

The Influence of Social Context on Changes in Fruit and Vegetable Consumption: Results of the Healthy Directions Studies

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As part of the Harvard Cancer Prevention Program Project, we used a social contextual model of health behavior change to test an intervention targeting multiple risk-related behaviors in working-class, multiethnic populations. We examined the relationships between the social contextual factors in our conceptual model and changes in fruit and vegetable consumption from baseline to completion of intervention in health centers and small business studies. We analyzed change in fruit and vegetable consumption, measured at baseline and final assessments by self-report, in 2 randomized controlled prevention trials: 1 in small businesses (n=974) and 1 in health centers (n=1954).

Stronger social networks, social norms that were more supportive, food sufficiency, and less household crowding were associated with greater change in fruit and vegetable intake. We also observed differences between our intervention sites. Social context can play an important role in promoting changes in fruit and vegetable consumption. (*Am J Public Health*. 2007;97:1216–1227. doi:10.2105/AJPH.2006.088120)

The social epidemiology literature has consistently demonstrated that regardless of how it is measured, lower socioeconomic position is associated with poorer health outcomes.^{1–4} Disparities in health outcomes by race/ethnicity have also been observed.⁵ Socioeconomic position and race/ethnicity shape many health behaviors, such as dietary patterns, physical activity, and tobacco and alcohol consumption. Fruit and vegetable consumption, for example, increases with education level and income,^{6,7} is higher among individuals in white-collar rather than blue-collar occupations,⁸ and differs by race/ethnicity.⁹ These disparities are important because increased consumption of fruits and vegetables has been shown to reduce risk of chronic conditions, including type 2 diabetes, heart disease, stroke, and obesity,^{10–17} all of which disproportionately contribute to increased morbidity and mortality in lower socioeconomic groups.

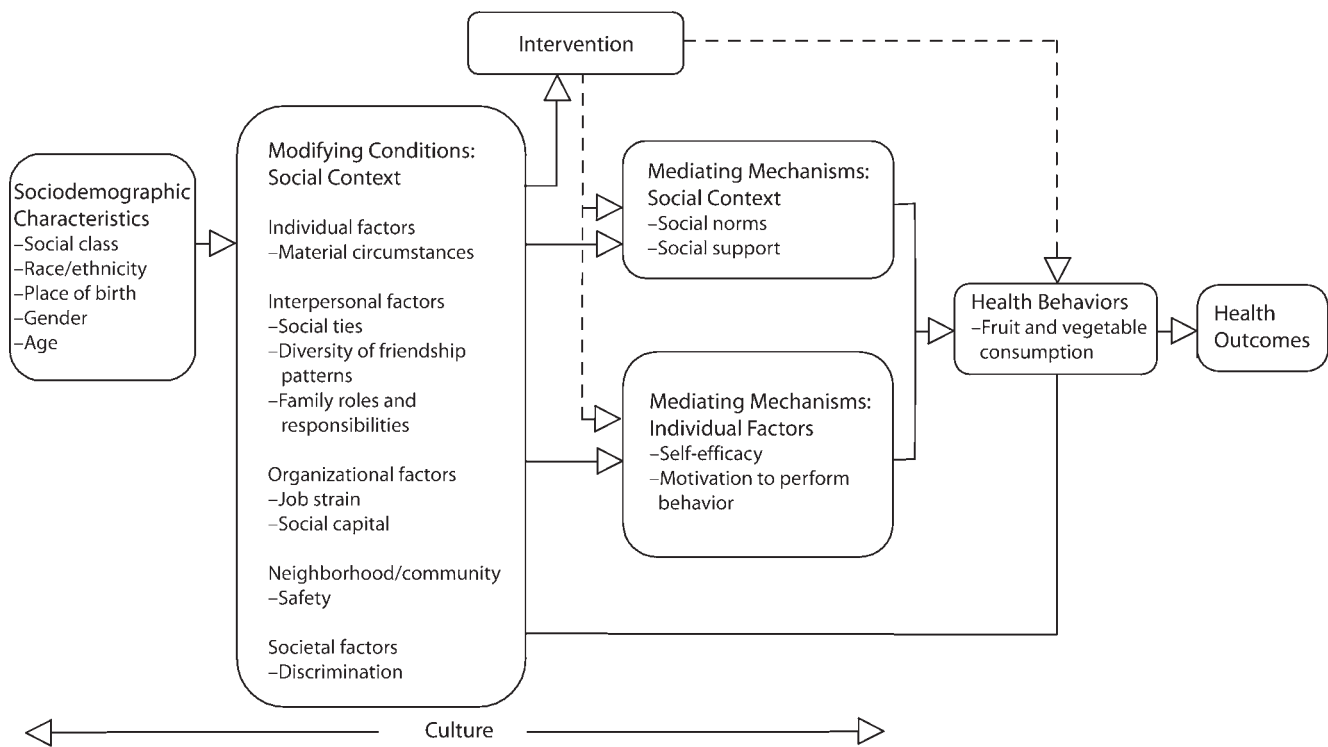
Strategies to influence less-healthy behaviors among lower socioeconomic populations have been initiated by others.^{18–21} As

part of the Harvard Cancer Prevention Program Project, we developed a common behavioral intervention model, “Healthy Directions,” that targeted multiple risk-related behaviors²²; we tested the model in 2 randomized trials, 1 conducted through small businesses^{23,24} and the other through health centers.²⁵ We designed this behavioral intervention specifically for working-class, multiethnic populations. The intervention tested in these studies operationalized a conceptual framework based on social context²² that delineated pathways through which population characteristics (e.g., income,^{26,27} race/ethnicity,⁵ and acculturation^{28–31}) might be related to and influence health behaviors. By explicating these pathways, we were able to design and test interventions that attended to the social context of participants’ lives and were therefore meaningful and relevant to the intended audiences. The interventions in both studies were designed to change selected social context factors that influenced behavior and were amenable to change (e.g., social norms) and to be responsive to factors that were important

determinants of behavior but that could not be altered by the intervention (e.g., material circumstances such as access to a car).^{22,32}

Overall, we found that these interventions were efficacious in changing the targeted health behaviors. In the Cancer Prevention in Health Centers Study (hereafter health centers study), participants in the intervention health centers made significantly greater improvements than did those in the control group in 3 of the 4 targeted risk behaviors: fruit and vegetable consumption, red meat consumption, and multivitamin use.³³ In the Cancer Prevention in Small Business Study (hereafter small business study), workers in intervention sites made significantly greater improvements than did those in control sites in the use of multivitamins and in physical activity. Although there was no significant intervention effect for the overall sample regarding fruit and vegetable consumption, we found a statistically significant interaction between the intervention and job status: the effects of the intervention were larger among nonmanagers than among managers.³⁴ This finding was promising because our intervention was specifically targeted to working-class men and women.

We present the first analyses from the Harvard Cancer Prevention Program Project to examine the relationships of the social contextual model to change in 1 of our outcomes. We examined the relationships between the social contextual factors in our conceptual model and changes in fruit and vegetable consumption from baseline to completion of intervention in both the health centers study and small business study. We also examined the extent to which these relationships might be influenced by the interventions.



Note. Dotted lines represent the impact of the intervention through the mediating mechanisms and on the health behavior outcomes. For information on the crosscutting role of culture, see reference 22.

FIGURE 1—The social contextual model of health behavior change used in the Healthy Directions Studies: health centers and small business, Boston, Mass, 1999–2003

SOCIAL CONTEXTUAL MODEL FOR HEALTH BEHAVIOR CHANGE

We developed a guiding conceptual framework (Figure 1), based on theories and models from multiple disciplines^{2,22,35–43} as well as our own research, to explicate the role of the social context in health behavior change; further descriptions of this model are available elsewhere.²² This framework defines a set of *modifying conditions*, factors that independently affect outcomes but are unlikely to be influenced by the intervention, and *mediating mechanisms*, which we defined as factors along the pathway between the intervention and the outcomes. We identified mediating mechanisms that social and behavioral theory and previous research have indicated are important to behavior change and that were potentially modifiable within the context of the targeted channels (i.e., small businesses and health centers) and our planned interventions.

Social context includes life experiences, social relationships, organizational structures, societal influences, and structural forces. For example, residential segregation may influence the access of some groups to nutritious foods. An increasing body of literature demonstrates that poorer neighborhoods have restricted access to grocery stores.^{44–48} Neighborhoods with high proportions of African American residents also have reduced access to grocery stores, even after control for the income characteristics of the neighborhood.⁴⁹ (Figure 1 includes only the variables measured and tested in this study, although additional factors may be considered within this framework.²²)

METHODS

We included baseline and final data collected as part of 2 randomized controlled prevention trials in the Harvard Cancer

Prevention Program Project, conducted between 1999 and 2003. These studies targeted health behaviors (fruit and vegetable consumption, red meat consumption, multivitamin intake, and physical activity) among employees in small businesses and patients in community health centers. We recruited 26 small manufacturing businesses in Massachusetts and 10 community-based health centers in the greater Boston area to participate.^{22,50} These settings were selected because they employed or served multiracial/multiethnic working-class populations.⁵¹

Small Business Study

Details of the study design are provided elsewhere.^{34,51} Briefly, we recruited 26 worksites that met eligibility criteria, including employing a multiethnic workforce. Worksites agreed to be randomly assigned to an intervention and condition, to allow completion of surveys on work time at baseline and final

assessments, and to participate in baseline and final assessments of occupational hazards. Thirteen sites were randomized to the intervention condition and 13 to the minimal-intervention control condition. Of 26 worksites, follow-up assessment was completed on 24 sites; 1 site was lost to follow-up from each condition.

Intervention methods. The intervention strategies were based on (1) principles of employee participation and (2) a social contextual framework that focused on multiple levels of influence on behaviors, with special attention given to low literacy skills, and unique features of culture between ethnic groups, as well as the shared themes across cultural groups.³⁴ Over the 18-month intervention period, we delivered 1 monthly intervention activity focused on individual behavior change and made an average of 1 monthly contact with management regarding environmental support and organizational change in each of the 12 intervention worksites. The organizational intervention included efforts to reduce exposures to occupational hazards as well as policy changes to support changes in health behavior. Participants in both the minimal-intervention control groups and the intervention groups took part in smoking cessation programs. The number and type of activities were consistent across sites, with an average of 16.9 events and 19.4 consultation contacts with management representatives.²⁴ The intervention activities were translated into Spanish, Portuguese, and Vietnamese.

Data collection. Data were collected by interviewer-administered surveys of 2 cross-sectional samples of employees, one before the beginning of the 18-month intervention (baseline) and the other after its completion (final). Interviews were administered on company time in English, Spanish, Portuguese, or Vietnamese. Baseline and final surveys were conducted at approximately the same time of year to avoid seasonal differences in patterns of eating and physical activity. Participation in the final survey was not contingent on participation in the intervention. The survey response rate in the 26 sites at baseline was 84% (range=70%–98%, n=1740 in the 26 baseline sites and n=1684 in the 24 sites completing the study). The response rate in the 24 sites at final assessment was 77%

(range=54%–93%, n=1408). An embedded cohort of 974 participants in 24 worksites completed both baseline and final surveys. We present analyses of the embedded cohort to track individual behavior changes.

Health Centers Study

Health centers were recruited for study participation from Harvard Vanguard Medical Associates, a health care system comprising 14 multispecialty medical practice centers in greater Boston. All of the 10 health centers invited to enroll agreed to participate. Providers practicing in the internal medicine department of each center were asked for permission to recruit from their patient pool; 83% of providers (n=97) agreed. Patients were eligible to be included in the study if they lived in a low-income, multiracial/multiethnic neighborhood, had a well or follow-up care visit scheduled with a participating provider, spoke and read either English or Spanish, had not been diagnosed with cancer, were not employed by any of the participating health centers or worksites, and consented to participate in the randomized control trial. Neighborhood eligibility was determined through geocoding of census data.²⁵

Intervention methods. The intervention used a social contextual approach targeting multiple levels of influence on behaviors, with special attention to low-literacy skills and the unique features of culture between each ethnic group, as well as the shared themes across cultural groups.²⁵ The intervention consisted of (1) an endorsement of the study from the participant's clinician at a scheduled routine care visit and provision of tailored instructions for the recommended health behavior changes in the form of a "prescription," (2) an initial in-person counseling session with a health adviser, (3) 4 follow-up telephone counseling sessions with the health adviser, (4) 6 sets of tailored materials written for low-literacy audiences that targeted social contextual factors (e.g., family composition, available social support or networks, occupational status, neighborhood safety concerns), and (5) connections to relevant local activities. Ninety percent (978 of 1088) of intervention group participants completed at least 5 of the 6 intervention activities.⁵² The intervention was offered in English and Spanish.

Data collection. To enroll, participants were asked to complete a telephone survey 1 week before their scheduled health center visit, agree to participate in the study, and consent to be randomized to the intervention group.⁵⁰ Study staff attempted to recruit 8963 potentially eligible candidates. Of these candidates, 2547 (28%) could not be reached. Of the remaining 6416, 867 (14%) were ineligible; 3330 (52%) refused. Overall, 2219 participants were enrolled. Assuming that 14% of those not contacted were also ineligible; the response rate was 29% of those assumed to be eligible. All the patients who responded to the baseline survey were contacted after the intervention for the final survey. Of the 2219 baseline respondents, 1954 (88%) completed the final survey. The follow-up response rate was equivalent across conditions.

Measures

Health behaviors. We assessed servings of fruit and vegetables consumed per day by using the 7 survey items that make up the National Cancer Institute's fruit and vegetable screening tool. This measure was developed for the 5-A-Day for Better Health research projects that focused on adults.⁵³ The responses were recoded to equivalent servings per day and summed to obtain total fruit and vegetables servings per day.

Sociodemographic characteristics. Respondents were asked their date of birth and gender and to identify all the racial and ethnic groups to which they belonged. We coded participants who reported being of Hispanic origin in the Hispanic group regardless of any other racial/ethnic groups mentioned. For the remaining participants, those who reported only 1 race/ethnicity were categorized by that group (White, Black, Asian, American Indian), which by definition did not include Hispanics; respondents who selected more than 1 group were classified as multiracial/multiethnic. Because of the small numbers in some categories, we combined some multiracial/multiethnic groups, depending on the racial/ethnic representation in each study. In the health centers study, this combined group included Americans Indians, Asians, other, and multiracial/multiethnic individuals; for the small business study, the combined group included

American Indians, Blacks, and multiracial/multiethnic individuals.

Socioeconomic position was assessed on 3 dimensions: poverty status, occupational class, and education. We assessed household income in \$10 000 increments, from less than \$10 000 per year to \$50 000 or more per year. By combining household income with number of people supported by that income and the ages of household members, we categorized respondents according to the federal poverty guidelines for food aid.⁵⁴ In 2001, the poverty threshold for a single person was \$9214, and the threshold for a family of 2 adults and 2 children was \$17 960. The threshold for eligibility for federal nutrition programs for low-income and working-class families (e.g., the Special Supplemental Nutrition Program for Women, Infant and Children, or WIC) was 185% of the poverty threshold in Massachusetts.

In the small business study, occupational class (manager or nonmanager) was determined by whether the employee managed or supervised others^{26,55} according to information provided by the worksites. In the health centers study, respondents reported the title of their current or most recent job. Job titles were then coded as working class, managerial or technical, or no job reported. Respondents reported their education in 1 of 8 categories, which were collapsed to 3: high school education or less, some post-high school training, and an undergraduate degree or greater.

We combined information about the participants' and their parents' birthplaces into a 3-category measure of generational status: participant born outside the United States, participant born in the United States but 1 or both parents born outside the country, and both the participant and parents born in the United States.⁵⁶ US territories were considered outside the United States for the purposes of this classification.

Modifying conditions

We organized the social context measures by following a social-ecological framework across multiple levels of influence. These levels included individual, interpersonal, organizational, neighborhood, community, and societal factors.

Individual factors. We assessed 4 aspects of material circumstances. First, we asked

respondents to rate their financial situation according to 1 of 4 categories: "Comfortable, with some extras," "Enough, but no extras," "Have to cut back," and "Cannot make ends meet." Second, we asked whether they had run out of food in the last year when they did not have the money to buy more.⁵⁷ Third, we asked whether they owned a car or if one was available to them on a regular basis. Fourth, we asked how many rooms were in the household (excluding bathrooms, porches, halls, and entry ways) and how many people lived there. Households were divided into 3 categories: low crowding, with 3 or more rooms per person; medium crowding, with 1.5 to 3 rooms per person; and high crowding, with less than 1.5 rooms per person.

Interpersonal factors. We examined social networks in 2 dimensions⁵⁸: social ties and diversity of friendship patterns. The presence of social ties was assessed by 4 items: whether the participant (1) had a spouse or partner, (2) had relatives he or she felt close to, (3) had friends he or she felt close to, or (4) was an active member of any groups or clubs. The social ties variable was computed as the number of these ties each participant had (0–4). To evaluate diversity of friendship patterns, we asked participants the ethnicity of their close friends. The 5 response categories were (1) all friends belonged to the participant's ethnic group, (2) most friends belonged to the participant's ethnic group, (3) half belonged to the participant's ethnic group and half to other ethnic groups, (4) most belonged to other ethnic groups, and (5) all belonged to other ethnic groups. (In Table 1, the last 2 groups have been combined.) In addition, respondents who said they were not married or living with a partner but were living with at least 1 child aged younger than 18 years were classified as single heads of household.

For a "multiple family roles" measure, we asked how much responsibility the respondent had for each of the following family roles: "earning money to support the family," "taking care of children," "food shopping and cooking," "taking care of the home," and "taking care of another household." For each role, the response was coded as 0 (little or no responsibility), 0.5 (half the responsibility) or 1 (most or all). We averaged the responses to

arrive at the respondent's portion of all of the family's responsibilities. An average of 0 to 0.33 was categorized as "low," 0.34 to 0.66 as "medium," and 0.67 to 1.0 as "high."

Organizational factors. In the small business study, we asked about job strain and social capital at work. Job strain has been defined by Karasek et al.^{59,60} as the condition of having high psychological demands on the job and low control over the job. Job strain was assessed with items adapted from the Job Content Questionnaire.⁵⁹ We used 2 items to assess the psychological demands of a job ("job makes conflicting demands" and "job requires working fast"). Two measures were combined to assess "job control": 1 item on "decision authority" (respondent had a "lot of say about what happens on the job") and 2 items to assess "skill discretion" ("job requires learning new things" and "job involves doing same things over and over").⁵⁹ "Job control" was created as a weighted sum of "decision authority" and "skill discretion." A worker was considered to have job strain if the psychological demand of his or her job was greater than the national median and job control was below the national median. We obtained national medians^{60,61} and rescaled them to adjust for the number of items used in our study.

To assess social capital at work, we asked respondents to report their agreement with 3 statements: "The people I work with are willing to help each other," "I trust the people I work with," and "The managers of this company look out for the people who work here." Agreement with the 3 items (yes = 1, no = 0) was averaged; the summary score ranged from 1 to 3, with a higher score indicating higher social capital.⁶¹

Neighborhood and community and societal factors. We asked respondents to rate daytime walking in their neighborhood as "safe," "a little unsafe," or "not at all safe."⁶² We also asked whether they had ever been discriminated against; the 5 response categories ranged from "never" to "all the time."^{63–66}

Mediating Mechanisms

Social support. We assessed social support in 3 of the 4 domains of the Inventory of Social Supportive Behaviors⁶⁷—emotional, instrumental, and financial support—using 1

TABLE 1—Baseline Characteristics of Participants, by Study Location: Healthy Directions Studies, 1999–2003

	Health Centers (n = 1954)	Small Business (n = 974)
Sociodemographic characteristics		
Age, mean (SD)	50.2 (12.9)	44 (11)
Education, no. (%)		
High school or less	532 (27.4)	449 (46.5)
Some post-high school	644 (33.2)	328 (34.0)
Undergraduate degree or greater	763 (39.4)	189 (19.6)
Occupation, no. (%)		
Manager or technical	896 (45.9)	
Working class	847 (43.4)	
No job	211 (10.8)	
Manager status, no. (%)		
Nonmanager		805 (82.7)
Manager		169 (17.4)
Poverty, ^a no. (%)		
Above 185%	1618 (84.2)	835 (86.7)
Above poverty, below 185%	197 (10.3)	102 (10.6)
Below poverty	107 (5.6)	26 (2.7)
Race/ethnicity, no. (%)		
Asian/Pacific Islander		65 (6.7)
Black	485 (25.1)	
Hispanic	156 (8.1)	107 (11.1)
Multiracial/multiethnic or other	151 (6.3)	128 (13.3)
White	1168 (60.5)	666 (68.9)
Birth status, no. (%)		
Not born in United States	403 (20.7)	313 (32.3)
Respondent, but not both parents, born in United States	363 (18.7)	90 (9.3)
Respondent and parents born in United States	1180 (60.6)	567 (58.5)
Gender, no. (%)		
Men	663 (34.0)	641 (65.8)
Women	1290 (66.1)	333 (34.2)
Modifying conditions		
Food ran out in last 12 mo, no. (%)		
No	1739 (90.1)	9.3 (94.8)
Yes	192 (9.9)	50 (5.3)
Current financial situation, no. (%)		
“Comfortable, with some extras”	1255 (65.2)	608 (63.3)
“Enough, but no extras”	438 (22.7)	225 (23.4)
“Have to cut back”	148 (7.7)	101 (10.5)
“Cannot make ends meet”	85 (4.4)	26 (2.7)
Diversity of friends, no. (%)		
All from respondent's ethnic group	407 (22.0)	211 (22.6)
Most from respondent's ethnic group	628 (34.0)	317 (33.9)
Half and half	654 (35.4)	354 (37.9)
Most or all from other ethnic groups	161 (8.7)	53 (5.7)
Amount of multiple family roles, ^b no. (%)		
Low	498 (25.5)	288 (29.7)
Medium	1102 (56.4)	546 (56.3)
High	354 (18.1)	136 (14)
Single head of household, no. (%)		
No	1853 (94.8)	944 (96.9)
Yes	101 (5.2)	30 (3.1)

Continued

item from each domain. For each item, participants responded that support was “always available,” “sometimes available,” “available but wouldn’t accept help,” that participants “don’t need help,” or that support was “not available.” Social support was then computed as the number of domains always or sometimes available to the respondent (0–3, excluding “don’t need help” and “available but wouldn’t accept”).

Social norms for fruit and vegetable consumption. Our measure was based on the work of Raven and Rubin⁶⁸ and adapted from the Treatwell 5-A-Day social norms measures.⁶⁹ We asked participants how many of their coworkers (small business study respondents) or friends and family (health center study respondents) ate at least 5 servings of fruits and vegetables a day. Response categories were “few or none,” “some,” “most or all,” and “don’t know.”

Self-efficacy. Self-efficacy to change was measured as a single item: “If you thought you needed to improve at least 1 of the target health habits, how sure are you that you could do something about it in the next 30 days?” Health habits targeted by the Healthy Directions intervention model included eating at least 5 servings of fruits and vegetables daily, eating red meat no more than 3 times a week, being physically active, and taking a daily multivitamin. Response categories were “sure,” “maybe,” and “not at all sure.”

Motivation to change. Motivation to change was not measured separately for each behavior; rather, it was assessed by a participant’s intention to improve any of the health habits (e.g., fruit and vegetable intake, physical activity, multivitamin intake, red meat consumption) in the next 30 days or 6 months. Categories included “not seriously thinking about improving any of the target health habits in the next 6 months” (precontemplation), “thinking about improving 1 or more health habits in the next 6 months but not planning on doing something to improve them in the next 30 days” (contemplation), and “planning to do something to improve at least 1 health habit in the next 30 days” (preparation).⁷⁰

Statistical Analysis

To evaluate the effect of the variables in the model on the consumption of fruit and

TABLE 1—Continued

Neighborhood safety, no. (%)		
Safe	1858 (95.5)	932 (96.1)
A little safe	65 (3.3)	29 (3.0)
Not at all safe	22 (1.1)	9 (0.9)
Crowding in household, no. (%) ^c		
Low	472 (24.2)	176 (18.1)
Medium	998 (51.1)	482 (49.5)
High	484 (24.8)	316 (32.4)
Car owned or available, no. (%)		
No	273 (14.0)	73 (7.6)
Yes	1673 (86.0)	894 (92.5)
Experienced discrimination, no. (%)		
Never	636 (32.8)	614 (64)
Only a few times in life	851 (43.8)	242 (25.2)
Sometimes	345 (17.8)	83 (8.7)
Often	89 (4.6)	16 (1.7)
All the time	20 (1.0)	5 (0.5)
Job strain, no. (%)		
No		698 (73.3)
Yes		254 (26.7)
Social ties, ^d mean (SD)	2.5 (0.9)	2.5 (0.8)
Social capital, ^e mean (SD)		2.76 (2.8)
Mediating mechanisms		
Social norms for fruit and vegetable consumption, ^f no. (%)		
Few or none	367 (18.9)	246 (25.5)
Some	609 (31.3)	243 (25.2)
Most or all	529 (27.2)	102 (10.6)
Don't know	441 (22.7)	375 (38.8)
Self-efficacy, ^g no. (%)		
No	563 (29.0)	280 (29.7)
Yes	1380 (71.0)	664 (70.3)
Motivation to change, ^h no. (%)		
Precontemplation	230 (11.8)	196 (20.6)
Contemplation	95 (4.9)	77 (8.1)
Preparation	1619 (83.3)	680 (71.4)
Social support, ⁱ mean (SD)	4.7 (1.6)	5 (1.5)

^aPoverty status categories are (1) income 185% or more of the federal poverty line, (2) income above the poverty line but below 185% of the poverty line, and (3) income below the poverty line. For assessment of poverty status, see "Methods" section.

^bThe number of family roles for which a respondent had most or all of the responsibility. For explanation of assessment, see "Methods" section.

^cLow crowding = 3 or more rooms per person; medium crowding = 1.5 to 3 rooms per person; high crowding = less than 1.5 rooms per person.

^dThe presence of social ties was assessed by 4 items: whether respondents (1) had a spouse or partner, (2) had relatives they felt close to, (3) had friends they felt close to, (4) were an active member of any groups or clubs.

^eTo assess social capital at work, we asked respondents to report their agreement with 3 statements: "The people I work with are willing to help each other," "I trust the people I work with," and "The managers of this company look out for the people who work here." Agreement with the 3 items (yes = 1, no = 0) was averaged; the summary score ranged from 1 to 3, with a higher score indicating higher social capital.⁶²

^fRespondents were asked how many of their coworkers (Small Business Study) or friends and family (Health Centers Study) ate at least 5 servings of fruits and vegetables a day.

^gRespondents were asked, "If you thought you needed to improve at least one of the target health habits, how sure are you that you could do something about it in the next 30 days?"

^h"Precontemplation" indicates that respondent was "not seriously thinking about improving any of the target health habits in the next 6 months," "contemplation" that respondent was "thinking about improving 1 or more health habits in the next 6 months but not planning on doing something to improve them in the next 30 days," and "preparation" that respondent was "planning to do something to improve at least 1 health habit in the next 30 days."

ⁱFor assessment of social support, see "Methods" section.

vegetables, we computed a least squares linear regression analysis of servings of fruit and vegetables at the final survey on baseline characteristics of the respondents. We analyzed the 2 samples separately and used data from the respondents who completed both the baseline and final surveys. In all analyses, we controlled for baseline fruit and vegetable consumption as well as the design effects, intervention group, and unit of randomization (health center or worksite).⁷¹

In all analyses, we controlled for baseline fruit and vegetable consumption, intervention group, and unit of randomization. We first tested the association of each baseline variable alone with servings of fruit and vegetables at final assessment, controlling for baseline consumption, intervention group, and randomization unit. We then computed the same multivariable model in each study. For this model, we selected all variables that were individually significantly associated with fruit and vegetable consumption at final assessment in either study. To assess intervention effect modification (the extent to which a relationship differed in the presence or absence of the intervention), we tested for the interaction of statistically significant main effects and intervention group. The interaction effects tested differed by study sample depending on the significant main effects in that sample.

We report the slope coefficients from the resulting analyses. The slope coefficients represent the change at final assessment in fruit and vegetable consumption per unit change in the explanatory variable, with baseline consumption held constant. We retained the same variables in the models in both study samples so that we could compare the slope coefficients across samples and so that all associations would be adjusted for the same covariates. All tests were analyzed using the Wald test based on the type III sums of squares.⁷¹

RESULTS

Sociodemographic Characteristics and Overall Trial Results

The 2 study samples differed on several baseline characteristics, as would be expected with the different study populations. The health centers sample had a higher mean age

TABLE 2—Association of Selected Variables With Fruit and Vegetable Consumption at Final Assessment, by Study Location: Healthy Directions Studies 1999–2003

	Health Centers (n = 1920)		Small Business (n = 974)	
	Slope	P ^a	Slope	P ^a
Education		.001		.46
High school or less	-0.26		-0.15	
Some post-high school	-0.21		-0.16	
Undergraduate degree or more	0		0	
Occupation		.07		
Manager or technical	0.09			
Working class	-0.06			
No job	0			
Manager status				.36
No			-0.115	
Yes			0	
Poverty ^b		.007		.82
Above 185%	0.23		-0.18	
Above poverty, below 185%	-0.08		-0.148	
Below poverty	0		0	
Race/ethnicity		.21		.70
Asian			-0.17	
Black	-0.09			
Hispanic	-0.19		0.09	
Multiracial/multiethnic or other	-0.21		-0.06	
White	0		0	
Birth status		.03		.06
Not born in the United States	-0.21		0.25	
Respondent, but not both parents, born in the United States	-0.10		0.16	
Respondent and parents born in the United States	0		0	
Gender		.30		.002
Men	-0.07		-0.33	
Women	0		0	
Food ran out in last 12 mo		.003		.01
No	0.32		0.54	
Yes	0		0	
Social networks (continuous) ^c	0.16	<.001	0.09	.11
Multiple roles ^d		.49		.04
Low	0.04		-0.40	
Medium	0.09		-0.28	
High	0		0	
Single head of household		.69		.004
No	0.06		-0.80	
Yes	0		0	
Crowding in household ^e		<.001		.06
Low	0.19		0.33	
Medium	0.15		0.16	
High	0		0	

Continued

and a greater percentage of women than the small business sample. Both samples had smaller percentages of Whites than did the population of the eastern Massachusetts consolidated metropolitan statistical area,⁵¹ and the racial/ethnic makeup of non-Whites was different in the 2 samples.

Increases in fruit and vegetable consumption from baseline to final assessment were significantly greater in the intervention than in the control groups. Overall mean consumption of fruits and vegetables at baseline was 3.24 servings per day in the health centers sample and 3.28 servings per day in the small business sample. Patients in the intervention health centers increased their consumption by 0.32 servings per day, compared with a slight decrease among participants in the control health centers ($P < .001$). Similarly, workers in the intervention worksites increased consumption an average of 0.37 servings per day, compared with a very small increase among workers in the control worksites ($P = .003$).

Baseline Social Contextual Factors and in Fruit and Vegetable Consumption

We tested the association of an increase in fruit and vegetable consumption with each social contextual factor shown in Table 1. Table 2 shows the effects of selected variables on final fruit and vegetable consumption, with control for baseline consumption, intervention group, and randomization group. In the health centers study sample, increases in fruit and vegetable consumption were significantly associated with higher education, income above 185% of the poverty line, being born in the United States or with parents born in the United States, not having had food run out in the last 12 months, greater social networks, access to a car, more supportive social norms, and greater self-efficacy. The slopes presented in Table 2 represent the difference among groups in change in fruit and vegetable consumption compared with the reference group. For example, among health centers participants, the increase in daily intake of fruit and vegetables was about a quarter (0.26) of a serving less among those with a high school education or less than among those with an undergraduate degree or greater, and those with some education

TABLE 2—Continued

Car owned or available		<.001		.50
No	-0.31		0.13	
Yes	0		0	
Social norms for fruit and vegetable consumption ^f		.003		.02
Few or none	0.06		0.02	
Some	0.13		-0.17	
Most or all	0.32		0.38	
Don't know	0		0	
Social support (continuous)	0.04	.06	-0.01	.85
Self-efficacy ^g		.005		.19
No	-0.20		-0.14	
Yes	0		0	
Motivation ^h		.37		.52
Precontemplation	0.12		-0.08	
Contemplation	0.12		-0.18	
Preparation	0		0	

Note. Zero denotes reference category. Analyses were controlled for baseline consumption, intervention group, and randomization unit.

^aP value for test of no association between that characteristic and fruit and vegetable consumption.

^bPoverty status categories are (1) income 185% or more of the federal poverty line, (2) income above the poverty line but below 185% of the poverty line, and (3) income below the poverty line. For assessment of poverty status, see "Methods" section.

^cFor assessment of social networks, see "Methods" section.

^dThe number of family roles for which a respondent had most or all of the responsibility.

^eLow crowding = 3 or more rooms per person; medium crowding = 1.5 to 3 rooms per person; high crowding = less than 1.5 rooms per person.

^fRespondents were asked how many of their coworkers (small business study) or friends and family (health centers study) ate at least 5 servings of fruits and vegetables a day.

^gRespondents were asked, "If you thought you needed to improve at least one of the target health habits, how sure are you that you could do something about it in the next 30 days?"

^h"Precontemplation" indicates that respondent was "not seriously thinking about improving any of the target health habits in the next 6 months," "contemplation" that respondent was "thinking about improving 1 or more health habits in the next 6 months but not planning on doing something to improve them in the next 30 days," and "preparation" that respondent was "planning to do something to improve at least 1 health habit in the next 30 days."

beyond high school reported a daily increase of about a fifth (0.21) of a serving less than those with an undergraduate degree or greater.

In the small business study, increases in fruit and vegetable consumption were significantly associated with being a woman, not having had food run out, performing a greater number of multiple family roles, not being a single head of household, and more supportive social norms. Other variables tested in the analyses were not statistically significant (data not shown).

Multivariable Model for Social Context and Fruit and Vegetable Consumption

We computed the same multivariable model in each study sample, selecting the variables that were statistically significant in either sample (Table 2), with several

exceptions. We did not include poverty because it was correlated with whether food ran out, which was significant in both samples. We did not include "multiple roles" because it was correlated with single heads of households. The resulting models are presented in Table 3.

After we controlled for other variables in the model, increases in fruit and vegetable consumption were significantly associated with more supportive social norms and more social ties in both studies. In addition, increases in consumption were highest among women, those born outside the United States, and single heads of households in the small business study and among those with more education in the health centers study. In the small business study, increases in fruit and vegetable consumption were significantly higher for those for whom food did not run

out and those with lower household crowding. In the health centers study, increases in consumption were significantly associated with having access to a car and were also associated with higher self-efficacy to change 1 or more target behaviors.

We tested for intervention effect modification by examining the interaction of statistically significant main effects with the intervention effect. In the health centers study, we found significant intervention effect modification with regard to access to a car ($P=.02$). Among participants in the intervention group, those with access to a car reported an increase in fruit and vegetable consumption of 0.55 servings more than those without access to a car. In the control group, those with and without a car reported changes in consumption that were similar to those in the intervention group who had no access to a car. In the small business study, we found 2 significant interactions between the intervention and characteristics posited by the social contextual model. In the intervention group, those not born in the United States increased consumption of fruits and vegetables by more than 0.5 servings more than those born in the United States, and all those in the control group reported increases smaller than those in the intervention group ($P=.008$). In addition, within the intervention condition, those who were single heads of households increased consumption by 1.7 servings more than those who were not, and those in the control group reported increases smaller than those in the intervention group ($P=.002$).

DISCUSSION

Social context matters in health behavior change. We examined the relationships of selected social contextual factors and individual factors hypothesized to be associated with change in fruit and vegetable consumption in this racially/ethnically diverse, working-class population. As illustrated in the model, we sought to explicate the pathways through which population characteristics, such as income and occupation, might influence changes in consumption. Although the pattern of these relationships varied to some extent in these 2 sister studies, the results demonstrate the important roles that social context

TABLE 3—Main Effects Model of Multivariable Associations of Social Contextual Variables With Fruit and Vegetable Consumption at Final Assessment, by Study Location: Healthy Directions Studies, 1999–2003

	Health Centers (n = 1850)		Small Business (n = 899)	
	Slope	P ^a	Slope	P ^a
Intercept	1.94		2.45	
Education		.04		.55
High school or less	-0.16		-0.15	
Some post-high school	-0.18		-0.12	
Undergraduate degree or greater	0		0	
Birth status		.08		.04
Not born in United States	-0.14		0.24	
Born in United States	0		0	
Food ran out in last 12 mo		.14		.02
No	0.17		0.52	
Yes	0		0	
Crowding in household ^b		.23		.03
Low	0.15		0.40	
Medium	0.12		0.17	
High	0		0	
Car owned or available		.04		.25
No	-0.20		0.23	
Yes	0		0	
Social norms for fruit and vegetable consumption ^c		<.001		.02
Most/all	0.24		0.39	
Other	0		0	
Gender		.10		.01
Men	-0.11		-0.27	
Women	0		0	
Single head of household		.76		.03
No	-0.05		-0.62	
Yes	0		0	
Self-efficacy ^d		.03		.19
No	-0.15		-0.14	
Yes	0		0	
Social ties ^e	0.13	<.001	0.12	.04
Intervention status		<.001		<.001
Control group	0		0	
Intervention group	0.37		0.40	
Baseline servings of fruits and vegetables	0.42	<.001	0.52	<.001

Note. Zero denotes reference category. Analyses were controlled for baseline consumption, intervention group, and randomization units.

^aP value for type III test that all slope(s) = 0.

^bLow crowding = 3 or more rooms per person; medium crowding = 1.5 to 3 rooms per person; high crowding = less than 1.5 rooms per person.

^cRespondents were asked how many of their coworkers (small business study) or friends and family (health centers study) ate at least 5 servings of fruits and vegetables a day.

^dRespondents were asked, "If you thought you needed to improve at least 1 of the target health habits, how sure are you that you could do something about it in the next 30 days?"

^eFor assessment of social ties, see "Methods" section.

can play in promoting changes in fruit and vegetable consumption.

Main Effects

Across the 2 studies, change in fruit and vegetable consumption was strongly and consistently associated with 2 social contextual factors—social networks and supportive social norms—suggesting a particular robustness in these relationships. Prior reports have also found social support to be a correlate of change in fruit and vegetable consumption.^{72–76} Furthermore, increased fruit and vegetable consumption was less likely to be reported by those in households with indicators of substantial financial strain, represented in the small business study by household crowding and running out of food over the last 12 months and by access to a car in the health centers study. Several sociodemographic characteristics also were associated with improvements in fruit and vegetable consumption, including being a woman and having higher levels of education. These results are consistent with other studies that have demonstrated increased intake of fruits and vegetables by women compared with men^{77–79} and by persons with higher education levels.⁷⁷ These findings indicate that even within working-class populations, education confers an advantage, and economic constraints appear to limit capacity to change.

In both studies, increased consumption of fruit and vegetables was associated with higher baseline levels of self-efficacy, replicating the work of prior studies.^{33,80,81} Others have reported associations between positive change in fruit and vegetable consumption and belief in a link between behavior and disease, perception of a risk to health from not eating enough fruits and vegetables, and knowledge about nutrition.^{82–86} This study broadens the focus of this research by simultaneously examining multiple social contextual factors.

Interactions With the Intervention and Differences in Intervention Effectiveness

This intervention was successful in promoting increases in fruit and vegetable consumption among its intended audience—diverse racial/ethnic groups and working-class populations. In both studies, there was no meaningful or statistically significant difference in

the efficacy of the intervention by race or ethnicity. In the small business study, the intervention effect was actually greater among those born outside of the United States. The intervention was also more successful in the small business study in influencing consumption patterns of single heads of households. In addition, the intervention was equally effective across occupational groups. In the health centers study, the only variable to interact significantly with the intervention was access to a car. In the intervention group, those without access to a car were similar to the control group in being less likely to increase fruit and vegetable intake.

These differences between the study sites in the interactions with the interventions may reflect the differing approaches to the intervention in the 2 studies. In the small business study, the intervention capitalized on the social interactions and environmental supports of the worksite, and it was particularly efficacious for immigrant groups and single heads of households. In the health centers study, the intervention was tailored to social contextual factors; in both in-person and telephone counseling sessions, social contextual variables were addressed as participants worked on implementing behavioral recommendations. Differences could also reflect variations in the compositions of each study sample; for example, a larger proportion of small business than health centers participants were not born in the United States, and a larger proportion of health centers participants were Black. In addition, the social contextual conditions surrounding the intervention participants differed across the 2 samples, as illustrated in Table 1.

Limitations and Strengths

Several caveats must be considered in the interpretation of our findings. Because these were not population-based samples, we were not able to look at the relationship of these social contextual factors outside the circumstances of an intervention evaluation. We recognize that there are limitations in self-report measures of dietary intake and that some measurement error may have been introduced by our use of the fruit and vegetable screening tool. There may be an artificial floor or ceiling effect because of the limited

number of items and categories for response. In population-based studies such as these, it is necessary to balance the costs and feasibility of self-report versus biological outcome measures of potential intervention effects.

We selected a short measure of self-reported fruit and vegetable intake with known characteristics. Using self-report and combining fruit and vegetable intake into a single metric are common ways of assessing the effectiveness of interventions targeting this aspect of the diet.^{53,87} The social environment also was measured through self-report and thus should be interpreted with caution, given that these reports likely reflect individual perceptions and interpretations of the social environment; future research would benefit from incorporating objective measures of the social environment. We should also note that this study specifically aimed to include a working-class, multiethnic sample; the relatively low percentage of the study population below the federal poverty level was consistent with this aim.

This study also had numerous strengths. To our knowledge, ours is the first analysis to examine multiple indicators of the social context in relation to improvements in fruit and vegetable consumption. These studies were designed to test interventions hypothesized to be effective in a multiethnic population; the efficacy of this approach is demonstrated by the finding that the intervention effects did not differ by race/ethnicity. We were able to examine longitudinally the relationship between social contextual factors measured at baseline and changes in health behaviors measured after the intervention. We examined and compared these relationships across data collected in 2 settings—small businesses and health centers—thereby increasing the generalizability of these results.

Conclusion

We underscore the importance of the social context in the process of health behavior change.^{1–3,5,88} Understanding patterns in the distribution of health behaviors and related health outcomes by socioeconomic position and other aspects of the social environment is necessary for guiding priority setting in resource allocation. In addition, our social contextual model of health behavior change posits that social class matters because of its

impact on the social context. We have explored the pathways through which population characteristics, such as income, might influence change in fruit and vegetable consumption. For example, we observed that smaller improvements in consumption were associated with material circumstances such as not having access to a car, living in crowded housing conditions, and running out of food. It is important that behavioral interventions incorporate and reflect these realities of participants' daily lives and that policy interventions be designed to reduce these constraints.

We also found that the presence of strong social ties and social norms supporting fruit and vegetable consumption were pivotal to the behavior change process, indicating the need for interventions that directly aim to build such supports. The social contextual model of health behavior change provides a useful tool for designing and testing interventions for working-class, multiethnic populations. This intervention model presents a starting point as the public health field moves toward developing interventions that will be most effective among such populations. ■

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Contributors

G. Sorensen originated the study and, as the principal investigator for the overall program project and the small business study, supervised all aspects of its

implementation and took the lead in writing the article. A. Stoddard assisted in the overall study design, led the data analyses, participated in interpretation of the findings, and wrote the first drafts of the sections on data analysis and results. T. Dubowitz led the literature reviews and wrote the first draft of the introduction. E.M. Barbeau assisted in overall study design and implementation. J.A. Bigby participated in originating the article and contributed to interpreting the findings, with particular attention to the literature on health disparities. K.M. Emmons was the principal investigator for the Health Centers Study and managed all aspects of its implementation. L.F. Berkman contributed to the study design and measures development. K.E. Peterson contributed to the conceptualization of the article and interpretation of the findings.

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Human Participant Protection

This research was approved by the institutional review boards of Harvard School of Public Health and the Dana-Farber Cancer Institute. The Healthy Directions–Health Centers Study was additionally reviewed and approved by Harvard Medical School's Division of Ambulatory Care and Prevention.

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