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Sociodemographic Determinants of Low Fruit and Vegetable Consumption Among Bangladeshi Adults: Results From WHO-STEPPS Survey 2010

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Abstract

This study aimed to investigate factors affecting fruit and vegetables (FAVs) intake among Bangladeshi adults. Dietary data of 9275 adults from the Bangladesh Noncommunicable Disease Risk Factor Survey 2010 were analyzed. The mean age of the respondents was 42.4 (± 13.5) years. Multistage cluster sampling was applied to identify samples. Demographics, personal habits, physical activity, diet, and anthropometric data were collected using the WHO-STEPs questionnaire. Average daily intake of <5 servings of FAVs combined was considered to be low FAV consumption, and its prevalence was 82.8%. A mixed-effect logistic regression model was fitted to assess association of factors with low FAV intake. Higher educational attainment, greater wealth, female sex, low physical activity, body mass index >25 kg/m², and smokeless tobacco consumption were significantly associated with higher FAV consumption. Frequency of low FAV intake increased with increasing age and decreased with increasing educational attainment. Programs targeting people at risk of low FAV consumption are needed to promote consumption.

Keywords

Bangladeshi population; fruit intake; vegetables intake; diet; NCD and risk factors

Introduction

Globally, around 2.8% of deaths are attributable to low fruit and vegetable (FAV) consumption, and these deaths are mainly from gastrointestinal cancer, coronary heart disease, and stroke.¹ Low FAV consumption contributes to 1.8% of the global burden of

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disease.² Regular, adequate consumption of FAVs has been reported to improve survival³ and may confer protection against chronic diseases.^{4,5} When consumed in adequate amounts on a regular basis, FAVs can play an important role in management of weight,⁶ lowering the risk of obesity, and can ward off many oxidative stress related chronic diseases. One report shows that higher FAV intake is associated with better overall nutritional intake from other food sources as well.⁷

Dietary guidelines throughout the world are increasing the emphasis on consuming FAVs. The World Health Organization (WHO) recommends FAV as central to a healthy diet and has long advocated for increased consumption through targeted campaigns. Despite the growing body of evidence and promotion of consumption in guidelines and by other means, FAV intake is far less than the recommended amount in many low- and middle-income countries (LMICs).⁸ Among these are some countries where the majority of the population is engaged in agriculture, which confounds the availability and accessibility hypothesis of FAV consumption. Studies^{9–13} have investigated correlates of low FAV consumption in different populations and identified several sociodemographic, psychosocial, and behavioral factors. They found associations of FAV consumption with place of residence, socioeconomic status, educational attainment, occupational category, household income, and television viewing along with non-modifiable factors such as age, gender, and ethnicity.

Like most LMICs, Bangladesh, which is the setting of the current study, is experiencing a rise in noncommunicable diseases (NCD).¹⁴ Thus, with the overwhelming burden of communicable diseases, together with other LMICs, Bangladesh faces a dual challenge. Urgent action is imperative to curb the rise of NCDs. Increased intake of FAVs can increase life expectancy and reduce NCD incidence without additional health costs.¹⁵ To develop effective interventions to increase FAV intake, an understanding of precise dynamics and potentially modifiable correlates is needed.¹⁶ Hence, the aim of this study was to investigate factors affecting FAV intake among Bangladeshi adults.

Methods

We analyzed data on dietary intake and NCD risk factors of 9275 Bangladeshi adults, collected during November 2009 to April 2010. The survey was conducted per standardized approach devised by WHO, known as STEPS (STEPwise approach to Surveillance of NCD risk factors).¹⁷ Details of the methods have been described elsewhere.¹⁸ For better understanding of the study results, a brief description of the methods is given here. Multistage cluster sampling method was applied to identify a sample of 11200 households from 400 clusters (200 rural and 200 urban). These clusters were the primary sampling units (PSUs) of the survey. The rural PSUs were *mauza*, and the urban PSUs were *mahalla*. Sampling of eligible individuals was done from these households, with 1 individual randomly selected per household using the Kish method.¹⁹ All men and women aged 25 years or older who consider Bangladesh to be their primary place of residence were eligible for the survey. The sampling frame excludes tourists; persons residing in a military base, dormitory, or quarters; and those who are institutionalized, including people residing in hospitals, prisons, nursing homes, and other such institutions. A randomly selected person was excluded only if, after 3 visits to the selected household, the data collector failed to

reach the person. A replacement was not taken. Data were collected by trained data collectors (interviewers) using face-to-face interviews with the respondent who consented. From 400 clusters, 9947 (90.6%) households could be covered from 398 clusters. Out of them 9275 respondents (93.3%) participated.

Data were collected using steps I and II of the WHO STEPS questionnaire.¹⁷ The core components of the survey included information regarding demography, personal habits, physical activity, diet, and anthropometry. Along with all the core components, information about diet, particularly FAV intake, was collected in detail. Data included the number of days (frequency) the respondent ate FAVs in a typical week, and on those days, how many servings (quantity) they ate. Servings were determined based on response after showing pictorial show cards (for uncooked items) or measuring cups (cooked items).²⁰ For raw green leafy vegetables, 1 serving equaled 1 cup; for cooked or chopped vegetables, 1 serving equaled half a cup; for fruit, 1 serving equaled 1 medium-sized piece; for chopped, cooked, and canned fruit and fruit juice, 1 serving equaled half a cup. The average daily intake of <5 servings of FAVs combined was considered to be low intake of FAV.¹⁷

The wealth index of each household was determined using household ownership of 20 assets and using principal component analysis. The sample was divided into wealth index quartiles from 1 (lowest) to 4 (highest). Physical activity level was determined by converting physical activity related to work, transportation, and leisure time into metabolic equivalents (METs) in minutes per week. A MET of <600 was categorized as low physical activity. Information on tobacco use was collected for both smoking and smokeless forms. Those who smoked or used smokeless tobacco daily within the past 30 days were considered as “current” users. Alcohol consumption was measured by asking the respondents if they had consumed alcohol within the past 30 days.

Distribution of FAV intake by age, gender, quartiles of wealth, level of education, and place of residence was examined. Factors increasing low FAV intake were explored through mixed-effect logistic regression analysis. Multilevel modeling was used to address the random effect of multistage cluster sampling. Unadjusted odds ratios and 95% CIs were generated using univariable mixed-effect logistic regression. Multicollinearity between predictors was assessed using a correlation matrix. To rule out any residual collinearity, backward stepwise regression was performed prior to selecting candidate predictors for multilevel modeling. Selected predictors were then entered simultaneously into the multivariable mixed-effect logistic regression model to generate adjusted odds ratios and 95% CIs. Trends for increased or decreased FAV consumption were investigated across levels of predictors. All analyses were done using Stata version 14. Ethical approval was obtained from the Bangladesh Medical Research Council.

Results

Demography

Of the 9275 respondents, 4312 (46.5%) were men and 4963 (53.5%) were women; the mean age was 42.4 (± 13.5) years. Four in 10 of them completed primary education (men 47%; women 38%). Median duration of schooling was 3 years (men 5 years; women 3 years).

According to the wealth index, the survey population was found to be equally distributed in all 4 wealth quartiles from lowest to highest (Table 1).

Frequency and Quantity of FAV Intake

On average, the study participants consumed fruit 1.8 (± 1.8) days in a week and vegetables 6.1 (± 1.4) days in a week. The mean volume of consumption was 1.0 (± 1.2) servings of fruit per day and 2.2 (± 2.2) servings of vegetables per day, and for the combined parameter, FAV, mean consumption was 3.2 (± 2.6) servings per day. Around 82.8% of the survey population consumed less than 5 servings/d of FAV (low FAV).

A trend to increasing low FAV consumption was evident with increasing age ($P < 0.01$). The prevalence of low FAV consumption was significantly higher in men (84.7%) than women (81.1%; $P < 0.001$; Table 2). Frequencies of low FAV consumption across categories of key variables included in the analysis are illustrated in Figure 1.

Predictors of Low FAV Consumption

Table 3 presents unadjusted and adjusted association of low FAV consumption with the factors investigated, and even in the adjusted analysis, increasing age was again seen to be a significant predictor for low FAV consumption. People aged between 55 and 65 years and 65+ years were, respectively, at 57% (OR = 1.57; 95% CI = 1.25, 1.97) and 63% (OR = 1.63; 95% CI = 1.24, 2.15) increased risk of low FAV consumption in comparison to people aged less than 35 years. Women were 25% less likely to have low FAV consumption (OR = 0.75; 95% CI = 0.64, 0.88).

Increasing levels of education and wealth were associated with decreasing risk of low FAV consumption. People with higher secondary level and graduate and above education levels were, respectively, 54% (OR = 0.46; 95% CI = 0.34, 0.62) and 61% (OR = 0.39; 95% CI = 0.29, 0.51) less likely to have low FAV intake in comparison to those with not more than primary level education.

People in the second, third, and fourth wealth quartiles were, respectively, 34% (OR = 0.66; 95% CI = 0.55, 0.79), 47% (OR = 0.53; 95% CI = 0.44, 0.65), and 61% (OR = 0.39; 95% CI = 0.34, 0.54) less likely to have low FAV consumption in comparison to the people of the first quartile. A similar trend was present among both male and female participants, separately. People with low physical activity (OR = 0.52 for low vs sufficient; 95% CI = 0.40, 0.66) and high body mass index (BMI; OR = 0.71 for >25 vs ≤ 25 kg/m²; 95% CI = 0.61, 0.82) were less likely to have low FAV intake.

Both smoking and smokeless tobacco use showed unadjusted association with low FAV intake, but after adjustment for the confounders, only smokeless tobacco consumption showed association with low FAV consumption relative to nonuse of tobacco (OR = 0.86; 95% CI = 0.75, 0.99). Place of residence (urban vs rural; $P > 0.05$) and alcohol consumption (none vs some $P > 0.05$) did not influence frequency of low FAV consumption.

Discussion

In the present study, the fruit intake in this population was very low in both frequency and quantity. Although people eat vegetables most days in a week, the daily consumption is low. A greater frequency of vegetables consumption was not a sign of health awareness among people; rather, poverty makes preferred meat or fish unaffordable, and as a result, people resort to low-cost vegetables. The prevalence of inadequate FAV intake in Bangladeshi adults was very high (82.8%). Our study finding is similar to that of the World Health Survey: more than three-fourths of men and women from 52 LMICs consumed less than the minimum recommended 5 daily servings of FAV.⁸ Bangladesh was among the participating countries in the survey during 2002-2004, and since then, the situation has deteriorated further. Low consumption of FAVs is not unique to the Bangladeshi population; it is a regional phenomenon. Kanungsukkasem et al²¹ and the World Health Survey⁸ reported inadequate consumption of FAVs, particularly fruit, among Asian adults, with findings similar to ours.

In the current study, we investigated the association of sociodemographic factors with consumption of FAVs, after adjusting cluster variation of geographic location, addressed by multilevel modeling. Published evidence suggests that sociodemographic factors account for around 10% of the variation in FAV consumption, and individual factors account for about 25%.²² Our analysis also identified age, gender, wealth status, and level of education as the significant correlates of FAV consumption.

In our study, women were around 25% less likely to have low FAV intake. This result is consistent with that of another population-based study.²³ Researchers have attributed this phenomenon to women's awareness and willingness to follow a healthy diet, observing that women are significantly more likely than men to meet the target for FAV intake. However, this may not be the case in our population. Higher intake of FAVs in women may be related to the dominant cultural concepts and their gender roles in the society.²³ This positive fact for women is probably not a result of their preference but is culturally driven in low- and middle-income families because women eat the leftovers, after the rest of the family members have eaten. Mostly, little or none of the preferred meat or fish is left for them.

As in most population-based studies, wealth and education had a significant effect on FAV consumption in our study. These 2 factors serve as a function of several possible individual and social determinants.²⁴ Wealth quartile in this study serves as a surrogate of household income, expenditure, and socioeconomic status. Increasing FAV intake in our data across increasing wealth quartiles supports the well-established link of economic status with consumption of FAVs.²⁵ The overall energy intake at the population level in Bangladesh was not high, but in certain affluent groups, excess energy intake is becoming evident. According to the Bangladesh Bureau of Statistics²⁶ mean per-capita energy intake in Bangladesh was 2554 kcal in 2000-2001, which appears to be good, until it is noted that for many, the caloric intake is considerably less than this. The main problem is low intake of FAVs. Whereas there had been a steady increase in the per capita intake of rice, meat, and fish from 1998 to 2001, the intake of FAVs remained unchanged. In a low-income population such as that in Bangladesh, cheap sources of energy such as grains, rice in

particular, are used as staple diet. Once basic energy needs are met, households start diversifying their diets by including animal sourced foods, including dairy products, and only after that, FAVs. Nevertheless, FAV intake may be a function of total caloric intake, and this link is worth investigating. Unfortunately, data on daily energy intake were not available from the survey.

Educational attainment can be expected to be accompanied by greater knowledge of good eating habits and self-efficacy to adopt those habits. Thus, it is no surprise that we found increasing FAV consumption with increasing education. Poor knowledge about the necessity is probably a big predictor of low FAV intake.²⁷ Our results also support lack of education as an important determinant along with wealth status. Furthermore, education increases the efficacy of promoting good nutrition.⁹ Low socioeconomic status alone or in combination with low educational attainment may surrogate the disadvantaged groups in the population.

Studies in western populations report clustering of lifestyle factors, poor FAV consumption, low physical activity, obesity, and alcohol and tobacco consumption.²⁸ In our population, the clustering differed. Low physical activity, smokeless tobacco consumption, and larger BMI were related with more FAV consumption. A possible explanation is the mediation effect of economic status and gender. The association of smokeless tobacco with higher FAV consumption may be a result of the greater prevalence of this habit among women. Furthermore, larger BMI and less physical activity are more predominant among the affluent in Bangladesh.

FAVs are heterogeneous food groups differing in growing and storage conditions, processing methods, and seasonal availability. Intake pattern and measurement of consumption is also different. Most current research, including ours, has treated FAVs as a single variable; however, there are differences in the perceived quality, cultural norms, and attributes, which suggest that different factors may sway consumption.²⁹ Some studies have investigated the determinants of fruit consumption and vegetable consumption separately.³⁰ Although factors influencing FAV consumption have similarity, the extent of influence may differ.³¹ Further research directed toward factors influencing consumption of FAVs separately may provide more insight.

When considering <5 servings of FAVs in combination as our parameter, consumption of FAVs did not differ across place of residence. However, when considered separately, rural residents tended to consume vegetables in greater frequency but not fruit. For vegetables, place of residence may serve as an indicator for availability and accessibility. In rural areas, most households possess a kitchen garden. Fruit is generally more expensive than vegetables and other common foods, and this is reflected in the fact that people with higher income are more likely to incorporate fruit in their diet,³² irrespective of their place of residence.

One limitation of our study is that we did not assess environmental factors such as supply-side and demand-driven factors, including availability, cost, and social networks, which may act either as barriers or facilitators for access to FAVs. Different psychosocial, cultural, and livelihood factors, such as food culture, nutrition knowledge, dietary attitudes, food habits, food belief, lifestyle choices, and cooking skills in different areas, can also affect different

levels of FAV consumption. In-depth analyses of these factors were restricted by the availability of information within the structural framework of the STEPS protocol. However, wealth index and place of residence may surrogate the affordability and availability, respectively. In our study, the data were collected during a specific period of time, which might have failed to capture the seasonal variation in intake. However, apart from this, no nationally representative survey data are available that captured data for an entire year. Collection of self-reported data is another limitation of the survey, particularly for dietary data, including serving size. Effort was taken to minimize the impact by strict adherence to the standard operating procedure for the WHO STEPS questionnaire. Extensive training was provided to the data collectors to make data collection as accurate and consistent as possible.

In conclusion, FAV intake, especially fruit intake, is very low in the Bangladeshi adult population. Older adults and poorer and less-educated people are more prone to inadequate intake of FAVs. These factors may provide clues for an effective intervention program. To help guide future policy initiatives to promote greater consumption of FAVs, further detailed investigation is required. Because a large proportion of adults consume inadequate amounts of FAVs, education and behavior change programs are needed to promote their consumption.

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Figure 1.

Distribution of low FAV consumption by key predictors: A. Level of education. B. Wealth quartile. C. Place of residence. D. Low physical activity. E. Smoking tobacco. F. Smokeless tobacco. G. Alcohol consumption. H. BMI.

Abbreviation: FAV, fruit and vegetable; BMI, body mass index.

Table 1
Sociodemographic Characteristics of the Study Participants.

Variables	Frequency	Percentage
Age (years)		
25-34	3164	34.1
35-44	2531	27.3
45-54	1847	19.9
55-64	1015	10.9
65+	718	7.7
Gender		
Male	4312	46.5
Female	4963	53.5
Education		
Up to primary level ^a	6362	68.6
Secondary level	2053	22.1
Higher secondary level	356	3.8
Tertiary level	502	5.4
Residence		
Urban	4629	49.9
Rural	4646	50.1
Wealth quartile ^b		
First quartile	2281	24.6
Second quartile	2356	25.4
Third quartile	2286	24.6
Fourth quartile	2352	25.4
Smoking tobacco		
No	6846	73.8
Yes	2429	26.2
Smokeless tobacco		
No	6337	68.3
Yes	2938	31.7
Alcohol ^c		
No	8756	94.4
Yes	519	5.6
Physical activity (PA)		
Sufficient PA	8835	95.3
Low PA	440	4.7
Body mass index (kg/m ²)		
<25	7579	82.3
25	1635	17.7

^aIncludes illiterate people and those with no formal education.

^b First of the quartiles being the poorer and fourth being the wealthier.

^c Ever consumed alcohol.

Table 2
Distribution of FAV Consumption by Age and Gender.^a

	FAV Consumption (servings/d)		
Variables	5 Servings	<5 Servings	Test Statistics
Age (years)			
25-34	600 (19.2)	2526 (80.8)	$\chi^2 = 34.4; P < 0.001$
35-44	462 (18.4)	2046 (81.6)	
45-54	299 (16.3)	1538 (83.7)	
55-64	137 (13.7)	867 (86.4)	
65+	86 (12.8)	626 (87.9)	
Gender			
Male	657 (15.4)	3624 (84.7)	$\chi^2 = 20.2; P < 0.001$
Female	927 (18.9)	3979 (81.1)	

^aFigures in parentheses denote percentages.

Table 3
Predictors of Low FAV (<5 Servings of Fruit and/or Vegetables Per Day) Intake.

Predictors	Unadjusted ^a	Adjusted ^b
	OR (95% CI)	OR (95% CI)
Age 35-44 years ^c	1.08 (0.94, 1.25)	1.10 (0.95, 1.29)
Age 45-54 years ^c	1.27 (1.08, 1.50) ^d	1.26 (1.06, 1.51) ^d
Age 55-65 years ^c	1.60 (1.30, 1.99) ^e	1.57 (1.25, 1.97) ^e
Age 65+ years ^c	1.98 (1.53, 2.56) ^e	1.63 (1.24, 2.15) ^e
Female ^f	0.72 (0.64, 0.81) ^e	0.75 (0.64, 0.88) ^e
Education (Primary) ^g	0.74 (0.64, 0.86) ^e	0.88 (0.76, 1.04)
Education (Secondary) ^g	0.55 (0.47, 0.64) ^e	0.79 (0.66, 0.94) ^d
Education (Higher secondary) ^g	0.29 (0.22, 0.39) ^e	0.46 (0.34, 0.62) ^e
Education (Tertiary) ^g	0.23 (0.18, 0.30) ^e	0.39 (0.29, 0.51) ^e
Residence (rural) ^h	1.59 (1.41, 1.80) ^e	1.05 (0.91, 1.28)
Second wealth quartile ⁱ	0.71 (0.61, 0.85) ^e	0.66 (0.55, 0.79) ^e
Third wealth quartile ⁱ	0.63 (0.53, 0.74) ^e	0.53 (0.44, 0.65) ^e
Fourth wealth quartile ⁱ	0.46 (0.40, 0.55) ^e	0.43 (0.34, 0.54) ^e
Smoking tobacco ^j	1.55 (1.34, 1.78) ^e	1.13 (0.94, 1.36)
Smokeless tobacco ^k	1.17 (1.02, 1.32) ^d	0.86 (0.75, 0.99) ^d
Low physical activity ^l	0.47 (0.37, 0.60) ^e	0.52 (0.40, 0.66) ^e
BMI > (25 kg/m ²) ^m	0.48 (0.41, 0.55) ^e	0.71 (0.61, 0.82) ^e
Alcohol ⁿ	0.93 (0.69, 1.25)	0.89 (0.65, 1.22)
Constant	—	15.9 (4.02, 63.0) ^e

Abbreviation: FAV, fruit and vegetable; OR, odds ratio; BMI, body mass index.

^aUnadjusted ORs (95% CIs) were generated using univariable mixed-effect logistic regression, with dependent variable FAV intake <5 servings/d).

^bAdjusted ORs (95% CIs) were generated using multivariable mixed-effect logistic regression, with dependent variable FAV intake <5 servings/d).

^cReference group: age 25-34 years.

^d $P < 0.05$; dependent variable: low FAV consumption (<5 servings of fruit and/or vegetables per day).

^e $P < 0.01$; dependent variable: low FAV consumption (<5 servings of fruit and/or vegetables per day).

^fReference group: female.

^gReference group: up to primary.

^hReference group: urban.

ⁱReference group: first quartile.

^jReference group: nonsmoker.

^kReference group: nonuser of smokeless tobacco.

^lReference group: low physical activity.

^mReference group: BMI <25 kg/m².

ⁿReference group: no alcohol consumption.