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Associations of psychosocial factors with fruit and vegetable intake among African-Americans

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Abstract

Objective: To examine associations of various psychosocial factors with fruit and vegetable intake in African-American adults.

Methods: A cross-sectional survey of a population-based sample of 658 African-Americans, aged 18–70 years, in North Carolina. Information was collected on diet-related psychosocial (predisposing, reinforcing and enabling) factors based on the PRECEDE (Predisposing, Reinforcing, and Enabling Constructs in Educational Diagnosis and Evaluation) planning framework; demographic, lifestyle and behavioural characteristics, and fruit and vegetable intake.

Results: The mean participant age was 43.9 years (standard deviation 11.6), 57% were female and 76% were overweight/obese. Participants expressed healthy beliefs regarding many of, but not all, the psychosocial factors. For example, although half of the respondents believed it is important to eat a diet high in fruits/vegetables, only 26% knew that ≥5 daily servings are recommended. The strongest associations of the psychosocial factors with fruit/vegetable intake were for predisposing factors (e.g. belief in the importance of a high fruit/vegetable diet and knowledge of fruit/vegetable recommendations) and one reinforcing factor (social support), with differences between the healthiest and least healthy responses of 0.5–1.0 servings per day. There was evidence of effect modification by gender in associations between psychosocial factors and fruit/vegetable consumption (e.g. self-efficacy was only significant in women), with higher intakes and generally healthier responses to the psychosocial variables in women than men.

Conclusions: Interventions to increase fruit/vegetable intake in African-Americans may be more effective if they focus primarily on predisposing factors, such as knowledge, self-efficacy and attitudes, but not to the exclusion of reinforcing and enabling factors. The psychosocial factors that are targeted may also need to be somewhat different for African-American men and women.

Keywords
African-Americans
Eating behaviour
Fruits
Vegetables
Psychosocial factors
PRECEDE framework

Diets high in fruits and vegetables are associated with lower risks of obesity and several chronic illnesses[1–5]. In the USA, African-Americans are at disproportionately higher risk for many diet-related medical conditions, such as diabetes[6] and cardiovascular disease[7], and have the highest cancer burden of any US racial or ethnic group[8]. Approximately 70% of African-Americans are overweight or obese, considerably higher than the national average (57% for the total population)[9]. Underscoring these disparate health risks are survey data showing that African-Americans do not meet the recommended 5–9 servings of fruits and vegetables daily[10]. According to the 2002 Behavioral Risk Factor Surveillance Survey (BRFSS), fewer than 19% of African-Americans in North Carolina consumed at least five fruit and vegetable servings per day, which is lower than the median for the US (22.6%) and North Carolina white populations (24.7%)[11]. Baseline data from the National Cancer Institute's (NCI) '5 A Day' programme indicate that African-Americans consume more fruit (mostly via fruit juice) but fewer vegetables than whites[12]. On average, African-American men and women consume 3.3 and 3.5 servings of fruits and vegetables per day, respectively, far less than the recommended 5–9 servings[12]. A variety of demographic and environmental factors, including age, gender, education, socio-economic status, childhood eating

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patterns and the local food environment, have been associated with lower fruit and vegetable intakes among African-Americans[13–15] and, although less studied, so have several key psychosocial variables, such as self-efficacy and social support[16–18].

Interventions to increase fruit and vegetable consumption in the general population have been conducted with varying levels of success, with most programmes resulting in increases of 0.2–0.6 servings per day[19]. These interventions have typically examined sociodemographic characteristics, such as age, gender, education and socio-economic status, and a handful have considered psychosocial factors as potentially mediating variables[17,20,21]. However, psychosocial factors may be important predictors or correlates of dietary behaviour, particularly fruit and vegetable consumption. For example, results from NCI's '5 A Day' programme showed that psychosocial factors were more important determinants of fruit and vegetable intake than demographic factors alone[22]. Three dietary interventions, aimed at African-American churches, that incorporated both demographic and psychosocial factors in their design resulted in relatively large increases of 0.7–1.4 fruit and vegetable servings per day[19]. Even so, few studies have examined the possible influence of psychosocial factors on fruit and vegetable intake, and there are even fewer such data for African-Americans. One recent study of psychosocial factors in a sample of African-American men concluded that men were motivated by perceived benefits to consume fruits, whereas vegetable consumption was driven by extrinsic rewards[23]; we are not aware of a similar study in African-American women. Clearly, additional knowledge regarding the possible impact of psychosocial factors on fruit and vegetable consumption is essential for designing optimal interventions to promote this behaviour in African-American men and women.

One particularly effective theory-based dietary intervention trial, the Black Churches United for Better Health Project, used the PRECEDE/PROCEED planning framework to organise concepts based on the Social Cognitive Theory, Stages-of-Change Transtheoretical Model and Social Support Models[17]. This intervention resulted in an increase of 0.85 servings of fruits and vegetables per day after 2 years. The PRECEDE (Predisposing, Reinforcing, and Enabling Constructs in Educational Diagnosis and Evaluation) planning framework, used to understand motivations for healthy dietary behaviours and mediating factors in dietary interventions, categorises psychosocial factors into three main categories: predisposing, reinforcing and enabling factors[24]. Predisposing factors are antecedents that influence the likelihood of how one will behave and include the individuals' knowledge, attitudes, beliefs, existing skills, personal preferences and self-efficacy (i.e. the extent that someone believes they can successfully perform a given behaviour)[24]. Reinforcing factors are incentives following a behaviour that may affect the likelihood that this behaviour will be repeated over time, such as social support, peer influence, significant others and rewards[24]. Enabling factors help facilitate a behaviour and may include programmes, services and resources necessary for a behaviour to occur[24]. It has been noted that this model is particularly well suited for studies of minority populations because it is amenable to adaptation to the population of interest[25].

In this report, we use the PRECEDE framework to (1) describe psychosocial (predisposing, reinforcing and enabling) factors related to fruit and vegetable intake; and (2) examine associations of these factors with fruit and vegetable intake in a population-based sample of African-American men and women in North Carolina. This work has important implications for the design of interventions to increase fruit and vegetable intake in African-Americans.

Methods

Study population and data collection

Data presented here were collected as part of a study examining methods and strategies to recruit African-Americans into cancer prevention studies. Detailed study design and data collection information are described elsewhere[26]. Briefly, 5000 potential African-American participants, aged 18–70 years, residing in six North Carolina counties (three urban, three rural) were randomly selected from Department of Motor Vehicle rosters and assigned at random to one of five recruitment strategies, based on variations of approach letters and inclusion, non-inclusion or promise of an incentive. Specifically, the five recruitment strategies were: generic letter only, culturally sensitive letter only, culturally sensitive letter plus promise of an incentive, generic letter plus included incentive and culturally sensitive letter plus included incentive. All prospective participants were sent an 11-page questionnaire by mail with a pre-paid return envelope, as well as instructions for completing the survey via the Internet or by telephone. An advance postcard was sent to alert potential participants to the upcoming questionnaire mailing and a reminder letter was sent 2–3 weeks later with information for obtaining a replacement questionnaire and instructions for completing the survey by telephone or the Internet. The questionnaire assessed various demographic, lifestyle, dietary and behavioural cancer risk factors and was pre-tested in a small sample. The study had a 17.5% response rate ($n = 747$): 87.7% by mail, 11.2% via the Internet and 1.1% by telephone. Data were excluded from 89 respondents who did not meet eligibility criteria and whose questionnaires failed quality control checks; data from the remaining 658 persons were used for the analyses presented here. The study was approved by the Institutional Review Board of the School of Public Health at the University of North Carolina–Chapel Hill.

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Survey instrument

Using the PRECEDE framework as a guide, an 11-page questionnaire was designed to measure demographic, psychosocial, lifestyle and behavioural factors related to cancer prevention. Three sets of these questions were used in our analyses: diet-related psychosocial factors, demographic characteristics, and fruit and vegetable intake. All data are self-reported.

Diet-related psychosocial factors

Questions designed to capture psychosocial factors were adapted from previous studies that used the PRECEDE framework to examine psychosocial variables as mediating factors in interventions aimed at increasing fruit and vegetable intake[21,27,28]. PRECEDE organises psychosocial factors into three main categories: predisposing, reinforcing and enabling factors[24]. Predisposing factors included questions regarding knowledge, attitudes, taste preferences and self-efficacy. Healthful eating self-efficacy was assessed by a Likert-scale (very confident, somewhat confident or not very confident) item about respondents' confidence in their ability to eat more fruits and vegetables. Reinforcing factors addressed social support. Respondents were asked whether they felt they could count on those close to them: to encourage them to eat healthfully; to tell them about healthier foods and how to prepare them; to prepare healthier foods with them; and to eat healthier foods with them. Enabling factors included four items related to perceived barriers to healthy eating, and queried respondents on whether: they can afford to purchase healthy foods and meals; it takes too much time and trouble to prepare healthy meals; it is easy for them to order healthy foods in restaurants; and they need more information on how to prepare healthy foods and meals. Scales were created for each set of factors by linearly summing responses to individual questions (least healthy responses scored the lowest and the healthiest responses scored the highest). All questions had an equal number of possible responses, and a summary score for each scale was computed as the mean of the non-missing responses. The distinctions 'least healthy' and 'most healthy' are used only to categorise the responses to each psychosocial factor. We do not intend to make any inference as to actual behaviour. Table 1 gives the questions, response options and the distribution of participants' responses.

Demographic characteristics

Various demographic characteristics were assessed, including age (categorised approximately into tertiles),

Table 1 Distribution of participants by response to each psychosocial factor among African-Americans in North Carolina ($n = 658$)

	Healthiest response	*n* (%)	Moderate response	*n* (%)	Least healthy response	*n* (%)
Predisposing factors						
Do you think what you eat and drink are related to your own chance of getting cancer? (Yes/No); Do you think this relationship between diet and cancer is:	Yes, strong	324 (49)	Yes, moderate	198 (30)	Yes, weak, or no	136 (21)
How many servings of fruits and vegetables should one eat *each day* for good health?	5 or more	173 (26)	3–4	274 (42)	1–2	211 (32)
How important is it to you personally to eat a diet high in fruits and vegetables?	Very important	326 (50)	Somewhat important	252 (39)	Not important	74 (11)
If you wanted to eat more fruits and vegetables, how confident are you that you could do it?	Very confident	389 (60)	Somewhat confident	208 (32)	Not confident	54 (8)
Have you ever heard of the Food Guide Pyramid?	Yes	533 (82)	Not sure/don't know	94 (14)	No	25 (4)
Do you like the taste of most fruits?	Yes	591 (91)	Sometimes	32 (5)	No	30 (5)
Do you like the taste of most vegetables?	Yes	514 (79)	Sometimes	68 (10)	No	70 (11)
Reinforcing factors						
If you tried to eat healthier foods, how much could you count on the people close to you to:						
Encourage you	A lot	310 (48)	Some	261 (40)	Not at all	76 (12)
Tell you about healthier foods and how to prepare them.	A lot	164 (26)	Some	336 (52)	Not at all	142 (22)
Prepare healthier foods with or for you.	A lot	161 (25)	Some	300 (46)	Not at all	185 (29)
Eat healthier foods with you.	A lot	198 (31)	Some	361 (56)	Not at all	89 (14)
Enabling factors						
Do you feel that you can afford to purchase healthy foods, such as fruits and vegetables?	Yes	463 (72)	Sometimes	127 (20)	No	55 (9)
Do you feel that it takes a lot of time and trouble to prepare healthy foods and meals?	No	338 (52)	Sometimes	146 (23)	Yes	162 (25)
Do you feel that it is easy for you to order healthy foods when you go out to eat at restaurants?	Yes	246 (38)	Sometimes	205 (32)	No	196 (30)
Do you more need information on how to prepare healthy foods and meals?	No	196 (30)	Sometimes	75 (11)	Yes	379 (58)

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gender, education (less than or equivalent to high school, some college, college graduate or advanced degree), marital status (never married, married/living with partner or divorced/separated/widowed), self-rated health status (excellent, very good, good, fair or poor) and county of residence (urban or rural). Using self-reported height and weight, body mass index (BMI) was calculated as kg m^{-2} and further categorised as normal (18.5–24.9), overweight (25.0–29.9) or obese ($\geq$30.0)[29]. Information was collected about other lifestyle and behavioural characteristics, such as physical activity and smoking, but was not included in these analyses.

Fruit and vegetable intake

Fruit and vegetable consumption during the past 3 months was assessed using the 7-item fruit and vegetable screener developed at the NCI[30,31]. Fruit intake was the sum of 'fruit juice' and 'fruit, not counting juice', and vegetable intake was calculated as the sum of green or lettuce salad, potatoes (boiled, baked or mashed), other vegetables, beans and peas, and vegetables in mixed dishes. Fruit and vegetable intake was calculated as the sum of all seven items. The standard approach for evaluation in the '5 A Day' programme was used to calculate fruit and vegetable servings per day[32].

Statistical analyses

Data analyses were performed using Stata (version SE 8.2; STATA Corp.). Descriptive statistics (means and percentages for continuous and categorical variables, respectively) were calculated for all demographic, psychosocial and dietary variables. Missing data were excluded from analyses; on average, $<$2% of data were missing. For each demographic characteristic, one-way analysis of variance models were used to assess whether there were statistically significant differences between the mean values of each psychosocial (i.e. predisposing, reinforcing and enabling) scale and mean fruit and vegetable consumption (servings per day). To examine associations between the psychosocial scales (categorised into approximate tertiles) and fruit and vegetable intake, we used multiple linear regression models to calculate unadjusted and adjusted (for age, gender, education and BMI) means for fruit, vegetable and total fruit and vegetable intake (servings per day) as well as overall *P*-values. We also compared associations of each psychosocial factor (categorised by least healthy to most healthy response) with fruit and vegetable intake by using multiple linear regression models to generate mean values for fruit and vegetable intake, unadjusted and adjusted for age, gender, education, BMI and the other predisposing, reinforcing and enabling factors. The fruit and vegetable variables were not transformed because the data were not markedly skewed, based on recommendations in Curran *et al.*[33]. Statistical tests were two-sided, and *P*-values $\leq$0.05 were considered statistically significant.

Results

Table 1 gives each predisposing, reinforcing and enabling factor and the distributions of responses ($n = 658$). Participants expressed healthy beliefs regarding many of, but not all, the psychosocial factors. Among predisposing factors, half of the participants believed it is important to eat a diet high in fruits and vegetables and 60% were very confident they had the ability to increase their intake; however, only 26% knew that five or more daily servings of fruits and vegetables are recommended. The vast majority had heard of the Food Guide Pyramid (82%) and liked the taste of most fruits (91%) and vegetables (79%). Among reinforcing factors (social support), 88% of respondents could count on those around them 'a lot' or 'some' to encourage them if they tried to eat healthier foods. Approximately half could rely on their family and social referents 'some' to: tell them about healthier foods (52%), prepare healthier foods with them (46%) and eat healthier foods with them (56%). Among enabling factors, most respondents (72%) could afford to purchase fruits and vegetables and 52% stated that it does not take a lot of time and trouble to prepare healthy foods. About a third believed it is easy to order healthy foods in restaurants (38%) and did not need more information on how to prepare healthy foods (30%).

Table 2 gives mean psychosocial scale scores and fruit and vegetable intakes by demographic characteristics. The mean age of participants was 43.9 years (standard deviation (SD) 11.6); 57% were female, 40% had some college education, 76% were overweight or obese (BMI $>$24.9 kg m^{-2}), 56% were married/living with a partner and 82% resided in an urban county. In comparison, based on 2000 North Carolina census data for the six counties included here, 53% were female, 30% had some college education, 68% were overweight or obese (using BRFSS North Carolina statewide data), 44% were married/living with a partner and 82% resided in an urban county[9,34]. Females had statistically significantly higher predisposing scale scores, lower reinforcing and enabling scores, and higher fruit and vegetable intakes than males. Higher education was positively associated with predisposing scale scores and fruit and vegetable intake; respondents with advanced degrees reported eating almost one extra serving of fruits and vegetables each day compared with those with a high school degree or less. Excellent or very good self-rated health (43% of respondents) was inversely associated with the predisposing and enabling scales, whereas respondents with poor self-rated health had the highest fruit and vegetable intakes (all $P < 0.001$).

Associations of individual psychosocial factors with fruit and vegetable intake are given in Tables 3–5. All analyses were adjusted for age, gender, education, BMI and the other psychosocial (predisposing, reinforcing and enabling) factors within its category. Table 3 presents the associations of fruit and vegetable intake with each individual predisposing

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Table 2 Mean fruit and vegetable intake by participant characteristics among African-Americans in North Carolina ($n = 658$)

		Mean scale score*			Fruit and vegetable intake		
Characteristic	*n* (%)†	Predisposing	Reinforcing	Enabling	Vegetables (servings per day)	Fruits (servings per day)	Total (servings per day)
Gender							
Male	271 (41)	2.35[a]	2.24[a]	2.23[a]	1.46[a]	0.79[a]	2.25[a]
Female	378 (57)	2.45[a]	2.05[a]	2.13[a]	1.76[a]	0.94[a]	2.70[a]
Overall *P*-value		<0.001	<0.001	0.01	0.004	0.02	0.002
Age (years)							
20–34	154 (23)	2.34[a,b]	2.04	2.13[a]	1.56	0.89	2.45
35–49	286 (43)	2.44[a]	2.15	2.13[b]	1.67	0.89	2.56
50–70	218 (33)	2.44[b]	2.17	2.26[a,b]	1.65	0.86	2.51
P for trend		0.005	0.08	<0.001	0.72	0.88	0.82
Education							
< High school	146 (23)	2.26[a,b,c]	2.06	2.16	1.47[a]	0.67[a]	2.14[a]
Some college	256 (40)	2.41[a,d]	2.13	2.13	1.56	0.88[b]	2.44
College graduate	168 (26)	2.48[b]	2.17	2.22	1.74	0.94	2.69
Advanced degree	74 (11)	2.57[c,d]	2.15	2.23	2.01[a]	1.10[a,b]	3.11[a]
Overall *P*-value		<0.001	0.44	0.26	0.02	0.001	0.001
BMI							
Underweight (<18.5 kg m^{-2})	4 (1)	2.32	2.19	2.25	2.05	1.48	3.52
Normal (18.5–24.9 kg m^{-2})	147 (23)	2.40	2.16	2.28[a]	1.65	0.90	2.55
Overweight (25–29.9 kg m^{-2})	227 (35)	2.44	2.11	2.18	1.71	0.97	2.68
Obese (≥30 kg m^{-2})	266 (41)	2.39	2.13	2.09[a]	1.58	0.79	2.37
P for trend		0.74	0.87	<0.001	0.68	0.05	0.21
Marital status							
Single	177 (27)	2.37	1.99[a]	2.11	1.43[a]	0.87	2.29[a]
Married/living with partner	368 (56)	2.43	2.22[a]	2.22	1.69	0.86	2.55
Separated or divorced	88 (13)	2.40	2.01	2.11	1.59	0.88	2.47
Widowed	19 (3)	2.53	2.28	2.10	2.58[a]	1.19	3.77[a]
Overall *P*-value		0.10	<0.001	0.03	0.002	0.38	0.01
Self-rated health status							
Excellent	67 (10)	2.50[a]	2.23	2.28	2.01	1.06	3.07
Very good	214 (33)	2.49[b]	2.13	2.24[a]	1.61[a]	0.96	2.57
Good	260 (40)	2.39	2.12	2.14	1.60[b]	0.81	2.41[a]
Fair	93 (14)	2.29[a,b]	2.08	2.04[a]	1.44[c]	0.70[a]	2.14[b]
Poor	13 (2)	2.24	2.23	2.15	2.95[a,b,c]	1.48[a]	4.42[a,b]
Overall *P*-value		<0.001	0.55	0.004	<0.001	<0.001	<0.001
County of residence							
Urban	518 (82)	2.43[a]	2.14	2.19	1.69[a]	0.90[a]	2.59[a]
Rural	97 (16)	2.31[a]	2.10	2.09	1.34[a]	0.70[a]	2.04[a]
Overall *P*-value		<0.001	0.49	0.06.	0.01	0.02	0.005

BMI – body mass index.
*Scales were created by combining responses to individual questions (least healthy responses scored the lowest and the healthiest responses scored the highest). Possible scores range from 1.00 to 3.00.
†Numbers may not add up to 658 and percentages may not add up to 100 due to rounding and missing data.
a,b,c,d Values with the same superscript letters are significantly different (<0.05) from one another within the characteristic category.

factor. Three of the seven predisposing factors were statistically significantly associated with higher total fruit and vegetable intake, with differences between the healthiest and least healthy responses ranging from 0.5 to 0.9 serving per day. The two predisposing factors associated with the largest differences were belief in the importance of a diet high in fruits and vegetables (0.9 serving) and high self-efficacy to eat more fruits and vegetables (0.7 serving). The amount of variance in intakes explained by the demographic and predisposing factors ranged from 9% (adjusted R^2 for vegetable intake) to 11% (adjusted R^2 for total fruit and vegetable intake); only 2–3% of the variance is explained by demographic characteristics alone (data not shown).

As shown in Table 4, only one reinforcing factor was significantly associated with fruit and vegetable intake; specifically, total fruit and vegetable intake was approximately 0.8 serving per day higher for those who felt they could count on those close to them to help prepare healthier foods 'a lot' (2.9 servings per day) compared with 'not at all' (2.1 servings per day). There were no significant associations for any of the enabling factors (Table 5). The variance in fruit and vegetable intakes explained by reinforcing, enabling and/or demographic factors was small, ranging from 2 to 4%.

We also examined associations of fruit and vegetable intake with the predisposing, reinforcing and enabling factor scale scores (data not shown). Individual scales were created by linearly summing the responses within each category and dividing by the number of factors within each category (i.e. predisposing, reinforcing and enabling). Healthiest responses, as defined in Table 1, were scored the highest. Respondents in the healthiest

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Table 3 Adjusted* mean fruit and vegetable intake by individual predisposing factors among African-Americans in North Carolina ($n = 658$)

	Belief that diet is related to cancer risk	Knowledge of recommended FV servings	Belief in importance of a high FV diet	Self-efficacy to eat more FV	Awareness of FGP	Taste preferences for fruits	Taste preferences for vegetables	Unadjusted R^2	Adjusted R^2
Total fruits and vegetables (servings per day)								14%	11%
Healthiest response	2.82	2.82	2.74	2.71	2.54	2.52	2.61		
Moderate response	2.60	2.50	2.45	2.32	2.44	2.39	2.29		
Least healthy response	2.36	2.31	1.87	2.02	2.57	2.82	2.14		
P-value	0.06	0.04	0.002	0.01	0.88	0.64	0.10		
Fruits (servings per day)								13%	10%
Healthiest response	0.96	0.95	1.03	0.94	0.88	0.90	0.86		
Moderate response	0.93	0.87	0.78	0.82	0.86	0.59	1.00		
Least healthy response	0.82	0.83	0.58	0.68	0.93	0.87	0.88		
P-value	0.16	0.44	<0.001	0.05	0.94	0.13	0.45		
Vegetables (servings per day)								11%	9%
Healthiest response	1.85	1.87	1.71	1.76	1.66	1.62	1.75		
Moderate response	1.67	1.63	1.67	1.51	1.58	1.80	1.29		
Least healthy response	1.54	1.47	1.30	1.34	1.65	1.95	1.25		
P-value	0.09	0.03	0.07	0.03	0.87	0.39	0.003		

FV – fruits and vegetables; FGP – Food Guide Pyramid.
*Mean values adjusted for all predisposing factors, body mass index, education, age and gender.

tertile of the predisposing scale consumed almost 1.3 more daily servings of fruits and vegetables than those in the lowest tertile (3.2 vs. 1.9 servings per day, $P < 0.001$) after controlling for age, gender, education and BMI. There were also slightly higher total fruit and vegetable intakes for those in the healthiest tertile of the enabling scale compared with the least healthy tertile (0.6 serving per day, $P = 0.03$). There were no significant associations for the reinforcing scale.

Associations of each significant individual psychosocial factor (presented in Tables 3–5) with fruit and vegetable intake, adjusted for age, education, BMI and all other statistically significant psychosocial factors, are given in Table 6. Associations are shown for the total study population and also stratified by gender. After adjustment, all four psychosocial (three predisposing and one reinforcing) factors as above were still significantly associated with total fruit and vegetable intake: belief in the importance of a diet high in fruits and vegetables; high self-efficacy to eat more fruits and vegetables; knowledge of recommended fruit and vegetable servings; and could count on those close to them to help prepare healthier foods, with differences between the healthiest and least healthy responses of 1.0, 0.7, 0.6 and 0.5 serving per day, respectively. For fruits only, two predisposing factors (belief in the importance of a diet high in fruits and vegetables and high self-efficacy) remained significant after adjustment, whereas for vegetables only, all three predisposing factors remained significant.

Since women reported higher intakes (Table 1), we explored whether there were gender differences in the associations of psychosocial factors with fruit and vegetable consumption. For total fruits and vegetables, both men and women with a strong belief in the importance of a high fruit and vegetable diet reported significantly higher intakes compared with those with a weak/no belief in this relationship (0.9 and 1.1 servings for men and women, respectively). Among men, no other factors were significantly associated with high fruit and vegetable intakes; however, for women, the following factors were statistically significant: high self-efficacy (0.9 serving), having someone with whom to prepare healthy foods (0.9 serving) and knowledge of recommended servings (0.7 serving). Similar trends were found for fruit intake. For vegetables, both men and women who like the taste of vegetables reported significantly higher intakes compared with those who did not (0.5, 0.2 and 0.6 serving for men and women, men only and women only, respectively). One additional factor remained significant after adjustment in men (knowledge of recommended servings) and in women (high self-efficacy) (0.5 serving for each).

Discussion

This study examined psychosocial correlates of fruit and vegetable intake, using the PRECEDE framework, in a

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Table 4 Adjusted* mean fruit and vegetable intake by individual reinforcing factors among African-Americans in North Carolina ($n = 658$)

	Can count on people close to you:					
	To encourage you to eat healthy foods	To tell you about healthier foods	To prepare healthier foods with you	To eat healthier foods with you	Unadjusted R^2	Adjusted R^2
Total fruits and vegetables (servings per day)					6%	4%
Healthiest response	2.61	2.26	2.92	2.64		
Moderate response	2.44	2.52	2.58	2.46		
Least healthy response	2.48	2.84	2.11	2.54		
P-value	0.68	0.19	0.03	0.72		
Fruits (servings per day)					5%	4%
Healthiest response	0.88	0.72	1.07	0.90		
Moderate response	0.86	0.90	0.87	0.86		
Least healthy response	0.93	1.00	0.73	0.87		
P-value	0.84	0.11	0.05	0.94		
Vegetables (servings per day)					5%	3%
Healthiest response	1.73	1.54	1.85	1.73		
Moderate response	1.59	1.62	1.71	1.60		
Least healthy response	1.55	1.83	1.38	1.67		
P-value	0.54	0.40	0.08	0.66		

*Mean values adjusted for all reinforcing factors, body mass index, education, age and gender.

population-based sample of 658 African-American men and women in North Carolina. We found that items from the predisposing and reinforcing scales were associated with fruit and vegetable consumption; however, the predisposing factors, specifically belief in the importance of a high fruit and vegetable diet and high self-efficacy to eat more fruits and vegetables, had the strongest associations with fruit and vegetable intake.

Several demographic factors were also associated with the psychosocial scales and fruit and vegetable intake. Women, those with higher education and those with high self-rated health reported higher fruit and vegetable consumption, confirming previous work[12,15,17,35]. These groups of participants also had higher predisposing scale scores, supporting our finding that among the psychosocial factors, predisposing variables were most strongly associated with fruit and vegetable consumption. Also, more of the variance in fruit and vegetable intake was explained by the psychosocial (particularly predisposing) factors than by demographic characteristics. Men reported higher reinforcing and enabling scores than women, suggesting that men may focus more on external or environmental factors, rather than the individual, (intrapersonal) predisposing factors. Respondents aged 50–70 years, those with normal BMI and those with higher self-rated health reported higher enabling scores; the latter group also had high fruit and vegetable intakes.

These relationships of psychosocial factors with fruit and vegetable intake have been reported in other studies that applied the PRECEDE framework[21,36,37]. In the Working Well Trial, a worksite intervention consisting of a largely white population, Kristal *et al.* reported that

Table 5 Adjusted* mean fruit and vegetable intake by individual enabling factors among African-Americans in North Carolina ($n = 658$)

	Can afford to purchase healthy foods, such as fruits and vegetables	It takes time and trouble to prepare healthy foods	Feel it is easy to order healthy foods at restaurants	Need information on how to prepare healthy foods	Unadjusted R^2	Adjusted R^2
Total fruits and vegetables (servings per day)					5%	3%
Healthiest response	2.52	2.65	2.46	2.72		
Moderate response	2.49	2.44	2.51	2.65		
Least healthy response	2.39	2.29	2.57	2.38		
P-value	0.88	0.14	0.84	0.11		
Fruits (servings per day)					5%	3%
Healthiest response	0.90	0.92	0.85	0.94		
Moderate response	0.85	0.85	0.87	0.92		
Least healthy response	0.73	0.80	0.91	0.83		
P-value	0.41	0.29	0.79	0.33		
Vegetables (servings per day)					4%	2%
Healthiest response	1.63	1.72	1.61	1.78		
Moderate response	1.63	1.58	1.64	1.73		
Least healthy response	1.66	1.50	1.66	1.54		
P-value	0.99	0.21	0.84	0.14		

*Mean values adjusted for all enabling factors, body mass index, education, age and gender.

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Table 6 Adjusted* mean fruit and vegetable intake by all significant psychosocial factors by gender for African-Americans in North Carolina ($n = 658$)

	Knowledge of recommended FV servings	Belief in importance of a high FV diet	Self-efficacy to eat more FV	Taste preference for vegetables	To prepare healthier foods with you	Unadjusted R^2	Adjusted R^2
Total fruits and vegetables (servings per day)							
Men and women						13%	11%
Healthiest response†	2.86	2.76	2.73	NS‡	2.77		
Moderate response	2.50	2.44	2.28	NS	2.55		
Least healthy response	2.26	1.80	2.01	NS	2.27		
P-value	0.01	<0.001	0.002	NS	0.05		
Men						10%	6%
Healthiest response	2.49	2.57	2.51	NS	2.37		
Moderate response	2.47	2.24	2.10	NS	2.40		
Least healthy response	2.03	1.69	2.11	NS	2.22		
P-value	0.09	0.02	0.14	NS	0.81		
Women						16%	13%
Healthiest response	3.19	2.98	2.96	NS	3.35		
Moderate response	2.62	2.73	2.55	NS	2.65		
Least healthy response	2.54	1.89	2.03	NS	2.41		
P-value	0.02	0.01	0.02	NS	0.01		
Fruits (servings per day)							
Men and women						11%	10%
Healthiest response	NS	1.05	0.94	NS	0.95		
Moderate response	NS	0.76	0.81	NS	0.86		
Least healthy response	NS	0.55	0.69	NS	0.83		
P-value	NS	<0.001	0.04	NS	0.38		
Men						10%	7%
Healthiest response	NS	0.96	0.86	NS	0.78		
Moderate response	NS	0.72	0.72	NS	0.83		
Least healthy response	NS	0.47	0.77	NS	0.80		
P-value	NS	<0.001	0.33	NS	0.86		
Women						13%	10%
Healthiest response	NS	1.14	1.03	NS	1.19		
Moderate response	NS	0.83	0.93	NS	0.89		
Least healthy response	NS	0.65	0.66	NS	0.89		
P-value	NS	0.001	0.09	NS	0.05		
Vegetables (servings per day)							
Men and women						9%	7%
Healthiest response	1.92	NS	1.77	1.74	NS		
Moderate response	1.63	NS	1.49	1.26	NS		
Least healthy response	1.43	NS	1.32	1.26	NS		
P-value	0.003	NS	0.01	0.001	NS		
Men						9%	5%
Healthiest response	1.79	NS	1.64	1.64	NS		
Moderate response	1.61	NS	1.44	1.02	NS		
Least healthy response	1.28	NS	1.41	1.49	NS		
P-value	0.02	NS	0.36	0.02	NS		
Women						10%	8%
Healthiest response	2.02	NS	1.90	1.86	NS		
Moderate response	1.70	NS	1.57	1.48	NS		
Least healthy response	1.59	NS	1.38	1.25	NS		
P-value	0.06	NS	0.04	0.02	NS		

* Mean values adjusted for all other factors deemed significant in Tables 3–5, body mass index, education and age.
† Detailed description of healthiest, moderate and least healthy responses can be found in Table 1.
‡ The factor was not significant after adjustment for body mass index, education, age, gender and other psychosocial factors in Table 3–5.

predisposing factors were stronger predictors of fruit and vegetable intake than were reinforcing or enabling factors, and found greater differences (those with highest predisposing scale scores consumed 1.6 extra servings of fruit and vegetables compared with those with the lowest)[21] than in the present study. Other investigations using different theoretical frameworks and conducted in largely white or Asian populations have also found that predisposing factors are associated with higher intakes of fruits and vegetables[22,36,38–40]. Regrettably, there are few such studies with sizeable numbers of African-Americans with which we can compare our results.

The sole significant reinforcing factor, 'could count on those close to them to help prepare healthier foods', was significant for women but not for men, with a difference of approximately one fruit and vegetable serving for those who could, compared with those who could not, count on others. Similar results have been reported in other studies of African-Americans, suggesting an important role for social support in dietary change[41] and preventive health

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practices[42] in African-Americans. None of the enabling factors was significantly associated with fruit and vegetable consumption, perhaps suggesting that the specific variables we examined may not be salient in this study population. Nonetheless, other enabling factors may still be appreciable barriers to higher fruit and vegetable consumption in African-Americans.

We also found that relationships of fruit and vegetable intake with psychosocial factors differed between men and women. Only two factors were salient for both men and women: strong belief in the importance of a high fruit and vegetable diet (with total fruit/vegetable and fruit consumption) and taste preference for vegetables (with vegetable intake). Knowledge of the recommended servings, self-efficacy and having someone with whom to prepare healthy foods were only associated with higher consumption in women, while knowledge of fruit and vegetable recommendations was only associated with higher vegetable intakes in men. These results in women are supported by a recent study of low-income African-American mothers, in which high self-efficacy and awareness of health benefits were associated with later stages of change[43]. High self-efficacy has consistently been shown to influence healthy dietary behaviour in women[17,22,32,37,44]. The latter results are in agreement with those reported by Moser and colleagues who found that different factors influenced fruit vs. vegetable consumption in African-American men[23]. Specifically, intrinsic benefits and social norms influenced fruit consumption, whereas extrinsic benefits, such as tangible rewards, and preferences for other foods influenced vegetable consumption in men. However, in a racially diverse population, Van Duyn *et al*. found that perceived benefits (which Moser called intrinsic benefits) were associated with both fruit and vegetable intake in men, but were associated with neither in women[22]. Data from a cross-sectional survey in Washington State indicated that intrinsic motives were associated with fruit and vegetable intake in both men and women, but extrinsic motives were not associated with intake in either men or women[35].

Our results suggest specific psychosocial factors that may be prioritised in intervention design and planning, with an emphasis on factors that can be modified. Specifically, a sizeable portion of study participants reported 'less healthy' responses for several important factors associated with fruit and vegetable intake. For example, only 26% of participants knew that five or more servings of fruits and vegetables are recommended for good health. Van Duyn *et al*.'s finding that knowledge of the '5 A Day program' resulted in a 22% increase in fruit and vegetable intake in a nationwide sample[22] suggested that this factor is indeed modifiable and important. Similarly, only half of our respondents felt it was 'very important' to eat a high fruit and vegetable diet, although it was consistently associated with higher fruit and vegetable intakes.

This study has a number of strengths. To our knowledge, this is the first study of psychosocial factors related to fruit and vegetable consumption in a population-based sample of African-American men and women. Respondents represent a demographically diverse population and the sample size was large enough ($n = 658$) to permit detection of associations that may be obscured in smaller studies. Also, our survey instrument was adapted from questionnaires that have been used in other studies[17,21,35,45,46].

We also acknowledge some limitations. The overall response rate was relatively low (17.5%), which may limit the generalisability of our findings, and we are unable to compare responders and non-responders in this sample. Based on 2000 US Census data for the six counties included in this study and North Carolina state data in the BRFSS, our sample is generally comparable with African-Americans in North Carolina (data not shown)[9,34]. In addition, all data are from self-report, which is subject to both random and systematic bias[47]. Fruit and vegetable intake was assessed using a brief 7-item screener, which may result in measurement error, under-reporting and/or misclassification[30,48,49]. Nonetheless, this instrument has been used extensively in other studies[30,31,35]. The psychosocial factors we examined are proabably not a complete sampling of possible psychosocial variables that could be studied in this context. Finally, because this is a cross-sectional study, no inferences can be made regarding causality.

In conclusion, while many fruit and vegetable interventions focus on reinforcing (social support) and enabling (barriers) factors, the results of this study suggest that interventions in African-Americans that target predisposing factors, such as knowledge, self-efficacy and attitudes, may be more effective. This does not mean, however, that reinforcing and enabling factors should be ignored; for example, social support in the provision and preparation of fruits and vegetables may be very helpful for increasing intake in women. Our finding of different associations of psychosocial factors with fruit and vegetable by gender, and specifically that there were fewer salient correlates for men compared with women, also has implications for intervention design. Programmes aimed at increasing fruit and vegetable consumption in both men and women might focus on increasing one's belief in the merits of a high fruit and vegetable diet and taste preferences, and, for women specifically, also incorporate self-efficacy and social support.

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