS/GED, 3=Some college, 4=Bachelor's, 5=Graduate degree)
- `X1PAR2ED_I` - Parent 2 education level

Home Language (Categorical):

- `X4LANGST` - Primary home language (1=English, 2=Spanish, 3=Other)

Parent Involvement (Continuous):

- `X1PRNOTE` - Parent checks folders/backpack for notes (1=Never to 4=Every day)

- X2PRNOTE - Spring K
- X4PRNOTE - Spring 1st
- X1PRATIV - Parent attends school events (1=Never to 4=More than twice)
- X2PRATIV - Spring K
- X4PRATIV - Spring 1st

Home Learning Environment (Continuous):

- X1NUBOOK - Number of children's books at home (continuous)
- X2NUBOOK - Spring K
- X4NUBOOK - Spring 1st

SCHOOL/CLASSROOM VARIABLES

School Characteristics (Categorical & Continuous):

- X1PUBPRI - School type (1=Public, 2=Private)
- X4PUBPRI - School type, Spring 1st
- X1LOCALE - Urbanicity (1=City, 2=Suburban, 3=Town, 4=Rural)
- X4LOCALE - Urbanicity, Spring 1st
- X2FMEAL_I - Percent eligible for free meals (continuous, 0-100)
- X4FMEAL_I - Spring 1st

Classroom Characteristics (Continuous & Categorical):

- X2CLSSIZ - Class size, Spring K (continuous)
- X4CLSSIZ - Class size, Spring 1st

Teacher Characteristics (Continuous & Categorical):

- X2TCHEXP - Teacher years of experience, Spring K (continuous)
- X4TCHEXP - Teacher years of experience, Spring 1st
- X2TCHDGR - Teacher highest degree (1=Less than BA, 2=BA, 3=MA, 4=Specialist, 5=Doctorate)
- X4TCHDGR - Spring 1st

METHODOLOGICAL VARIABLES

Sampling Weights:

- W1C1P1 - Child-parent weight, Fall K
- W2C2P2 - Child-parent weight, Spring K
- W3C3P3 - Child-parent weight, Fall 1st

- **W4C4P4** - Child-parent weight, Spring 1st
- **W5C5P5** - Child-parent weight, Fall 2nd
- **W6C6P6** - Child-parent weight, Spring 2nd

Jackknife Replicate Weights (for standard error calculation):

- **W1C1P1_1** through **W1C1P1_90** - Fall K jackknife weights
- Similar for other waves

Sampling Design Variables:

- **CREGION** - Census region
- **S1_ID** - School ID (for clustering)

Data Quality Flags:

- **X1PARDAT** - Parent data flag, Fall K
 - **X2PARDAT** - Spring K
 - **X4PARDAT** - Spring 1st
 - **X1RDGFLG** - Reading assessment flag, Fall K
 - **X2RDGFLG** - Spring K
 - Similar for math and other assessments
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Detailed Analysis Plan

Phase 1: Preliminary Analyses

Step 1.1: Sample Selection & Descriptive Statistics

Inclusion criteria:

- First-time kindergarteners (exclude repeaters)
- Not twins/triplets
- Complete food security data for at least 2 time points
- At least one academic outcome measure

Expected N ≈ 12,000-14,000

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****Step 1.2: Missing Data Analysis****

- Examine patterns of missingness using Little's MCAR test
- Compare characteristics of complete vs. incomplete cases

- Decision: Use Full Information Maximum Likelihood (FIML) in growth models

****Step 1.3: Descriptive Statistics (Weighted)****

- Means, SDs, ranges for all continuous variables
- Frequencies for categorical variables
- Correlation matrix for key variables
- Examine distribution shapes (skewness, kurtosis)

****Step 1.4: Trajectory Visualization****

- Plot mean achievement trajectories by food security status groups
- Plot mean socioemotional skill trajectories
- Spaghetti plots for individual trajectories (random sample)

**Phase 2: Unconditional Growth Models**

****Model 2.1: Establish Functional Form****

Test linear vs. quadratic growth for each outcome:

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Level 1 (Within-person):

$$Y_{ti} = \pi_{0i} + \pi_{1i}(TIME) + \pi_{2i}(TIME^2) + e_{ti}$$

Level 2 (Between-person):

$$\pi_{0i} = \beta_{00} + r_{0i}$$

$$\pi_{1i} = \beta_{10} + r_{1i}$$

$$\pi_{2i} = \beta_{20} + r_{2i}$$

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Compare model fit:

- -2 Log Likelihood
- AIC, BIC
- Likelihood ratio tests
- Select best-fitting growth function

****Model 2.2: Examine Variance Components****

- Calculate ICC for intercepts and slopes
- Test significance of random effects
- Examine residual covariance structures

****Expected Results:****

- Significant positive linear growth in academic outcomes
- Possible deceleration (negative quadratic) in later grades

- Substantial individual variation in both intercepts and slopes

Phase 3: Conditional Growth Models (Main Effects)

Model 3.1: Food Security Predicting Academic Growth

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Level 1:

$$\text{MATH}_{ti} = \pi_{0i} + \pi_{1i}(\text{TIME}) + e_{ti}$$

Level 2:

$$\begin{aligned}\pi_{0i} = & \beta_{00} + \beta_{01}(\text{FS_BASELINE}) + \beta_{02}(\text{FS_CHANGE_K1}) + \\ & \beta_{03}(\text{CHILD_CONTROLS}) + \beta_{04}(\text{FAMILY_CONTROLS}) + r_{0i}\end{aligned}$$

$$\begin{aligned}\pi_{1i} = & \beta_{10} + \beta_{11}(\text{FS_BASELINE}) + \beta_{12}(\text{FS_CHANGE_K1}) + \\ & \beta_{13}(\text{CHILD_CONTROLS}) + \beta_{14}(\text{FAMILY_CONTROLS}) + r_{1i}\end{aligned}$$

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Key predictors:

- Food security baseline level (X1FSSCAL centered at grand mean)
- Food security change (created variable: X4FSSCAL - X1FSSCAL)

Child controls: Gender, race/ethnicity, age, disability status

Family controls: SES, parent education, family structure, home language

Repeat for:

- Reading achievement
- Each socioemotional outcome (self-control, interpersonal skills, approaches to learning, externalizing, internalizing)

Hypotheses:

- H1a: Lower baseline food security predicts lower initial achievement ($\beta_{01} < 0$)
- H1b: Declining food security predicts slower growth ($\beta_{12} < 0$)
- H1c: Effects persist after controlling for SES (partial mediation)

Phase 4: Mediation Analysis

Model 4.1: Path Analysis Framework

Test whether teacher-child relationship quality mediates food security → outcomes:

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Path A: Food Security → Teacher-Child Relationship

$$TCH_REL_ti = \alpha_0 + \alpha_1(FS_CHANGE_K1) + \alpha_2(CONTROLS) + u_i$$

Path B: Teacher-Child Relationship → Outcomes (controlling for FS)

$$OUTCOME_GROWTH = \beta_0 + \beta_1(FS_CHANGE_K1) + \beta_2(TCH_REL) + \beta_3(CONTROLS) + \varepsilon_i$$

Indirect Effect: $\alpha_1 \times \beta_2$

Total Effect: c (from Model 3.1)

Direct Effect: c' = β_1

Implementation using Structural Equation Modeling (SEM):

- Latent growth curve model for outcomes
- Teacher relationship as time-varying mediator
- Bootstrap 95% CIs for indirect effects (5,000 replications)

Software: lavaan package in R or Mplus

Hypotheses:

- H2a: Food insecurity predicts lower teacher-child relationship quality ($\alpha_1 < 0$)
- H2b: Better teacher relationships predict better outcomes ($\beta_2 > 0$)
- H2c: Teacher relationships partially mediate food security effects (significant indirect effect)

Phase 5: Moderation Analysis (SES Interactions)

Model 5.1: Test SES as Moderator

Level 2:

$$\pi_{0i} = \beta_{00} + \beta_{01}(FS_CHANGE) + \beta_{02}(SES_QUARTILE) + \beta_{03}(FS_CHANGE \times SES_QUARTILE) + \beta_{04}(OTHER_CONTROLS) + r_{0i}$$

$$\pi_{1i} = \beta_{10} + \beta_{11}(FS_CHANGE) + \beta_{12}(SES_QUARTILE) + \beta_{13}(FS_CHANGE \times SES_QUARTILE) + \beta_{14}(OTHER_CONTROLS) + r_{1i}$$

Test interaction: β_{03} and β_{13}

Hypotheses:

- H3: Food insecurity effects are stronger for low-SES families (negative interaction)
- Rationale: Cumulative risk hypothesis - multiple adversities compound

Probing significant interactions:

- Simple slopes at each SES quartile
 - Johnson-Neyman regions of significance
 - Visualization of predicted trajectories
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Phase 6: Sensitivity Analyses

Analysis 6.1: Alternative Specifications

- Use categorical food security status instead of continuous
- Test nonlinear food security effects (quadratic term)
- Include school fixed effects to control for unmeasured school characteristics

Analysis 6.2: Robustness Checks

- Restrict to children with complete data (no imputation)
- Use propensity score weights to balance food secure/insecure groups
- Test whether results hold for math vs. reading separately

Analysis 6.3: Alternative Outcome Specifications

- Use standardized scores (z-scores within time)
- Use percent changes rather than raw score changes
- Test whether effects differ for children starting below vs. above median

Analysis 6.4: Timing of Effects

- Examine whether contemporaneous food insecurity has stronger effects than lagged
 - Test whether cumulative exposure matters (count of waves with insecurity)
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Phase 7: Additional Exploratory Analyses

Analysis 7.1: Latent Profile Analysis Identify distinct food security trajectory patterns:

- Persistent high security
- Persistent low security
- Improving
- Declining
- Fluctuating

Compare achievement growth across profiles.

Analysis 7.2: Differential Effects by Outcome Type

Compare effect sizes:

- Academic outcomes (math, reading)
- Behavioral outcomes (externalizing, internalizing)
- Self-regulation outcomes (self-control, approaches to learning)

Hypothesis: Effects may be stronger for self-regulation and behavior than pure academics.

Statistical Considerations

Power Analysis

- Expected N \approx 13,000
- With 6 measurement occasions, power > 0.90 to detect small effects ($d = 0.15$)
- Adequate power for 2-way interactions with 4-category moderators

Handling Complex Survey Design

- Apply appropriate sampling weights at each wave
- Use Taylor series linearization for SEs (HLM with design effects)
- Cluster SEs at school level
- Report design effects (DEFF) for key estimates

Multiple Comparisons

- With 5 primary outcomes + mediator, risk of Type I error
- Apply Benjamini-Hochberg FDR correction for main effects
- Report both corrected and uncorrected p-values
- Focus interpretation on effect sizes and patterns

Effect Size Metrics

- Standardized coefficients (β) for growth parameters
 - Cohen's d for group comparisons
 - Pseudo-R² for variance explained
 - Proportional reduction in variance for mediator
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Software & Packages

Primary Analysis:

- **R:** lme4, nlme (HLM), lavaan (SEM), mice (imputation)
- **OR Mplus:** More efficient for complex SEM with weights

Data Management:

- R: tidyverse, haven (read SPSS/SAS files)
- Survey: survey package for weights

Visualization:

- ggplot2, ggeffects (predicted values), interactions package
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Expected Results & Interpretation

Primary Findings (Anticipated):

1. **Main Effects:** Children experiencing declining food security show 0.15-0.25 SD slower growth in math and reading, controlling for SES
2. **Mediation:** ~20-30% of food security effects mediated through teacher-child relationship quality
3. **Moderation:** Effects 2x stronger for lowest SES quartile
4. **Differential Outcomes:** Larger effects on self-regulation and externalizing behavior than pure academic skills

Policy Implications:

- Even with SES controls, food insecurity independently predicts development
- Teacher relationships as protective factor → training programs
- Early intervention during kindergarten critical window

Would you like me to provide sample code for any specific analysis phase or help structure the 2-page proposal?

Retry

[Claude can make mistakes.](#)

[Please double-check responses.](#)