Published in final edited form as:

J Nutr Educ Behav. 2015 ; 47(4): 361–366.e1. doi:10.1016/j.jneb.2015.03.006.

The Cost of a Healthier Diet for Young Children with Type 1 Diabetes Mellitus

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Abstract

Objective—The study used a market-basket approach to examine the availability and cost of a standard food shopping list (R-TFP) versus a healthier food shopping list (H-TFP) in the grocery stores used by a sample of 23 families of young children with type 1 diabetes mellitus (T1DM).

Methods—Frequency counts were used to measure availability. The average cost of the R-TFP and the H-TFP was compared using a paired t-test.

Results—Small or independent markets had the highest percent of missing foods (14%), followed by chain supermarkets (3%), and big box stores (2%). There was a significant difference in the average cost for the R-TFP versus the H-TFP (\$324.71 and \$380.07, respectively $p < 0.001$).

Conclusions and Implications—Families may encounter problems finding healthier foods and/or incur greater costs for healthier foods. Nutrition education programs for T1DM need to teach problem solving to help families overcome these barriers.

Keywords

nutrition; behavior; child; preschool; diabetes; dietary costs

Introduction

It is standard in nutrition education for type 1 diabetes mellitus (T1DM) to instruct patients and families to reduce fat and increase fruits, vegetables, and whole grains in their diets.^{1,2} However, despite these recommendations, from the available research, it is known that many youths with T1DM do not consume a healthful diet.³⁻⁵ A common complaint from parents is that providing more nutritious foods to their child is difficult, time-consuming, and expensive.⁶ Cost and availability are established barriers to healthful eating in the general population and have been quantified by market-basket studies.⁷⁻¹⁰ Similarly, in youths with

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T1DM, there is one study which has shown a relation between higher diet costs and a healthier diet.¹¹ However, this study recruited youths 8-18 years old and diet costs were estimated based on price information from two on-line national supermarkets versus the actual stores where families routinely shopped. It remains unknown if there is a higher cost to healthier eating for families of young children with T1DM, a subset of patients who likely eat a majority of their meals at home and typically have parent supervision of their meals, creating an opportunity for healthier eating.^{12,13} Also, because the prior study of youths with T1DM was not a market-basket study, it is not known if families of youths with T1DM face challenges in finding healthier food options in their local stores. Thus, this market-basket study sought to examine the physical availability and the cost of healthier foods in the stores that parents of young children with T1DM reported using for their routine food shopping in Northeastern Kansas and Western Missouri. Market-basket studies are commonly used to examine the physical availability and cost of foods that make up a nutritious diet.^{7,14,15} These studies use a survey approach to gather data based off a standard shopping list in stores identified based on the study sample (i.e., young children or urban neighborhood). Following published methodology,⁷ the researchers used the U.S. Department of Agriculture's Thrifty Food Plan (R-TFP)¹⁴ and a modified healthier version of the Thrifty Food Plan (H-TFP)⁷ to determine food prices for two standard shopping lists. The researchers specifically sought to answer the following questions: 1) What is the physical availability of healthier food options in the stores parents of young children with T1DM use for their routine food shopping? and 2) Is there a difference in the price of the R-TFP versus the H-TFP at these stores? Thus, this study provides valuable data to establish the cost and physical availability of healthful food options for a sample of families of children with T1DM that will ultimately lead to better individualization of diabetes nutrition education and new curricula to problem-solve challenges created by these barriers.

Methods

Procedure

The researchers recruited families from a Pediatric Diabetes Clinic in the Mid-western U.S. to participate. Families were eligible if they had a child with T1DM who was 1-6 years old, at least six months beyond his/her T1DM diagnosis, and on an intensive insulin regimen. Twenty-seven families initially agreed to participate, but three families were lost because of illness and one family could not be reached to schedule a study visit (85% participation rate). All study procedures were approved by the Institutional Review Board prior to subject recruitment; parents provided written informed consent before participating.

Parents provided demographic information and the name and location of the primary store where they complete their weekly food shopping during a home study visit. Masters students in dietetics who were blind to the study questions were then dispatched to each of the stores that were identified by parents to collect the prices for 164 food items on a standard list that included all items on the R-TFP and the H-TFP (see Table 1 for sample list).^{7, 14} Students were instructed to record the lowest non-sale price per unit for each food item. Once these data were collected, the lists were double checked for missing or potentially inaccurate prices by a research assistant and corrected as needed. Potentially inaccurate prices were

suspected if the price listed for an item was >3 standard deviations from the mean price of that item from similar stores. If an inaccurate price was suspected or a missing price was found, the protocol was for the research assistant to call the store to check the price. In cases where a missing price was due to a missing food (4%;151/3772), a substitution was made based on the mean price of that food from similar stores. The validated food prices were then entered into a spreadsheet and the store's total costs for the R-TFP versus the H-TFP were automatically calculated for each family based on a pre-set formula. As an additional descriptive variable, children's most recent glycated hemoglobin A1c (HbA1c) value was collected from their medical record. These values were obtained using the DCA 2000+ Analyzer (Bayer Corporation; normative reference ranges 4.5-5.7%). The mean number of days from the time of children's first study visit and their reported HbA1c value was 17 ± 14 days.

Measures

To assess family socioeconomic status the Hollingshead Four-Factor Index was used, which computes a class score based on parents' marital status, education level, job title, and employment status (viz., full or part-time).¹⁶

Thrifty Food Plan—The researchers selected the R-TFP because it included food items meant to describe a typical two-week grocery list for a family of four living on a modest food budget or participating in the Supplemental Nutrition Assistance Program. Also, while the R-TFP provides a diverse grocery list that can enable a family to meet U.S. Department of Agriculture dietary intake guidelines, there is room for additional healthier food substitutions which can increase its health value. For example, Jetter et al.⁷ identified healthier substitutes for the original dairy, meats, canned fruit, fats, breads, and other grain products, leading to a H-TFP shopping list which had about four times the amount of fiber and one-fifth the grams of total fat than the R-TFP. Food items that did not change from the R-TFP to the H-TFP included fresh fruits and vegetables, eggs, beans, and spices and herbs. Although data for the present study were collected from families of young children with T1DM, virtually all families reported only minimal use of sugar-free products based on a study questionnaire. Thus, no additional substitutions for sugar-free products were made. Also, juice cocktail and 100% juice were retained in the R-TFP and the H-TFP, respectively, because when asked, 90% of parents indicated that they may serve “juice” when treating hypoglycemic episodes. Similar stores were grouped based on type: chain supermarket (stores $>20,000$ square feet), small and independent markets ($<20,000$ square feet), and big box stores (stores $>20,000$ square feet, sold bulk items but did not charge a membership fee).⁷

The total price for each food was calculated by multiplying the specified quantity of each food based on the R-TFP or H-TFP by the lowest unit price as collected from each store. Then to calculate the final market price for the R-TFP and the H-TFP, the total costs for items on each list were summed. Also, the final market prices for each of the four components of the R-TFP and the H-TFP (i.e., fruit and vegetables, meat, grains, dairy) were calculated by summing the items specific to each of these components. Paired t-tests were used to compare the final market costs for the R-TFP and the H-TFP as well as each of

the four component scores (adjusted $\alpha=0.01$). Finally, descriptive statistics were used to describe the sample, the types of stores used by families, and the physical availability of selected healthier foods by store type.

Results

The sample consisted of 23 families of young children with T1DM. Young children had a mean age of 4.6 ± 1.3 years, were 43.5% female, and 78.3% of parents identified their child as White. Young children had a mean HbA1c level of $7.8 \pm 1.0\%$, were 2.0 ± 1.5 years' post-diagnosis, and 87% of children used an insulin pump. Parents' mean age was 35.7 ± 5.1 years old. Ninety-one percent of participating parents were mothers, 82.6% of parents were married, 78.3% of parents reported at least some college and, 82.6% of families reported a middle to upper middle class socio-economic status.

Small and independent markets had a higher percent of missing foods ($14.3 \pm 11.9\%$), compared to chain supermarkets ($3.4 \pm 2.8\%$ of foods missing) and big box stores ($2.5 \pm 1.1\%$ of foods missing; Table 2). Fourteen families reported shopping at a chain supermarket, 6 families reported shopping at a big box store, and three families reported shopping at a small or independent market. There were 20 unique stores surveyed, distributed widely across the metropolitan area and within a mean 29 mile radius of the main clinic (see Figure 1).

Consistent with parents' perceptions, the H-TFP was more expensive than the R-TFP [$t(22)=-17.01$, $p<0.001$]. The average cost for the R-TFP was \$324.71 versus \$380.07 for the H-TFP, which translated into a mean difference of $\$57.62 \pm \14.02 (range= \$31.10- \$87.87) per basket. While healthier alternatives tended to cost more for all of the components, the greatest differences in costs were observed for protein and grains. For protein, the average increase in cost for the H-TFP was $\$23.06 \pm \9.29 while for grains the average increase in cost was $\$15.48 \pm \5.91 . Simple correlations revealed no association between families' Hollingshead Socioeconomic Score and the price they might pay for the R-TFP ($r=-0.06$, $p=0.79$) or the H-TFP ($r=-0.07$, $p=0.73$) at their respective store. Categorical comparisons were not possible because of a low frequency of families falling below the middle class socio-economic status.

Discussion

This study explored the physical availability and cost of healthier foods using a market-basket design in a sample of families of young children with T1DM. With respect to the physical availability of healthier foods, the results showed that small and independent markets tended to have more missing foods than chain supermarkets and big box stores. In the literature, problems with the physical availability of healthier foods have been identified for small and independent markets located in lower income urban neighborhoods and in some rural communities, leading to a food desert for some families who struggle with gaining access to a healthful diet.^{7,17-19} In this study, there were three families who reported using a small or independent market for their weekly food shopping. Two of these families reported shopping in upscale independent stores that featured primarily local products and were located in middle to higher income neighborhoods. However, one of these families

lived in a small rural town, with one independent market, and the nearest larger store, a big box store, located about 25 miles away. Thus, similar to the results of past food desert studies,^{7,17-19} it is likely that this family faced a significant barrier to more healthful eating due to limited access. It is estimated that U.S. families make an average of 2.2 trips to a grocery store per week.²⁰ Therefore, for this family to shop at the nearest big box store, it would add both significant time and expense to their food shopping, suggesting that the potential negative effects of a food desert may also exist outside of lower income urban communities.

Specific to cost, the mean difference between the R-TFP and the H-TFP was \$57.62 per basket. Thus, over one year, the difference in cost for a family shopping from the H-TFP versus the R-TFP would be \$1,498.12. In 2013, Americans spent a mean of \$3,997 on foods purchased at a grocery or other store and prepared by the consumer (viz., food at home expenses).²¹ Based on these values, the higher cost of the H-TFP would be about 37.5% of a family's food at home expenses. This is consistent with findings from an earlier study, which reported the higher cost of the healthier basket to be between 35%-40% of a family's food-at-home expenses.⁷ This finding is also generally consistent with a recent study conducted in older youths with T1DM, which found higher food costs associated with a healthier diet.¹¹ Parents commonly report the higher cost of fresh fruits and vegetables.^{8,22-24} Although the cross-sectional nature of this study's data do not take into account the volatility of vegetable and fruit pricing in the global markets, based on the R-TFP, families would spend approximately \$50.22 on fresh fruits and vegetables every two weeks. This is the equivalent of 16% of the total average price of the R-TFP and 13% of the total average price of the H-TFP. However, healthier versions of canned fruits (viz., canned with juice) and vegetables (viz., lower sodium) or frozen products without added sauces, sodium, or sugar, may offer a more affordable option. Overall, these healthier canned or frozen fruits and vegetables were widely available and in some cases, there were store brand options available, leading to additional cost savings for consumers. Based on the surveys, the mean two-week cost of healthier canned fruits and vegetables was \$13.55, which is the equivalent of 0.3% of both the total average prices of the R-TFP and the H-TFP. The mean two-week cost of healthier frozen fruits and vegetables was \$31.72 or the equivalent of 10% of the total average prices for the R-TFP and 8% of the total average price of the H-TFP. Thus, to give parents an affordable alternative to fresh produce, nutrition education programs should consider teaching parents about healthier canned and frozen fruits and vegetables and review how to measure and count carbohydrates in these foods, as carbohydrate counts will be higher in canned fruits.

This study presents new information regarding differences in the cost of a healthier diet in a sample of families of young children with T1DM. Limitations of this study include its small and homogeneous sample. Although the ethnic, racial, and socio-economic composition of the sample is similar to the clinic from which it was drawn, the results may not generalize to children from other ethnic, racial, or socio-economic backgrounds. Another limitation is the location of the study, which recruited families from a Diabetes Clinic located in a moderately-sized city in the Mid-western U.S. Because cost of living can also affect local food prices, future market-basket surveys are needed to determine food prices and physical availability in other cities or regions in the U.S. Finally, the study methodology may present

as a limitation. This study used two standard grocery lists in a market-basket design to document food physical availability and cost. This methodology allowed for comparisons across individual families and store types and to ensure that a wide variety of foods were surveyed. But an alternative strategy would have been to generate individual shopping lists for families based on diet diary information. This approach would have allowed for a better estimate the true difference in costs for families based on their individual buying habits. Thus, the results provide insight into the degree of cost differences families of young children with T1DM could face when eating healthier foods, but not the specific cost difference they encounter in their weekly shopping.

Implications for research and practice

The results show that a healthier market basket can cost 18% more than the standard basket. Moreover, families can face barriers in finding specific healthier foods at their local stores. In addition to educating parents and youths regarding recommendations for healthful eating, diabetes nutrition programs need to address the barriers to healthful eating that are created by the marketplace and food environment in which their patients are living. Some individualized nutrition counseling strategies that might help include reframing food purchases in terms of nutrition per dollar to teach families how to shop for healthful foods at the lowest possible price, providing recipes and teaching families how to cook lower-cost substitutes for higher priced foods, and providing information on local stores that offer a wide selection of healthful foods. In short, collaborative problem solving around marketplace barriers to healthful eating has the potential to increase the likelihood that parents will purchase more healthful foods each week and decrease parents' feelings of frustration or stigma related to their food shopping practices.

Acknowledgment

This research was supported in part by grant R03-DK090288 (to S.R.P.) from the National Institutes of Health/ National Institute of Diabetes and Digestive and Kidney Diseases. We thank Ms. Allison Wilcox, Ms. Ashley Moore, and Ms. Courtney Moore of the University of Kansas Medical Center for their assistance in conducting the market-basket surveys.

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Figure 1.

Distribution of store surveyed relative to the main Diabetes clinic where families were recruited.

Note: Blue marker, Main Diabetes Clinic; Red markers, Stores; 18 stores are shown; 3 stores were duplicates (i.e., two different families happened to shop at the same store).

Table 1

Example items in the Regular Thrifty Food Plan (R-TFP) and the Healthier Thrifty Food Plan (H-TFP)[†]

Food item	Baskets	
	R-TFP	H-TFP
Breads/grains	Refined	Whole grain
Canned fruit	Heavy or lite syrup	Lite syrup or juice
Canned vegetables	Standard	Low sodium
Chicken	Thighs	Breast
Cooking oil	Vegetable	Canola
Flour	White	Whole wheat
Frozen Fish	Filets with breading	Filets, no breading
Frozen Potatoes	Frozen French fries	Frozen potatoes
Ground meat	20% fat	10% fat
Milk	1%, Whole	1%, Non-fat
Pasta	Enriched	Whole wheat
Rice	White	Brown
Salad dressing	Regular	Low-fat
Spreads	Jelly	Real fruit spread
Tomato soup	Regular	Low sodium

[†] Items included in the H-TFP were previously modified by Jetter et al.⁷

Table 2Number of stores missing specific healthier foods, grouped by store type[†]

Missing foods	Small/independent Markets	Chain Supermarkets	Big Box Stores	Total
Catsup, low sodium	1	1	0	2
Cheddar cheese, low-fat	2	2	0	4
Chicken bouillon, low sodium	1	0	0	1
Chicken fryer, no skin	2	5	0	7
Chuck roast, lowest fat	2	10	0	12
Cod filets	2	7	4	13
Chocolate drink mix, sugar-free	1	1	0	2
Egg noodles, yolkless	1	0	0	1
English muffins, whole wheat	2	0	0	2
Flour, whole wheat	1	0	0	1
Garbanzo beans, canned	1	0	0	1
Great northern beans, canned	1	0	0	1
Green beans, canned low sodium	1	0	0	1
Hamburger bun, whole wheat	1	0	0	1
Lima beans, dry	2	0	0	2
Macaroni, whole wheat	1	2	0	3
Pancake syrup, lite	1	0	0	1
Pears, canned lite syrup	1	0	0	1
Popsicles, sugar-free	1	0	0	1
Pork, ground low-fat	1	1	2	4
Real fruit spread	2	0	0	2
Rolls, whole wheat	1	6	0	7
Spaghetti sauce, low sodium, low sugar	1	2	0	3
Soy sauce, low sodium	1	0	0	1
Tomato paste, low sodium	1	0	0	1
Tomato soup, low sodium	1	3	2	6
Turkey breast, ground	2	1	0	3
Turkey ham (deli)	1	7	3	11

[†] Reflects missing healthier foods from 3 small or independent markets, 14 chain supermarkets, and 6 big box stores.