

# The Effectiveness of the Expanded Food and Nutrition Education Program (EFNEP) on Diet Quality as Measured by the Healthy Eating Index

**Abstract:** *The objective of the study was to assess the relationship between participation in the Expanded Food and Nutrition Education Program (EFNEP) and food-related behavior change, as measured by the Healthy Eating Index (HEI)-2005, using a single-state, case study approach. Pre-EFNEP and post-EFNEP participation HEI scores as well as demographic, geographic, socioeconomic, and program participation characteristics from fiscal years 2013-2016 were analyzed using summary statistics and Ordinary Least Squares regressions. HEI scores were adjusted for age, sex, race, rural/urban residence, county, highest grade achieved, income, number of children, public assistance programs, and number of hours in EFNEP in the analysis. The total HEI score and several HEI subscores improved from pre-EFNEP to post-EFNEP at the 5% significance level or better. Sodium and total grains scores decreased post-EFNEP:  $P = .003$  and  $P = .05$ , respectively. Participation in Women, Infants, and Children or the Supplemental Nutrition Assistance*



*Program had no effect on HEI scores or changes in scores post-EFNEP. Spending less than 7 hours in the program was associated with a smaller improvement in total HEI score ( $P = .05$ ) and an increased intake of sodium ( $P = .03$ ), compared with*

*spending 7 to 16 hours in the program. Overall, EFNEP participation was associated with improvements in diet quality.*

**Keywords:** Expanded Food and Nutrition Education Program (EFNEP); Healthy Eating Index (HEI); nutritive quality; eating behavior; nutrition education

## Introduction

In 2017, 12.3% (15.6 million) of American households lived in poverty and 11.8% (15 million) of US households were food insecure.<sup>1,2</sup> Maine has the ninth highest rate of food insecurity in

 Poor diet quality can leave individuals and families who are food insecure at a higher risk for physical and mental health issues, such as obesity, diabetes, and depression. 

the nation and the highest rate of food insecurity in New England.<sup>3</sup> Food insecurity has a considerable effect on diet quality; it has been associated with decreased consumption of fruits, vegetables, and whole grains, which the food insecure population may replace with calorie-dense, highly processed foods.<sup>4</sup> Poor diet quality can leave individuals and families who are food

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insecure at a higher risk for physical and mental health issues, such as obesity, diabetes, and depression.<sup>4</sup> Higher rates of obesity have been found among low-income individuals,<sup>5-7</sup> especially low-income women and children.<sup>8,9</sup> Health care costs associated with the treatment of obesity are estimated to range from \$147 to \$210 billion per year.<sup>10,11</sup> Because low-income individuals are more likely to be food insecure,<sup>12</sup> the relationship between food insecurity and health disparities warrants public health action in the form of education and food assistance.<sup>13</sup>

Programs have been implemented in the United States to aid the low-income, food insecure population in acquiring the knowledge, skills, and behaviors necessary to facilitate a healthy diet and to improve the overall well-being of these individuals and families. The Expanded Food and Nutrition Education Program (EFNEP), delivered nationally through the Cooperative Extension System, provides interactive nutrition education to low-income families in a community setting using a paraprofessional (peer educator) model.<sup>14,15</sup> In addition to EFNEP, other federal programs deliver nutrition education to low-income families. The Supplemental Nutrition Assistance Program Education (SNAP-Ed)<sup>16</sup> provides nutrition education to SNAP participants, and the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) offers nutrition education and supplemental foods to eligible participants.<sup>17</sup> Both WIC and SNAP-Ed serve an audience similar to that for EFNEP. Therefore, many EFNEP participants also participate in, and receive education from, these 2 programs. EFNEP, SNAP-Ed, and WIC have all documented success in improving diet quality and nutrient intake in adults.<sup>18-20</sup>

In Maine, EFNEP uses the evidence-based-Eating Smart—Being Active (ESBA) curriculum to deliver nutrition education, meeting the 4 core areas of EFNEP: diet quality and physical activity, food resource management, food safety, and food security.<sup>14,20</sup> The ESBA

curriculum delivered during the evaluation period is based on 8 lessons designed to be taught in 8 to 12 hours. Dosage is important in nutrition education because there needs to be a balance between providing enough time for information and skills to be retained and practiced while making the educational opportunity brief enough to prevent fatigue and dropout of participants.<sup>21</sup> Nationally, EFNEP effectiveness and self-reported dietary change in adults are measured using a standardized behavior questionnaire and a 24-hour diet recall, preprogram and postprogram participation. The diet recall is administered in a group or individual setting and the 5-step multiple pass method is utilized in Maine. The 5-step, multiple pass method elicits information on foods consumed and portion sizes.<sup>22,23</sup> Further probing can capture frequently forgotten foods as well as time and occasion of foods eaten.<sup>24</sup> The 5-step, multiple pass method has been validated in adult populations.<sup>23,25</sup> From the 24-hour recall, a Healthy Eating Index (HEI) score is generated.

The HEI was created in 1995 by the Center for Nutrition Policy and Promotion to monitor the diet quality of the US population. The HEI measures diet quality by assessing adherence to the current *Dietary Guidelines for Americans*.<sup>26,27</sup> In 2016, the nation's average HEI score was 59 out of 100, increasing by nearly 10 points since 1999.<sup>28</sup> Since its inception, the HEI has been updated as dietary recommendations have changed. Updates to the HEI were conducted in collaboration with the National Cancer Institute to reflect the 2005, 2010, and 2015 *Dietary Guidelines for Americans*. The HEI-2005<sup>29</sup> was used to measure diet quality for EFNEP participants included in this study from 2013 to 2016 because the data reporting system for EFNEP only included the 2005 version at that time.

To calculate the HEI, a scoring algorithm is applied to the 24-hour diet recall. A score for each dietary component is identified by calculating the ratio of component intake to component standard. Once each

component is scored individually, the scores are summed to calculate the total HEI score.<sup>30</sup> The HEI-2005 score was found to be a valid measure of diet quality and internally consistent.<sup>31</sup> The HEI has been previously utilized to measure EFNEP outcomes.<sup>18,32</sup>

The relationship between EFNEP participation and diet quality has been measured<sup>18,20,32,33</sup>; however, approaches have varied. Additionally, some studies explored the effect of socioeconomic factors on diet quality of EFNEP participants<sup>32</sup> while others focused on evaluating specific curriculum.<sup>20</sup> Outcome variables also differed from one study to the other, with some assessing total HEI<sup>32</sup> and others focusing on nutrient intake.<sup>33</sup> Finally, the effectiveness of EFNEP curricula delivery in Maine has never been formally analyzed utilizing the HEI. The present study can be used to inform and add to the body of knowledge on utilizing the HEI to assess dietary quality and behavior change in an EFNEP setting.

The aims of this study were to use the HEI to assess the association between participation in EFNEP and dietary behavior change using Maine as a case study. Researchers also explored whether participation in other food assistance programs, such as WIC and SNAP, and hours of direct education had any effect on change in HEI scores of EFNEP graduates. Assessing the relationship between EFNEP participation and education on the change in dietary quality of Maine's low-income population could create a model for other states to follow to better understand the impact of EFNEP delivery.

## Methods

### Study Design

This study was a secondary analysis of deidentified data selected from the Web-Based Nutrition Education Evaluation and Reporting System (WebNEERS) software (version 1.2, Clemson University, SC, 2012), which is the software used for the storage and analysis of EFNEP data. EFNEP participants completed a demographic

questionnaire prior to starting the program, which included age, sex, race, self-reported rural/urban residence, county, highest grade achieved, monthly household income, number of children in the household, and public assistance programs utilized. Participants also completed a 24-hour diet recall pre-EFNEP and post-EFNEP. Paper recalls were sent to the University of Maine Cooperative Extension State Administrative office, where staff entered data into WebNEERS.

The researchers used data on adult (age 18 years and older) Maine EFNEP participants from 2013 to 2016. A total of 1967 adults were enrolled in EFNEP during that time period, with 1064 completing (graduating from) the program. Data were limited to those with complete preprogram and postprogram information. EFNEP participants were excluded if they had missing values that were pertinent to the analysis or if they had an obvious data entry error. The estimating sample included 507 graduates, observed pre-EFNEP and post-EFNEP. The University of Maine Institutional Review Board for the Protection of Human Subjects determined the study to be exempt from continuing review because of the use of secondary deidentified data.

### Variables

The outcome variables for this study were based on the HEI-2005, which was used nationally in WebNEERS to measure diet quality of EFNEP participants until the year 2016. The HEI includes both adequacy (higher quantities yield higher scores) and moderation (lower quantities yield higher scores) components. Adequacy components comprise total fruits, vegetables, total grains, protein foods, dairy, whole grains, oils, whole fruits, and dark green and orange vegetables and legumes. Moderation components consist of saturated fat, sodium, and solid fats and added sugars (SoFAS). Using a 24-hour diet recall, the score for each dietary component was calculated as the ratio of intake compared with the HEI standard. Scores

are then summed to calculate the total HEI score.

Demographic, socioeconomic, and geographic characteristics of participants were considered in assessing HEI scores pre-EFNEP and post-EFNEP. First, age was coded as a continuous variable. Sex was coded as a binary variable for female versus male. Likewise, race was coded as a binary variable for nonwhite versus white. The combination of multiple races into *nonwhite* was necessary because of the small number of participants in each race other than white. Rural/urban residence was coded as a binary variable, and categorical variables were used to represent county of residence. Those counties with a small number of EFNEP participants were combined with an adjacent county. Additionally, highest education level achieved was coded into 3 categories: less than high school (grade 11 or below), high school (grade 12, general education development or some college), and postsecondary (2-year, 4-year, or postgraduate degree). Monthly household income was adjusted for inflation using the Consumer Price Index (2015 dollars). The number of children in the household was coded into 2 categories: 0 to 2 versus 3 or more. Moreover, although the data contained information about various public assistance programs (eg, Child Nutrition, Head Start, Temporary Assistance for Needy Families, The Emergency Food Assistance Program, and others), the focus of the study was on 2 programs that targeted an audience similar to the EFNEP: WIC and SNAP. Each of these scenarios were coded as a binary variable. The number of hours spent in EFNEP were coded into 3 categories: less than 7, 7 to 16, and more than 16. Finally, binary variables were created for each year, from 2013 to 2016, to capture time trends.

### Analysis

All analyses were conducted using STATA software (Special Edition 14.1, StataCorp LLC, College Station, TX, 2015). First, demographic, socioeconomic, and geographic characteristics of participants

were reported via frequencies for binary variables as well as means and SDs for continuous variables (age, income). Then, means of HEI scores pre-EFNEP and post-EFNEP were reported for the total score and for each component. Differences in means of HEI scores pre-EFNEP and post-EFNEP were tested using Ordinary Least Squares regressions. This was done by pooling all observations and adding a binary variable to indicate post-EFNEP. A full set of demographic, socioeconomic, and geographic controls were included in each model (age, sex, race, rural/urban residence, county, highest grade achieved, real monthly household income, number of children, public assistance programs utilized, hours spent in EFNEP, and year of participation). To complement these regressions, the importance of other public assistance programs was considered by estimating a set of models in which were included binary variables for WIC, SNAP, or both, respectively, as well as interactions with the post-EFNEP indicator (in addition to individual characteristics). Additionally, to consider the importance of time spent in the program, we estimated a set of models in which were included binary variables for less than 7 hours and more than 16 hours (vs 7 to 16 hours) as well as interactions with the post-EFNEP indicator (in addition to individual characteristics).

## Results

### Frequencies and Means of Demographic, Socioeconomic, and Geographic Characteristics

As outlined in Table 1, the average age of participants was 32 (SD = 9.7) years, and the mean monthly income of participants was \$1121 (SD = 749; 2015 dollars). Most of the participants were female (n = 433, 85.4%) and white (n = 431, 85%). More than half of the participants resided in rural communities (n = 351, 69.2%). More than three-quarters (77.5%) of participants (n = 393) reported that they had 0 to 2 children in their household, and 22.5% (n = 114)

**Table 1.**

Demographic, Socioeconomic, and Geographic Characteristics of Maine Adult EFNEP Participants (n = 507).

Characteristic		
Age	Mean (SD) in Years	32.0 (9.7)
Monthly household income	Mean (SD) in 2015 dollars	1121.1 (748.8)
Sex	Male	74 (14.6%)
	Female	433 (85.4%)
Race	White	431 (85.0%)
	Nonwhite	76 (15.0%)
Residence	Rural	351 (69.2%)
	Urban	156 (30.8%)
County	Oxford/York	63 (12.4%)
	Penobscot/Hancock	57 (11.2%)
	Somerset/Kennebec	48 (9.5%)
	Androscoggin/Sagadahoc	96 (19.0%)
	Aroostook	146 (28.8%)
	Cumberland	96 (18.9%)
Highest education level achieved	Less than high school	53 (10.5%)
	High school	368 (72.5%)
	Postsecondary	86 (17.0%)
Number of children in household	0 to 2 Children	393 (77.5%)
	3 or More Children	114 (22.5%)
Public assistance programs utilized	SNAP	354 (69.8%)
	WIC	259 (51.0%)
	Both SNAP and WIC	187 (36.9%)
	Head Start	137 (27.0%)
	Child Nutrition	136 (26.8%)
	TANF	96 (18.9%)
	TEFAP	34 (6.7%)
	Other	94 (18.5%)
Number of hours spent in program	<7 Hours	134 (26.4%)
	7-16 Hours	318 (62.7%)
	>16 Hours	55 (10.8%)

Abbreviations: EFNEP, Expanded Food and Nutrition Education Program; SNAP, Supplemental Nutrition Assistance Program; WIC, Women, Infants, and Children; TANF, Temporary Assistance for Needy Families; TEFAP, The Emergency Food Assistance Program.

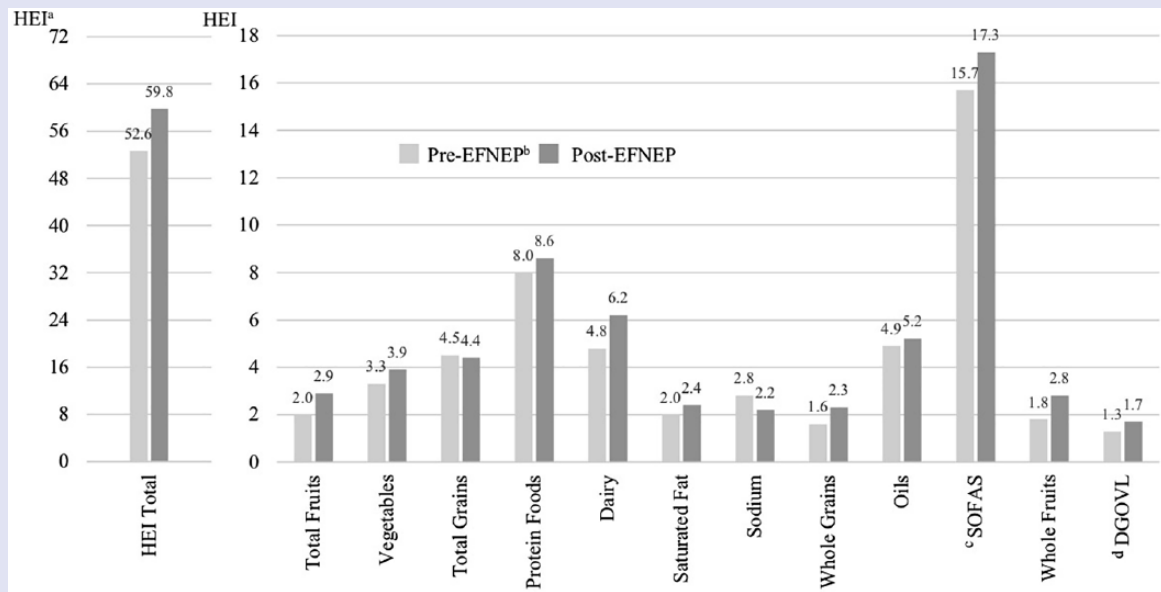
reported that they had 3 or more children. The highest level of education achieved by most participants was high school (n = 368, 72.5%). Of all participants, 69.8% (n = 354) also participated in SNAP at the time of EFNEP participation. Similarly, 51% (n = 259) were also participating in WIC. Moreover, 36.9% (n = 187) of participants were in both SNAP and WIC while enrolled in EFNEP. A majority of participants spent between 7 and 16 hours in the program (n = 318, 62.7%). A total of 134 participants (26.4%) spent less than 7 hours in the program, and 55 participants (10.8%) spent more than 16 hours in the program.

#### HEI Scores Pre-EFNEP and Post-EFNEP

Means of HEI scores pre-EFNEP and post-EFNEP are presented in Figure 1. Differences in HEI scores pre-EFNEP and post-EFNEP were tested using Ordinary Least Squares regressions, controlling for individual characteristics. Estimates are presented in Table 2. As shown in Figure 1, total HEI score pre-EFNEP (out of 100 points) was 52.6 (SD = 13.7) and post-EFNEP was 59.8 (SD = 13.2). When scores were adjusted for individual characteristics (Table 2), the difference from pre-EFNEP to post-EFNEP was 7.18 ( $P < .001$ ). A similar trend emerged for total fruits, with a difference in score from pre-EFNEP to post-EFNEP of 0.94 ( $P < .001$ ). The difference in score for vegetables was 0.62, which was also significant ( $P < .001$ ). All the following HEI components showed significant improvement from pre-EFNEP to post-EFNEP (Table 2): protein foods ( $P = .001$ ), dairy ( $P < .001$ ), saturated fat ( $P = .05$ ), whole grains ( $P < .001$ ), SoFAS ( $P < .001$ ), whole fruits ( $P < .001$ ), and dark green and orange vegetables and legumes ( $P = .001$ ). Contrary to expectations, Figure 1 indicates that the post-EFNEP score for sodium, 2.2 (SD = 2.6) out of a possible 10 points, was lower than the pre-EFNEP score of 2.8 (SD = 2.9). As a moderation component, this indicates higher intake. The difference is statistically significant, controlling for individual characteristics, as shown in Table 2 ( $P = .003$ ). Likewise,

**Figure 1.**

Mean HEI scores and subscores of Maine EFNEP participants.<sup>1</sup>



<sup>1</sup> <sup>a</sup>HEI, Healthy Eating Index; <sup>b</sup>EFNEP, Expanded Food and Nutrition Education Program; <sup>c</sup>SoFAS, solid fats and added sugars; <sup>d</sup>DGOVL, dark green and orange vegetables and legumes. Data range from 2013 to 2016. Differences in means of HEI scores from pre-EFNEP to post-EFNEP are statistically significant at the 1% level except total grains and saturated fat (significant at the 5% level) and oils (not significant).

the post-EFNEP score for total grains, 4.4 (SD = 1.2) out of a possible 5 points, was lower than the pre-EFNEP score of 4.5 (SD = 1.0). Although small, this difference was statistically significant when the full set of covariates was added to the model ( $P = .05$ ; Table 2). Finally, the only subscore that failed to change was that of oils, with a post-EFNEP score of 5.2 (SD = 3.8) out of 10 versus 4.9 (SD = 4.0) pre-EFNEP. This difference was not statistically significant ( $P = .38$ ; Table 2).

**The Effect of WIC, SNAP, or Both on HEI Scores and Changes in Scores**

As outlined in Table 3, we estimated models in which we included binary variables for WIC, SNAP, or both, respectively, as well as interactions with the post-EFNEP indicator (in addition to individual characteristics). There were no significant differences in the total HEI score or subscores between people who participated in WIC, SNAP, or both and those who did not. Moreover, there were

no significant differences in changes in total HEI score or subscores as a result of participating in EFNEP for people who were also in SNAP, WIC, or both. In other terms, being in these programs did not give any added benefit to participants in terms of the level or change in total HEI score or subscores.

**The Effect of Hours in EFNEP on HEI Scores and Changes in Scores**

Table 4 presents a different set of models in which were included binary variables for the number of hours spent in EFNEP (less than 7 or more than 16 versus 7 to 16), as well as interactions with the post-EFNEP indicator, in addition to individual characteristics. There were no significant differences in total HEI score or subscores between people who spent less than 7 hours or more than 16 hours in the program compared with those who spent 7 to 16 hours.

However, participants who spent less than 7 hours in the program had a

smaller improvement in total HEI score from pre-EFNEP to post-EFNEP compared with those who were in the program for 7 to 16 hours (4.65 vs 8.44;  $P = .05$ ). Additionally, participants who spent less than 7 hours in the program had a small increase in total grains from pre-EFNEP to post-EFNEP compared with a small reduction among those who spent 7 to 16 hours in the program ( $P = .02$ ). Similarly, participants who spent less than 7 hours in the program did not experience a significant change in their dark green and orange vegetables and legumes score, compared with an increase among those who spent 7 to 16 hours in the program ( $P = .04$ ). Finally, those who spent less than 7 hours in the program had a statistically significant reduction in their sodium score (which indicates higher quantities) compared with those who spent 7 to 16 hours in the program ( $P = .03$ ). Changes in scores of participants who spent more than 16 hours in EFNEP were not significantly different from those who spent 7 to 16 hours in the program.

**Table 2.**

Differences in HEI Scores of Maine Adult EFNEP Participants From Pre-EFNEP to Post-EFNEP, Adjusted for Individual Characteristics<sup>a</sup> (n = 507 Pre-EFNEP and Post-EFNEP).

Outcome	Coefficient on Post-EFNEP <sup>b</sup>	P Value	R <sup>2</sup>
Total HEI	7.18	<.001	0.13
Total fruits	0.94	<.001	0.10
Vegetables	0.62	<.001	0.08
Total grains	-0.14	.05	0.03
Protein foods	0.54	.001	0.04
Dairy	1.37	<.001	0.15
Saturated fat	0.44	.05	0.05
Sodium	-0.50	.003	0.04
Whole grains	0.72	<.001	0.10
Oils	0.21	.38	0.03
SoFAS	1.58	<.001	0.09
Whole fruits	1.02	<.001	0.10
Dark green and orange vegetables and legumes	0.37	.001	0.06

Abbreviations: HEI, Healthy Eating Index; EFNEP, Expanded Food and Nutrition Education Program; SoFAS, solid fats and added sugars.

<sup>a</sup>Adjusted for age, sex, race, rural/urban residence, county, highest grade achieved, real monthly household income, number of children, public assistance programs utilized, hours spent in EFNEP, and year of participation.

<sup>b</sup>Ordinary Least Squares regression.

## Discussion

Pre-EFNEP, the average HEI score in Maine was 52.6 out of a possible 100 points, which is below the national average of 59.<sup>28</sup> However, post-EFNEP, the average HEI score increased to 59.8, which is similar to the national average. This improvement in total HEI score was found to be statistically significant ( $P < .001$ ) when adjusting for individual characteristics. Several crucial HEI subscores (such as total fruits, vegetables, and whole grains) increased significantly ( $P < .001$ ). These 3 HEI subgroups are part of the 4 core educational areas of EFNEP, and an increased intake of these food groups is consistent with improved

health outcomes.<sup>14,34</sup> Because almost all HEI subgroups exhibited a positive correlation with EFNEP participation in Maine, there is modest evidence that EFNEP is reaching one of its major goals of improving diet quality of participants.

The dietary behavior change exhibited by Maine EFNEP participants is comparable to that of similar studies.<sup>18,33</sup> Guenther and Luick<sup>18</sup> utilized the HEI-2005 to assess the effectiveness of EFNEP education in the Mountain Region of the United States. The authors found that the average HEI score pre-EFNEP was 49.1 and improved to 55.2 post-EFNEP ( $P < .001$ ). Additionally, average intake of total fruits, whole fruits, vegetables, and dark green and orange

vegetables and legumes increased significantly ( $P < .001$ ) from pre-EFNEP to post-EFNEP, whereas intake of saturated fat and SoFAS decreased significantly ( $P < .001$ ).<sup>18</sup> The increase in total HEI score and several crucial subscores mirror the results of the current study, demonstrating the positive relationship between EFNEP participation and diet quality.

Another important finding from the current study was that there were no statistically significant differences in total HEI score or subscores between people who participated in WIC, SNAP, or both programs compared with those who did not. Additionally, people who participated in WIC, SNAP, or both did not experience an increase in HEI scores from pre-EFNEP to post-EFNEP. This suggests that although WIC and SNAP provide access to supplemental food and nutrition education (through SNAP-Ed for SNAP participants), participation in these programs does not equate to improvements in diet quality in Maine EFNEP participants. Additional research is needed to confirm these findings nationally.

A key finding in this study was the relationship between time spent in the program and HEI score. Spending less than 7 hours in the Maine EFNEP program was not as effective at encouraging positive dietary behavior change as spending 7 to 16 hours in the program. Although a higher dosage of nutrition education is thought to produce a more positive dietary behavior change,<sup>21</sup> based on these results, there appears to be a “threshold” of education hours necessary to elicit this positive change. This could be used to inform state and national EFNEP leaders about standardizing educational delivery models.

Although education through Maine EFNEP was positively associated with improvements in the intake of many food groups, some food groups and subgroups, such as oils, were not affected by program participation. In Maine, EFNEP education about oils during the time of the study was focused on the intake of healthy, unsaturated fats. An ideal outcome of EFNEP participation

**Table 3.** Effect of Participation in WIC, SNAP, or Both on HEI Scores and Changes in Scores of Maine Adult EFNEP Participants, Adjusted for Individual Characteristics<sup>a</sup> (n = 507 Pre-EFNEP and Post-EFNEP).

Outcome	Coefficient <sup>b</sup> on Post-EFNEP (P Value)	Coefficient on WIC (P Value)	Coefficient on SNAP (P Value)	Coefficient on Both WIC and SNAP (P Value)	Coefficient on Post-EFNEP × WIC (P Value)	Coefficient on Post-EFNEP × SNAP (P Value)	Coefficient on Post-EFNEP × Both WIC and SNAP (P Value)	R <sup>2</sup>
Total HEI	9.03 (<.001)	-0.40 (.86)	1.64 (.39)	-0.40 (.88)	-2.03 (.47)	-2.09 (.38)	1.74 (.61)	0.13
Fruits	1.06 (.002)	0.54 (.15)	0.12 (.68)	-0.38 (.38)	-0.72 (.10)	0.02 (.96)	0.62 (.25)	0.10
Vegetables	0.68 (.007)	0.15 (.62)	0.17 (.51)	-0.07 (.84)	-0.30 (.46)	-0.00 (.99)	0.28 (.56)	0.09
Total grains	-0.29 (.14)	-0.15 (.35)	-0.07 (.62)	0.00 (.99)	0.13 (.62)	0.07 (.76)	0.08 (.80)	0.03
Protein foods	0.83 (.02)	0.11 (.83)	0.20 (.63)	-0.18 (.75)	-0.53 (.37)	-0.28 (.56)	0.48 (.51)	0.04
Dairy	1.91 (<.001)	0.56 (.36)	0.85 (.09)	-0.97 (.18)	-1.08 (.15)	-0.76 (.23)	1.49 (.10)	0.15
Saturated fat	1.23 (.02)	-0.19 (.71)	0.67 (.16)	0.11 (.87)	0.28 (.73)	-1.07 (.11)	-0.50 (.60)	0.06
Sodium	-0.14 (.76)	0.21 (.66)	-0.09 (.81)	0.32 (.57)	-0.30 (.62)	-0.17 (.77)	-0.24 (.74)	0.04
Whole grains	0.79 (.01)	-0.26 (.42)	-0.17 (.54)	0.38 (.33)	0.14 (.76)	-0.23 (.53)	0.07 (.89)	0.10
Oils	0.22 (.70)	-0.61 (.37)	0.15 (.79)	0.11 (.89)	0.27 (.74)	0.02 (.98)	-0.43 (.67)	0.03
SoFAS	1.21 (.05)	-0.91 (.28)	-0.09 (.89)	0.49 (.60)	0.82 (.37)	0.41 (.60)	-0.89 (.43)	0.10
Whole fruits	1.03 (.004)	0.57 (.89)	-0.20 (.53)	-0.12 (.79)	0.44 (.40)	0.11 (.80)	0.39 (.53)	0.11
Dark green and orange vegetables and legumes	0.49 (.08)	0.10 (.76)	0.10 (.70)	-0.08 (.83)	-0.28 (.52)	-0.18 (.60)	0.40 (.43)	0.06

Abbreviations: WIC, Women, Infant, and Children; SNAP, Supplemental Nutrition Assistance Program; HEI, Healthy Eating Index; EFNEP, Expanded Food and Nutrition Education Program; SoFAS, solid fats and added sugars.

<sup>a</sup>Adjusted for age, sex, race, rural/urban residence, county, highest grade achieved, real monthly household income, number of children, public assistance programs utilized, hours spent in EFNEP, and year of participation.

<sup>b</sup>Ordinary Least Squares regression.

**Table 4.** Effect of Hours Spent in EFNEP on HEI Scores and Changes in Scores of Maine Adult EFNEP Participants, Adjusted for Individual Characteristics<sup>a</sup> (n = 507 Pre-EFNEP and Post-EFNEP).

Outcome	Coefficient <sup>b</sup> on Post-EFNEP (P Value)	Coefficient on <7 Hours (P Value)	Coefficient on >16 Hours (P Value)	Coefficient on Post-EFNEP <7 Hours (P Value)	Coefficient on Post-EFNEP >16 Hours (P Value)	R <sup>2</sup>
Total HEI	8.44 (<.001)	1.01 (.55)	0.01 (.10)	-3.79 (.05)	-2.35 (.34)	0.14
Total fruits	1.14 (<.001)	0.32 (.28)	0.02 (.96)	-0.52 (.07)	-0.61 (.12)	0.10
Vegetables	0.59 (<.001)	-0.23 (.29)	-0.55 (.06)	0.05 (.84)	0.14 (.70)	0.09
Total grains	-0.25 (.006)	-0.14 (.24)	-0.05 (.81)	0.38 (.02)	0.10 (.71)	0.04
Protein foods	0.65 (.001)	-0.41 (.31)	0.06 (.91)	-0.45 (.30)	0.13 (.82)	0.04
Dairy	1.46 (<.001)	0.49 (.34)	-0.41 (.52)	-0.44 (.35)	0.21 (.76)	0.15
Saturated fat	0.77 (.006)	0.37 (.42)	0.50 (.34)	-0.91 (.09)	-0.79 (.24)	0.06
Sodium	-0.19 (.38)	0.51 (.18)	0.70 (.15)	-0.82 (.03)	-0.88 (.11)	0.04
Whole grains	0.79 (<.001)	-0.16 (.52)	-0.16 (.59)	-0.26 (.35)	0.10 (.80)	0.10
Oils	0.16 (.61)	-0.33 (.51)	0.77 (.23)	0.41 (.45)	-0.52 (.50)	0.03
SoFAS	1.72 (<.001)	0.38 (.52)	-0.60 (.45)	-0.63 (.30)	0.26 (.79)	0.10
Whole Fruits	1.07 (<.001)	-0.01 (.97)	-0.03 (.94)	-0.07 (.82)	-0.22 (.61)	0.11
Dark green and orange vegetables and legumes	0.55 (<.001)	0.22 (.37)	-0.25 (.42)	-0.56 (.04)	-0.25 (.49)	0.06

Abbreviations: EFNEP, Expanded Food and Nutrition Education Program; HEI, Healthy Eating Index; SoFAS, solid fats and added sugars.

<sup>a</sup>Adjusted for age, sex, race, rural/urban residence, county, highest grade achieved, real monthly household income, number of children, public assistance programs utilized, hours spent in EFNEP, and year of participation.

<sup>b</sup>Ordinary Least Squares regression.



would have been an increase in the oils score. In this study, there was also a significant decline in the sodium score, which means that participants consumed more sodium after completing the EFNEP program. Similarly, participants had a decline in total grains from pre-EFNEP to post-EFNEP; however, this may have been mitigated by a significant increase in their whole grains subscore. We surmise that participants substituted whole grains for total grains, which would be a positive outcome of the program.

Interpretation of the HEI results leads us to believe that educational lessons on fruits, vegetables, protein foods, and whole grains are likely being covered in more depth than other lessons. It appears that Maine EFNEP provides added skills that apply to changes in these food groups. This is evidenced by the statistically significant positive HEI score changes for these food groups from pre-EFNEP to post-EFNEP. Conversely, the program did not have a significant positive effect on the intake of healthy unsaturated oils or sodium, which may indicate that lessons on healthy unsaturated oils and sodium are not being covered in enough depth to elicit behavior changes. Nationally, EFNEP coordinators can use this information to make changes in paraprofessional training and emphasis in curriculum delivery to improve the effectiveness of EFNEP nationwide.

### Limitations

There were some limitations to this study, such as an underrepresentation of African American and Asian American participants. Additionally, only participants who graduated from EFNEP were included; consequently, outcomes of participants who received some EFNEP education were not measured. Furthermore, because our study was not randomized, self-selection bias could be an issue, where those who elected to participate in EFNEP may have had greater positive changes in dietary behavior because they were motivated to finish the program. These factors may lead to overstating the relationship

between EFNEP participation and positive changes in diet quality. Moreover, the effect of class type (individual or group) was not considered. It is possible that participants who received one-on-one education from paraprofessionals had outcomes different from those who received education in a group setting. Group or individual education may also have had an impact on diet recall collection, even though the 5-step multiple pass method was used to collect dietary data in this study. Finally, whereas there was a positive correlation between EFNEP participation and improvement in diet quality, the present study design does not allow claims of causality. Future research, including a control group, would strengthen the results with regard to EFNEP's effectiveness in improving HEI and would also control for natural changes in dietary behavior.

### Implications for Research and Practice

The results of this study demonstrate a positive association between EFNEP completion and an improvement in diet quality of program graduates. Through continued and expanded long-term evaluation of EFNEP, greater recognition of the positive relationship between EFNEP participation and diet quality will be more widely disseminated, and program recognition will be expanded through national health promotion efforts.

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Not applicable, because this article does not contain any studies with human or animal subjects.

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Not applicable, because this article does not contain any clinical trials.

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### References

1. Fontenot K, Semega J, Kollar M. *US Census Bureau, Current Population Reports, P60-263: Income and Poverty in the United States: 2017*. Washington, DC: US Government Printing Office; 2018.
2. Coleman-Jensen A, Rabbitt MP, Gregory CA, Singh A. *Household Food Security in the United States in 2017*. Washington, DC: US Department of Agriculture, Economic Research Service; 2018. Economic Research Report No. 256.
3. US Department of Agriculture, Economic Research Service. Key statistics and graphics: food security status of US households in 2017. <https://www.ers.usda.gov/topics/food-nutrition-assistance/food-security-in-the-us/key-statistics-graphics.aspx#foodsecure>. Accessed March 5, 2019.
4. Holben DH; American Dietetic Association. Position of the American Dietetic Association: food insecurity in the United States. *J Am Diet Assoc*. 2010;110:1368-1377.
5. The State of Obesity. Socioeconomics and obesity. <http://stateofobesity.org/socioeconomics-obesity/>. Accessed March 5, 2019.
6. Zhang Q, Wang Y. Socioeconomic inequality of obesity in the United States: do gender, age, and ethnicity matter? *Soc Sci Med*. 2004;58:1171-1180.

7. Stunkard AJ. Socioeconomic status and obesity. *Ciba Found Symp.* 1996;201:174-193.
8. Datar A, Chung PJ. Changes in socioeconomic, racial/ethnic, and sex disparities in childhood obesity at school entry in the United States. *JAMA Pediatr.* 2015;169:696-697. doi:10.1001/jamapediatrics.2015.0172
9. Frederick CB, Snellman K, Putnam RD. Increasing socioeconomic disparities in adolescent obesity. *Proc Natl Acad Sci U S A.* 2014;111:1338-1342. doi:10.1073/pnas.1321355110
10. Cawley J, Meyerhoefer C. The medical care costs of obesity: an instrumental variables approach. *J Health Econ.* 2012;31:219-230. doi:10.1016/j.jhealeco.2011.10.003
11. Finkelstein EA, Trogon JG, Cohen JW, Dietz W. Annual medical spending attributable to obesity: payer-and service-specific estimates. *Health Aff (Millwood).* 2009;28:w822-w831.
12. Food Research & Action Center. Hunger & Health: the impact of poverty, food insecurity, and poor nutrition on health and well-being. <http://frac.org/wp-content/uploads/hunger-health-impact-poverty-food-insecurity-health-well-being.pdf>. Accessed March 31, 2019.
13. Crouch EL, Dickes LA. Evaluating a nutrition education program in an era of food insecurity. *J Hunger Environ Nutr.* 2017;12:101-111. doi:10.1080/19320248.2016.1227748
14. US Department of Agriculture; National Institute of Food and Agriculture. *The Expanded Food and Nutrition Education Program Policies.* Washington, DC: US Department of Agriculture; 2017. <https://nifa.usda.gov/sites/default/files/program/EFNEP-Policy-December-2017-Update.pdf>. Accessed May 28, 2019.
15. Dickin KL, Dollahite JS, Habicht J. Nutrition behavior change among EFNEP participants is higher at sites that are well managed and whose front-line nutrition educators value the program. *J Nutr.* 2005;135:2199-2205.
16. United States Department of Agriculture, Food and Nutrition Services. Supplemental Nutrition Assistance Program Education (SNAP-Ed) factsheet. [https://snaped.fns.usda.gov/snap/SNAP-Ed%20Factsheet%20\\_August%202016.pdf](https://snaped.fns.usda.gov/snap/SNAP-Ed%20Factsheet%20_August%202016.pdf). Accessed November 29, 2017.
17. US Department of Agriculture, Food and Nutrition Services. Special Supplemental Nutrition Program for Women, Infants and Children (WIC). <https://www.fns.usda.gov/wic/about-wic>. Accessed December 20, 2017.
18. Guenther PM, Luick BR. Improved overall quality of diets reported by Expanded Food and Nutrition Education Program participants in the Mountain Region. *J Nutr Educ Behav.* 2015;47:421-426.e1. doi:10.1016/j.jneb.2015.05.001
19. Molitor F, Sugeran SB, Sciortino S. Fruit and vegetable, fat, and sugar-sweetened beverage intake among low-income mothers living in neighborhoods with Supplemental Nutrition Assistance Program—Education. *J Nutr Educ Behav.* 2016;48:683-690.e1. doi:10.1016/j.jneb.2016.07.002
20. Auld G, Baker S, Conway L, Dollahite J, Lambea MC, McGirr K. Outcome effectiveness of the widely adopted EFNEP curriculum Eating Smart-Being Active. *J Nutr Educ Behav.* 2015;47:19-27. doi:10.1016/j.jneb.2014.07.001
21. Olander C. Nutrition education and the role of dosage. [https://fns-prod.azureedge.net/sites/default/files/LitReview\\_Dosage.pdf](https://fns-prod.azureedge.net/sites/default/files/LitReview_Dosage.pdf). Accessed March 1, 2019.
22. Raper N, Perloff B, Ingwersen L, Steinfeldt L, Ananad J. An overview of USDA's dietary intake data system. *J Food Comp Anal.* 2004;17:545-555.
23. Conway JM, Ingwersen LA, Moshfegh AJ. Accuracy of dietary recall using the USDA five-step multiple-pass method in men: an observational validation study. *J Am Diet Assoc.* 2004;104:595-603.
24. Gills SM, Baker SS, Auld G. Collection methods for the 24-hour dietary recall as used in the Expanded Food and Nutrition Education Program. *J Nutr Educ Behav.* 2017;49:250-256.e1. doi:10.1016/j.jneb.2016.10.009
25. Conway JM, Ingwersen LA, Vinyard BT, Moshfegh AJ. Effectiveness of the US Department of Agriculture 5-step multi-pass method in assessing food intake in obese and nonobese women. *Am J Clin Nutr.* 2003;77:1171-1178.
26. Kennedy ET, Ohls J, Carlson S, Fleming K. The Healthy Eating Index: design and applications. *J Am Diet Assoc.* 1995;95:1103-1108.
27. Bowman SA, Lino M, Gerrior SA, Basiotis PP. *The Healthy Eating Index: 1994-96.* Washington, DC: US Department of Agriculture, Center for Nutrition Policy and Promotion; 1995.
28. Wilson MM, Reedy J, Krebs-Smith SM. American Diet Quality: where it is, where it is heading, and what it could be. *J Acad Nutr Diet.* 2016;116:302-310.e1. doi:10.1016/j.jand.2015.09.020
29. Guenther PM, Reedy J, Krebs-Smith SM. Development of the Healthy Eating Index—2005. *J Am Diet Assoc.* 2007;108:1896-1901.
30. National Cancer Institute. Overview & background of the Healthy Eating Index. <https://epi.grants.cancer.gov/hei>. Accessed January 17, 2018.
31. Guenther PM, Reedy J, Krebs-Smith SM, Reeve B. Evaluation of the Healthy Eating Index—2005. *J Am Diet Assoc.* 2007;108:1854-1864.
32. Weatherspoon DD, Miller SR, Steele ME, et al. What social, program, and behavioral factors influence the Healthy Eating Index for EFNEP and SNAP-Ed participants? *Am J Lifestyle Med.* 2015;11:344-353. doi:10.1177/1559827615607194
33. Arnold CG, Sobal J. Food practices and nutrition knowledge after graduation from the Expanded Food and Nutrition Education Program (EFNEP). *J Nutr Educ Behav.* 2000;32:130-138. doi:10.1016/S0022-3182(00)70540-1
34. US Department of Agriculture; US Department of Health and Human Services. *Dietary Guidelines for Americans.* 7th ed. Washington, DC: Government Printing Office; 2015.