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

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ABSTRACT

Objective: This study used a market-basket approach to examine the availability and cost of a standard food shopping list (R-TFP) vs 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: The researchers used frequency counts to measure availability. The average cost of the R-TFP and H-TFP was compared using paired t test.

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

Key Words: nutrition, behavior, child, diabetes, food costs (J Nutr Educ Behav. 2015;47:361-366.)

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 problem reported by 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 T1DM, 1 study has shown a relation between higher diet costs and a healthier diet.¹¹ However, that study recruited youths aged 8–18 years and diet costs were estimated based on price information from 2 online national supermarkets compared with actual stores where families routinely shopped. It remains unknown whether 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, which creates 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 whether 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 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 on a standard shopping list in stores identified based on the study sample (ie, young children or urban neighborhood). Following published methodology,⁷ the researchers used the US 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 2 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 that parents of young children with T1DM use for routine food shopping? (2) Is there a difference in the price of the R-TFP vs 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 Midwestern US to participate. Families were eligible if they had a child with T1DM who was aged 1–6 years, at least 6 months beyond his or her T1DM diagnosis, and on an intensive insulin regimen. A total of 27 families initially agreed to participate but 3 families were lost because of illness and 1 could not be reached to schedule a study visit (85% participation rate). All study procedures were approved by the Children’s Mercy Hospital Institutional Review Board before 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 blinded to the study questions were then dispatched to each of the stores identified by parents to collect the prices for 164 food items on a standard list that included all items on the R-TFP and H-TFP. Table 1 provides a sample list. Students were instructed to record the lowest non-sale price per unit for each food item. Once these data were collected, a research assistant double-checked the lists for missing or potentially inaccurate prices and corrected them as needed. Potentially inaccurate prices were suspected if the price listed for an item was > 3 SD 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 of 3,772), 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 vs the H-TFP were automatically calculated for each family based on a preset 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, Tarrytown, NY; normative reference ranges, 4.5% to 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 researchers used the Hollingshead 4-Factor Index, which computes a class score based on parents’ marital status, education level, job title, and employment status (full or part-time). 16

Thrifty Food Plan

The researchers selected the R-TFP because it included food items meant to describe a typical 2-week grocery list for a family of 4 living on a modest food budget or participating in the Supplemental Nutrition Assistance Program. Also, although the R-TFP provides a diverse grocery list that can enable a family to meet US Department of Agriculture dietary intake guidelines, there is room for additional healthier food substitutions, which can increase its health value. For example, Jetter and Cassady identified healthier substitutes for the original dairy, meats, canned fruit, fats, breads, and other grain products, leading to an H-TFP shopping list that had about 4 times the amount of fiber and one fifth the grams of total fat as 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 current 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 they were asked, 90% of parents indicated that they may serve juice when treating hypoglycemic episodes. Similar stores
were grouped based on type: chain supermarkets (stores > 20,000 square feet), small and independent markets (< 20,000 square feet), and big box stores (stores > 20,000 square feet that 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 4 components of the R-TFP and H-TFP (ie, fruit and vegetables, meat, grains, dairy) were calculated by summing the items specific to each of these components. The researchers used paired t tests to compare final market costs for the R-TFP and H-TFP as well as each of the 4 component scores (adjusted α = .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 with young children with T1DM. Mean age of young children was 4.6 ± 1.3 years; 43.5% were female and 78.3% of parents identified their child as white. Young children had a mean HbA1c level of 7.8% ± 1.0% and were 2.0 ± 1.5 years post-diagnosis; 87% of children used an insulin pump. Parents’ mean age was 35.7 ± 5.1 years. A total of 91% 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 middle- to upper-middle-class socioeconomic status.

Small and independent markets had a higher percentage of missing foods (14.3% ± 11.9%) compared with chain supermarkets (3.4% ± 2.8% of foods missing) and big box stores (2.5% ± 1.1% of foods missing) (Table 2). Fourteen families reported shopping at a chain supermarket, 6 reported shopping at a big box store, and 3 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 (Figure).

Consistent with parents’ perceptions, the H-TFP was more expensive than the R-TFP (t[22] = −17.01; P < .001). The average cost for the R-TFP was $324.71 vs $380.07 for the H-TFP, which translated into a mean difference of $55.32 ± $14.02 (range, $31.20 to $67.87) per basket. Healthier alternatives tended to cost more for all of the components, but 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 ± $9.29 whereas for grains the average increase in cost was $15.48 ± $5.91. Simple correlations revealed no association between families’ Hollingshead Socioeconomic Score and the price they might pay for the R-TFP (r = −.06; P = .79) or the H-TFP (r = −.07; P = .73) at their respective store. Categorical comparisons were not possible because a low frequency of families fell below the middle-class socioeconomic status.

Table 2. Stores Missing Specific Healthier Foods, Grouped by Store Type, n

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

Note: Data reflect missing healthier foods from 3 small or independent markets, 14 chain supermarkets, and 6 big box stores.
DISCUSSION

This study explored the physical availability and cost of healthier foods using a market-basket design in a sample of families with 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 that struggle with gaining access to a healthful diet.7,17-19 In this study, 3 families reported using a small or independent market for 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, 1 of these families lived in a small rural town with 1 independent market, and the nearest larger store, a big box store, was 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 as a result of limited access. It is estimated that US 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, which suggests that the potential negative effects of a food desert may also exist outside lower-income urban communities.

Specific to cost, the mean difference between the R-TFP and H-TFP was $57.62/basket. Thus, over 1 year, the difference in cost for a family shopping from the H-TFP vs 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 (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% and 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 that higher food costs were 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 does 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 fruit and vegetables every 2 weeks. This is equivalent to 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 (canned with juice) and vegetables (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 store brand options were available, leading to additional cost savings for consumers. Based on the surveys, the mean 2-week cost of healthier frozen fruits and vegetables was $13.55, which is equivalent to 0.3% of both the total average prices of the R-TFP and the H-TFP. The mean 2-week cost of healthier frozen fruits and vegetables was $31.72, or the equivalent of 10% of 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, because 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 with young children with T1DM. Limitations of this study include its small and homogeneous sample. Although the ethnic, racial, and socioeconomic 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 socioeconomic backgrounds. Another limitation is the location of
the study, which recruited families from a diabetes clinic located in a moderately sized city in the Midwestern US. 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 US. Finally, the study methodology may be a limitation. This study used 2 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. 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 of 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 with 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 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 regarding 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.

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**REFERENCES**


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