

Family Meals and Neighborhood Food Resources Influence on Intake of Sugar-Sweetened Beverages and Added Sugars among Parents and Adolescents in Rural Counties

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Abstract

Purpose: Determine the influence that family meals; neighborhood food resources; and store selection within a weekly travel pattern has on dietary outcomes.

Design: A cross-sectional survey with real time assessment of weekly travel patterns

Setting: Four counties in Kentucky and Ohio, United States in fall 2013

Subjects: Adolescents, ages 13-18, and a primary caregiver who conducted at least 25% of the food shopping

Measures: To measure family meals, eating out behaviors, and dietary intake (n=154) a phone survey was used. A sub-sample of adolescents and primary care givers (n=75) wore a global positioning system (GPS) device and completed a travel log to identify travel patterns and food resources accessible in their daily lives.

Analysis: To test for individual level effects on dietary outcomes, linear regression was used

Results: Parents who consumed fast-food for dinner 1 time per week consumed 14.18 tsp more of added sugar compared to those who never consumed fast-food for dinner. Adolescents whose parents purchased fast-food for dinner at least one day or more on the weekends consumed more added sugars and sugars from SSB. Lastly, those with convenience stores in their travel pattern consume more added sugars from SSB.

Conclusion: Family meals remain a critical strategy for improving dietary intake. At the same time focusing on what is being served and where the food is being purchased from for the family meal is vital to improving intake.

Keywords: Food choice; Childhood behavior; Public health

Introduction

Adolescent obesity rates in the United States are at some of the highest levels in history; 33.6% of adolescents in 2010 were estimated to be obese or overweight [1]. One factor related to high obesity rates is the concept of “family meals” [2-4]. Family meals have continually been suggested to be an important strategy to improving dietary intake among children and adolescents [4,5], with strong evidence linking frequent family meals with lower body mass index and higher consumption of fruits and vegetables [4,6,7]. However, there are remains unclear linkages between the type of food served at the family being associated with lower weight and higher intake of fruits and vegetables. Research has hypothesized that it may not be the actual family meal, but rather the food served during a family meal which contains fewer calories and more fruits and vegetables rather than when eating alone or eating out [7].

However, what is served at family meals has drastically changed overtime. In the past several decades the primary care giver is preparing less meals at home [8] and several studies have reported when family meals are consumed together the food is typically from fast-food or carry-out food venue [4,5,7]. To these ends research has begun to address how the food environment, the type and number of food venues in an individuals’ neighborhood, may influence what food is purchased and thus served for meals.

Recent studies have pointed to the role of “place matters”, although there is little evidence suggesting that the neighborhood in which one resides explains a large variance on family meals [7]. However, there

is a substantial body of work highlighting the role that neighborhood food resources has on dietary intake [9,10], with one recent study highlighting how neighborhood food resources and food venue choice influence what is served at meal time and dietary intake [11]. The limited research and discrepancy in findings may reflect the methods used to define and measure neighborhood. Most studies addressing the availability of health foods rely on a priori neighborhood boundaries to identify accessible food resources in geographic information systems (GIS). However, recent studies have highlighted that individuals often leave their neighborhood to shop at food stores or eat at restaurants [12,13]. Daily mobility thus influences to a greater or lesser extent what food resources they are exposed to and where food may be purchased. Therefore, to improve understanding of how neighborhood food environment may influence family meals and dietary intake new methods are warranted. Researchers have thus begun to use global

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positioning system (GPS) devices to capture daily travel patterns, which can be used to more realistically define a zone of accessibility for food resources.

To these ends it's important to look at family meals as a complex construct including neighborhood food resources, daily travel patterns, as they impact what is served at the family meal as well. The aims of this study are thus to determine the association between 1) number of family meals per week and where food is purchased for family meal on dietary intake; and 2) neighborhood food resources and store selection within daily activity spaces on family meals.

Study Design and Setting

Families with adolescents between the ages of 13 and 18 years living within Webster and Woodford Counties in Kentucky and Noble and Jefferson counties in Ohio were recruited to participate in a cross-sectional survey in the fall of 2013. A total of 176 adolescents and parent dyads were recruited. A total of 154 adolescent and parent dyads were found to be eligible and participated in the study.

Recruitment

Kentucky adolescents were recruited within middle and high schools in both Webster and Woodford County. Both school districts gave permission to put flyers within the school, send an e-mail to all students and parents about the study, and distributed the flyer in homeroom to all classes. Ohio dyads were recruited through 4-H program coordinators in each county. Newsletter announcements and emails were sent to potential participants involved in the county 4-H programs.

Eligibility

Adolescent eligibility consisted of being between the ages of 13-18 year, resided in the county for at least one year, spoke English, obtained parental permission, had no serious health conditions that would dramatically alter their dietary intake, and the parent agreed to participate in the study. Parental eligibility consisted of conducting at least 25% of the food shopping, spoke English, and did not have any serious health conditions which would dramatically alter their dietary intake, and the adolescent provided assent to participate.

Enrollment and informed consent/assent

Interested study participants could text, phone, or complete an online survey to request information or study participation. The PI or trained graduate student reviewed the eligibility criterion for all interested participants. After a comprehensive list of eligible participants was generated, a reminder phone call or text was sent to potential participations to attend an information session. Information sessions were conducted in early fall 2013 to gather informed consents from parents, acquire parental permission for the adolescents to participate in the study, and for the adolescents to sign the assent form. University of Kentucky Internal review Board approved all procedures and protocols for this study.

Survey

At enrollment the adolescent and parent provided their phone number as well as days and times that were convenient. These times were used to contact the adolescent and the parent for the phone survey. The 30-40 minute phone survey was designed to capture food shopping patterns, behaviors, and dietary intake among adolescents and their parents. The survey utilized previously validated questions

from the University of Minnesota Project EAT on food purchasing habits, home availability, and fast-food buying habits, and eating out behaviors [13]. Dietary assessments were performed using the validated National Health and Nutrition Examination Survey (NHANES) 2009-2010 dietary screener [14], that have been previously tested among adolescents. The NHANES Dietary Screener Questionnaire is composed of 26 questions quantifying the frequency of consumption of selected foods and drinks to capture intakes of fruits and vegetables, dairy/calcium, whole grains/fiber, added sugars, red meat and processed meat during the past month [15].

Trained research assistants (RAs) administered 106 and 131 item surveys about food shopping behaviors, travel patterns and dietary habits to each parent and adolescent, respectively, via telephone. At enrollment, the adolescent and parent provided their phone numbers as well as convenient days and times to conduct the phone survey. This information was used to contact study participants. Participant responses were recorded with Research Electronic Data Capture (REDCap) [16].

Global positioning system device (GPS)

GPS data loggers were used to capture daily activity space, or where an individual travels on a daily basis [17]. GPS data loggers allow researchers to create participant-defined neighborhoods, versus reliance on neighborhoods defined by administrative boundaries (e.g., Census tracts) or investigator-defined GIS buffers [18,19]. In the current study, individuals' daily activity spaces were derived by having participants wear a GPS data logger (Qstarz BT-1000XT Travel Recorder) for three days (two weekdays and one weekend day) during a seven day week to record all locations at a given time. Of the 154 participants that completed the survey, only a sub-sample wore the GPS devices to capture travel patterns and identify their daily activity space (n=75).

For this study, each participant's daily activity space was defined as the area within 2640 feet (1/2 mile) of their three-day GPS track. Subsequently, the food locations present within each participant's daily activity space were identified in ArcGIS. The resulting data set contained counts of each food venue type (described below) within each participant's daily activity space [20].

Store selection

To capture store selection participants were given a paper copy travel diary to record where they purchased food, time of day, which they were with, and a general description of what food was purchased (ie. soda). The variable store selection was derived by store name recognition from the travel and through verification with the GPS device data. Since date and time were recorded on the travel diary the GPS also recorded this information. Cross check between the GPS address and the travel diary allowed for store selection variable to be derived.

Incentives

Both the adolescent and the parent each received a \$25 check payment as incentive per survey after participation and \$25 for wearing the GPS device and travel diary for one week. A mailed check for a total of \$50 was sent to each participant's residence. If the adolescent agreed, a \$100 check was sent to the residence made out to the parent.

Outcome and exposure measures

Family meals: Family meals was captured by asking the parent "how many family meals do you prepare each week?". The responses

consisted of 1-2 times per, 3-4, 5-6, and 7 or more. The parent was also asked “how many meals do you eat each week as a family?” with the same response options. The adolescent was asked “how many meals do you eat each week as a family?” with the same response options as above. These questions have been validated and used in the Project EAT University of Minnesota study [4].

Neighborhood food resources within daily activity space: To capture what type of stores were within an individual’s daily activity space two steps were taken. Step one consisted of collecting food venue addresses and verifying the location. To categorize each food venue, a list of Lexington food venues was obtained from Info USA in June 2013. To verify that stores were open and located ground-truthing was conducted. Such that, once the daily activity space was categorized the food stores that were within those spaces were verified to be open and located by driving to each store and comparing the list of stores on Info USA with what was found. Food venue types were categorized based on name recognition and based on North American Industry Classification System (NAICS) Codes. The categories reflected supercenters (i.e. Sam’s Club, Costco), supermarket/grocery stores (i.e. Kroger, Meijer), convenience stores (i.e. gas stations with convenience stores, Seven Eleven). These categories were included based on the travel diaries which are discussed below. Step two consisted of identifying the food venues available within the individuals’ daily activity space. Food venue availability was measured using data from the GPS data loggers to count how many food venues were within the individuals’ daily activity spaces. For example, a person traveling from their home to work and back might pass within a half-mile of one convenience store, two supermarkets, and one supercenter. Therefore their food venue availability consists of one convenience store, two supermarkets, and one supercenter.

Store selection: As described above store selection was captured from travel diary and GPS data. Store selection result was either grocery store/super market or fast-food restaurant. There were no other store types recorded on travel diary and verified with GPS. This variable was coded as 0 or 1 for shopping at the location for food.

Dependent variables

Dietary intake: Responses to the NHANES dietary screener were scored using the algorithm provided by the National Cancer Institute [18]. The algorithm generates predicted values for fiber (gm), calcium (mg), added sugars (tsp), added sugars excluding cereal (tsp), whole grains (ounce equivalents), dairy (cup equivalents), fruits and vegetables (cup equivalents, with and without French fries) and added sugars from sugar-sweetened beverages (tsp). In these analyses, all variables retained a linear shape and were not categorized.

Body Mass Index (BMI): Self-report BMI was captured by asking participants their height and weight. BMI for the parent was generate using kg/m² where as for the adolescent z-scores were used.

Statistical Analysis

Continuous variables were summarized with descriptive statistics (mean and standard errors); dietary intake, BMI, and age were treated as continuous variables. Categorical variables were described with percentages; demographic characteristics, frequency of shopping and food behaviors, and dichotomized variables were treated as categorical variables. Comparisons were made between males and females among adolescents by Chi-square tests of independence for categorical variables or by two sample t-test for continuous variables. To test the association between dietary outcomes and fast-food purchasing habits for meals,

linear regression adjusting for age and residency were used for each outcome. The association between neighborhood food resources and dietary outcomes and family meals were examined by linear regression adjusting for age. All statistical tests used a significance level of 0.05 and all analyses were performed using SAS V9.3 (SAS Institute, Cary, NC)

Results

As shown in Table 1 60% of parents report preparing family meals 7 times or more per week. When the adolescents was asked how often they eat a family meal 50% report 7 time or more per week while 40% of parents reported eating a family meal 7 times or more per week. There were no significant differences between the number of times per week a family meal was prepared or eaten.

When assessing the relationship between family meals and dietary

	Adolescent			Parent
	Male (N=37)	Female (N=38)	p-value	Total of Parent (N=79)
Age (yrs)	14.4	15.1	0.36	44.2
Race				
White	100%	100%		100%
Body Mass Index			0.72	
Normal	63%	58%		46%
Overweight	25%	37%		41%
Obese	13%	5%		14%
Dietary Habits				
Fiber (g) range 8.1-28.6	17.5	11.1	0.0004	14.8
Calcium (mg) range 500-2763	1547	7.81	0.0012	9.61
Added sugars (tsp) range 3.1-55	17.3	15.2	0.48	13.8
Whole grain (oz) range 0.1 - 5.8	1.2	0.5	0.09	0.6
Fruit/Veg minues french fries (cups) range 0.5-4.8	3	1.8	0.004	2.5
Added Sugar from SSB (tsp) range 0-49	9.5	8.6	0.83	7.2
Family Meals prepared each week				
7 or more	N/A	N/A	N/A	15 (60.0%)
5-6	N/A	N/A	N/A	6 (24.0%)
3-4	N/A	N/A	N/A	4 (16.0%)
1-2	N/A	N/A	N/A	0 (0.0%)
Family Meals eaten per week			0.8606	
1-2	1 (11.1%)	1 (5.3%)		2 (8.0%)
3-4	2 (22.2%)	5 (26.3%)		5 (20.0%)
5-6	1 (11.1%)	4 (21.1%)		8 (32.0%)
7 or more	5 (55.6%)	9 (47.4%)		10 (40.0%)
Assist with grocery shopping in the past week/Adolescent was with parent grocery shopping			0.3794	
Never	3 (33.3%)	7 (36.8%)		8 (32.0%)
One time	5 (55.6%)	6 (31.6%)		12 (48.0%)
More than one time	1 (11.1%)	6 (31.6%)		5 (20.0%)
Fast-Food for dinner				
Never	N/A	N/A		6 (42.86%)
1-2 times/month	N/A	N/A		6 (42.86%)
1 time/week	N/A	N/A		2 (14.29)
2-3 times/week	N/A	N/A		2 (14.29)
Fast-food on weekends				
Never	N/A	N/A		4 (16%)
1-2 times/month	N/A	N/A		9 (36%)
1 time/week	N/A	N/A		8 (32%)
2-3 times/week or every day	N/A	N/A		4 (16%)

Table 1: Descriptive of study sample, KY and OH, 2013.

	Fiber		Calcium		Added sugars (tsp)		Whole grain (oz)		Fruit/Vegminues FF		Sugar from SSB		BMI	
	β	95% CI	β	95% CI	β	95% CI	β	95% CI	β	95% CI	β	95% CI	β	95% CI
Family Meals per week (n=154)	0.5	(-1.18, 2.17)	-39.6	(-221.67, 142.46)	3.32	(-0.84, 7.49)	0.25	(-0.23, 0.72)	-0.12	(-0.48, 0.23)	2.91	(-1.18, 6.99)	-0.79	(-2.39, 0.81)
Food Resources in travel pattern (n=75)														
Convenience/Pharmacy	0.11	(-0.14, 0.35)	-5.77	(-31.25, 19.71)	0.11*	(0.09, 0.54)	-0.01	(-0.06, 0.06)	0.01	(-0.05, 0.07)	0.15*	(0.10, 0.55)	-0.01	(-0.18, 0.15)
Fast-food	0.04	(-0.05, 0.13)	-2.13	(-11.43, 7.17)	0.02	(-0.14, 0.18)	0.002	(-0.02, 0.02)	0.002	(-0.02, 0.02)	0.03	(-0.12, 0.18)	-0.004	(-0.07, 0.06)
Gas Station	0.15	(-0.23, 0.53)	-13.02	(-51.49, 25.44)	0.08	(-0.55, 0.72)	-0.01	(-0.10, 0.08)	0.005	(-0.08, 0.09)	0.04	(-0.56, 0.65)	-0.02	(-0.27, 0.23)
Grocery/Supermarket	0.04	(-0.21, 0.29)	-10.21	(-34.90, 14.48)	0.14	(-0.28, 0.56)	0.0003	(-0.06, 0.06)	-0.003	(-0.06, 0.06)	0.18	(-0.21, 0.57)	-0.04	(-0.21, 0.12)
Other restaurant	0.01	(-0.03, 0.06)	-1.73	(-6.27, 2.81)	0.03	(-0.05, 0.11)	0.0009	(-0.01, 0.01)	0.00006	(-0.01, 0.01)	0.03	(-0.04, 0.11)	-0.007	(-0.04, 0.02)
Food Store Selection														
Grocery/Supermarket	-2.46	(-9.82, 4.90)	-268.74	(-1005.71, 468.22)	0.24	(-12.71, 13.20)	0.23	(-1.55, 2.01)	-0.41	(-2.16, 1.34)	1.63	(-10.64, 13.90)	-0.63	(-5.63, 4.36)
Fast-food	2.22	(-3.85, 8.28)	-431.41	(-983.31, 120.49)	-3.4	(-13.89, 7.08)	0.47	(-0.97, 1.91)	-0.63	(-2.04, 0.77)	-7.11	(-16.15, 1.92)	-1.69	(-5.69, 2.30)
Gas station	1.7	(-4.07, 7.46)	-41.58	(-633.28, 550.12)	3.25	(-6.36, 12.85)	-0.26	(-1.64, 1.11)	0.06	(-1.28, 1.41)	-0.36	(-9.71, 8.99)	-0.55	(-4.34, 3.24)

*p<0.05

Table 2: Family Meals and Neighborhood Food Resources in travel pattern and the association with dietary intake among adolescents and parents.

Fast-food purchasing habits among parents §														
	Fiber (g)		Calcium (mg)		Added sugars (tsp)		Whole grain (oz)		Fruit/Vegminues FF		Sugar from SSB		BMI	
	β	95% CI	β	95% CI	β	95% CI	β	95% CI	β	95% CI	β	95% CI	β	95% CI
Fast-food for dinner														
Never	Reference		Reference		Reference		Reference		Reference		Reference		Reference	
1-2 times/month	1.35	(-5.27, 7.96)	-144.38	(-947.12, 658.36)	-1.01	(-9.75, 7.72)	0.38	(-0.40, 1.17)	0.22	(-0.90, 1.33)	0.59	(-8.75, 9.92)	0.47	(-7.50, 8.45)
1 time/week	-3.39	(-12.22, 5.44)	-468.02	(-1539.74, 603.71)	14.18*	(2.52, 25.84)	0.05	(-0.99, 1.10)	-0.75	(-2.23, 0.74)	15.73*	(3.26, 28.19)	-2.52	(-13.16, 8.12)
2-3 times/week	6.56	(-4.47, 17.59)	-61.44	(-1399.96, 1277.08)	-1.38	(-15.94, 13.19)	1.07	(-0.23, 2.38)	0.88	(-0.98, 2.74)	0.85	(-14.71, 16.42)	-0.82	(-14.22, 12.57)
Parents reported fast-food for dinner and adolescent intake														
Never	Reference		Reference		Reference		Reference		Reference		Reference		Reference	
1-2 times/month	7.26	(-2.84, 18.29)	397.69	(-600.87, 1396.24)	-9.13	(-28.46, 10.19)	1.88	(-1.09, 4.84)	-0.46	(-2.06, 1.13)	-4.61	(-21.27, 12.04)	-3.62	(-9.92, 2.67)
1 time/week	21.24*	(4.98, 37.51)	1118.42	(-419.30, 2656.14)	12.16	(-9.42, 33.74)	1.98	(-2.59, 6.54)	0.54	(-1.46, 2.53)	15.13	(-5.70, 35.96)	-5.24	(-13.11, 2.63)
2-3 times/week	11.8	(-4.21, 27.81)	884.02	(-629.73, 2397.77)	-21.92	(-50.86, 7.02)	3.13	(-1.36, 7.63)	-1.39	(-3.99, 1.20)	-19.79	(-46.86, 7.27)	-5.18	(-15.41, 5.05)
Fast-food on weekends														
Never	Reference		Reference		Reference		Reference		Reference		Reference		Reference	
1-2 times/month	-3.88	(-8.20, 0.44)	-503.93*	(-968.03, -40.84)	3.63	(-3.57, 10.84)	-0.46	(-1.03, 0.11)	-0.37	(-1.15, 0.41)	4.59	(-2.54, 11.71)	-1.04	(-6.46, 4.37)
1 time/week	-5.27*	(-9.82, -0.73)	-402.56	(-889.73, 84.61)	2.33	(-5.25, 9.92)	-0.66*	(-1.26, -0.06)	-0.93*	(-1.74, -0.11)	3	(-4.49, 10.50)	-2.74	(-8.51, 3.04)
2-3 times/week or everyday	-6.97*	(-12.22, -1.71)	-702.03*	(-1264.88, -139.17)	11.56*	(2.81, 20.32)	-0.56	(-1.25, 0.13)	-1.13*	(-2.07, -0.19)	13.51*	(4.85, 22.17)	-3.3	(-10.49, 3.90)

*p<0.05

§ parent linear regression model controlled for age and residency

Table 3: Fast-food purchasing habits for meals among parents and the association with diet among parents and adolescents, KY and OH 2013.

intake there were no significant associations between the number of times a family meal was served or prepared with dietary intake (Table 2). When assessing the type of food venue within a travel patterns and associated dietary outcomes. The results indicated those with convenience stores in their travel pattern consume more added sugars

and sugars from SSB compared to those without those type of stores in their travel pattern (0.11 95% CI (0.09, 0.54)) and (0.15 95% CI (0.10, 0.55)) (Table 2).

When assessing the relationship between what is served for food and the association with dietary outcome the results indicate those

parents who serve fast-food on weekends for dinner have adolescents that consume fewer grams of fiber, calcium, fruits and vegetables, and higher consumption of added sugars and sugar-sweetened beverages compared to those that never serve fast-food for dinner on the weekends (Table 3). This pattern is not seen when fast-food is served during the week for dinner.

Lastly, there was no relationship between food resources within participants' daily activity spaces or store selection with family meals (Table 4).

Discussion

Overall the results indicate that depending on what type of food venues are in a travel pattern and what food is served on the weekends has an association with dietary outcomes among adolescents. However, result indicated that number of family meals was not associated with any dietary outcomes. This may be due to the high percentage of family meals eaten together and not specifically assessing what is served at dinner. Although others have found that those eating family meals together was associated with higher fruit and vegetable intake and less consumption of fast-food [7,21]. The difference between the results may be a function of differences in urban adolescents' family habits compared to rural adolescents'. Whereby there are more family meals served, yet what is served at these meals may be more influential on dietary intake in rural families.

When determining the association between what is served for a family meal and dietary intake the results are not surprising. Those who serve fast-food on weekends for meals have adolescents that consume fewer grams of fiber, calcium, fruit and vegetables. At the same time these adolescents consume more added sugars and SSB. A previous study found similar results with regard to serving meals prepared away from home at dinner and the association with certain health outcomes. Results indicated that the more frequent the family meal was purchased away from home the higher the odds of being overweight or obese [11]. Although our study didn't find an association with weight, the results indicate that fast-food purchases for dinner on weekends was associated with a less than desirable dietary intake which may lead to being overweight.

Our study did find that those whose weekly travel pattern contains a convenience store consume more added sugars and SSB. This result doesn't suggest that these individuals shop at this store but rather the type of neighborhood they operate in on a weekly basis may promote a less than optimal diet. Those who travel within neighborhoods with many convenience stores also perhaps engage in other less healthy behaviors. Or conversely this type of neighborhood promotes a dietary behavior for consuming sugar and SSB. Future studies need to test for interactive effects among a larger sample.

Family Meals (n=75)		
Food Resources	β	95% CI
Convenience/Pharmacy	0.02	(-0.05, 0.09)
Fast-food	0.005	(-0.02, 0.03)
Gas Station	0.01	(-0.08, 0.12)
Grocery/Supermarket	0.01	(-0.06, 0.08)
Other restaurant	0.003	(-0.01, 0.02)
Food Store Selection		
Grocery/Supermarket	0.5	(-1.62, 2.61)
Fast-food	1.2	(-0.37, 2.78)
Gas station	-0.46	(-2.05, 1.13)

Table 4: Neighborhood food resources and the association with family meals KY and OH 2013.

Our study did not find any association between neighborhood food resources or store selection within the daily activity space to family meals. The lack of results within this small sample does not indicate that neighborhood or store selection do not influence family meals. The lack of significant findings highlights a limitation of the study having a small sample size. Perhaps in a larger sample results would indicate that neighborhood food resources do not influence the number of family meals but are a key variable on the pathway between family meals and dietary intake. A previous study found that several factors influence store choice, such as proximity, store characteristics, and availability of certain foods [22]. Therefore, assessing reasons for store choice may lead to understanding the role of neighborhood in dietary intake and family meals.

Limitations

There are several limitations to this study. The study design was cross-sectional and therefore no statements on causality can be made. A severe limitation is the small sample size and the limited scope with which to gain insight into these unique relationships between neighborhood and family meals. However, this study did report on the association with fast-food purchasing habits and family meals which has just recently been studied. This finding along with the limited scope of the GPS data highlights the need for future research to explore these constructs. Lastly, the sample was rural and geographically isolated which indicates that results cannot be generalizable to more urban or suburban settings.

Conclusion

Family meals remain a critical strategy for improving dietary intake. At the same time focusing on what is being served and where the food is being purchased from for the family meal is vital to improving intake.

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