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A population-based prospective study of energy-providing nutrients in relation to cancer mortality and cancers of digestive organs mortality

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Abstract

The effect of dietary composition on mortality in low income countries is largely unknown. We evaluated whether percentages of dietary energy derived from protein, fat, and carbohydrates were associated with all-cause and cancer mortalities in a Bangladeshi population. Data from a prospective population-based cohort study of 17,244 men and women were used. Percentages of dietary energy derived from protein, fat, and carbohydrates, assessed using a validated food-frequency questionnaire at baseline, were analyzed in relation to mortality over an average of 9 years (155,126 person-years) of follow-up. Cox proportional hazards regression models were used to estimate hazard ratios for all cause, all cancer, and cancers of the digestive organs mortalities. Percentage of dietary energy from protein appeared to be significantly associated with cancer mortality. Fully adjusted hazard ratios for cancer mortality in increasing tertiles of percentage of dietary energy from protein were 1.0 (reference), 1.21 (0.73, 2.00), and 1.84 (1.08, 3.15) (P for trend = 0.023). These associations were much stronger for deaths from cancers of the digestive organs with fully adjusted hazard ratios in increasing tertiles of percentage of dietary energy from protein being 1.0 (reference), 2.25 (0.91, 5.59), and 4.85 (1.88, 12.51) (P for trend = 0.001). No significant associations in relation to cancer-related mortality were observed for percentage of dietary energy from fat. Novel findings from this prospective study show protein is an important risk factor or proxy to an important risk factor for cancer mortality especially from digestive organ cancers in Bangladesh.

INTRODUCTION

Caloric intake in South Asia as well as other low income countries is largely derived from carbohydrates; however, there is variability in the percentages of energy derived from total fats and proteins consumed in these populations.[1] Ecologic studies have observed associations between the amount of dietary protein and fat consumed and cancer mortality in different countries,[2] suggesting that these specific macronutrients may be important in cancer etiology or survival.

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A substantial increase in worldwide cancer incidence and deaths has been projected for the next decade, one that is largely attributed to increased cancers in developing countries.[3] Several factors have contributed to the increasing cancer burden, including increased longevity, adoption of a Western diet and lifestyle, and exposure to environmental carcinogens.[4] Notably, many of these cancers are due to largely preventable risk factors.[3] For Bangladesh and other low income countries, the associations between diet and cancer mortality have not been prospectively evaluated with respect to percentages of dietary energy derived from protein, fat, and carbohydrates. Furthermore, total protein and fat intakes have been suggested to play an important role in gastric and other digestive cancers in middle and high income countries,[5-10] which has not been specifically examined in Bangladesh or other low income countries.

The objective of this study was to prospectively evaluate dietary composition (i.e., percentages of dietary energy from protein, fat, and carbohydrates) in relation to all-cause and cancer mortalities in an adult rural Bangladeshi population using individual-level population-based data from the Health Effects of Arsenic Longitudinal Study (HEALS).

MATERIAL AND METHODS

Study population

HEALS, described previously in detail,[11] is a population-based cohort study originally established to investigate health outcomes associated with chronic arsenic exposure from groundwater in a population-based sample of adults in Araihazar, Bangladesh. Eligibility criteria for participation included being married (to minimize loss to follow-up), aged between 18 and 75 years, and resident in the study area for at least 5 years. A total of 20,033 men and women were enrolled into the cohort in two phases: 11,746 during 2000-2002 and 8,287 during 2006-2008. Trained study physicians, blinded to participants' exposure to arsenic, conducted in-person interviews and clinical evaluations, and collected urine and blood samples from participants in their homes using structured protocols. Among other data, comprehensive dietary data were collected at enrolment using a validated food frequency questionnaire (FFQ).[12] For the purposes of this analysis, participants with incomplete or implausible (total daily caloric intake <500 or >3500 kcal) FFQ data or missing covariate data were excluded. The resulting sample size for this analysis after exclusions was 17,244. The distributions of demographic and lifestyle characteristics of individuals who were excluded were very similar to the overall cohort (data not shown). All participants provided informed consent for study participation, and the study protocol was approved by the institutional review boards of The University of Chicago, Columbia University, and the Bangladesh Medical Research Council.

Dietary intake

The FFQ, developed and validated for this study cohort,[12] included 39 food and beverage items commonly consumed in rural Bangladesh to assess average dietary intake during the previous 12 months. Briefly, participants were asked how many months of the year, how many days per week, and how many times per day they consumed each food item. They were also asked the usual portion size (measured as spoonfuls, cupfuls, or bowlfuls), with locally used serving items shown for reference. The frequency of intake was multiplied by usual portion size to obtain average grams per day for each food item. Nutrient intakes were calculated using the United States Department of Agriculture National Nutrient Database for Standard Reference.[13] For these analyses, nutrients of interest were total protein (% of energy), total fat (% of energy), total carbohydrates (% of energy) and total energy intake. The Pearson correlation coefficients, adjusted for total energy and corrected for within-person error, estimated from the FFQ and validated by 2-week food diaries were 0.53 for protein, 0.70 for fat, and 0.35 for carbohydrates.[12] Nutrient densities were utilized in these analyses by dividing total macronutrient intake by total energy and additionally adjusting for total energy in the regression models.[14]

Follow-up and assessment of mortality

Enrolled participants underwent in-person home follow-up visits by trained physicians every two years as well as monthly home-visits by village health workers. All deaths and their immediate and underlying causes were ascertained on a continuous basis. Date of death was ascertained by close relatives or neighbors of deceased participants. We implemented a verbal autopsy questionnaire, developed by the World Health Organization (WHO) and modified for and validated in a Bangladeshi population by the International Centre for Diarrheal Disease Research, Bangladesh (ICDDR, B), to investigate and assign the cause of death for our study participants.[15] In brief, a trained physician conducted an in-person interview with the informant to complete the verbal autopsy questionnaire, which included questions regarding the deceased's history of chronic conditions and symptoms for a determination of cause of death. Verbal autopsies were reviewed by a panel of local expert physicians and a cause of death was assigned and coded using the WHO's tenth revision of the International Classification of Diseases (ICD-10). These methods have been successfully used in our cohort for similar recent investigations in relation to all-cause, cardiovascular and respiratory mortality.[16, 17]

Among the 17,244 individuals eligible for this analysis, there were 818 deaths ascertained through January 15, 2013. Cancer mortality was classified as deaths with ICD-10 codes C00-C97 (n=135). Cancer of digestive organs mortality was classified as ICD-10 codes C15-C26 (n=53).

Covariates

All covariate data were derived from the baseline instruments. We included sex (male, female), age (years), water arsenic concentration (μg/L), formal education (yes, no), attained level of education (years), smoking status (never, former, current ≤10 cigarettes per day, current 11-20 cigarettes per day, current >20 cigarettes per day), study cohort (original, expansion), body mass index (BMI; kg/m^2), and height (m). Height and weight were measured as part of the baseline clinical examination by the study physician. Well water arsenic concentrations of all baseline wells in the study area were measured by graphite furnace atomic absorption spectrometry, with a detection limit of 5 μg/L. Samples below the limit of detection were subsequently reanalyzed by inductively coupled plasma-mass spectrometry, with a detection limit of 0.1 μg/L.[18]

Statistical analysis

Cox proportional hazards regression models were used to estimate hazard ratios (HR) and their 95% confidence intervals (CI) as measures of association between percentages of dietary energy from protein, fat, and carbohydrates at baseline and all-cause or cancer mortalities during the follow-up period. Follow-up time was calculated as the number of days between date of baseline interview and date of death, or if alive, date of last interview or report of being alive. The outcomes of interest were all-cause, all cancer, and digestive organ cancer mortalities. For cause-specific analyses, participants were censored at the time of death from a cause other than the cause of interest (any cancer or digestive organ cancer). For the purposes of the main analyses, the percentage of dietary energy derived from each macronutrient was tertiled according to the baseline distribution of the cohort eligible for analysis. Tests for trend were assessed via a single ordinal exposure variable and the corresponding P value of the coefficient was reported as the P for trend. All models, which met the proportional hazards assumption, were adjusted for sex, age (years), water arsenic concentration (μg/L), BMI (kg/m^2), height (m), formal education (yes, no), years of education (years), smoking status (never, former, current ≤10 cigarettes per day, current 11-20 cigarettes per day, current >20 cigarettes per day), study cohort (original, expansion), and total energy intake (kcal/day). Statistical analyses were performed using the Statistical Analysis System, including the procedure PHREG, release 9.2 (SAS Institute, Inc., Cary, North Carolina).

RESULTS

A total of 17,244 individuals were eligible for this analysis, with 818 total deaths, 135 cancer deaths, and 53 deaths related to cancer of the digestive organs ascertained through January 15, 2013 based on 155,126 person-years. Deaths related to cancers of the digestive organs primarily consisted of stomach (ICD-10 code C16; 28.3%) and liver (ICD-10 code C22; 52.8%) cancer deaths. Baseline characteristics of the study population as well as by vital status are shown in **Table 1**. Dietary composition of cohort participants was comprised on average of 78.5% carbohydrates, 12.4% of protein, and 9.1% of total fats, as shown in **Table 1**. Dietary fat, protein, and carbohydrates were associated with socio-demographic characteristics, as shown in **Table 2**. Higher protein and fat intakes were significantly associated with male sex, higher BMI, increased tobacco smoking prevalence, and increased years of formal education; whereas, the inverse associations were observed for higher carbohydrate intake.

We evaluated tertiles of total energy as well as percentages of dietary energy derived from total protein, fat, and carbohydrates in relation to all-cause and cancer mortalities, as shown in **Table 3**. Higher total energy intake was significantly inversely associated with all-cause mortality and moderately inversely associated with cancer mortality as well as digestive organs cancer mortality. For specific macronutrients, there was evidence of a significant positive association between percentage of energy derived from protein with cancer mortality. Fully adjusted HRs for cancer mortality in increasing tertiles of percentage of energy from protein were 1.0 (reference), 1.21 (0.73, 2.00), and 1.84 (1.08, 3.15) (P for trend = 0.023) when fat was included as a covariate in the model, with the HRs representing substitution of carbohydrate with energy from protein. Additionally, associations with dietary protein were particularly strong when we considered deaths from cancers of the digestive organs as the outcome of interest. Fully adjusted HRs for digestive organ cancer mortality in increasing tertiles of percentage of energy from protein were 1.0 (reference), 2.25 (0.91, 5.59), and 4.85 (1.88, 12.51) (P for trend = 0.001). Additionally, a protective effect of increased percentage of energy derived from carbohydrate was only observed with digestive organs cancer mortality when fat was included as a covariate in the model, with the HRs representing substitution of protein with energy from carbohydrate. The correlations of the food and beverage items ascertained in the FFQ with the intakes of fats, proteins, and carbohydrates are shown in **Table 4**. Consumption of beef/lamb and various fish were most strongly correlated with total protein intake in this population. We evaluated the intake of the individual food items most strongly correlated with total protein intake (i.e., beef/lamb, large freshwater fish, and small freshwater fish) in relation to mortality. There was moderate association of increased intake of large freshwater fish and small freshwater fish in relation to cancer mortality and cancer mortality of digestive organs (data not shown); although, overall trends were not statistically significant.

DISCUSSION

In this analysis of data from a large prospective population-based study, we observed an inverse association of total energy intake with all-cause mortality. Additionally, we observed positive associations of increased percentage of dietary energy from protein with cancer mortality as well as mortality from cancers of the digestive organs among Bangladeshi adults.

We previously reported an inverse association of BMI with all-cause mortality in this population,[19] which is consistent with the association observed with total energy intake in this analysis. The results for protein intake are consistent with a previous analysis conducted in this population in relation to cardiovascular mortality. We previously observed an increased risk of heart disease mortality among individuals with increased intake of animal protein-rich diets in this study sample based on analyses of dietary patterns.[20]

In a recent publication from the 2005-2006 National Health and Nutrition Examination Survey, the percentage of energy from carbohydrates, fat, and protein was 48.7%, 33.7%, and 15.7%, respectively, in a representative US population sample.[21] Relative to a western population, our study population appeared to differ significantly in percentage of energy from carbohydrates (78.5%) and fat (9.1%); however, the percentage of energy from protein was comparable (12.4%). The major distinction in protein intake between many western populations and Bangladesh is that protein intake in Bangladesh is heavily fish-based.[1]

A recent study observed an association between protein intake and plasma insulin-like growth factor 1 (IGF-1) concentrations, independent of body fat mass.[22] Furthermore, IGF-1 has been associated with cancer risk,[23] including cancers of the digestive organs in epidemiologic studies.[24, 25] As described previously, a major source of dietary protein in this study sample is from fish.[1] Based on the correlations of individual food items with percentage of energy derived from total protein, meat and fish intake appeared to be most strongly correlated with total protein intake. Studies have shown that cured or processed meat and fish are rich in N-nitroso compounds,[26] which are suspected to be carcinogenic in humans.[27-29] It is possible that protein intake is a proxy for exposure to dietary nitrate, nitrite, or other contaminants/toxins in relation to cancer mortality in this study. Furthermore, the cooking preparation of protein-rich foods that produce the formation of carcinogens may underlie the observed associations in this study;[30] the cooking methods were not ascertained as part of the FFQ administered in this study. These potential mechanisms should be examined specifically in future studies within this population.

The major strengths of this study were the prospective design, population-based sample, large sample size, and complete follow-up for mortality. Additionally, we used a validated FFQ. Our study instrument contains the food items most commonly consumed by our study population based on comparison with food diaries in this population and captures the major variability in diet.[12] While the actual nutrient intakes may not be accurately estimated by the FFQ within our study population, it is likely that it does rank participants reasonably well into tertiles of nutrient intakes.

We also recognize some limitations of this study. Protein and fat intake in this population appears to be related to socio-demographic characteristics. It is possible that the associations observed in this study could be related to residual confounding by socioeconomic status. Education and BMI, which are the most important proxies of socioeconomic status in this population, were included as covariates in these analyses to adjust for confounding by socioeconomic status. Another limitation of this study is that the FFQ measures average diet; the actual nutritional status of individuals may have varied from the reported average diet due to seasonal variability or fluctuations in household income. While this is a potential source of misclassification, it is likely to yield effect estimates smaller than the true underlying population estimates due to the misclassification of diet being independent of vital status in this study. Additionally, our analyses of fat intake, which served as an internal control to the analyses of protein intake, are not suggestive of any such major bias. Finally, mortality was the endpoint of interest in these analyses, which reflects both incidence and survival of diseases. It is possible that certain dietary factors may have contrasting effects (i.e., increasing risk of disease and decreasing risk of death due to that disease), which we were not able to tease apart based on our analyses of mortality data. This is a particular challenge for cancer-related outcomes in this population since cancers are still associated with very high fatality in this population.[31]

In conclusion, we observed associations between increased percentage of dietary energy derived from protein and increased cancer mortality, with markedly increased risk of mortality from cancers of the digestive organs, among adults in Bangladesh. These findings have important implications as Bangladesh and other developing countries face development transitions. Future studies are needed to unravel the biological mechanisms that underlie these associations, including examining hypotheses involving both nutritional aspects of protein, food preparation practices, as well as potential toxicant contaminants of protein-rich foods for the populations of Bangladesh and other developing nations.

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Novelty and impact

Few studies have evaluated the effect of dietary composition on mortality in low income countries. Novel findings from this prospective study of nearly 18,000 adults show percent of dietary energy from protein is an important risk factor or proxy to an important risk factor for cancer mortality especially from digestive organ cancers in Bangladesh.

TABLE 1

Selected characteristics of study participants

	Baseline Cohort n=17,244	All Deaths n=818	Cancer Deaths n=135	Digestive Organs Cancer Deaths n=53
Follow-up time, years	9.0 ± 3.0	5.8 ± 3.4	5.6 ± 3.3	5.0 ± 3.2
Male, %	37.9	68.1	69.6	62.3
Age, years	36.9 ± 10.5[1]	47.6 ± 10.3	47.4 ± 9.4	46.7 ± 8.9
BMI, kg/m^2	19.7 ± 3.2	18.7±3.3	18.8 ± 3.0	18.7±3.3
Ever smoked, %	31.2	66.3	68.1	66.0
Water arsenic, μg/L	82.0 ± 105.6	101.6 ± 118.5	103.5 ± 127.3	107.4 ± 118.1
Education, years	3.5 ± 3.8	3.0 ± 3.9	3.1 ± 3.8	2.5 ± 3.5
Total energy intake, kcal/day	2306.4 ± 524.2	2089.0 ± 587.1	2149.5 ± 596.4	2122.3 ± 537.1
Mean energy from carbohydrate, %	78.5 ± 3.8	77.3 ± 4.6	77.4 ± 4.4	77.5 ±3.1
Mean energy from protein, %	12.4 ±1.9	13.1 ± 2.3	13.2 ± 2.7	13.1 ± 1.6
Mean energy from fat, %	9.1 ± 2.2	9.6 ± 2.6	9.5 ± 2.3	9.4±1.8

[1] $\bar{x}$ ± SD (all such values).

TABLE 2

Socio-demographic characteristics by tertile (T) of dietary intakes

	Percent of energy from protein			Percent of energy from fat			Percent of energy from carbohydrates		
	T1	T3	P[1]	T1	T3	P[1]	T1	T3	P[1]
Range, %	8.9-11.4	12.7-39.2		1.8-7.8	9.3-37.4		29.1-78.2	80.6-89.0	
Male, %	31.0	46.1	<0.01	29.4	47.4	<0.01	47.1	29.9	<0.01
Age, years	36.3 ± 10.3[2]	37.7 ± 10.5	0.80	36.7 ± 10.3	37.2 ± 10.4	0.25	37.4 ± 10.4	36.4 ±10.3	0.66
BMI, kg/m^2	19.3 ± 2.9	20.2 ± 3.4	<0.01	19.2 ± 2.8	20.4 ± 3.4	<0.01	20.3 ±3.4	19.2 ±2.8	<0.01
Ever smoked, %	26.5	37.6	<0.01	26.9	36.8	<0.01	37.3	26.0	<0.01
Water arsenic, μg/L	83.3 ± 107.5	86.3 ± 108.1	0.16	85.0 ± 109.4	84.6 ± 105.8	0.30	85.1 ±106.6	83.4 ± 108.2	0.09
Education, years	2.6 ± 3.3	4.3 ± 4.1	<0.01	2.4 ± 3.2	4.6 ± 4.2	<0.01	4.6 ±4.2	2.4±3.2	<0.01

[1] Trend tests were performed by linear regression that included log-transformed intake as the dependent variable and sex, age, BMI, smoking status (ever, never), education, and total energy intake as the independent variables.

[2] $\bar{x}$ ± SD (all such values).

TABLE 3

Hazard ratios and 95% confidence intervals for energy and energy-providing nutrient tertiles in relation to all-cause and cancer-specific mortality

Nutrients	Tertile of intake			P for trend
	1 (lowest)	2	3 (highest)	
Total energy intake				
Range, kcal	516.0-2069.4	2069.5-2608.1	2608.2-3499.0	
N of deaths	403	229	186	
Sex- and age-adjusted HR (95% CI)	1.0	0.66 (0.56, 0.78)	0.55 (0.46, 0.66)	0.001
Multivariate HR (95% CI)[1]	1.0	0.72 (0.61, 0.84)	0.62 (0.52, 0.74)	0.001
N of cancer deaths	59	41	35	
Sex- and age-adjusted HR (95% CI)	1.0	0.80 (0.53, 1.19)	0.70 (0.45, 1.07)	0.093
Multivariate HR (95% CI)[1]	1.0	0.86 (0.57, 1.29)	0.77 (0.50, 1.18)	0.222
N of digestive organs cancer deaths	24	19	10	
Sex- and age-adjusted HR (95% CI)	1.0	0.92 (0.50, 1.69)	0.50 (0.24, 1.06)	0.083
Multivariate HR (95% CI)[1]	1.0	0.99 (0.53, 1.83)	0.54 (0.25, 1.15)	0.135
Percent of energy from protein				
Range, %	8.9-11.4	11.5-12.7	12.7-39.2	
N of deaths	198	224	396	
Multivariate HR (95% CI)[2]	1.0	0.96 (0.79, 1.17)	1.09 (0.88, 1.34)	0.429
Multivariate HR (95% CI)[3]	1.0	0.96 (0.79, 1.16)	1.07 (0.85, 1.35)	0.553
N of cancer deaths	28	37	70	
Multivariate HR (95% CI)[2]	1.0	1.21 (0.73, 2.00)	1.84 (1.08, 3.15)	0.023
Multivariate HR (95% CI)[3]	1.0	1.21 (0.73, 2.01)	1.79 (0.99, 3.25)	0.053
N of digestive organs cancer deaths	7	15	31	
Multivariate HR (95% CI)[2]	1.0	2.25 (0.91, 5.59)	4.85 (1.88, 12.51)	0.001
Multivariate HR (95% CI)[3]	1.0	2.40 (0.95, 6.06)	5.72 (1.99, 16.38)	0.001
Percent of energy from fat				
Range, %	1.8-7.8	7.9-9.2	9.3-37.4	
N of deaths	210	249	359	
Multivariate HR (95% CI)[4]	1.0	1.11 (0.92, 1.35)	1.22 (0.98, 1.51)	0.077
Multivariate HR (95% CI)[3]	1.0	1.11 (0.92, 1.34)	1.17 (0.93, 1.48)	0.175
N of cancer deaths	35	38	62	
Multivariate HR (95% CI)[4]	1.0	0.98 (0.61, 1.58)	1.15 (0.68, 1.94)	0.596
Multivariate HR (95% CI)[3]	1.0	1.03 (0.64, 1.66)	1.33 (0.75, 2.37)	0.349
N of digestive organs cancer deaths	13	15	25	
Multivariate HR (95% CI)[4]	1.0	1.13 (0.53, 2.43)	1.58 (0.68, 3.65)	0.283
Multivariate HR (95% CI)[3]	1.0	1.22 (0.56, 2.63)	1.98 (0.78, 5.05)	0.162

Nutrients	Tertile of intake			P for trend
	1 (lowest)	2	3 (highest)	
Percent of energy from carbohydrate				
Range, %	29.1-78.2	78.2-80.5	80.6-89.0	
N of deaths	373	240	205	
Multivariate HR (95% CI)[2]	1.0	0.97 (0.80, 1.18)	0.99 (0.79, 1.25)	0.978
Multivariate HR (95% CI)[4]	1.0	0.94 (0.77, 1.14)	0.97 (0.76, 1.23)	0.787
N of cancer deaths	60	49	26	
Multivariate HR (95% CI)[2]	1.0	1.01 (0.63, 1.64)	0.61 (0.33, 1.11)	0.095
Multivariate HR (95% CI)[4]	1.0	1.25 (0.78, 1.99)	0.81 (0.44, 1.49)	0.525
N of digestive organs cancer deaths	24	21	8	
Multivariate HR (95% CI)[2]	1.0	0.86 (0.41, 1.83)	0.33 (0.12, 0.92)	0.032
Multivariate HR (95% CI)[4]	1.0	1.09 (0.52, 2.28)	0.46 (0.16, 1.29)	0.155

[1] Adjusted for sex, age, smoking status (never, former, current ≤10 cigarettes per day, current 11-20 cigarettes per day, current >20 cigarettes per day), BMI, height, water arsenic concentration, formal education, years of education, and cohort.

[2] Additionally adjusted for total energy and fat intake.

[3] Additionally adjusted for total energy and carbohydrate intake.

[4] Additionally adjusted for total energy and protein intake.

TABLE 4

Pearson correlation coefficients of food items with percent of energy derived from fat, protein, and carbohydrate intake

	Fat	Protein	Carbohydrate
Banana	0.19	0.13	−0.17
Beans	0.08	0.24	−0.16
Beef/lamb	**0.78**	**0.51**	−0.69
Large fish (freshwater)	0.30	**0.44**	−0.39
Wheat bread	0.18	0.23	−0.21
Bitter gourd	0.11	0.18	−0.15
Cauliflower	0.16	0.23	−0.20
Lentil	0.16	0.20	−0.19
Dried fish	−0.07	0.04	0.02
Eggplant	0.05	0.10	−0.08
Eggs	**0.41**	0.26	−0.36
Green papaya	0.11	0.14	−0.13
Guava	0.09	0.09	−0.10
Cabbage	0.12	0.16	−0.15
Mango	0.16	0.19	−0.18
Milk	**0.44**	0.28	−0.39
Okra	0.08	0.15	−0.12
Potato	−0.09	−0.02	0.07
Poultry	**0.46**	0.32	−0.42
Puffed rice	0.11	0.12	−0.12
Bottle gourd	0.14	0.19	−0.17
Pumpkin	0.07	0.08	−0.08
Yam	0.02	0.04	−0.03
Salted fish	0.09	0.06	−0.08
Small fish (freshwater)	0.25	**0.55**	−0.41
Spinach	0.06	0.16	−0.11
Ridge gourd	0.08	0.11	−0.10
Snake gourd	0.05	0.09	−0.08
Parwar	0.11	0.15	−0.13
Ghosala	−0.05	−0.01	0.04
Steamed rice	−0.35	−0.53	**0.46**
Radish	−0.04	0.02	0.01
Spinach stalks	0.02	0.10	−0.06
Sweet potato	−0.04	0.00	0.02
Tea	0.21	0.20	−0.22
Tomato	0.16	0.23	−0.20
Water rice	−0.08	−0.06	0.07
Jack fruit	0.09	0.11	−0.10

	Fat	Protein	Carbohydrate
Watermelon	0.14	0.12	−0.14

Bolded values indicate r≥0.40.

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