Title: Fruit and vegetable intakes of preschool children are associated with feeding practices facilitating internalization of extrinsic motivation

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ABSTRACT

Objectives: To examine the association between feeding practices and both fruit and vegetable intakes of preschoolers.

Design: Cross-sectional; data collected from 2009 to 2010

Settings and Participants: Primary caregivers of children aged 2 to 5 years were recruited from childcare centers enrolled in the cohort of the STRONG (Synergistic Theory and Research on Obesity and Nutrition Group) Kids program. Analyses of baseline data from 316 mother-child dyads were conducted.

Main Outcome Measures: Ten aspects of maternal feeding practices were measured using a Comprehensive Feeding Practices Questionnaire. The frequency of children's fruit and vegetable consumption was estimated by mothers.

Analysis: Spearman's rank order correlation and linear regression analysis between parental feeding practices and both fruit and vegetable consumption were adjusted for potential confounders. Pearson's correlation coefficients among 10 parental feeding practices were calculated.

Results: The children in the study consumed fruits 1.7 ± 0.9 times per day and vegetables 1.4 ± 0.8 times per day. Feeding practices of "building a healthy home food environment" and "involvement" were positively related and those of "restriction for health" negatively related to children's vegetable consumption ($p < .001$); moreover, "encouraging balance and variety" and "monitoring" were positively related to children's fruit consumption ($p < .001$).

Conclusions and Implications: The results of this study suggested that both the fruit and vegetable intakes of preschool children are more likely to increase if parents employ feeding practices that encourage child autonomy, competence, and relatedness.

Keywords: Feeding practice; fruit and vegetable intake; self determination theory; preschool children

INTRODUCTION

Early childhood is a developmentally critical period for building healthy eating habits for optimal growth and disease prevention in later years.¹⁻³ Picky eating is a frequent problem among children.⁴ In addition, childhood obesity is a growing health concern in the United States.^{5, 6} Both problems have been associated with inadequate consumption of fruits and vegetables,⁷⁻⁹ with consumption among children aged 2 to 5 years not reaching the recommended level.¹⁰⁻¹²

Food acceptance (e.g., acceptance of fruits and vegetables) may be determined by food preference, which is genetically predisposed but also shaped by food experiences during early life.³ Therefore, parental feeding practices influence children's food preferences and consumption.^{13, 14} Parents report controlling children's eating through availability and accessibility to healthy foods, modeling, monitoring, restriction, pressure to eat, encouragement, and nutrition education.^{13, 15}

Feeding practices can be differentiated by their association with the orientation of children's motivation. Motivation is a theoretical way to understand human behaviors. One motivation theory, the self-determination theory (SDT), addresses intrinsic and extrinsic motives and internalization through satisfying psychological needs inherent to humans.¹⁶ For children who dislike vegetables and have no intrinsic motives to eat, parents may attempt to offer rewards for eating vegetables. Extrinsically motivated actions may be performed with resistance and/or disinterest, whereas SDT suggests that even extrinsic motivation can be internalized by allowing more autonomy, competence, and relatedness.¹⁷

Many previous studies on feeding practices and children's food consumption have dealt with restriction and pressure.^{18, 19} Furthermore, while there has been a large volume of studies on determinants of fruit and vegetable intakes in older children and adolescents,²⁰ research on the fruit and vegetable intakes of preschoolers to date has been relatively limited.^{18, 21, 22} In addition, studies addressing fruits and vegetables separately are scarce.²³ Thus, this study investigated the associations of various aspects of feeding practices and both fruit and vegetable consumption among U.S. preschoolers in east-central Illinois. This study utilized SDT¹⁷ to explain how feeding practices influence children's fruit and vegetable consumption. It was hypothesized that maternal controls related to autonomy (i.e., building a healthy food environment), competence (i.e., encouragement, teaching nutrition, and involvement in cooking), and relatedness (i.e., modeling) in SDT would be positively associated with both fruit and vegetable consumption by preschool children.

METHODS

Participants

This cross-sectional study used on the baseline data from 363 mothers enrolled in the cohort for the Synergistic Theory and Research on Obesity and Nutrition Group Kids (STRONG Kids) program. The STRONG Kids program is an interdisciplinary research project that aims to identify multiple risk factors for childhood obesity by following preschool children for 3 years.

A detailed description of the STRONG Kids program has been reported previously.^{24, 25} Participants in the program were children aged 2 to 5 years who were enrolled in 30 licensed childcare centers in Illinois. Between 2009 and 2010, in total 424 participants were recruited to take baseline surveys and their primary caregivers completed a self-administered parent survey. The STRONG Kids program comprises ~26.7% overweight/obese children,²⁶ which is comparable to the national prevalence of overweight/obese children aged 2 to 5 years in 2009–2010.²⁷

For the statistical analytic sample of mother–child dyads, data from primary caregivers who were not biological mothers were excluded. Of 363 biological mother–child dyads, 13 dyads with >50% missing responses for any feeding practice and 34 dyads with any missing responses to the other covariates were excluded, leaving a total sample of 316. The institutional review board of the University of Illinois at Urbana-Champaign approved all procedures used in this study.

Maternal Feeding Practices

Mothers were asked to complete the Comprehensive Feeding Practices Questionnaire (CFPQ).¹⁵ Using the CFPQ, the following 10 aspects of parental feeding practice were measured: “emotion regulation” (parents use food to regulate the children’s emotional states; 3 questions), “encouraging balance and variety” (parents promote well-balanced food intake, including the consumption of varied foods and healthy food choices; 4 questions), “building a healthy home food environment” (parents provide healthy foods in the home; 4 questions), “food as reward” (parents use food as a reward for children’s behavior; 3 questions), “involvement” (parents

encourage children's involvement in meal planning and preparation; 3 questions), "modeling" (parents actively demonstrate healthy eating for the children; 4 questions), "monitoring" (parents keep track of children's intake of less healthy foods; 4 questions), "pressure" (parents pressure children to consume more food at meals; 4 questions), "restriction for health" (parents control children's food intake with the purpose of limiting intake of less healthy foods; 4 questions), and "teaching nutrition" (parents use explicit didactic techniques to encourage children's consumption of healthy foods; 2 questions). Mothers rated their practices based on a 5-point response scale from 1 ("never/disagree") to 5 ("always/agree"). A higher score indicated greater use of a particular feeding practice. The validity of the CFPQ was examined among U.S. children aged 2 to 8 years.¹⁵ In this study, the internal consistency reliability of each sub-construct ranged from Cronbach's $\alpha = 0.62$ for "building a healthy home food environment" to $\alpha = 0.90$ for "monitoring" (Table 1).

Children's Fruit and Vegetable Consumption

Fruit and vegetable consumption was estimated separately using the eating habit questions included in the preschool wave of the U.S. Department of Education's Early Childhood Longitudinal Survey.²⁸ The question items were developed by the Economic Research Service of the USDA and incorporate the results of cognitive testing for both the preschool and kindergarten parent interviews from the focus groups. Specifically, fruit consumption was estimated using the question, "During the past 7 days, how many times did your child eat fresh fruit, such as apples, bananas, oranges, berries or other fruit such as applesauce, canned peaches, canned fruit cocktail, frozen berries, or dried fruit? Do not count fruit juice." Vegetable

consumption was estimated by the question “During the past 7 days, how many times did your child eat vegetables other than French fries and other fried potato items? Include vegetables served as a stir fry, soup, or stew in your response.” The response categories were “once a day”, “twice a day,” “three times a day”, “four or more times a day”, “one to three times during the past 7 days”, “four to six times during the past 7 days”, “my child did not eat any during the past 7 days”, and “do not know”. Research staff addressed the importance of ‘away-from-home food consumption’. Parents were advised to communicate with their children’s day care providers regarding consumption during day care hours as well as away-from-home meals.

Confounding Variables

Data on socio-demographic characteristics and known covariates^{20, 29} were obtained from a self-administered questionnaire. Potential confounders included the mother’s age, race/ethnicity (Hispanic, white, black, or other), marital status (married or non-married), education level (12th grade or less, some college or technical school, college graduate, or post graduate), and employment status (employed, student, or stay at home), and the child’s age, gender, race/ethnicity, and whether exclusively breastfed for 6 months.

Statistical Analysis

The participants’ characteristics were described as percentages for the categorical variables and as means and standard deviations for the continuous variables. Missing values were imputed as the mean score of the question.

Pearson's correlation coefficients were calculated among 10 feeding practices. The association between the maternal feeding practices and both fruit and vegetable consumption was assessed by Spearman's rank order correlation coefficients due to the uneven interval of the response categories for consumption data. The association was also assessed by partial correlation analysis to account for potential confounders.

Linear regression analysis was conducted to identify the maternal feeding practices that had the greatest influences on both fruit and vegetable consumption in children, controlling for potential confounders. A stepwise approach was applied to select independent variables including confounders with $P < .15$ in a model.²⁹ There was no multicollinearity among the variables involved in the regression model considering variance inflation factors.

The significance level was set to $P < .05$. All analyses were performed using Statistical Analysis Software (version 9.2, 2008, SAS Institute Inc., Cary, NC, USA).

RESULTS

The average age of the mothers was 31.8 ± 5.4 years, and 72.5% were white, 78.2% were married, 67.4% were employees or students, and 62% had a college diploma. The average age of the children was 3.1 ± 0.6 years. Of the children, 65.5% were white, 52.9% were female, and 14.6% were exclusively breastfed for 6 months. The children consumed fruits 1.7 times per day and vegetables 1.4 times per day on average (Table 1). Approximately 70% of the children consumed vegetables at least once per day, and ~85% consumed fruits at least once per day (data not

shown). Feeding practices were positively correlated with both fruit and vegetable consumption for 5 feeding practices, while one feeding practices was positively correlated with fruit consumption only (Table 1). The correlations among the 10 feeding practices are shown in Table 2. Regression analysis of the associations of both fruit and vegetable intakes with maternal feeding practices appear in Table 3. In contrast to other feeding practices, “restriction for health” represented a decrease in vegetable intake.

DISCUSSION

Adequate fruit and vegetable intakes are key when seeking to promote healthy eating in children, and to prevent the development of obesity and other chronic diseases of concerns to public health authorities.³⁰ From a life-course perspective, establishment of healthy eating habits (i.e., adequate consumption of fruits and vegetables) during early life is crucial to ensure good health later in life.³⁰ Although the intakes of both fruits and vegetables need to increase, fruits are relatively well-accepted by children whereas vegetables are less so.³¹ Therefore, it is important to identify the factors that influence fruit and vegetable consumption separately.

Zeistra and colleagues reported that parental feeding practices in terms of vegetables were performed in a more negative context than fruits.²³ Thus, this study examined the effect of various aspects of maternal feeding practices on the intakes of both food groups in preschool-aged children, using the SDT framework.^{16,17} The present study confirmed differences between fruit and vegetable intakes. However, not all the significant feeding practices detected by

correlation analysis were retained in the final regression models, which is attributable in part to the strong associations of these practices with more potent predictors such as “monitoring” for fruit intake and “building a healthy home food environment” for vegetables intake.

Restriction of unhealthy foods is an example of a direct control strategy. Previous research has shown that restriction of unhealthy foods can lead to an immediate decrease in unhealthy food intake,^{32, 33} while other studies have revealed that restrictive feeding practices promoted a preference for the restricted foods and eventually generated a counterproductive effect.¹⁸ The present study found that such restrictions reduced vegetable intake but not fruit intake.

It is noteworthy that by helping children themselves select vegetables, the home food environment may have positive significant effect on vegetable intake. A recent review of the determinants of fruit and vegetable consumption among children aged 6 to 18 years identified parental intake and home food availability as significant determinants, in addition to socio-demographic status.²⁰ Several reports on Head Start children revealed that a healthy home food environment was an exclusive and consistent predictor of children’s fruit and vegetable intakes, as evidenced by correlation coefficients of 0.20 and 0.26, respectively.^{21, 22} The present study also found that both fruit and vegetable intakes were influenced positively if the parents built a healthy home food environment. In addition, a more effective approach to improving preschool-aged children’s competence to eat vegetables may be participation in meal preparation rather than teaching nutrition as shown by the results in Table 1.

The correlation analysis of the present study showed that mothers monitored children’s eating and restricted unhealthy foods. Regression analysis indicated that just “monitoring”, which would not weaken children’s autonomy, was associated with increased fruit consumption.

“Encouraging balance and variety” was also associated with fruit intake. Several studies evaluating feeding styles reported that emotionally supportive interaction yielded a favorable influence of children’s healthy eating behaviors.^{34,35} A study on the association between the social-affective context during eating events and the food preference of preschool-aged children revealed that an emotionally warm interaction could have a favorable effect on food consumption.³⁵ Moreover, warm emotional interactions between parents and children during meal times may enhance the children’s healthy eating competence.¹⁷ The present study also found that parental monitoring, involvement, and role modeling were positive influences. The SDT suggests that such practices improve the autonomy, competence and relatedness of preschoolers to eat fruits and vegetables.

This study measured only frequencies of consumption and could not account for differences in serving size. Previous studies documented a reasonable level of accuracy of maternal or primary caregivers’ reports on young children’s dietary intake,³⁶⁻³⁹ but they consistently reported an underestimation of the intake. Although the ECLS survey team conducted cognitive testing, the validity and reliability of the test methods are unavailable. Since the food frequency method is a good tool for ‘ranking’ individual intake and thus can be used for relational epidemiological studies,⁴⁰ the associations in this study may be attenuated but not distorted due to diet measurement errors. In addition, it has been found that portion size estimations of children’s food intake are not accurate.⁴¹ Furthermore, the estimates of fruit and vegetable intakes in the current study were comparable to those in reported national studies. According to a recent nationally representative study of US children, ~75% of children aged 2–3 years consumed 1 distinct portion of vegetables a day.¹²

While this study had several strengths, it also had other limitations. First, a causal relationship could not be established due to the cross-sectional design of the study. Most of the observed associations may not be free from counter causality (i.e., mothers of children who consume enough fruits and vegetables may not need to apply strict rules on fruit and vegetable consumption). The directionality (i.e., whether this higher consumption originated from or led to parental feeding practices) could not be confirmed. Second, study variables were measured using a self-reported survey, which is subject to bias due to personal values and expectations. Third, the practices of “pressure” and “building a healthy home food environment” had relatively low alpha coefficients, suggesting that the items used to construct these scales exhibited low internal consistency. Therefore, these two feeding constructs are of limited power and should be interpreted cautiously, specifically the explanation power of “building a healthy home food environment” in increasing vegetable intake may have been overestimated. Also, the R^2 value of each regression model was low. Fruit and vegetable intakes are complex behaviors that might not be explained fully by a few demographic characteristics and feeding practices.

In conclusion, this study suggests that both the fruit and vegetable intakes of preschool-aged children are more likely to increase if parents apply SDT-based feeding practices to facilitate children’s internalization of their extrinsic motivation.

IMPLICATIONS FOR RESEARCH AND PRACTICE

The results indicated that parents/caregivers may influence their preschoolers to consume a greater quantity of fruits and vegetables by practicing feeding behaviors and

230 developing attitudes that encourage child autonomy, competence, and positive relatedness.
231 Establishment of a home food environment with easy access to vegetables could be helpful by
232 allowing more autonomy in food choice. On the other hand, restriction of unhealthy foods may
233 not be effective for encouraging children to eat more vegetables. Preparing meals with children
234 may also improve the competence of the children, enabling a positive experience with vegetables.
235 For fruit, it is useful to monitor what food children eat and to encourage consumption of more
236 fruits, which in turn enhances their competence.

237 The use of SDT in this study has yielded a deeper understanding of the relationships
238 between parental feeding practices and both fruit and vegetable intakes in younger children.
239 More research incorporating the SDT is needed to evaluate the existence and strength of a
240 potential causal relationship between parental feeding practices and children's eating patterns
241 during early childhood.

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Table 1. Descriptive Characteristics and Associations of Mothers' Feeding Practices and Fruit and Vegetable Consumption of Children Aged 2 to 3 Years (n=316)

Feeding practices				Food consumption			
				Fruits		Vegetables	
				Mean frequencies of consumption per day(SD) ^a			
				1.7(0.9)		1.4(0.8)	
	Cronbach's alpha	Mean scores (SD)		Correlation coefficients			
				Unadjusted	Adjusted ^b	Unadjusted	Adjusted
Emotion regulation	0.74	1.5	(0.6)	0.02	-0.01	-0.06	-0.07
Food as reward	0.71	2.1	(0.8)	-0.10	-0.07	-0.11	-0.07
Pressure	0.67	2.5	(0.8)	0.02	0.02	0.09	0.08
Restriction for health	0.77	2.8	(0.9)	-0.02	-0.04	-0.11	-0.11
Monitoring	0.90	4.1	(0.9)	0.26***	0.24***	0.19**	0.20***
Building a healthy home food environment	0.62	3.8	(0.6)	0.25***	0.21***	0.31***	0.26***
Involvement	0.76	2.9	(1.0)	0.14*	0.12*	0.20**	0.18**
Modeling	0.87	3.7	(0.9)	0.26***	0.21***	0.21**	0.14*
Encouraging balance and variety	0.75	4.3	(0.6)	0.28***	0.24**	0.26***	0.19**
Teaching about nutrition	0.74	3.3	(1.1)	0.20***	0.17**	0.15**	0.11

Significant by Spearman's correlation analysis($P<.05$, ** $P<.01$, *** $P<.001$)

^a Calculated by transforming response categories ("once a day," "twice a day," "three times a day," "four or more times a day," "one to three times during the past 7 days," "four to six times during the past 7 days," "my child did not eat/drink any during the past 7 days") to daily frequencies(1, 2, 3, 4, 2/7, 5/7, and 0, respectively)

^b Controlled for mother's age, race/ethnicity, marital status, employment status, and education level; child's age, gender, and race/ethnicity, exclusive breastfeeding for 6 months

Table 2. Correlation coefficients between Mothers' Feeding Practices of Children Aged 2 to 3 Years (n=316)

Feeding practices	Emotion regulation		Food as reward		Pressure		Restriction for health		Monitoring		Building a healthy home food environment		Involvement		Modeling		Encouraging balance and variety		Teaching about nutrition
Emotion regulation	1.00																		
Food as reward	0.33 ***		1.00																
Pressure	0.15 **		0.31 ***		1.00														
Restriction for health	0.12 *		0.26 ***		0.02		1.00												
Monitoring	-0.13 *		0.01		-0.05		0.29 ***		1.00										
Building a healthy home food environment	-0.18 **		-0.19 ***		-0.09		-0.10		0.33 ***		1.00								
Involvement	-0.06		0.03		0.07		0.01		0.20 ***		0.23 ***		1.00						
Modeling	-0.13 *		-0.13 *		0.04		0.09		0.31 ***		0.48 ***		0.36 ***		1.00				
Encouraging balance and variety	-0.18 **		-0.05		0.12 *		0.08		0.31 ***		0.41 ***		0.32 ***		0.65 ***		1.00		
Teaching about nutrition	-0.05		0.06		0.04		0.11		0.32 ***		0.33 ***		0.53 ***		0.54 ***		0.52 ***		1.00

Significant by Pearson's correlation analysis ($P < .05$, ** $P < .01$, *** $P < .001$)

Table 3. Multiple regression model for fruit and vegetable intake of children with parental feeding practices (n=316)^a

Feeding practices	Fruit intake ^b			Vegetable intake ^c		
	β	SE	P-value	β	SE	P-value
Pressure	-	-	-	0.08	0.05	0.103
Restriction for health	-0.11	0.05	0.052	-0.10	0.05	0.029
Monitoring	0.19	0.06	0.001	0.07	0.05	0.145
Building a healthy home food environment	-	-	-	0.23	0.08	0.003
Involvement	-	-	-	0.09	0.05	0.046
Encouraging balance and variety	0.27	0.08	0.002	0.13	0.08	0.097

^a Stepwise regression analysis for children's fruit intake and vegetable intake with ten feeding practices and potential confounding variables (i.e. mother's age, race/ethnicity, marital status, employment status, and education level; children's age, gender, and race/ethnicity, exclusive breastfeeding for 6 months) as independent variables.

^b Controlled for parental education, child's age and race/ethnicity, exclusive breast feeding for 6 months in the final model ($R^2=0.18$, $p<.001$).

^c Controlled for parental education, child's age and race/ethnicity in the final model ($R^2=0.21$, $p<.001$).