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The Family Home Environment, Food Insecurity, and Body Mass Index in Rural Children

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Abstract

Background. Family homes are a key setting for developing lifelong eating and physical activity habits, yet little is known about how family home nutrition and physical activity (FNPA) environments influence food insecurity (FI) and childhood obesity, particularly in rural settings. *Aims*. This study examined associations among FNPA, FI, and body mass index (BMI) in rural children. *Method*. Parents of 186 elementary school–age children completed FNPA and FI surveys. Child anthropometrics were directly measured. Logistic and linear regressions were used to examine associations. *Results*. Approximately 37% of children were overweight/obese; 43% of families were at risk for FI. Children whose families limited watching TV while eating were less likely to be obese (odds ratio [OR] = 0.56, p = .03) as were children whose families monitored intake of chips, cookies, and candy (OR = 0.54, p = .01). FI was higher in obese than normal weight children (OR = 11.00, p = .003) but only among families not eligible to receive free/reduced-cost school meals. Among eligible families, lower odds of FI were found for those who ate meals together often (OR = 0.31, p = .04) and for those with children frequently enrolled in organized sports/activities (OR = 0.65, p = .04). Findings were not significant after adjusting for multiple comparisons. *Discussion*. Results suggest that favorable FNPA factors were associated with healthier BMI and lower odds of FI. *Conclusion*. Opportunities for healthy eating at home may support rural children's weight health. Additional resources may be necessary to promote food security among low-income families. Future research is warranted to better understand FNPA in relationship to the disproportionate rates of obesity and FI in rural populations.

Keywords

food insecurity, health behavior, health promotion, nutrition, physical activity, overweight and obesity, school meals program

Childhood obesity is a public health priority in the United States (U.S. Department of Health & Human Services, 2014). Nearly 18% of children aged 6 to 11 years are obese and 34% are overweight (Ogden, Carroll, Kit, & Flegal, 2014). Obese children are at increased risk for physical, social, and psychological health problems and are more likely to become obese adults (Biro & Wien, 2010; Freedman, Mei, Srinivasan, Berenson, & Dietz, 2007; Whitlock, Williams, Gold, Smith, & Shipman, 2005). Evidence also suggests that being overweight is associated with poor academic achievement (Datar & Sturm, 2006; Judge & Jahns, 2007). Although childhood obesity is a national concern, population disparities present unique challenges for prevention (Singh, Siahpush, & Kogan, 2010; Wang, 2011). Of particular importance is the higher prevalence among rural compared to nonrural children (J. A. Johnson & Johnson, 2015).

From an ecological perspective of health promotion, the health of individuals results from complex interactions between multilevel factors of influence (McLeroy, Bibeau, Steckler, & Glanz, 1988). For example, though the behavioral correlates of obesity may be similar, the environmental contexts in which rural and nonrural children eat and play are dissimilar, resulting in different supports and barriers to achieving and maintaining healthy weight. Structural, socioeconomic, and cultural factors may influence opportunities

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for rural children to develop healthy eating and physical activity (PA) behaviors (Gamm, Hutchison, Dabney, & Dorsey, 2003). Whether and how these and other environmental influences contribute to higher obesity prevalence in rural settings is not well defined, particularly among elementary school–age children (Liu et al., 2012).

The home environment is a key setting that shapes children's obesity-related health behaviors (Crossman, Anne Sullivan, & Benin, 2006; McGuire, 2012). Although families are a target for obesity prevention efforts that aim to modify children's diet and/or PA practices, relatively few studies have examined the home setting (Showell et al., 2013; Wang et al., 2013). Research examining rural home environments is especially scarce (Kegler et al., 2012; Kegler, Escoffery, Alcantara, Ballard, & Glanz, 2008). A holistic approach to promoting weight healthy behaviors and environments in rural areas requires a better understanding of how family home practices and policies may promote or prevent obesity.

Food insecurity (FI), defined as a lack of consistent access to enough food to support an active, healthy life (Coleman-Jensen, Nord, & Singh, 2013), is also detrimental to children. FI has been associated with poorer health status (Alaimo, Olson, Frongillo, & Briefel, 2001; Skalicky et al., 2006), developmental and mental health problems (McLaughlin et al., 2012; Rose-Jacobs et al., 2008), and poor educational outcomes (Alaimo, Olson, & Frongillo, 2001; Jyoti, Frongillo, & Jones, 2005). FI has also been associated with overweight and obesity, although evidence among children is inconsistent (Eisenmann, Gundersen, Lohman, Garasky, & Stewart, 2011; Franklin et al., 2012).

Rural populations experience higher rates of obesity, poverty, and FI compared with nonrural populations (Befort, Nazir, & Perri, 2012; Coleman-Jensen et al., 2013; U.S. Department of Agriculture Economic Research Service, 2013). An overarching goal of Healthy People 2020 stipulates the elimination of health disparities, including those related to geographic location and socioeconomic status (U.S. Department of Health & Human Services, 2014). Furthermore, Healthy People 2020 objectives include reducing youth obesity and household FI. Given these public health priorities, and the call for more research to support interventions customized for rural settings (Liu et al., 2012; Lutfiyya, Lipsky, Wisdom-Behounek, & Inpanbutr-Martinkus, 2007), exploration of factors that may contribute to obesity and FI in rural areas is warranted.

The primary aim of this study was to determine whether family home factors related to nutrition and PA are associated with BMI and FI among rural children. The secondary aim was to determine whether FI is associated with overweight/obesity among rural children. It was hypothesized that more favorable family home environments would be associated with lower BMI and lower risk of FI. It was further hypothesized that FI would be associated with higher BMI.

Method

Participants

Data were collected as part of a larger childhood obesity study, Generating Rural Options for Weight (GROW)–Healthy Kids & Communities (John, Gunter, Etuk, Langellotto, & Manore, 2014). GROW is a multilevel intervention targeting rural family home, school, and community settings to promote healthful eating and PA, and prevent obesity, among rural children. GROW sampling started with selection of three Oregon counties, based on geographic distribution and number of rural, low-income communities. Eligible school districts and schools within each county were determined based on rurality as designated by the U.S. Census (U.S. Department of Agriculture, 2012) and low-income status (≥50% of families eligible for free or reduced-cost school meal programs). Two elementary schools were randomly selected from separate communities within each county and were randomized to control (n = 3) or intervention (n = 3) group. All families with elementary school–age children (N = 2,200 children) attending GROW schools were eligible to participate in the family home study. Approximately 12% of children (n = 270) and their parents consented to participate between 2012 and 2014. The Oregon State University institutional review board approved all protocol and procedures prior to initiation of this study.

Measures

Data for the present study included survey responses about family nutrition and PA, family FI, and demographics. Parents completed surveys during fall 2013 (baseline). BMI data were measured during fall of 2013 and 2014 (1-year follow-up). Details on survey instruments and BMI measures are provided below.

Family Nutrition and Physical Activity. The Family Nutrition and Physical Activity (FNPA) screening tool is a previously validated instrument applied in both urban and rural settings (Ihmels, Welk, Eisenmann, & Nusser, 2009; Ihmels, Welk, Eisenmann, Nusser, & Myers, 2009; Tami, Reed, Trejos, Boylan, & Wang, 2015; Tucker et al., 2014). The FNPA was designed to assess evidence-based family environmental and behavioral factors that predispose young children to becoming overweight. In addition, Ihmels, Welk, Eisenmann, and Nusser (2009) demonstrated internal consistency of the FNPA instrument (α = .72) with a sample of urban families and children, as did we in our study sample (α = .79).

The FNPA instrument includes 20 items in two component areas (nutrition and PA; Table 1). Each component contains five domains (e.g., Meal Patterns) defined by two items each (e.g., My child eats breakfast + Our family eats meals together). Item response categories were coded on a 4-point scale as, *almost never*, *sometimes*, *usually*, and *almost*

Table 1. Family Nutrition and Physical Activity (FNPA) Screening Tool (Ihmels, Welk, Eisenmann, & Nusser, 2009).

Nutrition component
Meal Patterns
FNPA 1: My child eats breakfast
FNPA 2: Our family eats meals together
Eating Habits
FNPA 3: Our family eats while watching TV
FNPA 4: Our family eats fast food
Food Choices
FNPA 5: Our family uses microwave or ready-to-eat foods
FNPA 6: My child eats fruits and vegetables at meals or snacks
Beverage Choices
FNPA 7: My child drinks soda pop or sugar drinks
FNPA 8: My child drinks low-fat milk at meals or snacks
Restriction and Reward
FNPA 9: Our family monitors eating of chips, cookies, and candy
FNPA 10: Our family uses candy as a reward for good behavior
Physical activity component
Screen Time Behavior/Monitoring
FNPA 11: My child spends less than 2 hours on TV/games/computer per day
FNPA 12: Our family limits the amount of TV our child watches
Healthy Environment
FNPA 13: Our family allows our child to watch TV in his or her bedroom
FNPA 14: Our family provides opportunities for physical activity
Family Activity Involvement
FNPA 15: Our family encourages our child to be active every day
FNPA 16: Our family finds ways to be physically active together
Child Activity Involvement
FNPA 17: My child does physical activity during his or her free time
FNPA 18: My child is enrolled in sports or activities with a coach or leader
Family Routine
FNPA 19: Our family has a daily routine for our child's bedtime
FNPA 20: My child gets 9 hours of sleep a night

Note. All items coded on 4-point scale (1 = *almost never*, 2 = *sometimes*, 3 = *usually*, 4 = *almost always*). Items 3, 4, 5, 7, 10, and 13 are reverse coded.

always. All items were coded such that higher scores indicated more favorable behaviors and environments. Previous research suggests that a higher total FNPA score reflects more favorable family policies and practices, inferring lower risk for child overweight (Ihmels, Welk, Eisenmann, Nusser, & Myers, 2009). For this study, total FNPA as well as component, domain, and item scores were examined.

At Risk for Food Insecurity. Family FI was assessed using a previously validated two-item screening instrument (Hager et al., 2010). The screener identifies households at risk for FI and was previously found to have high sensitivity (97%), good specificity (83%), and convergent validity among a large population (n = 30,098) of low-income families with young children. The screener consists of the following statements: (1) "Within the past 12 months, we worried if our food would run out before we got money to buy more" and (2) "Within the past 12 months, the food we bought just didn't last and we didn't have money to get more." Item response categories were *never true*, *sometimes true*, and *often true*. Responses were dichotomized for analysis (*often true* or *sometimes true* vs. *never true*). An affirmative response to either or both statements was used to identify families at risk for FI.

Child Body Mass Index. Height and weight measurements were obtained by trained research staff. Children removed their shoes and outerwear (coats, hats, etc.) during measurements. Height was measured to the nearest 1 mm using a portable stadiometer. Weight was measured to the nearest 0.1 kg using a digital scale. Measurements were repeated three times on each child, and average height and weight were used to calculate BMI as weight (kg)/height (m^2).

Children were classified as underweight (<5th percentile), normal weight (5th to <85th percentile), overweight (85th to <95th percentile), or obese (≥95th percentile) according to the sex-specific Centers for Disease Control and Prevention (CDC) BMI-for-age growth charts (CDC, 2010). BMI data were converted to z scores using the sex- and age-specific parameters from the CDC.

Covariates. Family information provided by respondents included eligibility for free or reduced-cost school meals (yes, no) and parent education (Grade 12 or less, 1-3 years college, 4 years or more college). Child-level variables were age (years), sex (female, male), race (American Indian or Alaska Native, Asian, Black, Native Hawaiian or Other Pacific Islander, White), and ethnicity (Hispanic or Latino, Non-Hispanic or non-Latino; recoded for analyses as race/ethnicity: non-Hispanic or non-Latino White, Other). Although evaluating the GROW intervention was beyond the scope of this analysis, we evaluated a binary variable for the GROW study intervention or control group as a potential covariate.

Data Analysis

We received surveys from parents of 69% (n = 186) of the 270 children enrolled in the GROW family study. Ten surveys lacked an answer to one or two FNPA items. Because those 10 surveys contained a small amount of missing data, average FNPA scores were calculated for all individuals

based on the number of items completed, which is equivalent to imputing the missing data by the mean of the reported FNPA items. A preliminary analysis indicated no differences in BMI *z* score, average FNPA score, or demographics between participants with complete and incomplete surveys. Of the 186 children with FNPA data, baseline BMI data were collected on 177 children, and 1-year follow-up BMI on 128 children. BMI data were unavailable for 49 children at follow-up for various reasons, including the child no longer attended the school ($n = 3$), the child was absent on the day of measurement ($n = 2$), and parent or child opted out of measurement ($n = 4$). Compared with the rest of the sample, participants without a second height/weight measurement were older (8.5 vs. 7.7 years), and a higher percentage were eligible for free or reduced-cost school meals (71% vs. 51%). There were no differences for other demographic variables, baseline BMI, or FNPA. Missing data were considered missing at random (Little & Rubin, 2002), and as a result, a full information maximum likelihood analysis was conducted (Allison, 2012).

Descriptive statistics were examined for all variables. Unadjusted linear, logistic, and multinomial logistic regressions were used to examine associations between FNPA, BMI, and at risk for FI. Bivariate associations were examined between all potential covariates and dependent variables. Covariates significant at the level of $p < .1$ were evaluated in the multivariate analyses, and final models are presented including covariates that significantly contributed to the final model ($p < .05$).

Associations between FNPA, BMI, and at risk for FI were then examined using multivariable regression models, adjusted for retained covariates. Adjusted models also included a cluster variable to account for potentially correlated observations within families. Two-way interactions between independent variables and significant covariates were examined. Likelihood ratio tests and Akaike information criterion were used for model comparisons. Residual plots, normality tests for residual distributions, and the Hosmer–Lemeshow test were used to assess model assumptions and goodness of fit. For final models, statistical significance was set at $\alpha = .05$. False discovery rate *p* values were computed to adjust for multiple comparisons (Benjamini & Hochberg, 1995). Data analyses were performed using Stata (Version 13, 2013, StataCorp) and *R* (Version 3.1, 2015).

Results

Baseline participant characteristics are displayed in Table 2. Table 3 presents the cross-sectional associations between FNPA and odds of overweight/obesity compared with normal weight at baseline, adjusted for parent education and including a cluster variable for correlated data within families. FNPA was not significantly associated with being overweight. The odds ratios [ORs] indicate that higher scores in FNPA Eating Habits and Restriction and Reward domains were associated with lower odds of being obese. Specifically, children with families who limited watching TV while eating were less likely to be obese (OR = 0.56, $p = .03$). Children with families who monitored intake of chips, cookies, and candy were also less likely to be obese (OR = 0.54, $p = .01$). After adjustment for multiple comparisons, these associations were no longer statistically significant.

For the cross-sectional association between BMI and FI status, we found an interaction between BMI and eligibility for the federal school meals program ($p < .05$). Specifically, among children not eligible for free or reduced-cost school meals, FI and BMI *z* score were positively associated ($p = .001$), whereas for children eligible for free/reduced school

Table 2. Characteristics of Rural Elementary School–Age Children at Baseline ($n = 186$).

Characteristic	*n*	*M* (*SD*) or %
Age (years), *M* (*SD*)	181	8.0 (1.9)
Sex, %	186	
Female	79	42.5
Male	107	57.5
Race, %	166	
White	148	89.2
Other	18	10.8
Ethnicity, %	169	
Hispanic or Latino	27	16.0
Non-Hispanic or non-Latino	142	84.0
Parent education, %	180	
Grade 12 or less	43	23.9
1-3 years of college	91	50.6
4 or more years of college	46	25.6
Eligible for free/reduced-cost school meals, %	176	
Yes	98	55.7
No	78	44.3
At risk for food insecurity, %	183	
Yes	79	43.2
No	104	56.8
BMI, *M* (*SD*)	177	18.4 (3.8)
BMI percentile, *M* (*SD*)	177	68.5 (26.8)
Underweight, %	3	1.7
Normal weight, %	108	61.0
Overweight, %	37	20.9
Obese, %	29	16.4
BMI *z* score, *M* (*SD*)	177	0.7 (1.1)
FNPA score, *M* (*SD*)	186	
FNPA: Total Nutrition and Physical Activity	186	3.3 (0.4)
FNPA: Total Nutrition	186	3.3 (0.4)
FNPA: Total Physical Activity	186	3.3 (0.5)

Note. BMI = body mass index; FNPA = Family Nutrition and Physical Activity. FNPA: Total Nutrition and Physical Activity, average of 20 items coded on 4-point scale (1 = *almost never*, 2 = *sometimes*, 3 = *usually*, 4 = *almost always*). FNPA: Total Nutrition, Nutrition component, average of 10 FNPA nutrition items. FNPA: Total Physical Activity, Physical Activity component, average of 10 FNPA physical activity items.

Table 3. Multinomial Logistic Regression Examining Cross-Sectional Associations Between Family Nutrition and Physical Activity (FNPA) and Odds of Being Overweight or Obese[a] Among Rural Elementary School–Age Children (n = 177).

	Adjusted associations[b]					
	Overweight (n = 37)			Obese (n = 29)		
Variable	OR	p	p adj[c]	OR	p	p adj
FNPA: Total Nutrition and Physical Activity	0.92	.87	.96	0.47	.21	.77
FNPA: Total Nutrition	1.00	.99	1.00	0.34	.06	.49
FNPA: Meal Patterns	0.84	.42	.87	1.16	.53	.88
FNPA 1: My child eats breakfast	0.70	.34	.83	1.06	.87	.96
FNPA 2: Our family eats meals together	0.91	.72	.95	1.22	.49	.87
FNPA: Eating Habits	1.03	.89	.96	0.63	.05	.49
FNPA 3: Our family eats while watching TV	0.94	.80	.95	0.56	.03*	.49
FNPA 4: Our family eats fast food	1.31	.49	.87	0.71	.43	.87
FNPA: Food Choices	0.95	.79	.95	0.71	.09	.54
FNPA 5: Our family uses microwave or ready-to-eat foods	0.71	.23	.77	0.53	.07	.49
FNPA 6: My child eats fruits and vegetables at meals or snacks	1.15	.57	.89	0.76	.40	.87
FNPA: Beverage Choices	1.06	.71	.95	0.94	.69	.95
FNPA 7: My child drinks soda pop or sugar drinks	1.30	.44	.87	0.63	.14	.68
FNPA 8: My child drinks low-fat milk at meals or snacks	1.00	.99	1.00	1.09	.63	.92
FNPA: Restriction and Reward	1.08	.71	.95	0.66	.04*	.49
FNPA 9: Our family monitors eating of chips, cookies, and candy	1.09	.75	.95	0.54	.01*	.44
FNPA 10: Our family uses candy as a reward for good behavior	1.05	.86	.96	0.99	.98	1.00
FNPA: Total Physical Activity	0.91	.81	.95	0.73	.53	.88
FNPA: Screen Time Behavior/Monitoring	1.14	.29	.78	0.87	.20	.77
FNPA 11: My child spends less than 2 hours on TV/games/computer per day	1.23	.35	.83	0.95	.82	.95
FNPA 12: Our family limits the amount of TV our child watches	1.23	.38	.86	0.68	.05	.49
FNPA: Healthy Environment	0.78	.14	.68	0.80	.17	.77
FNPA 13: Our family allows our child to watch TV in his or her bedroom	0.76	.22	.77	0.74	.14	.68
FNPA 14: Our family provides opportunities for physical activity	0.78	.35	.83	0.91	.80	.95
FNPA: Family Activity Involvement	0.91	.55	.88	0.88	.44	.87
FNPA 15: Our family encourages our child to be active every day	0.71	.28	.77	0.86	.62	.92
FNPA 16: Our family finds ways to be physically active together	1.01	.98	1.00	0.83	.49	.87
FNPA: Child Activity Involvement	0.87	.19	.77	1.20	.26	.77
FNPA 17: My child does physical activity during his or her free time	1.23	.42	.87	1.05	.87	.96
FNPA 18: My child is enrolled in sports or activities with a coach or leader	0.71	.05	.49	1.39	.10	.57
FNPA: Family Routine	1.48	.18	.77	0.78	.23	.77
FNPA 19: Our family has a daily routine for our child's bedtime	1.11	.76	.95	0.79	.46	.87
FNPA 20: My child gets 9 hours of sleep a night	2.76	.05	.49	0.68	.26	.77

Note. OR = odds ratio. FNPA: Total Nutrition and Physical Activity, average of 20 items coded on 4-point scale (1 = *almost never*, 2 = *sometimes*, 3 = *usually*, 4 = *almost always*). FNPA: Total Nutrition, Nutrition component, average of 10 FNPA nutrition items. FNPA: Meal Patterns, average of two items: My child eats breakfast + Our family eats meals together. FNPA: Eating Habits, average of two items: Our family eats while watching TV + Our family eats fast food (both items reverse coded). FNPA: Food Choices, average of two items: Our family uses microwave or ready-to-eat foods (reverse coded) + My child eats fruits and vegetables at meals or snacks. FNPA: Beverage Choices, average of two items: My child drinks soda pop or sugar drinks (reverse coded) + My child drinks low-fat milk at meals or snacks. FNPA: Restriction and Reward, average of two items: Our family monitors eating of chips, cookies, and candy + Our family uses candy as a reward for good behavior (reverse coded). FNPA: Total Physical Activity, Physical Activity component, average of 10 FNPA physical activity items. FNPA: Screen Time Behavior/Monitoring, average of two items: My child spends less than 2 hours on TV/games/computer per day + Our family limits the amount of TV child watches. FNPA: Healthy Environment, average of two items: Our family allows our child to watch TV in their bedroom + Our family provides opportunities for physical activity. FNPA: Family Activity Involvement, average of two items: Our family encourages our child to be active every day + Our family finds ways to be physically active together. FNPA: Child Activity Involvement, average of two items; My child does physical activity during his or her free time + My child is enrolled in sports or activities with a coach or leader. FNPA: Family Routine, average of two items; Our family has a daily routine for our child's bedtime + My child gets 9 hours of sleep a night.
[a]Reference category: normal weight and low weight combined. [b]Adjusted for parent education and including a cluster variable for correlated data within families. [c]False discovery rate adjusted p value for multiple comparisons.
*$p < .05$.

meals, we found no association between FI and BMI (p = .62). We thus present results stratified by school meals eligibility; for children who were not eligible for free/reduced-cost school meals, the odds of being at risk for FI

were greater for children classified as overweight (OR = 6.11, $p = .047$) and obese (OR = 11.00, $p = .003$) than normal weight (Table 4). With adjustment for multiple comparisons, these associations were no longer statistically significant.

As we found with BMI, we found an interaction between FNPA and eligibility for the federal school meals program ($p < .05$). Among children eligible for free/reduced-cost meals, an inverse association was found between FI and some FNPA factors, whereas for children not eligible, no associations were found (Table 4). The stratified results show that among families eligible for free/reduced meals, those with higher scores in the Meal Patterns domain had lower odds of being at risk for FI (OR = 0.38, $p = .03$). More specifically, among eligible families, those who ate meals together more often were 69% less likely to be at risk for FI (OR = 0.31, $p = .04$). Likewise, higher scores in the Child Activity Involvement domain were associated with lower odds of being at risk for FI among those eligible for free/reduced meals (OR = 0.69, $p = .04$). Eligible families with children who were more frequently enrolled in organized sports or activities were 35% less likely to be at risk for FI (OR = 0.65, $p = .04$). After adjustment for multiple comparisons, these associations were no longer significant.

We further examined associations of FNPA and FI at baseline with BMI *z* score at 1-year follow-up ($n = 128$). We found no significant associations for FNPA total, nutrition, or PA scores (Table 5). After adjusting for BMI *z* score at baseline and the GROW intervention, only one FNPA item was a significant predictor of change in BMI *z* score. Eating breakfast more often was associated with a lower BMI *z* score at Year 2 (B = −0.14, $p = .005$; data not shown). After adjusting for multiple comparisons, this association was no longer statistically significant. We also observed no association between FI at baseline and change in BMI *z* score after 1 year (Table 5).

Discussion

We found no association between total FNPA score and child BMI in a sample of families from six rural communities in Oregon. On further examination of each FNPA individual item score, we found that some FNPA items were associated with BMI. An unexpected finding was the modifying effect of eligibility to receive free or reduced-cost school meals on associations between FI and BMI, and FI and FNPA, respectively. It is important to note, however, that these results were no longer statistically significant after adjustment for multiple comparisons. We presented our findings with *p* values both unadjusted and adjusted for multiple comparisons to compare and contrast our findings with previous studies that did not adjust for multiple comparisons (Couch, Glanz, Zhou, Sallis, & Saelens, 2014; Dubois, Farmer, Girard, & Peterson, 2008; Hughes, Shewchuk, Baskin, Nicklas, & Qu, 2008; Ihmels, Welk, Eisenmann, Nusser, & Myers, 2009; L. Johnson, van Jaarsveld, & Wardle, 2011; MacFarlane, Cleland, Crawford, Campbell, & Timperio, 2009; Nackers & Appelhans, 2013; Pearson et al., 2012; Vereecken, Haerens, De Bourdeaudhuij, & Maes, 2010; Vik et al., 2013) as discussed below.

Our finding of no association between total FNPA score and BMI is contrary to previous research. In a sample of families from a large urban school district in the Midwest, Ihmels and colleagues found that a lower total FNPA score (i.e., less favorable family home environment and behaviors) was associated with increased risk for child overweight, and FNPA score predicted change in BMI over a 1-year period (Ihmels, Welk, Eisenmann, & Nusser, 2009; Ihmels, Welk, Eisenmann, Nusser, & Myers, 2009). Discrepancies in our findings may in part be due to differences in sample demographics. Ihmels and colleagues study was among urban families and limited to children in first grade whereas our study was with rural families and more heterogeneous by age. Our sample also included a greater percentage of children with no change or a decrease in BMI percentile over a 1-year period whereas Ihmels and colleagues observed an overall increase in BMI percentile.

To our knowledge, no previous studies have examined individual items of the FNPA instrument in association with BMI; however, others have examined similar concepts in nonrural populations (Couch et al., 2014; Dubois et al., 2008; Hughes et al., 2008; L. Johnson et al., 2011; MacFarlane et al., 2009; Pearson et al., 2012; Vereecken et al., 2010; Vik et al., 2013). For example, we found that children whose families monitored intake of chips, cookies, and candy were less likely to be obese. Several studies have shown that greater availability of unhealthy or energy-dense foods at home was positively associated with children's consumption of such foods (L. Johnson et al., 2011; Pearson et al., 2012; Vereecken et al., 2010), which may promote overweight/obesity. Others have found that authoritative parenting practices, such as setting "allow/limit" food rules, were favorably associated with dietary quality and/or weight status (Couch et al., 2014) whereas permissive and restrictive parent feeding practices were associated with higher child BMI (Couch et al., 2014; Hughes et al., 2008). Comparable with our finding that children whose families limited watching TV while eating were less likely to be obese, others have found higher BMI among children who frequently watched TV while eating compared to those who did so less often or never (Dubois et al., 2008; MacFarlane et al., 2009; Vik et al., 2013).

Limited research has examined relationships between family home nutrition and PA environments with FI. Nackers and Appelhans (2013) found that food-insecure caregivers of nonrural young children reported greater availability of and access to less healthful foods at home compared with food-secure participants, suggesting that food secure and food insecure families may report different home nutrition environments. Among children eligible for free/reduced-cost school meals, we found that families were less likely to be at risk for FI if they reported eating meals together or if their

Table 4. Multivariable Logistic Regression Examining Associations Between BMI and FNPA With Odds of Reporting Family at Risk for Food Insecurity, Stratified by Eligibility for Free or Reduced-Cost (f/r) School Meals, Among Rural Elementary School–Age Children (n = 169).

	Family at risk for food insecurity					
	Adjusted Associations[a,b]					
	Eligible for f/r school meals (n=95)			Not eligible for f/r school meals (n = 74)		
Variable	OR	p	p adj[c]	OR	p	p adj
BMI z score	0.88	.62	.93	3.63	.001**	.07
BMI category						
Normal weight	Reference					
Overweight	1.17	.78	.93	6.11	.047*	.42
Obese	1.07	.93	.98	11.00	.003**	.09
FNPA: Total Nutrition and Physical Activity	0.29	.11	.57	1.30	.74	.93
FNPA: Total Nutrition	0.36	.25	.75	1.55	.53	.92
FNPA: Meal Patterns	0.38	.03*	.38	1.30	.46	.92
FNPA 1: My child eats breakfast	0.34	.11	.57	0.54	.42	.92
FNPA 2: Our family eats meals together	0.31	.04*	.38	2.29	.10	.55
FNPA: Eating Habits	0.84	.52	.92	0.93	.83	.93
FNPA 3: Our family eats while watching TV	1.07	.84	.93	0.72	.52	.92
FNPA 4: Our family eats fast food	0.38	.09	.55	1.61	.52	.92
FNPA: Food Choices	0.92	.73	.93	1.06	.79	.93
FNPA 5: Our family uses microwave or ready-to-eat foods	0.79	.68	.93	1.18	.71	.93
FNPA 6: My child eats fruits and vegetables at meals or snacks	0.00	.98	.99	1.01	.99	.99
FNPA: Beverage Choices	0.70	.17	.64	1.11	.73	.93
FNPA 7: My child drinks soda pop or sugar drinks	0.77	.61	.93	2.46	.21	.72
FNPA 8: My child drinks low-fat milk at meals or snacks	0.68	.14	.63	0.93	.84	.93
FNPA: Restriction and Reward	1.28	.35	.87	1.18	.64	.93
FNPA 9: Our family monitors eating of chips, cookies, and candy	1.11	.74	.93	1.43	.42	.92
FNPA 10: Our family uses candy as a reward for good behavior	1.62	.24	.74	0.87	.79	.93
FNPA: Total Physical Activity	0.43	.14	.63	1.06	.93	.98
FNPA: Screen Time Behavior/Monitoring	0.88	.35	.87	1.05	.81	.93
FNPA 11: My child spends less than 2 hours on TV/games/computer per day	0.89	.63	.93	1.69	.31	.81
FNPA 12: Our family limits the amount of TV our child watches	0.69	.19	.68	0.69	.27	.75
FNPA: Healthy Environment	1.00	.99	.99	0.90	.69	.93
FNPA 13: Our family allows our child to watch TV in their bedroom	1.25	.49	.92	0.99	.96	.99
FNPA 14: Our family provides opportunities for physical activity	0.72	.47	.92	0.71	.58	.93
FNPA: Family Activity Involvement	0.90	.64	.93	1.22	.49	.92
FNPA 15: Our family encourages our child to be active every day	0.58	.24	.74	1.60	.37	.87
FNPA 16: Our family finds ways to be physically active together	1.02	.95	.99	1.10	.84	.93
FNPA: Child Activity Involvement	0.69	.04*	.38	0.94	.81	.93
FNPA 17: My child does physical activity during his/her free time	0.65	.33	.85	1.34	.57	.92
FNPA 18: My child is enrolled in sports or activities with a coach or leader	0.65	.04*	.38	0.72	.38	.87
FNPA: Family Routine	0.82	.48	.92	1.83	.16	.64
FNPA 19: Our family has a daily routine for our child's bedtime	0.86	.71	.93	5.21	.09	.55
FNPA 20: My child gets 9 hours of sleep a night	0.77	.56	.92	1.55	.48	.92

Note. BMI = body mass index; FNPA = Family Nutrition and Physical Activity; OR = odds ratio. FNPA: Total Nutrition and Physical Activity, average of 20 items coded on 4-point scale (1 = *almost never*, 2 = *sometimes*, 3 = *usually*, 4 = *almost always*). FNPA: Total Nutrition, Nutrition component, average of 10 FNPA nutrition items. FNPA: Meal Patterns, average of two items: My child eats breakfast + Our family eats meals together. FNPA: Eating Habits, average of two items: Our family eats while watching TV + Our family eats fast food (both items reverse coded). FNPA: Food Choices, average of two items: Our family uses microwave or ready-to-eat foods (reverse coded) + My child eats fruits and vegetables at meals or snacks. FNPA: Beverage Choices, average of two items: My child drinks soda pop or sugar drinks (reverse coded) + My child drinks low-fat milk at meals or snacks. FNPA: Restriction and Reward, average of two items: Our family monitors eating of chips, cookies, and candy + Our family uses candy as a reward for good behavior (reverse coded). FNPA: Total Physical Activity, Physical Activity component, average of 10 FNPA physical activity items. FNPA: Screen Time Behavior and Monitoring, average of two items: My child spends less than 2 hours on TV/games/computer per day + Our family limits the amount of TV child watches. FNPA: Healthy Environment, average of two items: Our family allows our child to watch TV in their bedroom + Our family provides opportunities for physical activity. FNPA: Family Activity Involvement, average of two items: Our family encourages our child to be active every day + Our family finds ways to be physically active together. FNPA: Child Activity Involvement, average of two items; My child does physical activity during his or her free time + My child is enrolled in sports or activities with a coach or leader. FNPA: Family Routine, average of two items; Our family has a daily routine for our child's bedtime + My child gets 9 hours of sleep a night.

[a]Association between BMI and at risk for food insecurity clustered by family. [b]Association between FNPA and at risk for food insecurity clustered by family and adjusted for BMI category. [c]False discovery rate adjusted p value for multiple comparisons.

*p < .05. **p < .01.

Table 5. Linear Regression Examining Associations of Family Nutrition and Physical Activity (FNPA) and Food Insecurity With BMI *z* Score at 1-Year Follow-Up Among Rural Elementary School–Age Children (*n* = 128).

	BMI *z* score Year 2 adjusted associations[a]		
Variable	β coefficient	*p*	*p* adj[b]
FNPA: Total Nutrition and Physical Activity	−.08	.27	.80
FNPA: Total Nutrition	−.07	.47	.87
FNPA: Total Activity	−.06	.26	.80
Family at risk for food insecurity	.09	.12	.79

Note. BMI = body mass index. FNPA: Total Nutrition and Physical Activity, average of 20 items coded on 4-point scale (1 = *almost never*, 2 = *sometimes*, 3 = *usually*, 4 = *almost always*). FNPA: Total Nutrition, Nutrition component, average of 10 FNPA nutrition items. FNPA: Total Physical Activity, Physical Activity component, average of 10 FNPA physical activity items.
[a]Clustered for multiple children in families and adjusted for BMI at Year 1 and intervention. [b]False discovery rate adjusted *p* value for multiple comparisons.

children were enrolled in organized sports/activities. We did not observe this among children who were not eligible for free/reduced-cost school meals. This difference may be in part, a residual effect of income. For example, eligible families not at risk for FI supporting participation in organized sports/activities for their children, and their reporting of more meals together as a family, may reflect having the income to provide these assets. Eligible families at risk for FI may have greater financial constraints with fewer resources for other meals and organized sports/activities.

We found that FI was more common in obese than normal weight children but only among those not eligible for the free/reduced-cost school meals program. Other studies suggest that FI and overweight/obesity tend to coexist though the relationship remains unclear (Eisenmann et al., 2011; Franklin et al., 2012). Potential explanations for observing this association only among children who were not eligible to receive free/reduced-cost school meals include the following. First, food purchasing and management practices may differ by family income level, which may influence risk for FI and obesity. Second, other research suggests that school meal programs may help maintain healthy weight (Kimbro & Rigby, 2010) and reduce FI (Arteaga & Heflin, 2014), particularly among low-income children. These protective benefits may partially explain the lack of association between obesity and FI observed among children eligible for free/reduced-cost school meals in our study.

Limitations of this study include relatively high average FNPA total scores in our sample (3.3 on a scale from 1 to 4), and little variability in scores, which limited our ability to evaluate higher risk (low FNPA score) environments. Our study may have been underpowered to detect some associations between FNPA score and child BMI, especially after adjusting for multiple comparisons. Family FI, nutrition and PA data were collected at one point in time; however, it is conceivable these factors vary over time. Although 28% of the children did not have follow-up BMI measures and were older and more likely to be eligible for free or reduced-cost school meals than children with follow-up BMI, there were no differences in baseline BMI or in FNPA. These limitations in addition to the narrow geographic region limit the generalizability of our findings.

Implications for Practice

In this study of children and families living in rural Oregon, we found that more favorable family home factors were associated with healthier BMI and lower odds of FI. Although our findings were no longer statistically significant after adjustment for multiple comparisons, our results were consistent with other studies that also did not adjust for multiple comparisons (Couch et al., 2014; Dubois et al., 2008; Hughes et al., 2008; Ihmels, Welk, Eisenmann, Nusser, & Myers, 2009; L. Johnson et al., 2011; MacFarlane et al., 2009; Nackers & Appelhans, 2013; Pearson et al., 2012; Vereecken et al., 2010; Vik et al., 2013), as previously discussed. The family home is one of the earliest and most influential social and environmental contexts for promoting healthy eating and PA habits (Birch & Davison, 2001; Birch, Savage, & Ventura, 2007; Showell et al., 2013). Our findings suggest that practitioners can encourage rural families to support children's weight health by providing opportunities for healthy eating at home, including monitoring intake of chips, cookies, and candy and limiting watching TV while eating. Additional resources may be necessary to assist low-income FI rural families to eat meals together and provide PA opportunities for their children. This study also contributes to the growing body of literature on the relationship between obesity and FI among children and suggests a need for further examination of federal school meals programs as a potentially influential factor. Future research, including longitudinal and rural/nonrural comparison studies, is needed to clarify the role of family environmental and behavioral factors in relationship to the disproportionate rates of childhood obesity and FI observed in rural populations.

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