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The Relationship Between Food Insecurity and Food Assistance Program Participation in Families of Preschool Children in the Rio Grande Valley

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ABSTRACT

The South Texas Early Prevention Study-PreK, a cluster rando-mized trial, explored the Bienestar Coordinated School Health Program's influence on health variables in South Texas children. Factors associated with food insecurity (FI) were analyzed. Income-to-poverty ratio, income, and food assistance (FA) pro-gram participation were all associated with FI. Forty percent of families (257/643) reporting FI did not utilize FA. Of those families with FI, but who reported no FA participation, 31.8% were FA eligible. Families experiencing FI may underutilize FA programs, despite eligibility. Curtailing obstacles preventing FA program participation and matching those who are eligible with FA programs are crucial.

Introduction

The US Department of Agriculture (USDA) defines food insecurity (FI) as "a household-level economic and social condition of limited or uncertain access to adequate food."[1] When we started our study in 2018, 11.1% of households in the U.S. were food insecure. Furthermore, 7.1% of households with children reported FI at least some of the time.[2] As per the most recent report from 2021, 10.2% of U.S. households are food insecure and 6.2% of households with children report some degree of FI.[3] With the financial and societal turmoil exacerbated by the COVID-19 pandemic, FI has continued to be a major public health concern.[4,5] Specific segments of the population report FI more so than the average population; most especially those families who have house-hold incomes less than 185% of the poverty threshold, as well as families with Hispanic and Black heads of household,[2] the latter likely due to systemic disparities and specific social determinants of health.[6] Past research suggests

that FI is influenced by a number of variables, such as income,[7,8] education,[9] employment,[10] race/ethnicity,[11] number of people living in the household[12] and disability.[13]

FI itself correlates with several morbidity risk factors, in both children and adults. FI is associated with some birth defects[1] and adolescent anemia,[14] and FI is associated with a higher risk of numerous chronic diseases in adults, such as coronary heart disease, cancer and diabetes.[15] Other factors impacted by FI are those that are diet-related such as diminished nutrient intake[16] and reduced diet quality [17] in adults. Behavioral factors are also affected by FI. FI has shown positive associations with cognitive difficulties in adults,[18] parent-to-child aggression,[19] depression and anxiety in caretakers and behavior problems in children.[20,21] FI has been linked with deficits in physical and psychosocial functioning in children and suboptimal physical health and decreased subjective well-being in those greater than 15 years of age.[22,23] Establishing the predictors and effects of FI is valuable in assessing and evaluating intervention strategies aimed to improve food access and financial literacy, especially in populations who are at the highest risk, including marginalized communities and individuals who have low incomes.[11]

Not only is it important to study the causes of FI, but it is critical to examine food assistance (FA) program use, since resources such as Supplemental Nutrition Assistance Program (SNAP), Women, Infants, and Children (WIC), free school meals, and others contribute significantly to decreased risk of FI.[24–29] Families with FI are more likely to participate in FA programs,[30] yet overall participation in such programs had decreased at the time of our study, in 2018.[31] While nearly 17% of households participated in SNAP during 2017, only 15% percent participated during 2018.[32] Thereafter, and possibly related to the COVID pandemic, SNAP participation increased to 16% of U.S. households in 2020 and, as of 2022, has risen to 17% of U.S. households.[32–34] While 8.8 million women, infants and children participated in WIC in 2016, this number declined to 7.8 million by 2018 and 7 million by 2020.[35] If families experience FI, or other hardships, and are financially eligible for support, they should be enrolled in the governmental assistance program for which they qualify. However, there are some reports of financially eligible families who are not enrolled in such programs. According to the USDA, in 2018, approximately 75% of all eligible people in Texas were enrolled in SNAP, and 74% of the "working poor" in Texas were enrolled.[36] A number of barriers may prevent SNAP enrollment, even in those that might need it most, such as disabilities, language gaps and immigration policies.[24] WIC participation of eligible U.S. families has been consistently low over the past 4 years. At the start of our study in 2018, about 57% of eligible U.S. families participated in WIC.[37] This participation rate has stayed steady at 57% through 2021.[38,39] Specifically in Texas during 2018, where and when our study took place, only 54.8% of those individuals who were WIC eligible

received WIC benefits.[37] There are identified barriers to WIC participation, such as disparities in knowledge, inadequate transportation and negative grocery store encounters, among others.[40]

Within a population of preschool children and their respective families in South Texas, the first aim of our study was to explore the eligibility and utilization of FA programs and how this related to FI. A secondary aim was to assess the association of baseline child and family demographics and health variables with FI. These children were part of a bigger study called the South Texas Early Prevention Study-PreK (STEPS-PreK). This matched-pair cluster randomized trial set out to study lower socioeconomic children and their families before and after the provision of the Bienestar Coordinated School Health Program curriculum.[41,42] With a focus on FA program participation as well as factors associated with FI, the information gathered from the current analysis provides for a deeper understanding of the needs of those families and children with FI and supports the creation, implementation and assessment of programs, interventions and curriculum that can help strengthen the ability to attain satiating, nutritious food.

Materials and Methods

Study Participants

The STEPS-PreK study group collected data at baseline from preschool children in two school districts located in Hidalgo County, TX. There were 48 elementary schools between the two school districts from which to recruit study participants. A power analysis with 80% power and alpha = 0.05 in order to detect a 5% difference in outcome measure of childhood obesity was conducted for a cluster randomized trial. Based on this sample size calculation, 28 total schools were chosen for participation. The eligibility criteria for participants were preschool enrollment in the selected school district and willingness to consent to the study. Total preschool enrollment in the 28 schools during the baseline collection period was 1907 children (Fig. 1). The 2 school districts had similar demographics where 99% of the population was Hispanic and 92% of the population was economically-disadvantaged. The information reported in this analysis is the cross-sectional data collected during the baseline period. The research protocol was reviewed and approved by the University of Texas Rio Grande Valley Institutional Review Board. Informed consent was obtained from all participants and the parent or caregiver provided signed consent.

Study Procedures

Parents were sent questionnaires inquiring about family demographics and household health characteristics through one of three modes: online, face-to-
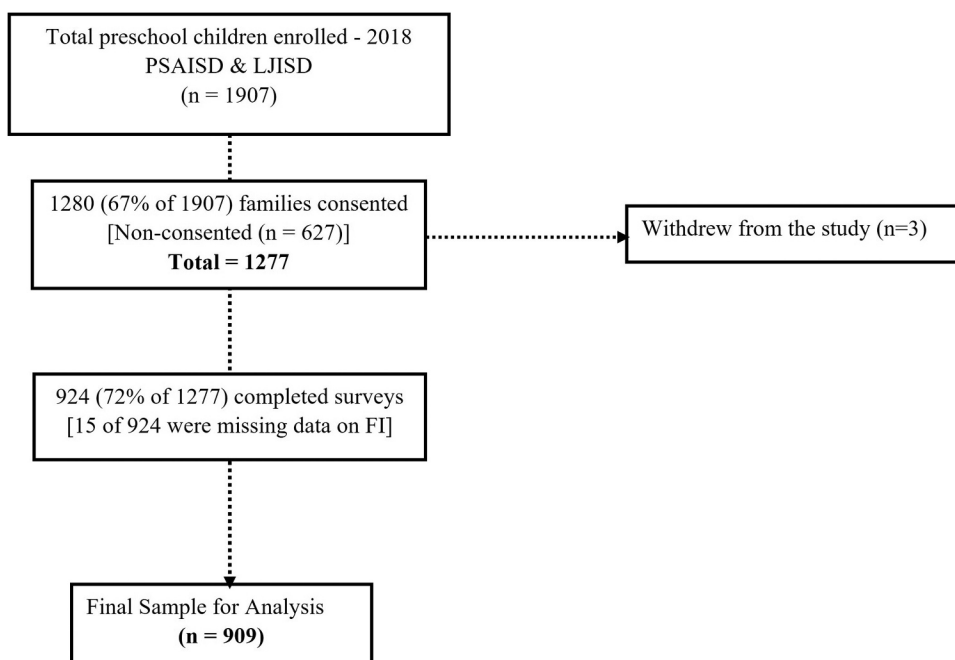
Figure 1. Flow diagram – consented and final sample size.

face or via school parental liaisons. The questionnaires were available in English and Spanish and asked parents about their child's age, sex and race/ ethnicity. Parents were also asked about the number of children and adults living in the household, and total household income. Other demographic variables were collected such as parental education, family history (1st and 2nd degree) of chronic disease (diabetes and hypertension), and participation in FA programs. Finally, parents were asked one question regarding food insecurity: "How often do you run out of food before the end of the month?" This question, created by the USDA Expanded Food and Nutrition Education Program,[43] offered the following responses: "never," "seldom," "sometimes," "most of the time," and "almost always." In our previous work, FI, as measured by this one question, was found to be associated with low income and diabetes.[42]

Anthropometric Measurements

To measure weight, each child was asked to remove their outer clothing, such as a jacket or sweater, as well as their shoes. Once the child stepped on the scale (Tanita Corp. of America, Inc., Arlington Heights, IL), the child was helped to center and vertically align their feet. When the number was stable, the STEPS-PreK staff recorded the weight to the nearest 0.1 kilogram. To measure height, each child was asked to step onto the stadiometer (Detecto Corp., Webb City,

MO). The child was directed to stand tall with the mid-axillary line perpendicular to the floor and standing evenly on both feet. They were instructed to keep their scapula and buttocks touching the vertical board. The headboard was firmly set on top of the head with enough pressure to push the hair down to the scalp. The STEPS-PreK staff recorded the height to the nearest 0.1 centimeter.

Data Definitions

For this study, the income to poverty ratio (IPR)[44] was calculated utilizing self-reported household income and the poverty threshold adjusted for size of household. For the designation of poverty, the Income to Poverty ratio (IPR) ratio was calculated as:

$$IPR = \frac{Total\ family\ income}{poverty\ threshold\ from\ HHS} \tag{1}$$

where the poverty threshold was determined by 2018 Department of Health and Human Services guidelines.[45] Using this threshold, if the value of the IPR >1 then poverty was No; if IPR ≤1 then poverty was Yes. Income measures were grouped into monthly incomes categories of $0–999, $1,000–1,999 up to $7,000–7,999 and $8.000+. To approximate income per person, the midpoint was used to create a quantitative value with the final grouping given a cap of $8,500. The authors acknowledge that, for the 65 respondents making 8,000+ per month, using this midpoint might truncate the income associated with a household's income values. BMI was calculated by dividing weight in kilograms by square of height in meters (kg/m^2). BMI z-scores and percentiles were calculated utilizing the CDC's SAS program using students' age and gender. These values were then used to classify participants into underweight, normal weight, overweight and obese using criteria of <5th percentile, 5th percentile - < 85th percentile, 85th percentile – 95th percentile and >95th percentile respectively. The presence of FI in the study participants was classified based on parental response to the one survey question mentioned previously. Those who indicated "never" were considered food secure, and those who indicated "seldom, sometimes, most of the time or almost always" as food insecure. Eligibility for SNAP and WIC benefits were determined based on USDA Supplemental Nutrition Assistance Program income eligibility standards (Figure SA1)[46] and WIC 2017 income eligibility guidelines (Figure SA2),[47] respectively. (See Appendix A2.1 and A2.2 for those standards).

Statistical Analysis

Simple descriptive statistics were created [mean (SD) - quantitative data and n (%) - categorical data] for all covariates (listed in Table 1) and stratified by FI

(outcome). Independent, two-sample t-test and chi-square tests were conducted to measure the association between FI and each covariate. Logistic regression was performed, and corresponding unadjusted odds ratios (ORs) and 95% confidence intervals (CIs) were reported for each covariate, individually, in prediction of FI. For the purposes of this study, purposeful model selection was utilized. Initial inclusion criteria for model inclusion were variables previously identified as important risk factors for FI[2,48–51] and covariates not in this set with p-values <0.25 when predicting FI. A backward selection was then employed. Variables were retained in the model if p-value <.05 or if they were deemed confounders. A variable was a confounder if it influenced the main effect of a significant covariate by 10% and was related to that covariate. In this final set of covariates, two-way interactions were then explored between all covariates to identify any important risk groups. To adjust for multiple comparisons, an interaction was deemed significant if p-value <.01. All data were analyzed using SAS v9.4.

Results

Consented and Final Sample Size

Total preschool enrollment in the 28 schools during the baseline collection period was 1907 children (Fig. 1). Of these, 1277 parents consented for their child to participate in the study. A demographics survey was completed and returned by 924 (72%) parents.

Demographics and Household Characteristics

The two school districts had similar demographics where 99% of the population was Hispanic and 92% economically-disadvantaged, as per school district reporting. The average age of children in the study was 55.6 months (range: 48–62) with an average BMI of 16.7 kg/m² (range: 12.4–35.2). Nearly 32% (31.7%) ($n = 405$) were classified as obese and overweight and 13.0% ($n = 166$) were classified as underweight. The average size of household in the study was 5 people (range: 2–14). Many of the participants were economically marginalized, where 57.1% ($n = 475$) had an IPR ≤1, indicating that, as a household, they lived below the poverty threshold. For the 861 families reporting information on income, 71.0% of the families were deemed to be eligible for some type of FA (WIC, SNAP-Ed, other).

Demographics and Household Characteristics by Food Security Status

FI affected 70.7% (643 of 909) of participants in our study. Without adjustment, there were significant associations with FI between income and use of

Table 1. Demographic and household covariates (*n = 909*).

Child characteristics	
Age (months)	55.6 (48–62)
Weight (kg)	19.0 (12–46.4)
Height (cm)	106.0 (93.1–123.5)
BMI Categories	
Underweight	166 (13.0)
Healthy Weight	706 (55.3)
Overweight	200 (15.7)
Obesity	205 (16.0)
Sex	
Female	440 (48.4)
Male	469 (51.6)
Household Characteristics	
Family History DM	
No	426 (48.3)
Yes	456 (51.7)
Family History HTN	
No	418 (48.1)
Yes	451 (51.9)
Mother's education	
< HS	244 (27.7)
HS	214 (24.3)
SC/TS	208 (23.6)
CH	216 (24.5)
Father's Education	
< HS	269 (30.9)
HS	293 (33.7)
SC/TS	199 (22.9)
CH	109 (12.5)
Annual Income	
$0 to 23,900	412 (47.8)
$24,000 to 47,900	218 (25.3)
$48,000 to 71,900	97 (11.3)
$72,000 to 95,900	69 (8.0)
$96,000 +	65 (10.1)
Food Assistance (FA)	
None	398 (45.3)
SNAP	185 (21.1)
WIC	74 (8.4)
SNAP+WIC	198 (22.6)
Other	23 (2.6)
Eligible FA	
No	216 (23.8)
Yes	645 (71.0)
Unknown	48 (5.3)
Children in HH*	
1	95 (10.5)
2	303 (33.3)
3	262 (28.8)
4	141 (15.5)
5+	97 (10.8)
Adults in HH**	
1	117 (12.9)
2	606 (66.7)
3	98 (10.8)
4+	58 (6.6)
Poverty*	
No	357 (42.9)
Yes	475 (57.1)

(*Continued*)

Table 1. (Continued).

Household Characteristics	
Food Insecurity	
Never	266 (29.3)
Seldom	199 (21.9)
Sometimes	259 (28.5)
Most of the time	102 (11.2)
Almost always	83 (9.1)
Food Insecurity	
No	266 (29.3)
Yes	643 (70.7)

Abbreviations: SC = Some College; TS = Technical School; CH = College Grad or Higher; HH = Household; Poverty was determined by the IPR as noted in methods. See methods for complete description.

Results represent *n* (%) for categorical variables and Mean (IQR) for continuous variables.

* = Mean (IQR): 2.9 (1–10)

** = Mean (IQR): 2.1 (1–6)

FA along with the income-driven variables of eligibility for FA and poverty (IPR <1). Of those who reported FI, 58.7% also reported using some type of FA, while 44.9% who reported no FI utilized FA ($p = .0013$). Additionally, 75.9% of those who were FI were eligible to receive assistance, while 59.0% not reporting FI were eligible for some FA (Table 2). Exploring household income directly within the classification of FI for the annual income ranges of $0–23,900, $24,000–47,900 and $48,000–71,900, those who reported not experiencing FI was 31.5%, 29.2% and 16.7%, respectively. Those who reported FI in these respective income ranges was 54.8%, 23.7% and 8.9%. This trend demonstrates the inverse association between higher income and lower FI, within our sample. Finally, in our population, FI was not associated with age, weight, BMI, BMI z-score, adults in the household, or gender without adjustment.

Food Insecurity, Food Assistance Participation and Eligibility

Table 3 presents how reported FA and eligibility are associated when stratified by FI status. This table directly addresses aim 1 by quantifying FA participation and eligibility. Based on reported household income, in those food insecure families who were eligible for FA, 65.8% utilized some assistance, but 31.8% (155 of 488) did not use any form of assistance. This problem was also prevalent with those who did not report FI, with 40.1% (63 of 157) eligible for assistance not partaking in any assistance program. It is important that WIC, SNAP and other programs are able to properly identify those in need. In our study, these programs were able to identify many families who were not eligible for food assistance. For those who did not report FI and were not eligible for a program, 76.0% did not report use of any programs. Additionally, of those who reported food insecurity, 73.3% who were not eligible reported

Table 2. Demographic and household covariates by food security status (n=909).

Variable	Food Insecurity No (FS) (n = 266)	Food Insecurity Yes (FI) (n = 643)	p-value
Child characteristics			
Age (months)	55.5 (48–62)	55.6 (49–62)	0.7670
Weight (kg)	19.0 (12–46.4)	18.9 (12.4–38.2)	0.8660
Height (cm)	106.1 (93.1–117.9)	105.9 (93.1–123.5)	0.6924
BMI Categories			
Underweight	42 (15.8)	73 (11.4)	0.3207
Healthy Weight	146 (54.9)	365 (56.8)	
Overweight	36 (13.5)	98 (15.2)	
Obesity	42 (15.8)	107 (16.6)	
Sex			
Female	119 (44.7)	321 (49.9)	0.1546
Male	147 (55.3)	322 (50.1)	
Household characteristics			
Family History DM			
No	132 (50.8)	294 (47.3)	0.3426
Yes	128 (49.2)	328 (52.7)	
Family History HTN			
No	125 (48.8)	293 (47.8)	0.7817
Yes	131 (51.2)	320 (52.2)	
Annual Income			
$0 to 23,900	81 (31.5)	331 (54.8)	**<0.0001**
$24,000 to 47,900	75 (29.2)	143 (23.7)	
$48,000 to 71,900	43 (16.7)	54 (8.9)	
$72,000 to 95,900	35 (13.6)	34 (5.6)	
$96,000 +	23 (9.0)	42 (7.0)	
Food Assistance (FA)			
None	141 (55.1)	257 (41.3)	**0.0013**
SNAP	49 (19.1)	136 (21.9)	
WIC	22 (8.6)	52 (8.4)	
SNAP+WIC	41 (16.0)	157 (25.2)	
Other	3 (1.2)	20 (3.2)	
Eligible FA			
No	100 (37.6)	116 (18.0)	**<0.0001**
Yes	157 (59.0)	488 (75.9)	
Unknown	9 (3.4)	39 (6.1)	
Children in HH*			
1	30 (11.5)	65 (10.2)	0.1467
2	97 (37.0)	206 (32.4)	
3	75 (28.6)	187 (29.4)	
4	42 (16.0)	99 (15.6)	
5+	18 (6.9)	79 (12.4)	
Adults in HH**			
1	37 (14.5)	80 (12.8)	0.5983
2	171 (66.8)	435 (69.8)	
3	33 (12.9)	65 (10.4)	
4+	15 (5.9)	43 (6.9)	
Poverty			
No	149 (60.3)	208 (35.6)	**<0.0001**
Yes	98 (39.7)	377 (64.4)	

Results represent n (%) for categorical variables and Mean (IQR) for continuous variables.
*= FS Mean (IQR): 2.7 (1–6)
FI Mean (IQR): 2.9 (1–10)
**= FS Mean (IQR): 2.1 (1–5)
FI Mean (IQR): 2.1 (1–6)
† = indicates variables was log transformed to accommodate independent samples t-test assumptions.
‡= indicates variables was square root transformed to accommodate independent samples t-test assumptions.
Bold typeface indicates statistical significance.

Table 3. Associations between food insecurity and food assistance eligibility and usage ($n = 909$).

	Food Insecurity No (FS) (n = 266)				Food Insecurity Yes (FI) (n = 643)			
Eligible – SNAP or WIC	None (n=398)	SNAP/WIC/ SNAP + WIC (n=457)	Other food assistance (n=23)	Missing (n=31)	None (n=257)	SNAP/WIC/ SNAP + WIC (n=345)	Other food assistance (n=20)	Missing (n=21)
No	76 (76.0)	19 (19.0)	2 (2.0)	3 (3.0)	85 (73.3)	24 (20.7)	2 (1.7)	5 (4.3)
Yes	63 (40.1)	88 (56.1)	1 (0.6)	5 (3.2)	155 (31.8)	303 (62.1)	18 (3.7)	12 (2.5)
Unknown	2 (22.2)	5 (55.6)	0 (-)	2 (22.2)	17 (43.6)	18 (46.2)	0 (5.2)	4 (10.3)

Unknown = eligibility not determined due to lack of income data.
Chi-Square Test for Independence <0.0001 for both groupings.

they did not use any assistance programs. Although this is self-reported income data, 19.0% and 20.7% of those who were not eligible based on income requirements indicated they were on WIC, SNAP-Ed or both for those food secure and food insecure respectively.

Predictors of Food Insecurity

The final adjusted model results are presented in Table 4. We found that sex, poverty and eligibility for FA were associated with FI. The odds of being in a family that reported FI were 43% higher for females than males ($p = .0281$). Additionally, families who were below the national poverty threshold reported by HHS had 85% higher odds of reporting FI relative to those who were above it. Finally, those who were eligible for FA had 77% ($p = .0261$) higher odds of FI relative to those who were not eligible.

Predicted Food Insecurity by Income per Person

FA eligibility is determined by income and number of people in the household. If we explore how income/person and predicted FI are related (Fig. 2), we can see that the threshold of approximately $1,000 per person designates a stark difference in the slope of predicted FI. Income per person is a primary driver of eligibility. This figure helps to demonstrate a continuous view of how

Table 4. Binary logistic regression predicting food insecurity ($n = 811$).

Variable	Class	OR (95% CI)	p-value
Sex	F vs M	**1.43 (1.04, 1.96)**	**0.0281**
Children in Household	2 vs 1	0.64 (0.36, 1.13)	0.1224
	3 vs 1	0.72 (0.41, 1.26)	0.2446
	4 vs 1	0.68 (0.36, 1.28)	0.2270
	5+ vs 1	1.03 (0.48, 2.22)	0.9353
Poverty	Yes vs No	**1.85 (1.14, 3.02)**	**0.0136**
Food Assistance (FA)	Yes vs No	1.06 (0.72, 1.56)	0.7601
Eligible for FA	Yes vs No	**1.77 (1.07, 2.94)**	**0.0261**

C = 0.654.
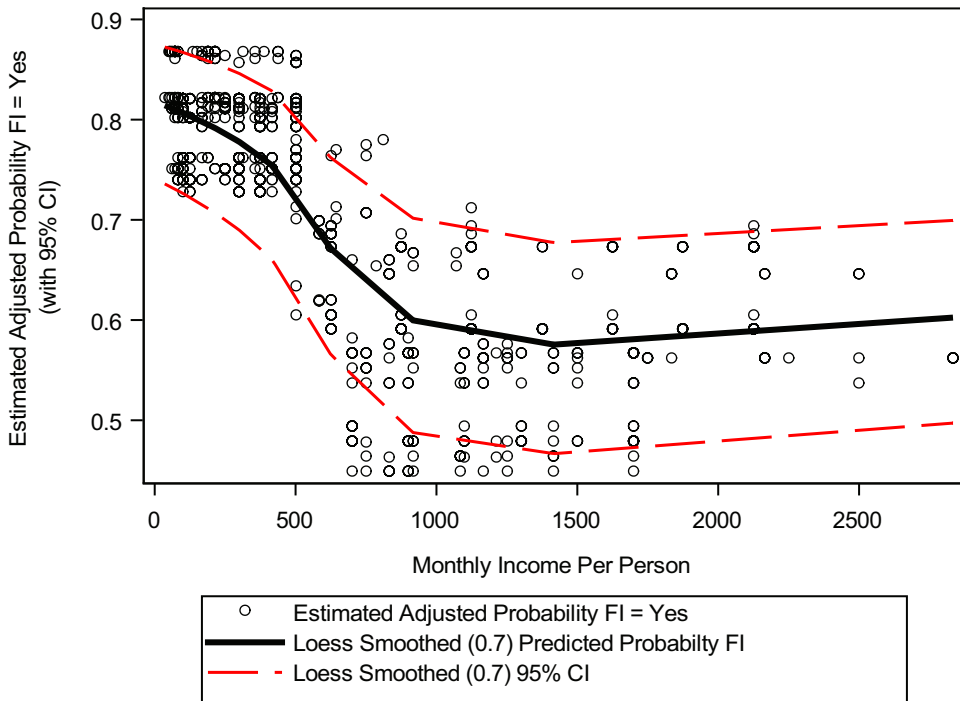Bold typeface indicates statistical significance.

Figure 2. Predicted FI by monthly income per person.

changes in eligibility affect FI. The predicted probability of FI for this entire population always lies above 50%, which is an indication of the high level of FI experienced by the population this study represents.

Discussion

Food Insecurity: Survey Question

Most of our study participants reported some level of FI (70.7%). In our study, FI was assessed by one question. A number of prior studies utilized longer 6–18 item questionnaires to assess FI.[7–9,12] Our findings demonstrate that FI, as gauged by a one-question device, still correlated with measures of income, poverty, FA eligibility and program participation. A limitation to this tactic is the inability to further assess variations in FI and causes of it. In our literature review on this topic, we did find one cross-sectional study assessing the relationship between FI and obesity in adults assessed FI through the use of only one question: "How often in the past 12 months would you say you were worried or stressed about having enough money to buy nutritious meals?"[52] However, this question conjures up emotions surrounding financial insecurity as well as the need for nutritional proficiency, while the one question used in our study focused more on the physical lack of food in the household at the

end of the month, which is a more direct quantification of food resources. Other research groups have examined the use of one question to screen for hunger,[8,53] though the USDA explicitly differentiates between hunger and FI, where hunger is a physical sensation yet FI is more about a inadequacy of resources, concern about running out of food and lack of diet quality.[1] More research is needed to confirm the use of our one-question survey as a valid instrument in assessing FI.

Food Insecurity and Income and IPR

FI was associated with reported annual income, poverty (as assessed by IPR), reported FA program participation and FA eligibility. Our data are consistent with past findings that link FI with income,[7,8] and poverty.[54,55] As reported participation in FA programs and poverty increased, so did FI. Those families eligible for FA had 77% higher odds of being food insecure and if the household lived in poverty, the family had 85% higher odds of being food insecure. Though increased household income predicted lower levels of FI, there was still FI (7.0%) even in families of the highest reported income. Of the families with FI, 40% (257/643) did not report using any type of FA program, yet 75.9% (195) of those same families were eligible to receive FA.

Upon exploring the relationship between income per person and predicted FI, we see an initial downward slope, with that line starting to level off upon reaching a monthly income of $1,000 per person. Past research substantiates a significant relationship between income and FI,[7,9,12] and we were able to capture this relationship across a continuum of income per person. Further research with better income data and greater variation in sociodemographic variables may help to validate our findings.

Food Insecurity and FA Participation and Eligibility

Regarding FA program participation, in 2014, Hilmers et al. reported that 77% of a population with FI partook in at least one federal FA program,[30] while in 2018 the USDA estimated that, in the U.S., 82% of eligible individuals participated in SNAP benefits[36] and 57% of eligible individuals participated in WIC benefits.[37] Our data showed that, of people who did not report FI, 56.1.% were eligible and reported receiving benefits, while, of those who reported FI, 62.1% were eligible and taking advantage of those benefits. Of families not eligible for FA, 76.0% of food secure and 73.3% of food insecure households were not receiving benefits, which means that these families were being properly screened. In our study, of those families who were food secure, 40.1% were eligible to receive FA but did not partake, while, in those families who were food insecure, 31.8% were eligible but did not report receiving FA. Not only is it important for those who are eligible for FA programs to be

receiving those benefits, but it is particularly important that families who report FI take advantage of FA programs. It is possible the lower participation rates in our sample were based on cultural influences and/or lack of reporting participation, which may also be culturally biased. A large majority of the population in the Rio Grande Valley are families where language, poverty and economic obstacles might preclude families from taking advantage of assistance they are qualified to use. In future work, nutritional literacy and education will be important in regards to the successful use of FA programs in eligible populations, as there is some prior evidence suggesting that mere participation does not always result in higher diet quality.[56] Additionally, documentation, or lack thereof, may impact eligibility for and subsequent use of federal food assistance. This barrier could leave a large segment of our communities at a higher risk for food insecurity and should be addressed in future work.

Food Insecurity and BMI

While previous studies have linked BMI with FI,[52,57–61] our study did not find any relationship between body weight or BMI with FI. The other studies mentioned focused on older elementary, college-aged and adults, whereas we were studying preschool children. It may be that the relationship between BMI and FI only emerges at some age threshold not met by our participants.

Food Insecurity and Sex

Though we found no relationship between sex and FI in our unadjusted model, once we adjusted for number of children in the household, poverty, FA and eligibility for FA, females in our study experienced 43% higher odds of FI. This finding is similar to Shanafelt et al.[62] as well as Pan et al.[52] who found that females were more likely to experience FI. Both studies, however, were implemented in an older adult population, which is a different setting from our study.

Study Strengths and Limitations

Our findings suggest the use of one question to identify those who have FI as defined solely by food inadequacy. Female children in the household, higher poverty, and greater reported participation in FA programs were all significant predictors of this FI question's simple assertion of a lack of food at the end of the month. Our ability to use one question for FI assessment does not necessarily mean that more detailed, longer questionnaires should not be utilized, especially since many of those longer questionnaires separately evaluate the specific food security of children. However, it does suggest that this one question could be

readily used as a tool for FI in large studies where study participants lack time and/ or literacy. We have also identified another highly food insecure population, almost half of whom do not take advantage of any FA programs, despite being eligible to partake in such programs. This leads us to question why families with FI are not participating in FA programs. Future studies should examine and try to curb the barriers that prevent the use of these resources. Some reasons may be pride, culture, dearth of knowledge about said programs, inability to partake in the enrollment process or lack of documentation. In terms of families who, despite earning higher incomes, are still acknowledging some amount of FI, it is possible that we have unveiled a segment of the population who are earning just enough money where they do not qualify for FA, but not enough where they feel confident feeding their families consistently. Additionally, these families may struggle with prioritizing food over other expenditures or might not have the financial literacy to balance expenses. In our analysis, we used the reported income per household and calculated income per person which allowed for a better understanding of how the finances are allocated within the household. Doing so helped demonstrate that FI is occasionally seen at relatively high levels of household income. Furthermore, our subject population was mainly Hispanic, but many of our findings were consistent with studies from a more general population.[7,9,12]

Our study did have some limitations. Some data and analyses were examining information derived from questionnaires filled out by the study participants' families. All survey data were subjectively reported and not objectively verified unlike our anthropometric data, which were measured by school/STEPS-PreK staff. A perfect measure of income per person cannot be made with this data set, as our income data was based on ranges of income rather than individually reported household income. Our questionnaire did not specifically ask about participation in Free Breakfast and Lunch programs, both which were available to 100% of the preschool children.[63] Additionally, our questionnaire did not ask about the use of local food pantries, resources that are reportedly utilized at higher levels in homes with limited income and more so amongst Hispanic adults than non-Hispanic white individuals.[64] It is possible that participation in free meals or the use of food pantries were unspecified yet accounted for within the "Other" category in the questionnaire. In future research, creating a write-in option for income and/or "Other" may give us even more insight into how specific income levels affect FI and elucidate what other FA programs may be available and utilized in our community. The exact nature of why the relationship between FI and FA program participation differs amongst various education/incomes classes cannot be explored given the limited information about how financial and food decisions were made inside each household.

Conclusions

The present study suggests that, despite some families experiencing FI, many are not participating in FA programs, which are meant to economically support families and alleviate some of the stress associated with obtaining enough food. This lack of participation does not seem to be solely related to ineligibility. It is possible that some families do not qualify for federal assistance as they are undocumented. Future studies should not only examine the rationale for nonparticipation, but also evaluate possible methods to encourage FA program participation and address the potentially high risk for food insecurity in undocumented populations. It is equally as important to implement supplemental education programs which promote financial literacy and specifically provide information on healthy food budgeting.

Disclosure Statement

No potential conflict of interest was reported by the author(s).

Funding

Authorship Contribution Statement

R T-P, ZR and LW conceived and planned the research project. R T-P, ZR, LW and EA carried out the study implementation. LMBS, MM, R T-P, ZR, LW and EA contributed to the interpretation of the results. LMBS and MM took the lead in writing the manuscript. All authors provided critical feedback and helped shape the research, analysis and manuscript.

Data Availability Statement

The data underlying this article will be shared on reasonable request to the corresponding author.

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