

# Household food insecurity and its relationship with childhood obesity, dietary intake, and diet-related behaviors

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## Introduction

In 2016, an estimated 12.3 percent of households in the United States were food insecure, and 8.0 percent of U.S. households with children (3.1 million households) were food insecure.<sup>1</sup> Food insecurity is defined as lacking consistent access to adequate food, resulting in reduced quality, variety, or desirability of diet, or disrupted eating patterns and lower food intake.<sup>2</sup> Rates of food insecurity are higher among households with children, households at or below the federal poverty level, Non-Hispanic Black households, and Hispanic households.<sup>1</sup>

Numerous studies have documented a link between food insecurity and adverse outcomes for children. Children living in food insecure homes are more likely to have poor-quality diets, lower physical activity, poorer physical health, poorer mental health and psychosocial problems, behavioral problems, and lower academic achievement.<sup>3-14</sup> However, extant research is inconclusive on food insecurity as a predictor of overweight/obesity in U.S. children and adolescents, with most studies reporting no relationship, and several observing a lower risk of obesity among food insecure children.<sup>15-18</sup> Fewer studies have found a significant association between food insecurity and children's weight status.<sup>19-22</sup>



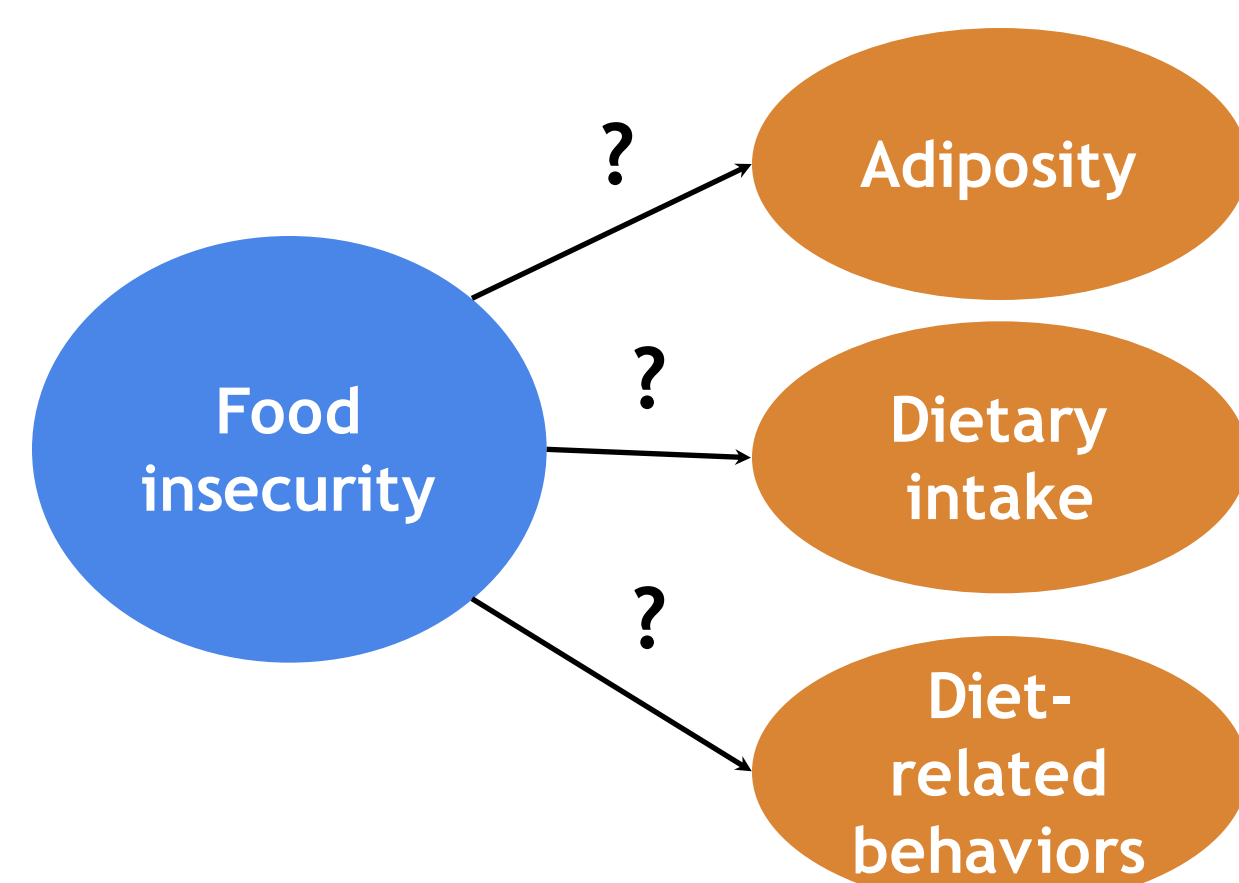
<https://www.nhlbi.nih.gov/research/resources/obesity/population/hcs.htm>

Examining food insecurity also raises questions pertaining to dietary intake and diet-related behaviors. Diet-related behaviors associated with obesity include higher intake of fast food, sugar-sweetened beverages (SSBs), and other foods with higher caloric density, as well as lower intake of fruits, vegetables, and whole grains.<sup>23</sup> Low-income households are more likely to consume "obesogenic" foods, and food insecure individuals are more likely to derive more of their energy needs from fat and carbohydrates, eat less protein, consume fewer fruits and vegetables, and have micronutrient deficiencies.<sup>24-26</sup> They are also more likely to eat irregular meals or skip breakfast.<sup>27-28</sup>

Overall, further research is warranted to better understand how food insecurity may be related to overweight/obesity status, dietary intake, and diet-related behaviors among children.

## Study Objectives

Figure 1. Overview of research question



This study investigated whether household food insecurity is a predictor of adiposity, dietary intake, and diet-related behaviors among a sample of U.S. schoolchildren, with a main focus on adiposity-related outcomes. It was hypothesized that household food insecurity would be positively associated with higher BMI, higher waist circumference, higher odds of overweight/obese status, poorer dietary intake, and less healthy diet-related behaviors.

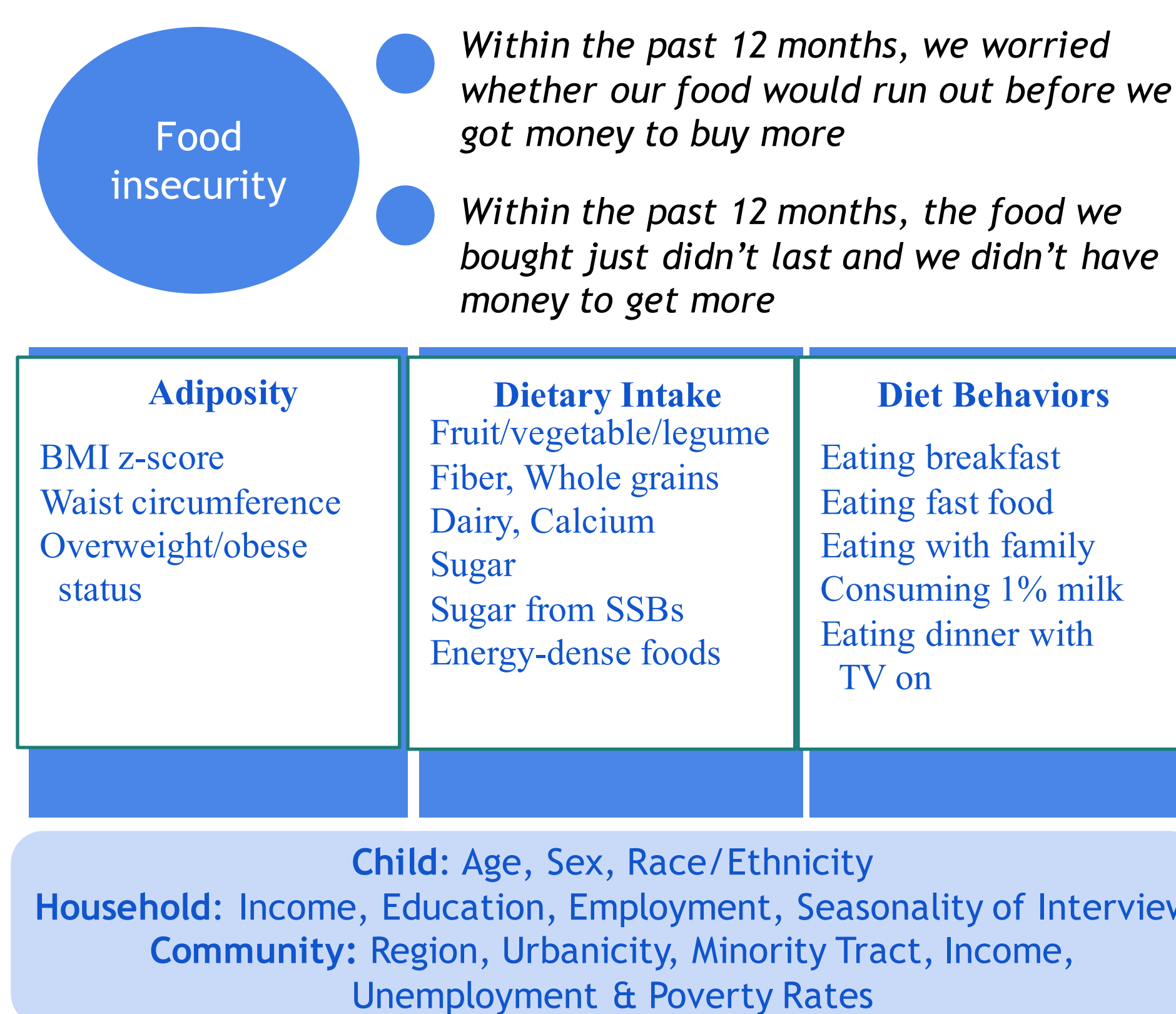
Additionally, this study examined interactions by subgroup characteristics. It was hypothesized that 1) food insecure older children would have higher measures of adiposity than food insecure younger children; 2) food insecure girls would have higher measures of adiposity than food insecure boys; and 3) food insecure Hispanic/Latino, Non-Hispanic African American, and Non-Hispanic Other Race/Ethnicity children would have higher measures of adiposity than food insecure Non-Hispanic White children.

## Methods

### Data Collection

The Healthy Communities Study (HCS) is an observational study of U.S. schoolchildren ages 4-15, conducted from 2013-15 to assess how community programs and policies targeting child obesity are related to diet, adiposity, and physical activity.<sup>29-33</sup> Participants were 5,138 children from kindergarten through eighth grade recruited from 130 diverse communities across the U.S. 32 children were missing data on variables of interest and thus excluded from the analytical sample, yielding a final sample size of 5,106 children. Data were collected on child anthropometry, dietary intake, diet-related behaviors, and household demographics (Figure 2). Food insecurity was operationalized using a validated 2-item screener derived from the U.S. Department of Agriculture's Household Food Security Survey.<sup>34</sup>

Figure 2. Summary of variables measured

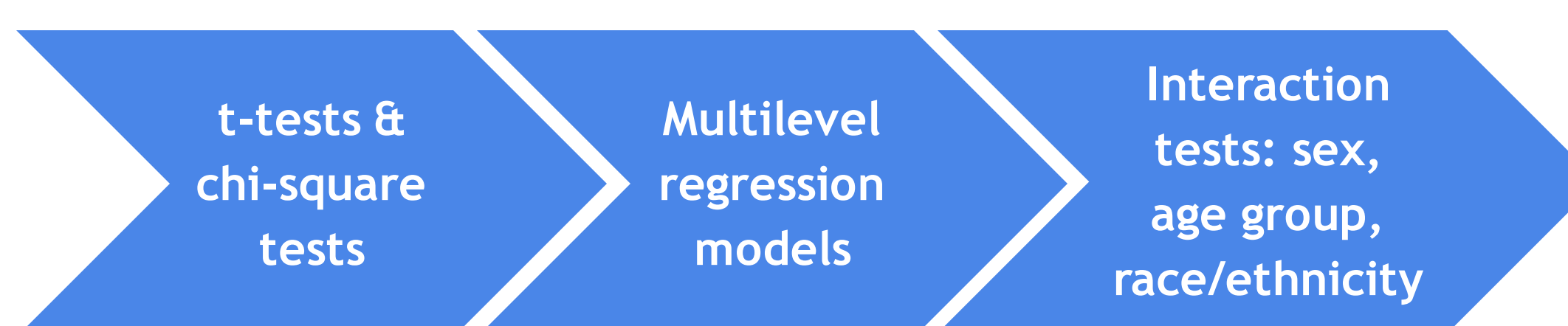


### Statistical Analysis

In the main analysis, unadjusted associations between food insecurity and outcomes were first examined using t-tests and chi-square tests. To identify relevant covariates that would adjust for confounding while maintaining model precision, the least absolute shrinkage and selection operator technique was used *a priori* to this study.<sup>35</sup> Multilevel statistical models were then generated to relate food insecurity with adiposity, dietary intake, and diet-related behaviors, adjusting for child and community-level covariates, and clustered by school and community levels.<sup>31</sup> Missing data due to non-response was addressed via multiple imputations.<sup>36</sup>

Interaction tests for child sex, age group (4-9 and 10-15 years old), and race/ethnicity were run. Least square means were then calculated to test for differences in anthropometric and dietary outcomes across subgroups, followed by Bonferroni corrections to adjust for multiple comparisons ( $p < 0.008$  level, where  $p = \alpha/n = 0.05/6$  groups = 0.008).

Figure 3. Summary of statistical analysis



## Results

Table 1. Relationship of food insecurity with child BMI-z, waist circumference, and overweight/obese status

Adiposity Outcomes	B	Odds Ratio	Standard Error	95% Confidence Interval	P-value
BMI z-score (N=5106)	0.14	-	0.04	0.06 0.21	0.0006**
Waist circumference (cm) (N=5063)	1.45	-	0.46	0.55 2.35	0.0015*
Overweight/obese (N=5106)	-	1.16	0.07	1.02 1.33	0.02*

\*Statistical significance at  $p < 0.05$ .

\*\*Statistical significance at  $p < 0.001$ .

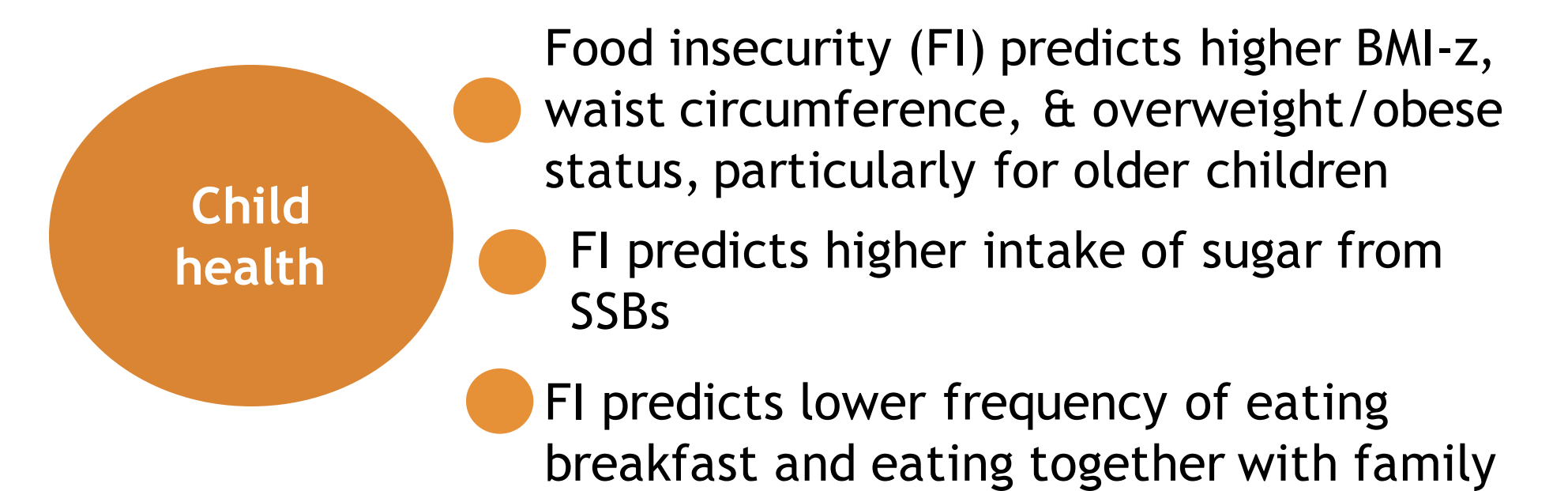
\*\*\*Statistical significance at  $p < 0.0001$ .

Both the unadjusted tests and the multilevel models revealed that food insecure children had a higher BMI z-score and waist circumference, as well as a greater likelihood of being overweight/obese, compared to food secure children (Table 1). Food insecure children also consumed more sugar from SSBs, ate breakfast less frequently, and ate together with family less frequently (Table 2). Finally, the interaction tests indicated a significant interaction by age group, in which children ages 10-15 from food insecure homes had the highest measures for adiposity (results not shown; see Appendix).

Table 2. Relationship of food insecurity with selected dietary outcomes

Dietary outcomes (N=5106)	B	Standard Error	95% Confidence Interval	P-value
Sugar from SSBs (tsp/day)	0.36	0.14	0.08 0.63	0.01*
Eating breakfast	-0.28	0.06	-0.40 -0.17	<0.0001***
Eating together with family	-0.23	0.08	-0.39 -0.07	0.004**

Figure 6. Summary of findings



## Discussion & Conclusion

Obesity is a condition attributable to multiple factors, and as this study found, household food insecurity is one plausible contributing factor to higher child adiposity. There are several considerations for the observed association. While parents may seek to protect their children from experiencing food insecurity, food insecurity can nevertheless be a point of stress for children. This may be true particularly for older children, who are more aware of the strains of food insecurity.<sup>37</sup> To cope with the stress, children may eat more highly palatable foods with high amounts of fats, sugar, or salt. Moreover, episodic food shortages may lead to overconsumption of previously restricted foods once the shortage ends. Such dietary choices or physiologic adaptations in response to food deprivation can then increase body fat.<sup>38-44</sup>

Figure 7. Strengths and limitations of the study

Category	Details
Limitations	<ul style="list-style-type: none"> <li>Observational study design</li> <li>Household FI measure may not capture child-level experience</li> <li>Self-reported diet measures: recall error, reporting bias</li> </ul>
Strengths	<ul style="list-style-type: none"> <li>Large and diverse sample</li> <li>Complex survey design</li> <li>Multilevel analysis with great statistical power</li> </ul>
Future Directions	<ul style="list-style-type: none"> <li>Study diverse populations of children</li> <li>Child-reported measures for FI</li> <li>Longitudinal study designs</li> <li>FI as it relates to critical development periods from a life course approach</li> </ul>

Unlike most previous studies, this study found a significant relationship between household food insecurity and child adiposity, as well as some dietary outcomes (see Figure 7 for limitations, strengths, and future directions). Further research is needed to better understand the mechanisms operating on the food insecurity-obesity pathway, and to thereby inform interventions that improve adiposity-related health outcomes.

## References

For list of references, see Appendix.

## Acknowledgements

Thanks to the UCOP Global Food Initiative, UC Berkeley School of Public Health Maternal & Child Health Division, Edward Frongillo, Karen Webb, Lilly Nhan, Battelle Memorial Institute, and the National Heart, Lung, & Blood Institute for their support in HCS and this project.