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Food insecurity and physical activity insecurity among rural Oregon families☆

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ABSTRACT

Among rural families, rates of both child obesity and household food insecurity (FI) are higher compared to non-rural families. These disparities result from a complex interplay of social and environmental conditions that influence behavior. The Transtheoretical Model suggests individual readiness to change underlies success in modifying obesity-preventing behaviors; however, whether an association between readiness to change obesity-related behaviors and FI status among rural families exists is unknown. We examined the association between readiness to change family-level nutrition and physical activity (PA) behaviors that predict child obesity and family FI status within a sample of rural families to better understand these relationships. Families (n = 144) were recruited from six rural Oregon communities in 2013. Families completed a FI screener and the Family Stage of Change Survey (FSOC), a measure of readiness to change family-level nutrition and PA behaviors associated with obesity. Demographic differences by FI status were explored, and regression was applied to examine relationships between FI and FSOC scores, adjusting for relevant covariates. Among FI families (40.2%), more were non-white (77.8% vs. 22.2%; p = 0.036) and had lower adult education (30.4% vs. 11.8% with > high school degree; p = 0.015) compared to non-FI families. After adjusting for education, race, ethnicity, and eligibility for federal meal programs, readiness to provide opportunities for PA was lower among FI families (p = 0.002). These data highlight a need to further investigate how food insecurity *and* low readiness to provide PA opportunities, i.e. "physical activity insecurity" may be contributing to the higher obesity rates observed among rural children and families.

1. Introduction

Children living in rural areas are known to have higher risk for obesity compared to their urban counterparts (Johnson and Johnson, 2015). This disparity is likely influenced by numerous factors, including individual diet and physical activity (PA) behaviors. While the behavioral correlates of obesity may be similar for rural and non-rural children, the ability to enact these behaviors is impacted by socio-economic and cultural factors that may vary considerably between rural and non-rural settings (Gamm et al., 2010). Family-level factors, such as higher poverty and lower education levels among rural households, and environmental-level factors, such as distance to resources, result in less access to safe, healthy, affordable food and opportunities for physical activity (U.S. Department of Health and Human Services, Health Resources and Services Administration, Maternal and Child Health Bureau, 2013; Institute of Medicine and National Research Council, 2009). These differences make it challenging for rural families to provide the necessary supports children need to eat healthfully and be physically active outside of school hours and likely contribute to rural-urban disparities in obesity prevalence.

Families in rural areas also are more likely to be food insecure (FI) than non-rural families (Coleman-Jensen et al., 2016). The relationship between FI and obesity is not completely understood, but data suggest food insecure households experience higher rates of obesity (Metallinos-Katsaras et al., 2012; Franklin et al., 2012), and rural households in the United States (US) experience higher rates of *both* food insecurity and obesity compared to non-rural families in the US (Piontak and Schulman, 2014). While the higher rates of poverty in rural compared to non-rural households (DeNavas-Walt and Proctor, 2014) likely play a role in both outcomes, there may be additional factors unique to rural environments that elevate FI and obesity risk for rural families. To date, little research has examined the relationships between FI and behavioral risk factors for obesity among children (Metallinos-Katsaras et al., 2012; Hanson and Connor, 2014; Fram

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et al., 2015). While it is clear that excess calories and insufficient PA contribute to weight gain, low PA consistently emerges as a stronger predictor of overweight than poor diet among children identified as food insecure (Hanson and Connor, 2014; Fram et al., 2015). However, the relationships between poor diet and low PA among rural, food insecure children and families have not been examined.

Because children have limited control over the factors that enable them to enact healthy behaviors, child obesity prevention strategies have shifted toward environmental approaches, with most of the current research focused on school settings (Institute of Medicine, 2012). Though the importance of the family-home environment on children's risk for obesity is evident (Maitland et al., 2013; Appelhans et al., 2014), how family-level obesity-preventing policies, practices, and behaviors relate to family FI status is not known. A better understanding of these phenomena and their theoretical underpinnings among rural families, who disparately experience both obesity and FI, may be crucial for extending obesity prevention efforts into the family home environment.

The Transtheoretical Model (TTM) is a comprehensive, integrative model describing intentional behavior change that can be applied to a variety of behaviors, populations, and settings (DiClemente et al., 1991). Current behaviors and behavioral intent are categorized along a continuum represented by five distinct stages of change (SOC) that reflect readiness to change targeted behaviors: precontemplation, contemplation, preparation, action, and maintenance. The further along the continuum, the higher the "readiness to change", and the more likely change will occur from undesired toward desired behaviors in response to stage-targeted intervention strategies.

Understanding the interplay between families' readiness to change family-level policies and practices that influence child obesity and household FI status may provide insights as to why rural children are at higher risk for both obesity and FI compared to non-rural children. The objective of this study was to evaluate associations between family FI status and readiness to change family-level diet and PA behaviors associated with child obesity among a sample of rural Oregon households with elementary-age children.

2. Methods

2.1. Study design and participants

This study was conducted as part of a larger collaborative research effort funded by the United States Department of Agriculture examining the influence of rural family home, school, and community environments on child obesity, Generating Rural Options for Weight-Healthy Kids & Communities (John et al., 2016). Schools served as the hub for recruitment and data collection activities and were selected based on the following criteria: 1.) Located in a community designated as a rural place by the US Census (U.S. Department of Agriculture (USDA), 2012), 2.) ≥ 50% of school families eligible for free and reduced meals, 3.) Oregon State University Health Extension county faculty were available to lead community-based research efforts. The cross-sectional data presented in this paper were collected in Fall 2013 from rural families with elementary-age children (grades k–6) recruited from the six participating schools. All families with children enrolled in selected schools were eligible to participate, and all families received similar recruitment strategies and opportunities to enroll in the study.

This study was reviewed and approved by the Oregon State University Institutional Review Board.

2.2. Survey measures

Data for this study include survey responses about family FI, family stages of change, and demographics. After consenting, surveys were mailed to participants or distributed online via the survey hosting website Qualtrics (Qualtrics, Provo, UT) based on participant preference. Participants who chose to fill out paper surveys were provided business reply envelopes at no cost. Survey data were scored and double entered into a data management system by trained research assistants.

2.2.1. Food insecurity

Families were identified as at-risk (food insecure) or not at-risk (food secure) for FI (FI or FS, respectively) using a two-item FI-screener that has been validated among low-income families with young children (Hager et al., 2010). Families were classified as FI if they responded "Sometimes True" or "Often True" to either of the two 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*. If participants responded with "Never True" to both questions, they were categorized as FS.

2.2.2. Family stage of change (FSOC)

The FSOC was developed and validated (Gunter et al., 2014) to specifically address readiness to make obesity related behavior change within the family home environment. The FSOC items were derived from the Family Nutrition and Physical Activity (FNPA) screening tool, which has been shown to predict children's risk for obesity (Ihmels et al., 2009). The specific family-level health behaviors surveyed include eating behaviors (items 1–6; Nutrition Domain) and PA, sleep, and screen time behaviors (items 7–12; PA Domain). Each FSOC item was scored by applying a value of 1 (precontemplation) through 5 (maintenance) based on respondents' answers for that item.

2.2.3. Covariates

Information provided by adult respondents included sex, race, ethnicity, education level (grade 12 or less, 1–3 years college, 4 years or more college), and family eligibility for free or reduced-cost school meals (yes, no).

2.3. Statistical analysis

Descriptive statistics were examined for all variables. Data were collapsed to create a dichotomous variable with categories of "white" and "non-white" due to low responses among non-white categories. Chi-square and Fisher's exact tests were used to examine whether FI was associated with demographics. To test for differences in mean FSOC domain and item scores by FI risk, we conducted independent *t*-tests on FSOC continuous variables. We used linear regression to examine the association between being at-risk for FI and FSOC scores, adjusted for relevant demographic variables (race, adult education, and school meal eligibility). All data analyses were performed using Stata (version 13, 2013, StataCorp). Statistical significance was set at $\alpha = 0.05$.

3. Results

3.1. Demographics

The Final sample included 144 families. Respondents primarily identified as white (94%) and non-Hispanic (87%). Most (55%) completed 1–3 years of college, 26% completed four or more years of college, and 19% had obtained a high school diploma or less. Approximately 40% of families were at-risk for FI. When stratified by FI status (Table 1), FI families were more likely to be non-white (78% versus 22%; $p = 0.027$) and have lower adult education (30% versus 12%; ≥ high school degree; $p = 0.015$) compared to FS families.

3.2. FSOC scores by FI risk

No differences by FI status were observed on individual nutrition items or Nutrition Domain scores. In the PA Domain, FI families

Table 1
Family characteristics by total sample and at-risk for food insecurity.

	Total Sample $n = 144$	FS $n = 86$	FI $n = 58$	p-values
Family-level variables				
Adult race				
White	93.5%	64.8%	35.2%	0.027
Non-White	6.47%	22.2%	77.8%	
Adult ethnicity				
Latino	12.7%	7.1%	21.1%	0.015
Non-Latino	87.3%	92.9%	78.9%	
Adult education				
High school graduate or less	19.2%	11.8%	30.4%	0.015
College 1–3 years	55.3%	57.6%	51.8%	
College 4 + years	25.5%	30.6%	17.8%	
School meal eligibility				
Eligible	56.1%	36.6%	84.2%	< 0.001
Not eligible	43.9%	63.4%	15.8%	
FI risk				
At-risk (FI)	40.3%	–	–	
Not at-risk (FS)	59.7%			

Note: FI = families that are identified as being at risk for food insecurity; FS = families that are identified as not being at risk for food insecurity; Data were collected in Oregon in 2013.

exhibited lower scores on item 8 "*In our family we make time for PA. We also provide support so our children can play actively and do organized physical activities and/or sports*" compared to FS families ($p = 0.0001$; Table 2).

3.3. Relationship between FI and FSOC scores

After adjusting for covariates, results of multiple linear regression analyses revealed that FI families exhibited lower readiness to change family-behaviors related to making time and providing support for PA (FSOC item 8; $\beta = -0.58$, $p = 0.002$).

4. Discussion

The coexistence of high obesity and FI prevalence among rural families and recent reports of associations between FI and low PA (Johnson and Johnson, 2015; Fram et al., 2015) suggest socioeconomic disadvantage may underlie families' abilities to enact diet and PA behaviors needed to reduce obesity risk. Our results show that families who struggle with food security report lower readiness to provide support and opportunities for organized PA. Practically speaking, the degree of difference in absolute FSOC-item scores on this item is rather small, nonetheless we believe these preliminary results suggest that for rural children, food insecure families' lower readiness to provide support and opportunities for PA may be contributing to associations of low PA levels with FI observed by others (Fram et al., 2015; To QG et al., 2014).

Initial evidence describing the relationships between FI and low PA at the population level was reported by To and colleagues (To QG et al., 2014). Their research included analyses of FI status and self-reported ($n = 5674$) and objectively monitored ($n = 4973$) PA levels of children (ages 6–17) and adults (ages 18–65). Only objective PA data were used for children ages 6–15. Results showed FI adults were less likely to adhere to the PA guidelines, whereas FI children were significantly more sedentary (~12 min more sedentary time) and participated in less moderate to vigorous PA (MVPA; ~3 min less) compared to FS children.

More recently, a California-based study of over 3600 fourth and fifth graders in high-poverty elementary schools found children experiencing the highest levels of FI self-reported lower minutes of daily PA (17 min/d; $p = 0.06$) and exhibited lower odds of expressing a liking for PA (0.78; $p < 0.001$), and higher odds of citing weight or fatigue as a barrier to PA (2.0 and 1.7, respectively; $p < 0.001$) compared to children who were FS (Fram et al., 2015). Moreover, greater degrees of severity in FI among children was associated with consuming more total calories, fat, and sugar, and fewer vegetables compared to being food secure (Fram et al., 2015). Taken collectively, the existing research suggests FI and low PA may be contributing in concert to the higher rates of obesity observed among socioeconomically disadvantaged rural populations. With this in mind one interpretation of our results showing low readiness among FI families to support and provide PA opportunities may be that low readiness is a function of their intersecting socioeconomic and rural status. In our sample, the large majority of children were bussed long distances to school, and achieved low amounts of MVPA at school (Gunter et al., 2015). The TTM contends that to achieve the recommended level of MVPA, families must advance to the "action stage" which requires sufficient confidence to encourage and support PA at home, and deem benefits outweigh costs of securing or providing opportunities to participate in structured PA programs

Table 2
FSOC scores for families At-risk and not at-risk for FI.

	FS ($n = 86$)		FI ($n = 58$)		p-Values
	n	Mean (SD)	n	Mean (SD)	
FSOC total score (items 1–12)	86	49 (7.2)	58	50 (6.3)	0.48
Nutrition domain (items 1–6)	92	23 (4.7)	63	24 (3.8)	0.25
1) We eat meals together as a family.	105	4.5 (1.0)	74	4.6 (0.8)	0.69
2) In our family we limit eating of chips, cookies, and candy.	101	3.8 (1.5)	77	4.0 (1.2)	0.46
3) Our family eats meals and/or snacks while watching TV/computer or playing electronic games.	105	3.3 (1.6)	78	3.3 (1.4)	0.94
4) In our family we eat fast food.	98	3.9 (1.6)	72	3.8 (1.2)	0.81
5) In our family we eat microwavable or ready-to-eat foods.	104	4.1 (1.5)	73	4.2 (1.3)	0.63
6) In our family we use candy/sweets as a reward for good behavior.	104	3.8 (1.8)	74	4.1 (1.4)	0.17
PA domain (items 7–12)	102	14 (1.9)	71	13 (2.8)	0.08
7) In our family we encourage our children to be active every day.	105	4.8 (0.7)	79	4.6 (0.9)	0.06
8) In our family we make time for PA. We also provide support so our children can play actively and do organized physical activities and/or sports.	105	4.8 (0.6)	79	4.3 (1.2)	< 0.0001
9) In our family we find ways to be active together.	102	4.0 (1.3)	73	4.0 (1.2)	0.88
10) In our family we limit the time children can spend watching TV/computer and playing electronic games.	102	4.0 (1.4)	78	4.2 (1.2)	0.57
11) In our family we allow children to watch TV/computer or play electronic games in their bedroom.	103	3.6 (1.8)	73	3.5 (1.7)	0.59
12) In our family we have a daily bedtime routine for our children.	101	4.9 (0.5)	72	4.8 (0.7)	0.11

Note: FI = families that are identified as being at risk for food insecurity; FS = families that are identified as not being at risk for food insecurity; *FSOC readiness scores range from 1 to 5 per statement corresponding with different stages of behavior change according to the Transtheoretical Model (1 = pre-contemplation; 2 = contemplation; 3 = preparation; 4 = action; 5 = maintenance); Data were collected in Oregon in 2013.

outside of the home, something the data indicate the FI families in our sample were less ready to do compared to the FS families. As such, we propose low PA in this rural context could be termed "physical activity insecurity", that is, a hypothesized *inability* to provide sufficient health-promoting MVPA for children. While only a hypothesis, this interpretation may be worth further consideration given the observed relationships between poverty and higher risk for obesity and FI (Johnson and Johnson, 2015; Fram et al., 2015). Investigating this concept more intentionally may help identify more effective strategies to reduce childhood obesity among rural children and families.

There are several limitations to this study. First and foremost, this was a cross-sectional exploration of the examined associations, and causality cannot be determined. Second, the data were obtained from adult respondents about their home environment and family FI status, and we do not have child-level data to enrich these preliminary results. Finally, while we hypothesize these results may be driven by differences in socioeconomic status, we did not collect income data on our families. We did however collect information about eligibility for free and reduced meal programs, and there was a significant difference observed by FI status with 84% of FI versus 37% of FS families reporting they were eligible for meal programs. Despite these limitations, we contend that the results presented here are novel and thought-provoking, and are intended to stimulate more research to confirm or refute the concept of physical activity insecurity and the hypothesized contribution of physical activity insecurity, in concert with FI, as a catalyst for obesity. In doing so, we may collectively inform and optimize obesity prevention efforts for vulnerable children and families living in rural areas.

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