




Impact of Enhanced Food Pantry Services on Food Security among Adults with Diabetes Using a Crossover Study Design

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ABSTRACT

Food banks and pantries provide food to millions of food-insecure households each year. However, there has been limited research to understand the extent to which they improve food security. This is a secondary, prespecified analysis of a randomized controlled trial (ClinicalTrials.gov ID: NCT02569060). We examined whether an enhanced food bank intervention impacted the food security status of adults with diabetes. Using a crossover design, participants ($n = 568$) were randomly assigned to receive the intervention (usual pantry services plus twice-monthly diabetes-specific food boxes, diabetes self-management education, health care referrals, and glucose monitoring) or 6 mo of usual services. Results demonstrate a statistically significant improvement in food insecurity among participants following the intervention phase compared with the control phase (mean: 0.49-point decrease; 95% CI: 0.21, 0.77; $P = 0.0006$). This finding adds to evidence that the charitable food system plays an important role in mitigating short-term food insecurity for adults with diabetes. *Curr Dev Nutr* 2022;6:nzac021.

Keywords: charitable food system, food security, food pantry intervention, diabetes management, low-income populations

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Introduction

For more than 40 y, the United States' charitable food system has provided food-insecure households with food from food banks and pantries. Feeding America, the nation's largest hunger relief organization, serves an estimated 40 million people annually through its network of 200 food banks and over 60,000 pantries and meal programs (1).

In 2020, 10.5% of American households experienced food insecurity (2). Among individuals with diabetes, food insecurity is associated with poorer disease-appropriate dietary intake and worse glycemic control (3, 4).

Interventions and policies that support food security could improve capacity for diabetes self-management, prevent complications, and reduce diabetes-related health disparities. However, it is still unclear the extent to which charitable food services improve food security because of limited opportunities for rigorous research designs and heterogeneity in the types of services offered. Between 2015 and 2018, we conducted a randomized controlled trial of enhanced food pantry services among adults with diabetes.

Methods

This is a secondary, prespecified analysis of a randomized, controlled comprehensive diabetes-support intervention. The trial enrolled people with diabetes attending food pantries in Detroit, Michigan ($n = 8$ pantries); Houston, Texas ($n = 7$ pantries); and Oakland, California ($n = 12$ pantries) for a total of 27 food pantries affiliated with 3 food banks. Full details of the study design, recruitment, eligibility, intervention, and primary results have been reported elsewhere (5). We screened 5329 adults for diabetes and individually randomly assigned 568 participants with glycated hemoglobin (HbA1c) results of 7.5% or greater to an immediate 6-mo intervention or to receive the intervention after a 6-mo delay using a crossover design. The enhanced pantry services intervention included diabetes-specific food boxes distributed twice per month, diabetes self-management education (DSME), health care referrals, and glucose monitoring. This differed from usual pantry services where participants were provided with regularly available pantry foods and no additional diabetes-related support.

The study included 2 phases, each 6 mo in duration. Surveys were administered at enrollment (baseline) and at 6 and 12 mo after

enrollment. In phase 1, participants randomly assigned to the “intervention group” immediately received the intervention in addition to ongoing access to usual pantry services. The remaining participants (those randomly assigned to the “waitlist control group”) only received access to usual pantry services. In phase 2, which immediately followed phase 1, the original intervention group ceased having access to the intervention but maintained access to usual pantry services. At this point, the original waitlist control group began receiving the 6-mo intervention along with usual pantry services. The intervention in phase 2 differed from the original intervention only in that it included lighter-touch DSME. Participants in the original intervention group received access to DSME group classes, 1:1 education, and passive nutrition education materials, while in the second phase of the intervention, we eliminated DSME classes, due to the low rate of uptake in the first phase. As in the first phase, control subjects received access to 1:1 education and passive education materials. There was no washout period. Our primary study results, published previously, demonstrated that, at the end of phase 1 (6 mo after study enrollment), participants in the intervention group had significant reductions in food insecurity compared with the control group (5).

Although the primary analysis compared the intervention with the control at 6 mo, the fact that participants were crossed over to the alternative group after 6 mo allowed us to use subjects as their own controls for the subgroup that had data available for both trial phases. In this analysis, we examined changes in food security as participants gained and lost access to the intervention.

Our primary outcome in this analysis was food insecurity at baseline, 6 mo, and 12 mo using the USDA’s 10-item Adult Food Security Survey Module (FSSM) (6), chosen over the 18-item measure to reduce respondent burden. Food security was defined as both a dichotomous and a continuous measure. The continuous measure used a custom-fitted 12-point Rasch score for each participant (6, 7). This continuous scoring improves power to detect differences between groups compared with a dichotomous measure of “food insecure” versus “food secure.” Higher scores indicate more severe food insecurity.

Because our intention was to perform an analysis that took advantage of available crossover data, only participants who completed both phases were included. Carryover effects were felt to be unlikely. While diabetes-specific foods were added as part of the intervention, we did not restrict access to the participants’ regular food choices.

Although we did not anticipate a period effect due to the short study time frame, we checked this assumption by comparing the effect of the treatment (treatment differences) in the 2 periods. A significant test result would indicate the need for adjustment in the analysis. For continuous outcomes, the intervention and control groups were compared using a paired *t* test. The McNemar test was used to determine the marginal frequencies of the 2 binary outcomes.

Statistical analyses were performed using Stata software, version 16.1 (StataCorp). This study was approved by the Western Institutional Review Board (1,157,298) and the University of California San Francisco Institutional Review Board (15–16,858).

Results

In phase 1 of the study, 568 subjects were randomly assigned to the intervention group ($n = 285$) or waitlist control group ($n = 283$); 534 com-

pleted a baseline survey. Our analytic sample included the 284 participants who completed both phases of the study and were thus eligible for inclusion in the crossover analysis. During phase 1, 128 participants received the intervention; during phase 2 (after crossover), 156 participants received the intervention. Participants were racially/ethnically diverse (49% Latino/Hispanic, 35% African American) and predominantly female (70%), with a mean (SD) age of 55.9 (10.3) y (range: 29–86 y; see [Table 1](#)). Mean BMI (in kg/m²) was 36, indicating class 2 obesity. Participants from Detroit were predominantly African American (50%), while participants from Houston and Oakland were predominantly Latino/Hispanic (59% and 75%, respectively). Site was associated with completion of both phases of the study. While 45% of participants came from Houston, these were the least likely to complete the study (32.6% completion rate). In both phases, participants from Oakland were fewer in number, representing 22% of the sample, but were more likely to complete the study (83%). Older participants were more likely to complete both phases than younger participants [mean (SD) age: 55.9 (10.3) vs. 53.2 (12.0) y; $P = 0.007$]. There were no differences in study completion by race. Although there were differences in completion rates between the 2 groups (45% of the control first group completed both phases vs. 55% of the intervention first group completed both phases), attrition appeared to be nondifferential, as both groups remained reasonably well balanced.

At baseline of phase 1, 80% of study participants were food insecure. Among those who were food insecure, the mean (SD) food insecurity score was 7.6 (2.2). There were no significant differences in food insecurity scores at baseline between the 2 study groups ($P = 0.86$).

In this crossover trial, the 284 participants who completed both phases served as their own controls. No period effect was observed ($P = 0.94$); therefore, data from both periods were used for the analysis. Food insecurity scores were significantly lower after the period during which participants received the intervention than after the period when participants were assigned to the control condition, indicating less severe food insecurity (see [Table 2](#)). There was a statistically significant mean 0.49-point reduction (on a 12-point scale; 95% CI: 0.21, 0.77; $P < .001$) in food insecurity scores under intervention conditions compared with control conditions.

When the intervention and control were compared using a dichotomous food insecurity score, a significant difference was no longer observed ($P = 0.12$). This is likely due to insufficient power, as crossover studies require a very large sample size to examine dichotomous outcomes.

Discussion

In this analysis of food insecurity in a crossover study of adults with diabetes, we identified significant improvements in food security when individuals received the pantry intervention and reductions in food security when the intervention was removed. This pattern, observed in both groups, suggests that the food intervention was causally related to improvements in food security, and indicates that the charitable food system has the potential to have an immediate and observable impact on household food security.

A small number of previous studies have examined the impact of charitable food services on food insecurity. However, all have been observational studies without comparison groups. In a study of 63

TABLE 1 Baseline characteristics¹

Characteristics	Both groups (n = 284)	Control first (n = 156)	Intervention first (n = 128)
Site, n (%)			
Site 1	79 (27.8)	43 (27.6)	36 (28.1)
Site 2	105 (37.0)	59 (37.8)	46 (35.9)
Site 3	100 (35.2)	54 (34.6)	46 (35.9)
Age, n (%)			
18–40 y	23 (8.1)	13 (8.3)	10 (7.8)
41–60 y	163 (57.4)	92 (59.0)	71 (55.5)
≥61 y	98 (34.5)	51 (32.7)	47 (36.7)
Female, n (%)	198 (69.7)	111 (71.2)	87 (68.0)
Race/ethnicity, n (%)			
Latino/Hispanic	140 (49.3)	74 (47.4)	66 (51.6)
Black or African American	98 (34.5)	55 (35.3)	43 (33.6)
White	36 (12.7)	21 (13.5)	15 (11.7)
Native American/Asian/Other	8 (2.8)	5 (3.2)	3 (2.3)
Education, n (%)			
Less than high school or GED	129 (45.4)	67 (42.9)	62 (48.4)
High school or GED	134 (47.2)	79 (50.6)	55 (43.0)
More than high school or GED	19 (6.7)	9 (5.8)	10 (7.8)
Employment, n (%)			
Full-time (≥35 h/wk)	36 (12.7)	22 (14.1)	14 (10.9)
Part-time (<35 h/wk)	33 (11.6)	17 (10.9)	16 (12.5)
Homemaker	48 (16.9)	27 (17.3)	21 (16.4)
Unemployed	59 (20.8)	33 (21.2)	26 (20.3)
Disabled	57 (20.1)	34 (21.8)	23 (18.0)
Retired	46 (16.2)	20 (12.8)	26 (20.3)
Other	5 (1.8)	3 (1.9)	2 (1.6)
Household total, median (IQR), n	3 (2, 5)	3 (2, 5)	3 (2, 5)
Household members <18 y, n	0 (0, 2)	0 (0, 2)	0 (0, 2)
BMI, kg/m ²			
Mean ± SD	36 ± 9.7	36 ± 10.1	35 ± 9.2
Median (range)	34 (19, 78)	34 (19, 70)	34 (19, 78)
Baseline food security score			
Mean ± SD	7.1 ± 2.7	7.2 ± 2.8	7.0 ± 2.7
Median (range)	7.1 (2.9, 13.5)	7.1 (2.9, 13.5)	7.1 (2.9, 12.4)
Baseline HbA1c, %			
Mean ± SD	9.5 ± 1.6	9.6 ± 1.6	9.5 ± 1.7
Median (range)	9.2 (7.5, 13)	9.3 (7.5, 13)	9.0 (7.5, 13)

¹GED, General Educational Development; HbA1c, glycated hemoglobin.

participants, the prevalence of food insecurity declined by 15% among food pantry users who received a 6-wk intervention of cooking classes, nutrition education, and food (8). Another food bank intervention provided diabetes-appropriate food packages, text-based health education, and referrals to health care among a cohort of patients with prediabetes. This pre/post study also showed significant improvements in food insecurity from baseline to follow-up, and maintenance of improvements postintervention (9).

Many low-income families remain food insecure despite the receipt of food from a food pantry. This may be due to inadequate

benefit levels or the fact that the receipt of additional food benefits allows low-income households to shift their budget to address other basic needs but is not enough to change their food security status. There likely exists a continuum of impact with increasing levels of charitable food. A small amount of food is unlikely to impact food security, a moderate amount may impact food insecurity, and a large amount may impact both food insecurity and have additional positive spillover effects on health and well-being. More research is needed to determine whether this dose-related hypothesis is true.

TABLE 2 Food insecurity scores in phase 1 and phase 2¹

Treatment sequence	Treatment phase		Within-individual difference: control – intervention
	1	2	
Intervention, then control (n = 128)	6.6 ± 2.7	7.1 ± 2.7	0.48 ± 2.38
Control, then intervention (n = 156)	7.2 ± 2.8	6.6 ± 2.8	0.50 ± 2.41
Treatment effect (n = 284)	—	—	0.49 ± 2.39 (95% CI 0.21, 0.77)
t Test for paired samples	—	—	P = 0.0006

¹Values are means ± SD unless otherwise indicated. Higher scores indicate more severe levels of food insecurity.

This study has several limitations. First, the intervention was implemented among adults with diabetes, and its impact may not be generalizable to other populations. Second, this subgroup analysis was only completed among those subjects who had participated in both phases of the trial. As such, our results may be biased by incomplete follow-up, because 50% of the initially randomly assigned subjects were not included in this analysis. Follow-up rates differed by enrollment site. This may be due to differences in implementation, as is typical for community-based trials. For example, some sites focused on retention, while other sites emphasized recruiting a larger number of participants but used fewer follow-up strategies. Furthermore, only 57% of participants felt that attending DSME was “very or somewhat easy,” which may have contributed to drop-out in this highly marginalized, low-income population. Although participants in the second phase of the study received a “lighter touch” DSME intervention, from a practical perspective, engagement with the DSME intervention in the first phase was so low that it ended up being only negligibly different from the “lower touch” intervention in the second phase. As a result, we do not believe these differences had a meaningful effect on our outcome. While the randomization used in this trial improves our confidence in the conclusion that the intervention contributed to improvements in participant food security status, our results should be interpreted with caution and are not a definitive determination of causality. Although study staff were blinded, blinding participants was not feasible in this study design, and knowledge of the intervention may have introduced bias. Participants may have received additional diabetes-appropriate food as part of standard pantry services. Finally, our intervention was provided in addition to usual pantry services and thus does not necessarily suggest that usual pantry services also reduce food insecurity.

This study also has several strengths, including its implementation in almost 30 pantry settings across 3 states, increasing the generalizability of our results. In addition, the use of a continuous measure of food security allows for a more powerful analysis of changes in food security. Finally, to our knowledge, this is the first randomized controlled trial to be conducted in a food pantry setting.

In conclusion, food bank and food pantry services can play an important role in supporting food security in the short term. Future research may help identify causal relations, inform what types of food pantry interventions contribute to better outcomes, and assess longer-term impacts on food security and other outcomes for interventions delivered from food banks and food pantries.

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responsibilities were as follows—HKS and EW: planned the trial and analysis; NH: conducted the statistical analysis; HKS and NH: interpreted the results; RR, RL, HKS, MS, and EW: drafted the content; HKS: had primary responsibility for final content; and all authors: read and approved the final manuscript.

Data Availability

The manual of operations, including detailed protocol and study forms, can be accessed at Open Science Framework (<https://osf.io>). Data described in the manuscript, code book and analytic code will be made available upon request to qualified parties pending application and approval.

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