

# Cost Savings and Clinical Effectiveness of an Extension Service Diabetes Program

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## Abstract

**Objective.** To evaluate the cost savings and clinical effectiveness of a Cooperative Extension Service diabetes education program for improving nutrition knowledge, food portioning skills, hemoglobin A<sub>1c</sub> (A1C), and anthropometric indices.

**Design.** Clients with type 1 or type 2 diabetes enrolled in a 3-month diabetes education course focused on food portioning skills. Pre- and post-course anthropometric measurements, a written food portion test, an observational food portioning skill test, and an A1C test were administered and scored. Paired *t* tests were calculated between pre- and post-course scores to measure statistical significance.

**Results.** Data analysis showed improvement in food portion knowledge written test scores (49.67% pre-

and 59.56% post-course, *P* = 0.004), food portioning skills (out of a possible score of 5, 2.43 pre-, 4.29 post-course, *P* = 0.023), A1C results (7.16% pre-, 6.43% post-course, *P* = 0.000), body mass index (BMI) (32.60 kg/m<sup>2</sup> pre-, 31.78 kg/m<sup>2</sup> post-course, *P* = 0.000), weight (202.58 lb pre-, 199.74 lb post-course, *P* = 0.000), waist circumference (42.43 inches pre-, 41.16 inches post-course, *P* = 0.000), hip circumference (45.96 inches pre-, 45.36 inches post-course, *P* = 0.000), and waist-to-hip ratio (0.92 pre-, 0.91 post-course, *P* = 0.000).

**Conclusions/Applications.** Evaluation of the Utah State University Extension Service diabetes education program showed improved nutrition knowledge, anthropometric measures, and glucose control. These improvements have been estimated to reduce medical costs by \$94,010.

Worldwide, the prevalence of diabetes, particularly type 2 diabetes, has grown considerably.<sup>1</sup> In 1995, 4% of the U.S. population was reported to have diabetes,<sup>1</sup> yet in 2002, the American Diabetes Association estimated 6.3% of the U.S. population (18.2 million people) had diabetes.<sup>2</sup> Of those diagnosed, 90–95% had type 2 diabetes. In younger populations, (< 20 years old) the rate of type 2 diabetes is increasing and in some cases exceeding the prevalence of type 1 diabetes.<sup>3</sup> In the United States, approximately one-third of newly diagnosed diabetes in adolescents is type 2 diabetes.<sup>4</sup>

Increased marketing and availability of food has contributed to the U.S. obesity epidemic and concurrent rise in type 2 diabetes.<sup>5</sup> Portion sizes have expanded over the past four decades, causing confusion among consumers concerning correct stan-

dardized portion sizes.<sup>6</sup> National surveys have shown that calorie availability per capita has increased by 500 kcal/day since the 1970s.<sup>6</sup> Consequently, it has become increasingly important for practitioners to focus on consistent carbohydrate intake and portion control skills.<sup>7</sup> Portion control skills can be emphasized by teaching the proper use of measuring cups, scales, and utensils typically used in households.

Food portioning skills may be recognized by clinicians as important but are often omitted in the core list of instructions to clients. Clinicians should be encouraged to educate clients regarding accurate food portioning. A study analyzing the practices of clinicians revealed that only half asked their clients with diabetes to weigh and measure their food portions.<sup>8</sup> The remaining half reported asking about portioning food only

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occasionally or never, which indicates that clinicians do not reinforce or emphasize food portioning skills.

General diabetes education programs, with and without a section on food portioning skills, are effective in improving disease outcome, especially when participants are involved in their own diabetes management.<sup>9-11</sup> Patient participation, plus active involvement of the physician and dietitian in patient care, improves long-term adherence to the diabetes care regimen.<sup>12</sup>

The purpose of this study was to determine whether participation in the “Diabetes: Stepping Up to the Plate” education program resulted in medical costs savings and significant improvements in anthropometric indices, A1C, written nutrition knowledge test, and food portioning skills.

**Methodology**

**Subjects.** Participants in this study were enrolled in the Utah State University Extension’s “Diabetes: Stepping Up to the Plate” program. Participants were recruited through newspaper advertisements, community newsletters, and flyers placed in public county buildings. A small fee was charged to cover handouts, food, and clinical supplies. One hundred fifty-five participants in seven Utah counties have enrolled in the voluntary program.

Just over half of participants completed both pre- and post-course data collection, although more completed the full education curriculum. In some rural counties, A1C testing was not available, limiting the data collection for this measurement.

Some of the participants who were enrolled did not have diabetes, but were at risk for developing diabetes. Analysis was conducted separately for all participants, for those with diabetes, and for those without diabetes. Table 1 shows demographic data collected from all participants.

**Course description.** The program curriculum and data collection tools were developed by senior dietetic students as part of a research project to determine the effectiveness of food portion education on diabetes outcomes. The curriculum was designed to provide a low-cost, intensive, hands-on food portioning skills experience. Because of the limited number

of dietitians and diabetes educators in rural areas, the curriculum and program were designed to focus on food portioning skills that could be taught within the scope of practice of family and consumer scientists.

The curriculum and data collection tools were reviewed by a University Extension nutrition specialist and a University Extension agent, both registered dietitians, and sent out of state for content validity. The curriculum for each class was pilot-tested before the final version was incorporated into the curriculum.

The curriculum consisted of seven classes starting and ending with an evaluation session to assess knowledge of nutrition and food portioning skills and measurement of A1C and anthropometric indices. The remaining five classes contained three core sessions on portion control, label reading, and adjusting recipes and two specialty classes chosen by the group. The topics for the specialty classes included: cooking for holidays or special occasions, planning meals on a limited budget, eating out, and situational obstacles to dietary adherence.<sup>12</sup> As part of the curriculum, participants drafted their own meal plans based on self-chosen calorie levels to

meet the recommendations of the Food Guide Pyramid.<sup>13</sup> Classes were ~ 75 minutes in length.

**Evaluation.** Anthropometric, biochemical, food portion knowledge, and food portion skills data were collected pre- and post-course and analyzed for changes. The data included weight, height (self-stated), waist circumference (measured at the navel), hip circumference (measured 7 inches below the waist), A1C, written knowledge test, and practical skills test.

Baseline knowledge of food portions was assessed by the administration of a 35-question, written, multiple-choice test directed toward portion sizes and label-reading skills. Practical portion skills were assessed using a skills exercise. During the skills exercise, each participant passed through a buffet line and was asked to correctly load a plate with five portions of 15 g of carbohydrate (a total of 75 g of carbohydrate). Buffet choices included items such as pasta, rice, corn, beans, tortillas, bread, vegetables, fruit, and milk. A full set of measuring cups (1/4 cup, 1/3 cup, 1/2 cup, and 1 cup) were placed in front of each food item to assist participants in accurate plate loading. Instructors observed the participants’ plate loading and recorded the actual amount and the exchange equivalent of each food placed on the plate.

**Cost savings calculations.** The cost savings for this study were based on those calculated by Gilmer et al.<sup>14</sup> for health care plans. The steps used to calculate cost savings were:

1. Calculate mean pre- and post-course A1C.
2. Assign a cost savings dollar amount to pre- and post-course mean A1C changes according to the following:
  - Pre- < 6.0% = no change in costs
  - Pre- 7.0% to post-course 6.1% = \$194
  - Pre- 8.0% to post-course 7.1% = \$486
  - Pre- 9.0% to post-course 8.1% = \$972
  - Pre- > 10% to post-course 9.1% = \$1,459
3. Adjust cost savings for inflation by 3% per year, with 1997 being the base year.

**Table 1. Participant Demographic Information**

Age (years)	20-83	(54.54 ± 11.87)
Age at diagnosis (years)	2-82	(51.45 ± 13.87)
<b>Sex</b>		
Male	28.6%	
Female	71.4%	
<b>Diabetes</b>		
Type 1	5.8%	
Type 2	67.7%	
No diabetes	26.5%	
<b>Education</b>		
8th-11th grade	5.4%	
High school graduate	31.5%	
College graduate	50.4%	
Graduate school	12.8%	
<b>Annual Income</b>		
< \$10,000	11.6%	
\$10,001-25,000	23.9%	
\$25,001-40,000	20.3%	
\$40,001-55,000	22.5%	
\$55,001-70,000	9.4%	
> \$70,001	12.3%	
Data for age and age at diagnosis are range (mean ± SD).		

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- Multiply the inflation-adjusted dollars by the total number of people participating in the program to obtain the total cost savings. *Note:* This included all people with diabetes participating in the program—not just those with access to an A1C measurement.

**Statistics.** Paired *t* tests were calculated to determine any significant difference in knowledge, biochemical, and anthropometric pre- and post-course measures. Analysis of variance (ANOVA) was calculated to determine whether there were any differences between those with diabetes and those without diabetes.

**Results**

The calculated medical cost savings related to hospitalization in this study was \$94,010. Further cost savings related to outpatient care may be realized, but were not calculated. Tables 2, 3, and 4 list the means, standard deviations, and ranges for the changes in knowledge (written test), behavior (food portioning skills), anthropometrics (weight, waist and hip circumference), and biochemical (A1C) measures. There were significant improvements in all measures except the food portioning skills without use of the *Exchange Lists for Meal Planning* guide (memorization only). There was a significant improvement in food portion skills when the participants could utilize the tools (exchange books and labels) provided to them in the program.

**Discussion**

Diabetes education plays a crucial role in preventing and controlling diabetes and reducing the risk for common diabetes-related problems.<sup>9-11</sup> Insulin resistance precedes the clinical development of type 2 diabetes by 10–20 years and is an underlying component in other diseases.<sup>15</sup> According to the World Health Organization, insulin resistance is a primary symptom of the metabolic syndrome. This syndrome is defined by: waist-to-hip ratio > 0.85 in women and > 0.9 in men, BMI > 30 kg/m<sup>2</sup>, increased triglycerides, elevated blood pressure, and microalbuminuria. Risk factors for type 2 diabetes include obesity, hypertension, low

**Table 2. Pre- and Post-Program Measurements for All Participants**

Variable	n	Mean ± SD	Range	P
Written knowledge score (%)	69	Pre: 49.67 ± 16.31 Post: 59.56 ± 16.31	0–100 25–96.6	0.004
Food portion skills memorized (Scale 1–5)	71	Pre: 2.564 ± 1.105 Post: 3.662 ± 1.241	0–5 1–5	0.151
Food portion skills using book (Scale 1–5)	42	Pre: 2.43 ± 1.02 Post: 4.29 ± 1.09	0–5 1–5	0.023
A1C (%)	48	Pre: 7.16 ± 1.35 Post: 6.43 ± 1.11	5.00–11.00 4.30–9.30	0.000
BMI (kg/m <sup>2</sup> )	78	Pre: 32.60 ± 7.78 Post: 31.78 ± 6.83	17.5–63.5 17.5–53.7	0.000
Weight (lb)	78	Pre: 202.58 ± 45.46 Post: 199.74 ± 45.10	90.0–290.4 90.0–289.6	0.000
Waist circumference (inches)	72	Pre: 42.43 ± 6.41 Post: 41.16 ± 6.08	28.00–54.75 26.00–52.00	0.000
Hip circumference (inches)	70	Pre: 45.96 ± 5.28 Post: 45.36 ± 5.39	35.00–59.50 35.00–59.50	0.000
Waist-to-hip ratio	70	Pre: 0.921 ± 0.08 Post: 0.905 ± 0.082	0.68–1.11 0.69–1.07	0.000

HDL cholesterol levels, hyperglycemia, and hyperinsulinemia.<sup>16</sup> The Nurses Health Study reported the risk of diabetes decreased by 91% by modifying dietary behavior, physical activity, weight, and cigarette smoking. In those with a family history of

diabetes, the risk was reduced by 88%.<sup>17</sup> The Framingham Study showed a 33% reduction in diabetes with an 8- to 15-lb weight loss and a 51% reduction when weight loss was > 15 lb.<sup>18</sup> Another study documented that sustained weight loss in obese

**Table 3. Pre- and Post-Program Measurements for Participants Without Diabetes**

Variable	n	Mean ± SD	Range	P
Written knowledge score (%)	16	Pre: 47.31 ± 13.87 Post: 54.9 ± 15.13	17.90–71.40 28.66–75.00	0.30
Food portion skills memorized (Scale 1–5)	16	Pre: 2.56 ± 1.26 Post: 4.0 ± 1.31	0–4 1–5	0.553
Food portion skills using book (Scale 1–5)	2	Pre: 2.0 ± 1.4 Post: 4.0 ± 1.4	1–3 3–5	0.000
A1C (%)	2	Pre: 5.1 ± 0.14 Post: 5.0 ± 0.00	5.0–5.2 5.0–5.0	NA
BMI (kg/m <sup>2</sup> )	16	Pre: 29.94 ± 8.87 Post: 29.34 ± 8.67	17.50–54.00 17.50–53.70	0.000
Weight (lb)	16	Pre: 177.46 ± 49.26 Post: 177.87 ± 47.57	90–275 90–275	0.000
Waist circumference (inches)	15	Pre: 38.28 ± 7.57 Post: 36.38 ± 6.32	28.00–54.75 26.00–52.00	0.000
Hip circumference (inches)	15	Pre: 45.78 ± 5.04 Post: 43.83 ± 6.46	36.00–59.50 35.00–59.00	0.006
Waist-to-hip ratio	15	Pre: 0.86 ± 0.08 Post: 0.83 ± 0.07	0.68–1.02 0.69–0.94	0.052

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**Table 4. Pre- and Post-Program Measurements for Participants With Diabetes**

Variable	n	Mean ± SD	Range	P
Written knowledge score (%)	53	Pre: 50.39 ± 17.04 Post: 60.97 ± 16.52	0–100 25–96.6	0.011
Food portion skills memorized (Scale 1–5)	55	Pre: 2.56 ± 1.07 Post: 3.56 ± 1.21	0–5 1–5	0.191
Food portion skills using book (Scale 1–5)	40	Pre: 2.45 ± 1.01 Post: 4.30 ± 1.09	0–5 1–5	0.047
A1C (%)	46	Pre: 7.25 ± 1.30 Post: 6.49 ± 1.09	5.30–11.00 4.30–9.30	0.000
BMI (kg/m <sup>2</sup> )	62	Pre: 33.28 ± 7.39 Post: 32.40 ± 6.21	19.0–63.5 19.3–47	0.000
Weight (lb)	62	Pre: 209.01 ± 42.47 Post: 206.15 ± 42.51	111–290 109–289	0.000
Waist circumference (inches)	57	Pre: 43.52 ± 5.66 Post: 42.42 ± 5.40	30.50–53.00 31.00–52.00	0.000
Hip circumference (inches)	55	Pre: 46.38 ± 5.03 Post: 45.78 ± 5.04	37.50–59.50 36.00–59.50	0.000
Waist-to-hip ratio	55	Pre: 0.94 ± 0.07 Post: 0.93 ± 0.07	0.79–1.11 0.80–1.07	0.000

diabetic adults is primarily the result of calorie restriction rather than diet composition.<sup>19</sup> These combined results provide evidence that weight control and food portioning skills are key to the prevention and treatment of diabetes.

Comprehensive diabetes education has also been shown to be effective in improving disease outcome.<sup>9–11,19</sup> A 2% drop in A1C results has been observed in patients who received diabetes follow-up education, whether by mail or in the classroom.<sup>8</sup> Personal instruction with follow-up telephone instruction showed similar positive outcomes; 63% achieved successful improvement in A1C (< 7.0% or a decrease of > 1%).<sup>10–20</sup> A variety of education methods ranging from group formats to individual instruction to telephone instruction have been shown to be effective.

An efficient education program should carefully consider the curriculum content. The “Diabetes: Stepping Up to the Plate” curriculum, while focusing on food portioning skills, included a weight loss component because of the critical importance of weight loss to diabetes outcome. Adherence to weight loss programs

has been reported to be low<sup>21</sup> according to a field study that evaluated the long-term glycemic success of education programs. Furthermore, a high BMI was the number one predictor of poor glycemic control.<sup>22</sup> The potential for weight loss becomes a discussion topic when food portioning skills are taught. Including weight loss in the curriculum was a benefit for a majority of the clients.

Our results agree with those of Miller et al.<sup>23</sup> that group education does not offer any significant disadvantages compared to individual education and that it is equally effective regardless of participants’ age. The participants in our study improved significantly in all measurements except the memorization of food portioning exchanges. Data analysis showed that all age-groups improved, with no significant difference in improvement with an ANOVA conducted between age-groups. This corroborates the finding of Miller et al., in which a group of elderly diabetic patients had nearly a 7% decrease in A1C over 6 months when they received intense nutrition education.<sup>23</sup>

The ability to state from memorization the correct portion sizes of a vari-

ety of foods did not significantly improve from pre- to post-program levels. When the participants were allowed to use the tools we provided them in class (*Exchange Lists for Meal Planning* and food labels), there was a significant improvement. This finding was not of concern because the participants may not eat the foods used for the practical skills assessment and thus did not memorize them. When given the tools to look up portion sizes, they could correctly find and report the correct sizes.

In conclusion, the Utah State University Extension Service’s “Diabetes: Stepping Up to the Plate” education series is a cost-effective method for diabetes treatment. The success of the program can be attributed to helping clients set reasonable goals and empowering them with the appropriate knowledge and skills to achieve their goals.<sup>23</sup> Long-term outcomes as measured by A1C and decreased anthropometric indices are promising.

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