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Food Stamp Program participation but not food insecurity is associated with higher adult BMI in Massachusetts residents living in low-income neighbourhoods

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Abstract

Objective: Food-insecure populations employ multiple strategies to ensure adequate household food supplies. These strategies may increase the risk of overweight and obesity. However, existing literature reports conflicting associations between these strategies and BMI. The objective of the present study was to examine whether food insecurity and strategies for managing food insecurity are associated with BMI in adults.

Design, setting and subjects: In 2005, RTI International and Project Bread conducted a representative survey of 435 adult residents of low-income census tracts in Massachusetts. Food insecurity was assessed using the US Department of Agriculture's eighteen-item Household Food Security Module.

Results: The prevalence of overweight and obesity was 51 % and 25 %, respectively. After adjusting for age, sex, sociodemographic characteristics and food insecurity, both participation in the Food Stamp Program (FSP) and participation in any federal nutrition programme 12 months prior to the survey were each associated with an approximate 3·0 kg/m^2 higher adult BMI. In the subset of current FSP participants (*n* 77), participation for ≥6 months was associated with an 11·3 kg/m^2 lower BMI compared with participation for <6 months. Respondents who consumed fast foods in the previous month had a mean BMI that was 2·4 kg/m^2 higher than those who did not. Food insecurity was not associated with BMI after adjustment for sociodemographic characteristics and FSP participation.

Conclusions: Participation in federal nutrition programmes and consumption of fast food were each associated with higher adult BMI independent of food insecurity and other sociodemographic factors. However, prolonged participation in the FSP was associated with lower BMI.

Keywords
Food insecurity
Body mass index
Low income
Massachusetts
Food Stamp Program

Household food insecurity occurs when the availability of or ability to acquire safe and adequate food is limited or uncertain[1]. The percentage of US households reporting food insecurity increased from 10·8 % in 2002 to 11·4 % in 2005[2]. A 2005 survey of low-income census tracts in Massachusetts reported that food insecurity in these areas had increased from 20 % in 2002 to 32 % in 2005[3]. By comparison, approximately 7·1 % of all Massachusetts households were food-insecure in 2002–2004[2].

Strategies used by households to manage food insecurity may include reducing food intake, meal size or meal frequency, relying on a limited number of low-cost, energy-dense foods, or obtaining free or reduced-price foods from emergency food sources[4]. These strategies may increase the risk of overweight and obesity by promoting disordered eating habits[5] and reducing diet diversity[6]. Paradoxically, energy intakes may increase due to the high energy density of many low-cost foods[7,8]. Some, but not all studies have found an association between food insecurity and overweight and obesity[9–16]. Multiple factors, including gender and ethnic differences in study populations and differences in the method of food insecurity assessment and study design, likely contributed to inconsistent findings.

Low-income households may also manage food insecurity by participating in government-sponsored food assistance programmes such as the Food Stamp

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Program (FSP), the School Lunch Program and/or the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC). Participation in the FSP was associated with overweight and obesity in adult participants[14,17–19]. However, in several studies, assessment of the relationship between FSP participation and overweight independent of food security was not possible and researchers could not rule out the possibility that FSP participation was serving as a proxy for food insecurity[20].

The aim of the present study was to examine whether FSP participation is associated with BMI in adults, independent of food security status. We analysed data collected in a representative survey of low-income neighbourhoods in Massachusetts. Additionally, we examined associations between FSP participation, food insecurity, sources of food (such as convenience stores, charitable sources and fast-food restaurants) and BMI, while accounting for potential sociodemographic confounders.

Methods

Between September and December of 2005, Project Bread, a Massachusetts-based non-profit anti-hunger organization, collaborated with RTI International to conduct a representative survey in qualified low-income neighbourhoods in Massachusetts. The aim of the survey was to assess household food security and food access, participation in federally sponsored nutrition programmes, self-reported health measures and perceived social climate in respondents' neighbourhoods.

Sampling strategy

To be eligible for participation in the survey, households had to be located in one of the 216 Qualified Census Tracts (QCT) in Massachusetts. As defined by the Department of Housing and Urban Development, a QCT is any census tract, or Census Bureau-designated geographic equivalent, in which at least 50 % of households have an income less than 60 % of the area median gross income. The QCT for this study were identified by the US Census in 2000. List-assisted random-digit dialling (RDD) techniques were used to generate a representative set of telephone numbers from these QCT. The selected numbers were stratified by those that were listed in the telephone directory and those that were not listed. This distinction was important for determining whether each sampled telephone number was associated with a household in one of the QCT. A total of 8187 unlisted telephone numbers and 2032 listed telephone numbers were randomly selected from the QCT. The unlisted telephone numbers were screened to eliminate non-working and business numbers. For households with directory-listed numbers, zip code information was used to ensure that households were within a QCT. Households without directory-listed numbers were required to provide their zip code when contacted to ensure that they resided within a QCT. Households with children were oversampled because the food security status of children was of great interest. Only adults aged 18 years and over were interviewed. In households with children, only an adult who was responsible for the children was interviewed. All interviews were conducted in English. A total of 2819 households were contacted. Among these 2149 (76·2 %) were eligible to participate in the survey. Eligibility required matching the households' zip code to one of the 216 QCT in Massachusetts. Dividing the 465 completed interviews by the 2149 eligible sample units produced a weighted response rate of 21·6 %, based on the American Association for Public Opinion Research (AAPOR) RR3 formula[21].

Sample weights

An analysis weight was applied to each case. The initial household sampling weight was calculated to be of equal size to the sampling frame and the sample size. Since households without children were sub-sampled, the analysis weight (for households without children) was multiplied by the inverse of the sub-sampling rate (=1·00/0·627). Households may have multiple residential phone numbers (such as teen lines). To account for multiple chances that these households could be reached, the initial sampling weight was multiplied by the inverse of the number of different residential telephone numbers. The sampling weights were then adjusted for non-response by the presence/absence of children in the household. The non-response factor for households with children (or households without children) is the ratio of the sampling weight-sum for households with children (or households without children) for which an interview was attempted and the corresponding weight-sums for households that completed the interviews. The analysis weight is the product of the household sampling weight and the non-response adjustment factor.

Survey tool

The survey included the US Department of Agriculture's (USDA) Household Food Security Module (HFSM) which asks about conditions that characterize households having difficulty meeting basic food needs[16]. For households with children, the full eighteen-item HFSM scale was used to determine food security status. For households without children, only the adult-specific ten-item subset was used. Each question asks whether a given condition occurred during the previous 12 months and specifies lack of money or other resources as the reason for the condition. Responses to the HFSM were scored

according to established criteria to classify households as either food-secure or food-insecure[16]. By definition, food-insecure households cannot buy enough food to meet the basic food needs of household members because of financial constraints. Households with and without children that answered affirmatively to more than three of the HFSM items were classified as food-insecure. Some food-insecure households were further identified as 'food-insecure with hunger' if they experienced prolonged periods without adequate food or more severe instances of hunger. Households without children that answered affirmatively to five or more items and households with children that answered affirmatively to seven items were classified as food-insecure with hunger[16].

The survey included additional questions regarding household income and other demographic characteristics, participation in three government-sponsored nutrition programmes (FSP, WIC and the free/reduced-price school meals programme), use of free or low-cost food from charitable sources (i.e. soup kitchens, church or community outreach programmes, shelters, food banks, friends, family) and use of supermarkets or other store types for food purchases. The survey also included questions related to health status, including self-reported height and weight of the respondent, health coverage, self-perceived health and indicators of social capital. For the purposes of the survey, social capital referred to civic engagement, community cohesion and functional reciprocity among residents of a community.

Statistical analyses

The dependent variable was the adult respondent's current BMI (kg/m^2) calculated using self-reported height and weight. Predictor variables of interest included food security status, participation in nutrition assistance programmes including the FSP, WIC and school lunch programme, and food sources. Weighted analyses were conducted using PROC SURVEYMEANS and SURVEYFREQ of the Statistical Analysis Systems statistical software package version 9 (SAS Institute, Cary, NC, USA). Variables that were significantly associated with BMI in univariate analyses ($P < 0{\cdot}05$) or that were considered to be potential confounders were included in multivariate linear regression models. The final models included BMI as a continuous outcome, the predictor of interest, respondent age, and categorical variables for race (white, Hispanic, black, other), sex, highest household education (not completed high school, high school diploma, college or more), household income (ten income brackets), household employment (all unemployed, only part-time, at least one member full-time) and place of birth (USA or not). Models in which food security status was not the predictor of interest were additionally adjusted for food security status. Models in which food security status was the predictor of interest were adjusted for FSP participation. For multivariate regression analyses, food-insecure without hunger and food-insecure with hunger were combined to create a binary food security variable (food-secure *v.* food-insecure). The length of FSP participation was defined dichotomously as <6 months or ≥6 months. Finally, we examined whether the associations between FSP participation or food insecurity and BMI were modified by sex or age, by testing interaction terms with the likelihood ratio test.

Results

Of the 465 households surveyed, 435 adult respondents provided information on their height and weight and were included for analysis of BMI. Forty-six per cent of households had at least one child. Thirty-three per cent of households were eligible for federal nutrition assistance based on income alone. Additional characteristics of the surveyed population are presented in Table 1. There were no differences between households reporting height and weight and those not reporting height and weight with respect to education, income and age, food security status, participation in the FSP or use of charitable food sources. Ethnicity of the population included for analyses differed significantly from those who did not report height and weight. Among those not reporting height and weight, 3 % were Hispanic, 48 % were African American and 45 % were white.

Fifty-one per cent of respondents were overweight (BMI > 25 kg/m^2), 25 % were obese (BMI > 30 kg/m^2) and 6 % were morbidly obese (BMI > 40 kg/m^2). Men, married respondents, respondents in households with no full-time employment and those with fair to poor self-reported health scores had significantly higher mean BMI compared with their respective reference groups (Table 1). BMI did not differ by immigrant status, respondent age, education, home ownership status, number of children, social capital score, household size, income eligibility for federal assistance, ethnicity, self-reported exercise in the past month or health-care coverage (all $P > 0{\cdot}05$; data available upon request).

Thirty per cent of households experienced food insecurity during the year preceding the survey and approximately 45 % of these experienced severe food insecurity with hunger. Respondents classified as food-insecure or food-insecure with hunger had significantly higher BMI than those classified as food-secure (Table 2). Mean BMI did not differ between food-insecure groups with or without hunger. The proportion of respondents with BMI > 30 kg/m^2 was significantly higher in those who experienced food insecurity compared with food-secure respondents ($P < 0{\cdot}05$, Fig. 1). Among food-insecure respondents, only those classified as food-insecure with hunger reported BMI < 19·5 kg/m^2 (6 %). With respect to specific questions from the HFSM,

Table 1 Mean BMI by sociodemographic characteristics for 435 adult residents of low-income neighbourhoods in Massachusetts who responded to a household food security survey administered in 2005*

Variable	*n*	Weighted %		BMI (kg/m^2)		*P*†
		Mean	SE	Mean	SE	
Respondent's age (years)						
<35	129	27·6	3·0	25·5	0·6	
35–55	196	47·2	3·4	27·1	0·7	
>55	103	25·3	3·1	26·9	1·0	0·09
Respondent's sex						
Male	150	32·0	3·2	27·8	0·8	
Female	285	68·0	3·2	25·9	0·5	<0·01
Place of birth for respondent						
USA	348	85·3	2·3	26·8	0·5	
Other	87	14·7	2·3	25·2	0·7	0·08
Ethnicity of respondent						
Hispanic	71	16·5	1·8	26·9	1·1	
African American	82	18·8	1·9	28·3	1·1	
White	244	56·0	2·4	26·0	0·6	
Other	8	1·8	0·6	25·1	0·8	0·60
Marital status of respondent						
Married or partnered	179	40·4	3·3	27·3	0·7	
Other	255	59·2	3·3	25·9	0·6	0·04
Self-reported health score of respondent						
Fair–poor	101	24·5	3·0	28·7	1·2	
Good–excellent	331	75·3	3·0	25·8	0·5	<0·01
Highest education in household						
Some high school	68	15·3	2·5	26·2	1·5	
High school diploma or equivalent	106	25·6	3·0	28·0	0·9	
College or more	244	57·7	3·4	26·1	0·5	0·74
Household size						
<4 persons	295	70·2	3·0	26·5	0·6	
≥4 persons	140	29·8	3·0	26·7	0·7	0·67
At least one person in household works full time						
Yes	139	30·9	3·2	25·0	0·5	
No	294	69·1	3·2	27·3	0·6	<0·01

*n 435; sum of weights = 786 900.
†From t test.

respondents whose food supplies did not last, who were unable to afford balanced meals, cut meal sizes and ate less than their perceived need had significantly higher BMI than those who reported never having those experiences (Table 2).

Forty-one per cent of households reported ever participating in the FSP and 18 % of surveyed households (n 77) were participating at the time of the survey (Table 3). Adult BMI was significantly higher in those who reported their households ever participating in the FSP. However, in analyses restricted to current FSP participants (n 77), BMI was significantly lower in those respondents whose households had participated in the programme for ≥6 months compared with those whose households had participated for <6 months. Those who reported household participation in the FSP, WIC and/or free/reduced-price school meals during the 12 months prior to the survey had significantly higher BMI than those who reported no federal nutrition assistance. BMI was significantly higher among those who obtained food from charitable sources such as soup kitchens or food banks, those who reported shopping at convenience stores and those who consumed fast foods in the month prior to the survey *v.* those who did not. BMI did not differ according to use of supermarkets, ethnic grocery stores or farmer's markets (data available upon request).

Ever participating in the FSP and participation in any federal nutrition assistance programme in the 12 months prior to the survey remained significantly associated with higher BMI after adjustment for sociodemographic factors (Table 4). Among current FSP participants, participation for 6 months or longer was associated with significantly lower BMI compared with participation for less than 6 months. These associations remained statistically significant after additional adjustment for food insecurity. Eating fast food at least once in the month prior to the survey remained significantly associated with higher BMI after adjustment for sociodemographic characteristics and food insecurity. The association between FSP participation and BMI was not significantly modified by sex or age of the participant ($P > 0·05$).

Neither food insecurity nor the individual components of the HFSM were associated with BMI after adjustment for sociodemographic characteristics and FSP participation. Similarly, the use of convenience stores and obtaining food from charitable sources were not associated with BMI after controlling for sociodemographic characteristics and food insecurity.

Table 2 Mean BMI of 435 Massachusetts adult residents in low-income neighbourhoods by food security status and responses to specific food security indicator questions from the US Household Food Security Module*

Variable	*n*	Weighted %		BMI (kg/m^2)		*P*†
		Mean	SE	Mean	SE	
Food security status‡						
Food-secure	285	69·7	3·2	26·0	0·5	
Food-insecure without hunger	84	13·3	2·2	27·9	1·2	
Food-insecure with hunger	66	17·0	2·6	27·7	1·2	<0·01
'The food that (I/we) bought didn't last, and (I/we) didn't have money to get more'						
Sometimes or often true	149	32·4	3·2	28·7	1·0	
Never true	284	67·6	3·2	25·5	0·5	<0·01
'(I/we) couldn't afford to eat balanced meals'						
Sometimes or often true	142	30·4	3·2	28·7	1·0	
Never true	291	69·6	3·2	25·7	0·5	<0·01
In the last 12 months, did you or other adults in your household ever cut the size of your meals or skip meals because there wasn't enough money for food?						
Yes	97	21·6	2·9	27·8	1·0	
No	337	78·3	2·9	26·2	0·5	0·02
In the last 12 months, did you ever eat less than you felt you should because there wasn't enough money to buy food?						
Yes	103	24·3	3·0	28·1	1·0	
No	331	75·7	3·0	26·0	0·5	<0·01
Proportion of respondents who reported that they changed their eating habits in any way§						
Yes	131	30·1	3·2	27·8	0·9	
No	301	69·9	3·2	26·0	0·5	<0·01

*n 435; sum of weights = 786 900.
†From t test.
‡In households with children, food security status was determined using the complete eighteen-item Household Food Security Module whereas in households with no children the adult-specific subset was used to determine food security status.
§Summary variable included reducing meal size, eating less than perceived need, not eating when hungry and/or skipping meals.

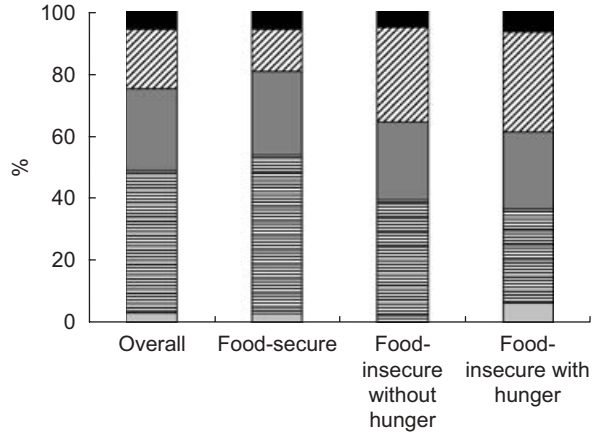

Fig. 1 Categories of BMI (■, ≥40·0 kg/m^2; ▨, ≥30·0 to 39·9 kg/m^2; ■, ≥25·0 to 29·9 kg/m^2; ▤, ≥19·5 to 24·9 kg/m^2; □, <19·5 kg/m^2) by food security status among 435 Massachusetts residents of low-income neighbourhoods who responded to a household food security survey administered in 2005 (P = 0·07)

Discussion

We examined whether participation in the FSP and other strategies for managing food security were associated with BMI independent of food security status in residents of low-income communities. These factors may be unique to residents of low-income communities and could potentially increase their risk of overweight and obesity. Ever participating in the FSP, participating in any federal nutrition programme at some point during the 12 months prior to the survey and fast-food consumption at least once in the month prior to the survey were each associated with increased BMI independent of socio-demographic factors and food insecurity. Conversely, among current participants in the FSP, those who had participated for ≥6 months had significantly lower BMI. The positive association between household participation in federal nutrition programmes and BMI in our population is consistent with previous studies[14,17–19]. In our study, these associations were independent of socio-demographic factors and food insecurity status.

The monthly distribution of FSP benefits has led some researchers to suggest a 'food stamp cycle' hypothesis[14,22]. Households cycle between times of sufficient and insufficient funds for food and, as a result, experience disordered eating patterns that put them at risk for obesity. A second hypothesis posits that participation in nutrition assistance programmes may inadvertently increase purchases of energy-dense foods by increasing a household's overall purchasing power. This hypothesis is plausible if, even with the additional income provided by

Table 3 Mean BMI by participation in the Food Stamp Program (FSP) and sources of food for 435 adult residents of low-income neighbourhoods in Massachusetts who responded to a household food security survey administered in 2005*

Variable	*n*	Weighted %		BMI (kg/m^2)		
		Mean	SE	Mean	SE	*P*†
Respondent's household had ever participated in the FSP						
Yes	175	40·5	3·4	27·9	0·8	
No	260	59·5	3·4	25·6	0·5	<0·01
Among households who had ever participated in the FSP (*n* 175), respondent's household was currently participating in the FSP						
Yes	77	56·7	5·3	29·6	1·5	
No	98	43·2	5·3	26·7	0·8	<0·01
Among those households currently enrolled in the FSP (*n* 77), the length of time participating						
<6 months	21	26·3	7·2	36·9	3·4	
≥6 months	56	73·7	7·2	26·9	1·2	<0·01
Households participated in any federal nutrition assistance programme during the 12 months prior to the survey‡						
Yes	141	58·6	4·3	28·4	0·9	
No	110	41·4	4·3	25·1	0·6	<0·01
Household obtained free or reduced-cost food from charitable sources during the 12 months prior to the survey§						
Yes	105	24·7	3·0	28·5	1·1	
No	328	75·3	3·0	25·9	0·5	<0·01
In the month prior to the survey, the household shopped at a convenience store						
Yes	197	47·6	3·4	27·2	0·6	
No	237	52·4	3·4	25·9	0·6	0·04
In the month prior to the survey, respondent ate fast food at least once						
Yes	298	66·2	3·3	27·4	0·6	
No	137	33·8	3·3	24·8	0·7	<0·01

*n 435; sum of weights = 786 900.
†From t test.
‡Federal nutrition assistance programmes included the FSP, the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) and the free/reduced-price school meals programme.
§Charitable sources included soup kitchens, food pantries, churches, friends and/or relatives, senior programmes and/or other sources of free or reduced-price foods.

Table 4 Multivariate associations of food eating and acquisition habits and household food insecurity with respondent BMI (kg/m^2) among 435 adult residents of low-income neighbourhoods in Massachusetts who responded to a household food security survey administered in 2005

	Model adjusted for sociodemographic characteristics*		Model adjusted for sociodemographic characteristics and food security status*	
	Difference in BMI	95 % CI	Difference in BMI	95 % CI
Household had ever participated in the FSP (yes *v.* no)	2·3	0·5, 4·0	2·2	0·3, 4·0
Among those ever participating (*n* 175), household was currently participating in the FSP (yes *v.* no)	3·0	−1·7, 7·8	3·0	−1·7, 7·8
Among those currently participating (*n* 77), the household had participated in the FSP for ≥6 months (yes *v.* no)	−10·3	−17·4, −3·3	−11·3	−17·5, −5·0
Household had participated in any federal nutrition assistance programme in the 12 months prior to the survey (yes *v.* no)†	3·2	0·7, 5·7	3·2	1·9, 4·5
Household obtained food or food funds from a charitable source during the 12 months preceding the survey (yes *v.* no)‡	2·4	−0·2, 4·9	2·2	−0·4, 4·9
Household shopped at a convenience store in the month prior to the survey (yes *v.* no)	0·9	−1·0, 2·8	0·9	−1·0, 2·8
Respondent ate fast food at least once during the month prior to the survey (yes *v.* no)	2·3	0·5, 4·2	2·4	0·7, 4·2
Household experienced food insecurity in the 12 months prior to the survey§	1·1	−1·0, 3·2		

*Sociodemographic covariates in the final model included sex, age, race, household employment, household education, household income and place of birth.
†Federal nutrition assistance programmes included the Food Stamp Program (FSP), the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) and the free/reduced-price school meals programme.
‡Charitable food sources included soup kitchens, food pantries, churches, friends and/or relatives, senior programmes and/or other sources of free or reduced-price foods.
§A food-insecure household may or may not have experienced hunger. Final model included sex, age, race, household employment, household education, household income, place of birth and participation in the FSP.

food stamps, fruits, vegetables, lean meats and low-fat dairy products remain too expensive for programme participants[17,18,23]. Findings from a USDA survey reported that, in higher-income households, increasing income was associated with small increases in expenditures on fruits and vegetables[24]. Conversely, in low-income households (<130 % of poverty line), purchases of fruits and vegetables did not increase with income. Rather, households allocated their increases in monthly income to other foods, such as staples, and/or to household needs, such as clothing, utilities or rent. Similarly, Wilde *et al.*[25] reported a positive association between FSP participation and increases in meat, added sugars and total fats, while intakes of fruits and vegetables did not change. These two studies suggest that modest increases in income do not facilitate changes in dietary intakes or food purchasing habits in low-income populations, perhaps because extra funds are allocated to household needs with higher priority, such as housing.

Of special interest was the observation that, in the subgroup of current FSP participants (*n* 77), participation for longer periods of time (≥6 months) was associated with lower BMI compared with shorter periods of participation. This association remained significant after adjustment for food insecurity and sociodemographic characteristics of the household. It is plausible that long-term participation allowed for gradual increases in expenditures on healthier food items such as fruits and vegetables or that increased exposure to nutrition education offered through the FSP altered dietary habits. However, information on food expenditures and nutrition education exposure was not available to test these hypotheses.

We also found that greater fast-food intake was associated with higher BMI. Bowman *et al.* reported that men and women consumed more energy, total fat and saturated fat on days that they consumed fast foods compared with days they did not[26]. Increased consumption of fast foods may therefore contribute to weight gain if compensatory reductions in the intake of other foods or increases in physical activity are not practised. We are unable to say, however, whether the association between fast-food consumption and BMI is unique to low-income populations because we did not collect information from higher-income neighbourhoods that would facilitate such analyses.

Our study did not find food insecurity to be associated with self-reported BMI as a continuous measure after adjustment for sociodemographic factors and FSP participation. Similarly, a longitudinal study in women reported that food insecurity as measured by the HFSM was not a predictor of subsequent, clinically significant weight gain[9]. Similarly, neither sex nor age significantly modified the associations between food insecurity or FSP participation on adult BMI.

Limitations and considerations

Owing to the cross-sectional nature of the present data, we are unable to ascertain the temporal sequence of the associations observed and are unable to address causality. Second, it is possible that the use of reported rather than measured heights and weights contributed to the lack of association between food insecurity and BMI. Because people tend to under-report their weight and over-report their height, self-reported BMI may have been underestimated which would bias our estimates towards the null[27]. Populations at high risk of food insecurity may not have been surveyed due to the sampling design, including the homeless, those without land-line telephones and households without an English speaker. The survey did attempt to address the exclusion of households without a land-line telephone service. Each respondent was questioned regarding interruptions in telephone services (ITS) in the 12 months prior to the survey; 15·3 % reported ITS. Assuming that households with a recent interruption were similar to households who could not be contacted due to current lack of phone service, sample weights that adjusted for non-telephone coverage were developed. Comparisons of multiple survey items using ITS-adjusted weights *v.* non-adjusted weights indicated that no biases were present[3].

The weighted response rate for this survey was low (21 %) and thus the surveyed population may not be generalizable. Indeed, survey respondents were more educated, less likely to be Hispanic and less likely to have been born outside the USA than respondents sampled from these QCT during the 2000 US Census[3]. However, despite being low, the response rate for our survey is consistent with the current downward trend in RDD response rates. For example, the median response rate for the state-wide Behavioral Risk Factors Surveillance System (BRFSS) surveys has dropped by 12 % over the past several years[28,29]. Although the median response rate for the BRFSS surveys was 51·4 % in 2006, state-wide response rates were significantly lower in north-eastern states like Massachusetts. In 2006, the response rate for the Massachusetts BRFSS survey was 38·6 % using the Council of American Survey Research Organizations' response rate formula, which generally produces a higher response rate than the AAPOR calculation[21,30]. Additionally, administration of the survey in English may have further contributed to ethnic discrepancies and a lack of generalizability. By excluding households without English speakers, the survey was less likely to capture the situation of recent immigrants.

Because of their national reach and financial support, government nutrition assistance programmes that target low-income populations have the potential to serve as vehicles for healthy diet and behaviour change by increasing awareness of and economic and physical access to healthy foods[18]. Additional studies examining

how and what aspects of nutrition assistance programmes influence the nutritional status and health of participants are needed, specifically those that utilize prospective approaches and monitor changes in weight, health outcomes, food security status, and dietary and food purchasing habits over time. Because the administration and nutritional education components of programmes differ by state, state-to-state comparisons of such data could help identify specific implementation strategies that would be most effective in promoting healthy habits.

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