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Food insecurity and diabetes self-management among food pantry clients

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Abstract

Objective: To examine the association between level of food security and diabetes self-management among food pantry clients, which is largely not possible using clinic-based sampling methods.

Design: Cross-sectional descriptive study.

Setting: Community-based food pantries in California, Ohio and Texas, USA, from March 2012 through March 2014.

Subjects: Convenience sample of adults with diabetes queuing at pantries (*n* 1237; 83 % response). Sampled adults were stratified as food secure, low food secure or very low food secure. We used point-of-care glycated Hb (HbA_{1c}) testing to determine glycaemic control and captured diabetes self-management using validated survey items.

Results: The sample was 70 % female, 55 % Latino/Hispanic, 25 % white and 10 % black/African American, with a mean age of 56 years. Eighty-four per cent were food insecure, one-half of whom had very low food security. Mean HbA_{1c} was 8·1 % and did not vary significantly by food security status. In adjusted models, very-low-food-secure participants, compared with both low-food-secure and food-secure participants, had poorer diabetes self-efficacy, greater diabetes distress, greater medication non-adherence, higher prevalence of severe hypoglycaemic episodes, higher prevalence of depressive symptoms, more medication affordability challenges, and more food and medicine or health supply trade-offs.

Conclusions: Few studies of the health impact of food security have been able to examine very low food security. In a food pantry sample with high rates of food insecurity, we found that diabetes self-management becomes increasingly difficult as food security worsens. The efficacy of interventions to improve diabetes self-management may increase if food security is simultaneously addressed.

Keywords
Food security
Food pantries
Diabetes self-management

Diabetes mellitus disproportionately affects low-income Americans, who experience higher disease prevalence and complication rates[1–3]. Food insecurity is one mechanism by which low income may increase risk of poor diabetes outcomes[4]. Food insecurity refers to limited or uncertain access to adequate food at the level of the household[5]. It is an independent risk factor for poor intermediate health outcomes, including glycaemic control, in adults with diabetes[6–8]. Food insecurity may impact diabetes self-management through varied mechanisms: reliance on inexpensive, shelf-stable foods which are generally poor for glycaemic control; binge eating when food becomes available; competing demands between food and health-care expenditures; and reduced capacity to manage the complexity of diabetes self-care when confronted with the immediacy of inadequate food[4,9].

Food insecurity is categorized by degree of severity: low food security or very low food security[5]. Low-food-secure households generally experience diets that are reduced in quality or variety, while very-low-food-secure households also experience reduced food intake[10]. In 2012, 14·5 % of US households (33 million adults) were food insecure, of which 8·8 % met criteria for low food security and an additional 5·7 % for very low food security[10]. Low and very low food security may differ in ways that are important for diabetes self-management[11–13]. For example, adults from very-low-food-secure households are more likely than those from low-food-secure households to have disrupted food

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supplies, including going hungry, reducing food intake and losing weight[10].

Although previous studies have examined food security and diabetes self-management, these studies have generally lacked adequate numbers of very-low-food-secure participants to permit stratified analysis by severity of food insecurity[14,15]. As part of a pilot study of food pantry-based interventions for diabetes support[16], we were able to reach a large number of very-low-food-secure individuals who are historically under-represented in clinic-based samples. The high prevalence of very low food security allowed us to examine the differential impact of low and very low food security on diabetes self-management.

Methods

Study design

We conducted a cross-sectional survey of adults with diabetes at food pantries in Sonoma County, California, Columbus, Ohio and Corpus Christi, Texas, USA. Baseline surveys for a diabetes self-management intervention located at the food pantries were administered between March 2012 and March 2014. Inclusion criteria included age ≥18 years; English or Spanish language fluency; and point-of-care glycated Hb (HbA_{1c}) percentage greater than or equal to 6·5 %, or self-reported diagnosis of diabetes with prescription bottles of oral hypoglycaemic medications or insulin on-hand. Point-of-care HbA_{1c} testing was performed with Bayer A1CNow® testing kits. Exclusion criteria included pregnancy, hearing impairment and cognitive impairment. Trained bilingual staff conducted the survey in person (58 %) or over the telephone (42 %) in the participants' preferred language.

Measures

Food security status was determined using the six-item short form of the US Department of Agriculture's Household Food Security Survey Module[10]. By convention, we categorized participants as food secure if they affirmed zero or one item, low food secure if affirming two to four items, and very low food secure if five or six items were affirmed.

We examined eight indicators of diabetes self-management: (i) HbA_{1c}; (ii) diabetes self-efficacy; (iii) diabetes distress; (iv) medication non-adherence; (v) severe hypoglycaemia; (vi) depressive symptoms; (vii) medication affordability; and (viii) food–medicine purchasing trade-offs.

Self-efficacy describes an individual's cognitive perception of his/her ability to actively manage his/her chronic disease. Previous studies have linked self-efficacy to diabetes self-care behaviours and glycaemic control[17–20]. We measured self-efficacy using an eight-item instrument[21] and calculated mean scores from Likert response options (range of 1–10). A higher score indicates greater self-efficacy, which is generally correlated with lower HbA_{1c} values[21].

Diabetes distress, a measure of the emotional burden an individual associates with managing her/his disease, is independently associated with glycaemic control[22,23]. We assessed diabetes distress using a two-item screening tool[24]. We averaged scores of the two six-point Likert items to generate a summary score between 1 and 6, with a higher score indicating greater distress.

We assessed medication non-adherence using the four-item Medication Adherence Questionnaire, with Likert response options from 0 to 4[25,26]. A higher score indicates lower adherence.

Hypoglycaemia is associated with food insecurity and is often indicative of poor diabetes self-management[15,27]. We dichotomized ('0 times' or '≥1 time') responses to the following item: 'In the past 4 weeks, how many times have you had a severe low blood sugar reaction, such as passing out or needing help to treat the reaction?'

Several studies have linked depression to poor glycaemic control and diabetes self-care[28–30]. We used the Patient Health Questionnaire-2 (PHQ-2) to assess depressive symptoms. Participants who answered affirmatively to one or both items were considered to have depressive symptoms.

We assessed participants' ability to afford medications with the following item: 'In the last 12 months, how often did you take less medicine than you were supposed to because you could not afford to buy more?'

We considered participants to have made trade-offs between food and medications or diabetes supplies if they answered any of the following four items affirmatively ('often' or 'sometimes' on a four-point Likert scale of 'often', 'sometimes', 'rarely' or 'never'), queried over the last 12 months: 'How often have you …' (i) '…put off buying food so that you would have money to buy medicines?', (ii) '… put off buying medicines so that you would have money to buy food?', (iii) '… put off buying diabetes supplies, like test strips or lancets, so that you would have money to buy food?' and (iv) '… put off buying food so that you would have money to buy diabetes supplies, like test strips or lancets?'

We measured five covariates, including age, gender, race/ethnicity, education and study site. We assessed race/ethnicity in order to capture the diversity of our sample and to adjust for known racial/ethnic differences in item response distribution for some of our variables[1,19]. Race/ethnicity was determined by participant selection of 'Latino or Hispanic', 'White', 'Black or African American', 'Native American', 'Asian/Pacific Islander' or 'Other'. Due to very small sample sizes for Native American (n 46) and Asian/Pacific Islander (n 9) participants, we collapsed the variable into 'Latino or Hispanic', 'White', 'Black or African American' and 'Native American, Pacific Islander or other.'

Statistical analysis

We compared baseline demographic characteristics using χ^2 or t tests for categorical and continuous variables, respectively. We analysed unadjusted associations between food

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security status and diabetes variables using χ^2 or one-way ANOVA tests. Participants who did not provide responses to question items pertaining to an individual measure were excluded from analysis of that measure, but included in other analyses. We used logistic or linear regression models depending on whether the self-management outcome was categorical or continuous and included age, gender, race/ethnicity, education and study site as covariates. In a sensitivity analysis, we additionally adjusted for depressive symptoms in all regression models. Statistical analyses were performed using the statistical software package Stata version 12.0 with a significance level of $P=0{\cdot}05$.

Results

Study population

Of 1495 eligible food pantry clients, 1237 provided informed consent and participated in the survey (83% response). More than 98% of the sample responded to all six of the food insecurity items and all respondents answered at least four items. Most of the sample was food insecure, with 42% reporting low food security and 42% very low food security. Almost all (98%) participants identified as having diabetes with point-of-care HbA_{1c} testing were previously aware of a diabetes diagnosis (i.e. few new cases of diabetes were identified). There were statistically significant differences in age, gender, education, race/ethnicity, BMI and tobacco use by level of food insecurity (Table 1). Survey non-response to each of the diabetes self-management measures ranged from 1% (depressive symptoms) to 7% (medication non-adherence).

Clinical characteristics

There was no statistically significant difference in mean HbA_{1c} (Table 1) or percentage of participants with HbA_{1c} level above 8·5% (data not shown) by level of food security. Mean BMI was greatest among the very-low-food-secure group and differed significantly from that of the food-secure group (35·0 *v.* 32·7 kg/m^2, $P=0{\cdot}009$). Tobacco use was more than twice as frequent in the very low-food-secure compared with the food-secure group (31% *v.* 12%, $P<0{\cdot}001$).

Diabetes self-management

We observed poorer diabetes self-management in the food-insecure groups compared with the food-secure group. All unadjusted associations examined were statistically significant with P values <0·001 (Table 2). After adjusting for age, gender, race/ethnicity, education and study site, we found statistically significant associations between food insecurity and seven of the diabetes self-management measures in the very-low-food-secure group and four measures in the low-food-secure group (Table 3; reference group is the food-secure group). Diabetes self-efficacy scores were on average 0·51 units lower (95% CI −0·85, −0·17) among very-low-food-secure participants compared with food-secure participants and the mean diabetes distress score was 0·79 points higher (95% CI 0·54, 1·04) in the very-low-food-secure compared with the food-secure group. Compared with food-secure participants, those identified as having very low food security had average medication non-adherence scores 0·31 units higher (95% CI 0·12, 0·50). The adjusted odds of reporting an episode of

Table 1 Sociodemographic characteristics, clinical characteristics and study site distribution of participants: a convenience sample of adults with diabetes receiving food assistance at community-based food pantries in California, Ohio and Texas, USA, March 2012–March 2014

			Food security status						
	Total (*n* 1237)		Secure (*n* 201, 16%)		Low (*n* 514, 42%)		Very low (*n* 522, 42%)		
	Mean or *n*	SD or %	Mean or *n*	SD or %	Mean or *n*	SD or %	Mean or *n*	SD or %	*P* value
Sociodemographic characteristics									
Age (years), mean and SD	56·4	12·5	61·0	13·5	56·3	12·5	54·7	11·6	<0·001
Female, *n* and %	869	70	124	62	377	73	368	71	0·03
Race/ethnicity, *n* and %									<0·001
Latino or Hispanic	670	55	112	56	319	63	239	46	
White	313	25	55	28	97	19	161	31	
Black or African American	121	10	12	6	42	8	67	13	
Native American, Pacific Islander or other	124	10	21	11	50	10	53	10	
Education, *n* and %									<0·001
<High-school degree/GED	523	30	90	17	252	48	181	34	
High-school degree/GED	282	27	48	17	114	40	120	43	
>High-school degree/GED	430	43	63	15	147	34	220	51	
Clinical characteristics									
HbA_{1c} (%), mean and SD	8·1	2·0	8·0	1·9	8·0	1·9	8·2	2·0	0·65
BMI (kg/m^2), mean and SD	34·3	8·5	32·7	6·9	34·1	8·5	35·0	9·0	0·009
Tobacco use, *n* and %	261	21	23	12	79	15	159	31	<0·001
Study site, *n* and %									<0·001
Sonoma County, California	456	37	96	21	210	46	150	33	
Columbus, Ohio	186	15	23	12	87	47	76	41	
Corpus Christi, Texas	590	48	82	14	216	37	292	49	

GED, General Education Diploma.

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Table 2 Unadjusted associations between food insecurity status and diabetes self-management among a convenience sample of adults with diabetes (*n* 1237) receiving food assistance at community-based food pantries in California, Ohio and Texas, USA, March 2012–March 2014

	Food security status						
	Secure		Low		Very low		
Diabetes self-management variables	Mean	SD	Mean	SD	Mean	SD	*P* value
Self-efficacy, scored 1–10	7·3	2·1	7·0	1·9	6·5	2·0	<0·001
Diabetes distress, scored 1–6	2·4	1·4	2·9	1·5	3·3	1·6	<0·001
Medication non-adherence, scored 0–4*	0·9	0·9	1·1	1·1	1·3	1·1	<0·001
	%		%		%		
Severe hypoglycaemic episodes	7		12		18		<0·001
Depressive symptoms	49		62		82		<0·001
Medication affordability challenges	11		23		35		<0·001
Food and medication or supply trade-offs	16		41		55		<0·001

*Higher scores indicate poorer medication adherence.

Table 3 Adjusted associations between food insecurity status and diabetes self-management among a convenience sample of adults with diabetes (*n* 1237) receiving food assistance at community-based food pantries in California, Ohio and Texas, USA, March 2012–March 2014

	Low food secure *v.* food secure		Very low food secure *v.* food secure	
Diabetes self-management variables	*β*	95 % CI	*β*	95 % CI
Diabetes self-efficacy	−0·15	−0·47, 0·18	−0·51*	−0·85, −0·17
Diabetes distress	0·27*	0·03, 0·51	0·79*	0·54, 1·04
Medication non-adherence	0·11	−0·06, 0·30	0·31*	0·12, 0·50
	OR	95 % CI	OR	95 % CI
Severe hypoglycaemic episodes	1·39	0·75, 2·59	2·63*	1·42, 4·85
Depressive symptoms	1·60*	1·13, 2·25	4·56*	3·13, 6·65
Medication affordability challenges	2·05*	1·23, 3·43	3·99*	2·40, 6·63
Food and medication or supply trade-offs	3·46*	2·21, 5·42	6·71*	4·25, 10·6

Adjusted for age, gender, race/ethnicity, education and study site.
*Denotes the 95 % CI does not include the null value.

severe hypoglycaemia among very-low-food-secure participants was 2·6 times greater than among participants who were food secure (OR = 2·63; 95 % CI 1·42, 4·85). Both the low- and very-low-food-secure groups had significantly higher odds of having depressive symptoms, experiencing challenges around affordability of medications and diabetes supplies, and making trade-offs between food and medications and medical supplies, compared with their food-secure counterparts. In a sensitivity analysis, significant associations in Table 3 remained statistically significant after additionally controlling for depressive symptoms, with the exception of diabetes distress in the low-food-secure group and medication non-adherence in the very-low-food-secure group (data not shown).

Discussion

In this community sample of adults with diabetes seeking assistance at food pantries, we identified many adults living in very-low-food-secure households. Our data suggest a dose–response relationship between severity of food insecurity and barriers to diabetes self-management.

Recruitment from food pantries allowed us to reach participants from very-low-food-secure households who we have been unable to reach easily in clinical settings, including clinical settings traditionally serving vulnerable and marginalized populations[6,27]. The discrepancy between food insecurity reports in clinical settings and community-based settings suggests that members of food-insecure households may not access clinical care as regularly as less-food-insecure groups. Interventions to engage marginalized groups in clinical care should focus on this underserved population and food pantries may be an ideal venue.

There is a growing capacity for food banks (which provide food, and often infrastructure, to food pantries which distribute food directly to clients) to conduct this work[31] and our research supports this trend. A number of food banks now employ dietitians and are beginning to deliver health-care support services[31]. Our ongoing intervention to provide diabetes self-management support

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through food pantry networks similarly seeks to address this apparent gap in care experienced by food-insecure groups[16]. Prescription food programmes, currently being used in some health-care systems, may also be effective interventions in this group[32–34] to assist in providing healthy, diabetes-appropriate foods to low- and very-low-food-secure patients who are engaged in clinical care. Our findings support the notion that food pantries are well positioned to deliver this type of lifestyle content, rather than relying solely on clinic-based approaches.

Participants from very-low-food-secure households did not have significantly higher HbA_{1c} values (8·2 %) than those from low-food-secure (8·0 %) or food-secure (8·0 %) households. The overall mean HbA_{1c} across the entire study population was 8·1 %, almost an entire percentage point greater than the national average HbA_{1c} among people with diabetes (7·2 %) reported in the National Health and Nutrition Examination Survey[35]. This may suggest that current clinical interventions to improve glycaemic control in low-income populations, widespread over the last decade, are not effectively reaching many high-risk adults. Furthermore, we do not yet know whether food-secure, low-food-secure and very-low-food-secure populations will respond to self-management support similarly. Prior studies in clinical settings suggest that food-insecure adults may respond differentially to self-management support[18]. Understanding the distinct self-management challenges of food-insecure populations will inform the development and implementation of self-management strategies across the spectrum of food security status.

The high BMI among this population may also be reflective of the unique setting in which the study was conducted: food pantries serving a highly vulnerable population. This finding further highlights the importance of studying community-based populations in order to improve our understanding of very low food security and its tight link to high BMI, depressive symptoms, and other barriers to good health in general and diabetes self-management in particular.

We also found high rates of diabetes distress in our sample, which has been linked to diabetes self-care behaviours and glycaemic control[22,23]. The very-low-food-secure group had a mean distress score >3, which has been interpreted as indicative of need for clinical intervention[36]. Our findings of the highest distress scores in the very-low-food-secure groups may further signal the low penetration of diabetes support into these high-risk groups.

Similarly, we observed a high frequency of severe hypoglycaemic episodes among the very-low-food-secure group. We suspect this high frequency reflects missed meals which accompany exhaustion of food budgets in the very-low-food-secure household and inadequate training in how to manage diabetes medications in the setting of reduced dietary intake[15,37].

Previous studies of depression and food insecurity have predominantly focused on women's and maternal health[38–42]. One study of depression and anxiety in mothers stratified by food security status observed proportions of depressive symptoms of 17, 21 and 30 % in the food-secure, low-food-secure and very-low-food-secure groups[42] – substantially lower proportions than we observed in our sample (49, 62 and 82 %, respectively). Diabetes and food insecurity are separately associated with depression[29,39,42,43], so the high prevalence we observed is unsurprising and emphasizes the ongoing need for mental health services in this population. The interrelationships among depression, diabetes and food insecurity are complex and interventions directed towards food-insecure populations to address depression and diabetes simultaneously are likely to offer advantages over interventions addressing each in isolation[44].

There are several limitations to the present study. It was a cross-sectional analysis and we therefore cannot infer causality. We were not able to control for all potential confounders, including medical co-morbidities, health literacy, substance use and access to care. Food insecurity is a household-level measure, not an individual measure; however, most adults residing in food-insecure households individually experience the effects of food insecurity. All diabetes self-management measures were self-reported, and some were reported via face-to-face interviews (58 %) and others via telephone (42 %), constituting potential sources of bias in our data[45]. Finally, the interplay among each of the investigated diabetes self-management measures is presumably more complex than our models can depict.

The present study is important in its ability to characterize the most vulnerable subgroup of food-insecure adults with diabetes. We identified independent associations between food insecurity and barriers to diabetes self-management, with greater food insecurity amplifying these challenges. Diabetes self-management support programmes for this population must address not only diabetes self-care and food affordability, but also low self-efficacy, emotional distress and mental health, and barriers to medication adherence. Non-clinical settings may effectively reach the most food-insecure adults with diabetes.

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