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THE DETERMINANTS OF DEMAND FOR MICRONUTRIENTS: AN ANALYSIS OF RURAL HOUSEHOLDS IN BANGLADESH

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ABSTRACT

Micronutrient deficiencies are particularly severe in Bangladesh. Understanding how household income, food prices, parental education and nutritional knowledge, and culturally-based customs and food preferences interact to determine food consumption patterns (particularly for nonstaple foods), and so micronutrient intake, can provide crucial information for designing policies and intervention programs to improve human nutrition.

Within the typical dietary patterns of the Bangladeshi survey population, the key food group with respect to micronutrient consumption is vegetables, providing nearly 95 percent of vitamin A intake, 75 percent of vitamin C intake, and 25 percent of iron intake. Vegetables are the least expensive sources of all of these nutrients.

Vegetables are sufficiently inexpensive sources of vitamin A and vitamin C that they could provide the RDA within normal dietary patterns and the budgets of low-income groups. There is no corresponding inexpensive source of iron.

Programs to educate consumers about the importance of meeting recommended daily allowances of vitamin A and vitamin C and about commonly eaten sources of these nutrients has the *potential* for improving intake. Because a high proportion of vitamin A and vitamin C intake apparently comes from own-production, extension programs to promote growing specific vitamin A and vitamin C rich foods not only would provide households with a ready supply of these nutrients, but increased production could bring the local price down.

In contrast, it is much more difficult to see how these types of education and extension programs could be effective in increasing iron intake, because sources of bioavailable iron are expensive. Fortification or supplementation may be the best policies for solving the low iron intake problem in the short to medium run, depending on the costs and feasibility of successful implementation in specific circumstances.

There is clear evidence that adult males are given preference in the intrahousehold distribution of certain micronutrient-dense foods (milk, eggs, and meat) while other micronutrient-dense foods (e.g., fish and vegetables) are more equitably distributed. Ceteris paribus, agricultural production programs aimed at more equitably distributed foods (e.g., fish and vegetables) will have a greater impact on the nutrient intake of women and children who are at greatest risk for micronutrient deficiencies.

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1. INTRODUCTION

It is now widely accepted by the international nutrition community that micronutrient deficiencies are a serious public health problem in developing countries. Statistics compiled by the World Health Organization (WHO) on a regular basis on the extent of micronutrient deficiencies demonstrate the enormous magnitude of the problem.

It is estimated that 2.1 billion people globally are iron-deficient and that this problem is severe enough to cause anemia in 1.2 billion people. The problem for women and children is more severe because of their greater physiological need for iron. Roughly 40 percent of nonpregnant women and 50 percent of pregnant women have anemia worldwide (ACC/SCN 1992). Iron deficiencies during childhood and adolescence impair physical growth and mental development and learning capacity. In adults, iron deficiency reduces the capacity for physical labor.

Iodine deficiency is the greatest single cause of preventable brain damage and mental retardation in the world. WHO estimates that around 1.5 billion people or one-third of the world's population live in iodine deficient environments. Deficiencies in iodine that occur later in infancy and childhood have been shown to cause mental retardation, delayed motor development, growth failure and stunting, neuromuscular disorders, and speech and hearing defects. Even mild iodine deficiency has been reported to reduce intelligence quotients by 10-15 points.

WHO (1995) reported that 3.1 million preschool age children had eye damage due to a vitamin A deficiency and another 227.5 million are subclinically affected at a severe or moderate level. Annually, an estimated 250,000 to 500,000 preschool children go blind from this deficiency and about two-thirds of these children die within months of going blind (WHO 1995).

Deficiencies in several other micronutrients, in particular, zinc, may be similarly widespread with equally serious consequences for health. However, because there are no specific indicators to screen for deficiencies in these nutrients (other than a positive health response to supplementation), they have not received as much attention.

While it is perhaps impossible to place a monetary estimate on the value of improved nutrition and health for those suffering from micronutrient deficiencies, a recent World Bank document estimates that the *recurrent annual economic* costs of vitamin A, iron, and iodine deficiencies are equal to five percent of gross national product at levels of malnutrition that exist in South Asia (World Bank 1994).

Micronutrient deficiencies are particularly severe in Bangladesh. The World Health Organization (1992; as cited in Figure 3.3 of ACC/SCN 1992) has estimated that over 70 percent of pregnant women in Bangladesh were anemic in 1988, one of the highest rates in the world. Similarly, the prevalence of clinical eye signs of vitamin A deficiency is among the highest in the world (WHO 1995), well above the cutoff point established by the WHO, indicating that vitamin A deficiency is a serious public health problem. A 1993 survey of iodine deficiency indicates that nearly one in two Bangladeshi show clinical signs of goitre (grade 1 + grade 2) and about 70 percent have biochemical iodine deficiency (Yusuf et al. 1993).

The primary underlying cause of micronutrient deficiencies is low quality diets. Diets of the poor consist primarily of food staples to meet minimum energy requirements. Vegetables, fruits, and animal products, which are much richer sources of micronutrients than food staples, are consumed in insufficient quantities because, depending on the specific food, (1) certain nonstaple foods are desired but are unaffordable, (2) low preference is given to certain nonstaple foods due to lack of nutritional knowledge and cultural factors, and/or (3) certain family members may be discriminated against (e.g., on the basis of gender and age) in the intrahousehold distribution of certain nonstaple foods.

It follows, therefore, that understanding how household incomes, food prices, parental education and their nutritional knowledge, and culturally-based customs, including food preferences, interact to determine food consumption patterns (particularly for nonstaple foods), and so micronutrient intake, can provide crucial information for designing government policies and intervention programs to improve human nutrition.

Consumers obviously are quite aware of fluctuations in their calorie intake; they experience hunger when calorie intake declines. Thus, they will take steps to even out energy intake as incomes and food prices vary. For this reason, it is presumed that there are substantial similarities in demand behavior (as measured by income and price elasticities) across countries and cultures. This may be contrasted with a general lack of awareness of fluctuations in intake of micronutrients—a circumstance from which the term "*hidden hunger*" has emerged to refer to micronutrient malnutrition.

Because deficiencies for the most part go unnoticed and so are not seen by parents to be related to adverse health outcomes, income and price elasticities for minerals and vitamins, and therefore policy recommendations, may vary widely, depending on country and region-specific circumstances (e.g., religious restrictions against consumption of certain types of foods, seasonal fluctuations in food prices, giving preferred nonstaple foods to males). Understanding the determinants of food consumption patterns for rural households can provide crucial information for designing policies and programs to reduce micronutrient malnutrition. That is what this paper sets out to do.

This paper is organized as follows. Methodologies for data collection are described in Section 2. Food staple and energy consumption, which is the overarching concern of poor families in determining food consumption patterns, is related to household incomes and food expenditures in Section 3. The implications for micronutrient intake of these patterns of food consumption by food groups across income levels are drawn in Section 4.

Section 5 presents evidence on seasonality in food prices and nutrient intake by food group by survey round. Section 6 examines issues of intrahousehold distribution of food, in particular, how consumption of specific foods, and thus nutrient intake, varies by age and gender. The results of estimating nutrient demand functions are presented in Section 7. Section 8 looks at linkages between micronutrient intake and morbidity patterns. The final section draws policy conclusions and discusses directions for future research.

2. DATA COLLECTION METHODS

With respect to understanding how nutrient intake is conditioned by household resource allocation behavior, the economics literature has focused for the most part on demand for calories. This literature on energy demand has implications for the type of data to be used in analysis of demand for micronutrients later in this paper (the relatively sparse literature on demand for micronutrients is also discussed there). In particular, data collected using 24-hour food recall or weighing methodologies is strongly preferred over data collected using food expenditure surveys (Bouis 1994). The Bangladesh data set analyzed here was collected using a food weighing methodology.

The data used in the analysis for Bangladesh were taken from a survey undertaken by the IFPRI Bangladesh Food Policy Project. The survey was originally designed to determine the effects of two of the largest public food intervention programs in Bangladesh: the Rural Rationing (RR) and the Vulnerable Group Development (VGD) programs. The RR program distributed rationed rice to low-income families at low prices. The VGD program provide a free ration of wheat to poor women.

The sampling frame was designed to capture the diversity of physical and infrastructural environments in Bangladesh. Eight *thanas* were selected, two from each of the four divisions in the country. Four *thanas* are located in distressed areas; the other four in nondistressed areas.[1] Two of the *thanas* in the distressed area and two of the *thanas* in the nondistressed

[1] The distribution of total calories among the food groups does not significantly differ between the two types of households to warrant their separation in the analysis of consumption and expenditure patterns.

areas have well-developed infrastructure, while the remaining *thanas* have poor infrastructure. Designation of distressed and nondistressed areas was based on an analysis undertaken by the World Food Programme (see Ahmed 1993a, 1993b), classifying all rural *thanas*. Distress level was determined by factors such as grain availability, agricultural wage rate, population density, number of landless households, employment opportunities, and susceptibility to natural disasters.

Eight villages where the RR program was operating relatively well were chosen, one in each of the eight *thanas*. A complete census of the households in these villages was undertaken. From the census, three groups of households were identified: the RR and VGD groups and a group of nonbeneficiary households. Details of how the sample size from each stratum was determined are provided in Ahmed (1993a).

The survey collected three rounds of data from 1991 to 1992 (Table 1). The first round was conducted during October-November, 1991, the lean season. The second round was conducted during January-March, 1992, the peak season, and the third, during September-November, 1992, again the lean season. This first round included only low-income households, 553 families that participated in only the RR or the VGD programs. The last two rounds both had sample sizes of 773 households, which included nonbeneficiary households. The RR program was suspended in December, 1991, so that Rounds 2 and 3 included only the VGD and control group households. For these reasons, the first round of data was excluded from the analyses below.

Based on the first round data, Ahmed (1993a) reported a significant difference in calorie intake among adults in VGD and non-VGD households (Table 2). This implies that the VGD program might have an effect on food consumption behavior and nutritional status of the VGD households. Due to this, it was decided to exclude the VGD households from the analyses as well. Finally, 590 households from the control group, those that are common to Rounds 2 and 3, are used for this report.

Mean characteristics of these selected households are presented in Table 3. Households are classified by per capita expenditure level (used as a measure of income), village location (distressed and nondistressed areas), and gender and main occupation of the household head. Total monthly income of households in the lowest quintile are only one-fourth the income of households in the highest quintile. Heads of the highest-income households have four more years of education than those of the lowest-income households.

During each round, food intake data for a 24-hour period was recorded for individual members of the household present at that time. Food weighing was the method used to measure food prepared at home, which included weighing of ingredients of various recipes. Recall was used for food (recipes) eaten and/or cooked outside of the household, for which individual ingredients could not be recorded. Standard recipes were used to calculate ingredient levels for food obtained outside of the household.

A total of 234 food codes were identified in the food intake survey. Conversion factors for calories, protein, fat, iron, vitamin C, carotene, retinol, calcium, and the B-vitamins niacin, riboflavin, and thiamine were obtained from the Indian Food Composition table found in Gopalan, Rami Sastri, and Balasubramanian (1994). The food names in Bengali were translated to their English equivalents and matched with the Indian Food Composition table. The Indian Food Composition Table was used instead of the Bangladeshi Food Composition table due to large discrepancies for commonly cited foods between the two tables, especially for iron (Indian values were closer to those cited in food composition tables for other countries). For Bangladeshi foods that have no matches in the Indian table, the Bangladeshi conversion rates were used, but with an adjustment factor for iron.[2]

3. FOOD EXPENDITURES, FOOD CONSUMPTION, AND CALORIE INTAKE BY INCOME GROUP BY FOOD GROUP

An understanding of how intake of micronutrients varies with family incomes, food prices, and other factors begins with an understanding of the specific foods that consumers purchase out of necessity (e.g., food staples to satiate hunger), that they switch between as food prices vary (e.g., seasonally available vegetables), and that they desire to eat throughout the year but are constrained to buy by a combination of low incomes and high prices (e.g., some animal products and fruits). The analysis in this section examines patterns of food expenditures for various aggregate food groups as income increases, with a particular emphasis on consumption of food staples and energy intake. Food staples account for a high proportion of total food expenditures and calorie intake, as is typical of poor populations.

RELATIONSHIP BETWEEN ENERGY INTAKE AND BODY WEIGHTS

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[2] In comparing iron conversion rates for the same foods between the Indian and Bangladeshi food composition tables, Bangladeshi conversion rates were considerably higher. Indian values were similar to those found in food composition tables for other countries. Therefore, Bangladeshi values were adjusted downward.

Before beginning the analysis of food consumption patterns, it is useful to undertake a rough check of the plausibility of the food intake information collected—by comparing individual calorie intake and body weights. Table 4 presents body weights and calorie intake per kilogram of body weight by age, gender, and income group. Note that calorie intake per kilogram of body weight declines with age. This is because children require proportionately more calories for growth.

For population groups in energy balance—those with stable weights, calorie intake equals energy expended. Energy is required both for maintaining metabolic functions at rest and for work. Ceteris paribus, the percentage increase in energy required for maintaining metabolic functions at a higher weight is less than the percentage increase in weight.[3] Therefore, if persons from poorer households work harder than persons from richer households, body weights will increase more than proportionately with income than with calorie intake.

Note in Table 4 that average body weights increase substantially with income, by 25–30 percent between lowest (1st quintile) and highest (5th quintile) income groups. This is partly due to the fact that the age composition of higher income groups consists of relatively more adults and fewer children and partly due to the fact that, controlling age and gender, calorie

[3] The arguments and assumptions used in reaching this conclusion is discussed in more detail in Bouis (1995), based, in particular, on information found in FAO/WHO/UNU (1985). It is recognized that the relation between calorie intake and body weights is a complex one, involving not just energy intake, but (among other factors) energy expenditures, health status, and individual-specific characteristics. ***Group*** averages are used in the analysis here with the presumption that, on average, individual-specific differences in efficiency of calorie use between groups will be similar. To the extent that energy expenditures and health status between groups is markedly different, or a particular group is gaining or losing a significant amount of weight over time, these confounding factors need to be accounted for.

intake of higher income persons is higher than calorie intake of lower income persons. However, calorie intake per kilogram of body weight increases somewhat with income, while they might have been expected to decline somewhat with income because of the older age composition (per capita calorie intake increases by 45 percent from lowest to highest income group, while body weights increase by only 28 percent). Thus, there may be some overstatement of the increase in energy consumption as income increases. A more disaggregated analysis of Table 4 by food group, gender, age, and income group (not shown here) suggests that this may be due to some upward bias in the estimated intake of rice of higher income adolescent and adult males.[4] It is not felt that this possible bias is of sufficient magnitude to invalidate the analysis that follows; indeed, it is much smaller than apparent biases generated by food expenditure surveys that are typically used in economic analyses (see Bouis and Haddad 1992); Bouis (1994).

FOOD EXPENDITURES, PRICES, AND QUANTITIES CONSUMED

Per capita food expenditures, food prices, and quantities consumed by food group by income quintile for Bangladesh are given in Table 5. Expenditures on rice alone account for more than one-half of the weekly per capita food expenditures for each income group. Although the increase in rice consumption with income may be somewhat overstated as explained in the previous section, the increase in expenditures for rice from lowest to highest income group (about 15 Tk) accounts for 40 percent of the increase in total food expenditures

[4] This bias, in turn, may be due to higher income households cooking atypically large amounts of rice during the days that the food weighing surveys were undertaken.

from lowest to highest income group. Wheat expenditures decline with income, but wheat consumption is less than 10 percent of rice consumption, even for the lowest income group.

Expenditures for vegetables and potatoes increase by about the same factor as for rice (all factors less than 2.0) between lowest and highest income groups, which (including wheat) are the lowest increases among all food groups. Price paid per kilogram increases modestly with income for both vegetables and potatoes, so that quantities consumed increase by a smaller factor. This suggests that lowest income groups may consume vegetables and potatoes as inexpensive sources of variety in the diet and purchase other more highly desired foods as incomes increase.

These more highly desired foods include fish, meat, eggs, and milk products, which account for one-third (about Tk 11; one-half from fish) of the increase in food expenditures between lowest and highest income groups, but only about one-seventh of total food expenditures, on average. Percentage increases with income for expenditures for pulses and fruits are also high, but account for small budget shares. The cooking ingredients category (e.g., sugar, oil, spices) accounts for about one-tenth of the total food budget, but about one-sixth of the increase in food expenditures from lowest to highest income groups.

The average price increases substantially with income only for the fruits group—the high-income group pays more than twice the price per kilogram for fruit than the lowest-income group. There are modest price increases with income for fish, meat, and eggs.

Table 6 presents calorie intake per adult equivalent and calories purchased per taka (Tk) by food group by income group. Rice and wheat provide the cheapest sources of calories. About Tk 7 would buy the daily requirement of 2,300 calories for the average person (equivalent to 0.8 of an adult). Seven taka is roughly 15–20 percent of the average daily agricultural wage rate (without in-kind food payments), ranging from Tk 32 to Tk 50 per day (Bangladesh 1994) in the surveyed regions. The average per capita food expenditure of the lowest income group is less than Tk 6 per day, so that this group cannot meet the RDA, even if the entire food budget were devoted to rice.

Calorie intake increased by almost 40 percent (again, if not overstated) from lowest to highest income groups; two-thirds of this increase was accounted for by higher rice consumption. The increase in rice consumption with income suggests that hunger for calories is not nearly satiated at low income levels. Despite this, consumers spent 60 percent of marginal food expenditures (out of an absolute total increase of Tk 36 per capita per week) at higher incomes for higher-calorie-cost nonstaple foods as compared with 40 percent for rice. Thus, the proportion of total calories coming from nonstaple foods increased slightly from 14 percent to 19 percent and the calories obtained per taka spent on food declined by 22 percent.

4. SOURCES AND COST OF MICRONUTRIENTS IN THE DIET, BY INCOME GROUP BY FOOD GROUP

In drawing conclusions later in the paper as to the effects of changes in prices and incomes on demand for iron, vitamin A, and vitamin C, it is important to establish which specific foods or food groups provide specific nutrients. It has already been established in the previous section that calorie consumption comes primarily from a few staple foods, although some additional calories at the margin are provided by nonstaple foods as income increases.

Nutrient adequacy ratios presented below measure the extent to which individuals (or an average for all individuals in a household) are satisfying their recommended daily nutritional requirements. It is computed simply as the ratio of nutrient intake to requirement. For households, the first step is to express the total household intake on a per adult equivalent basis. This means summing up the total intake of all household members (those who were present during the 24-hour weighing period) and dividing the sum by the total number of members, expressed as adult equivalents, with adult males over 18 years old as the reference person. The second step is to compute the ratio of this per adult equivalent intake to the requirement of the reference adult for a specific nutrient.

Tables 7 and 8 show the recommended dietary requirements used in this paper for 10 nutrients by gender and age group. The levels at which to set recommended daily allowances (RDAs) for various age and gender groups is a matter of considerable debate. RDAs vary widely by country and change over time as research provides new information. The only set of nutritional requirements for Bangladeshis known to the authors is about 20 years old and so may be outdated. The Indian standards are considered an appropriate substitute because of similarity in physique between Indians and Bangladeshis, in general.[5]

Because choice of specific RDA values is somewhat arbitrary, the analysis that follows of nutrient adequacy ratios will emphasize differences between income groups and seasons, rather than absolute values (above or below adequacy) for specific groups.

[5] The FAO/WHO standards for iron are used because it is generally believed that the iron requirements of women are greater than that of men. However, the Indian iron requirements do not mirror this.

Table 9 shows that nutrient adequacy ratios for several micronutrients increase markedly with income, with the exception of vitamin A and riboflavin. Many of the improved nutrient adequacy ratios are explained by increasing consumption of nonstaple foods with income, although the improvements in calorie and protein adequacy ratios is explained by increased rice consumption with income, as was shown in the previous section. Correspondingly, Tables 10 and 11 demonstrate that the percentage of households below 80 percent of requirements falls rapidly with income for several nutrients, again with the exception of vitamin A and riboflavin.

Table 12 shows sources of iron in the diet by food group by income group. Rice and wheat combined provide about half of total iron. Vegetables and cooking ingredients provide another 40 percent of total iron. The remaining 10 percent is provided by a number of other foods. These percentages remain more or less constant by income level. Very little iron comes from highly bioavailable sources such as meat.

Iron intake increases by 45 percent from lowest to highest income quintiles. 40 percent of this increase is accounted for by vegetables—higher income groups consume a mix of vegetables that are relatively iron-rich. The remaining 60 percent of the increase in iron intake is distributed among increases in consumption of food staples, pulses, fish, and cooking ingredients.

Vegetables provide the cheapest source of iron. One taka spent on vegetables provides more than 1.5 times the amount of iron obtainable from the next cheapest source of iron, which is wheat. Vegetables worth Tk 3 (one-half of the total per capita food expenditure for the lowest income group of about Tk 6 per day, and six times the observed rate of expenditure for vegetables of about Tk 0.50 per capita per day) would buy the recommended daily allowance of 18 milligrams for the reference male adult. The specific foods that provide the largest amounts of iron are listed in Table 13. The limited number of foods shown in this table account for four-fifths of the average iron intake.

In contrast with iron, Table 14 shows that vitamin A intake is very much concentrated (over 90 percent) in the vegetables food group. Fruits and meat can be very rich sources of vitamin A, but are so little consumed that they provide very little vitamin A to these households. Because rising incomes are not associated with increased vegetable consumption, higher incomes are not associated with increased vitamin A consumption.

Vegetables provide by far the cheapest sources of vitamin A. Vegetables worth about Tk 1 (one-sixth of the total per capita food expenditure for the lowest income group of about Tk 6 per day and two times the observed rate of expenditure for vegetables of about Tk 0.50 per day) would provide the required 600 micrograms per day. It would not be difficult even for low-income groups to satisfy their requirements.

Table 15 lists the foods, mostly green, leafy vegetables, that account for a large proportion of the average vitamin A intake. The reliance on green, leafy vegetables as the predominant source of vitamin A can result in substantial fluctuations in intake, depending on the seasonal availability of specific vegetables, as will be shown later. Tables 16 and 17 show the disaggregation of total vitamin A intake in Table 14 into provitamin A and retinol components. Almost all vitamin A comes from non-animal and fish sources.

Table 18 shows that vitamin C intake, in one respect, is similar to vitamin A intake—three-fourths of vitamin C intake comes from vegetables. However, specific vegetables rich in vitamin C apparently are eaten disproportionately by richer households, so that vitamin C intake increases with income. Potatoes provide 15 percent of vitamin C intake and potato consumption also increases with income. Fish and cooking ingredients, both with positive income elasticities, each contributed about five percent of the average vitamin C intake.

As for iron and vitamin A, vegetables are the cheapest source of vitamin C, although potatoes and fruits are also relatively inexpensive sources of vitamin C. Vegetables worth one taka can provide 50 percent more than the recommended daily allowance of vitamin C. Table 19 enumerates the specific food sources of vitamin C. Again, reliance on vegetables as the predominant source of vitamin C can result in substantial fluctuations in intake, depending on the seasonal availability of specific vegetables, as will be shown later.

Table 20 indicates that fat intake, which may be an important determinant of the bioavailability of vitamin A intake, increases rapidly with income, more than tripling from lowest to highest income group. Table 21, which lists specific food sources of fat, shows that cooking oil is the primary source of fat in the diet, providing one-third of fat intake for the lowest income quintile and nearly one-half of fat intake for the highest income quintile. Apart from cooking oil, sources of fat in the diet are quite diverse.

In summary, within the typical dietary patterns of the Bangladeshi survey population, the key food group with respect to micronutrient consumption is vegetables, providing nearly 95 percent of vitamin A intake, 75 percent of vitamin C intake, and 25 percent of iron intake. Vegetables are the least expensive sources of all of these nutrients.

Vegetables are sufficiently inexpensive sources of vitamin A and vitamin C that they could provide the RDA within normal dietary patterns and the budgets of low-income groups. There is no corresponding inexpensive source of iron.

Food staples are the predominate source of iron intake (50 percent). Cooking ingredients are a secondary source (15 percent) of iron intake and potatoes are a secondary source (15 percent) of vitamin C intake. Cooking ingredients (primarily cooking oil) are the predominate source of fat intake (50 percent).

Iron and vitamin C intake increases with income, in part due to the fact that the mixes of vegetables eaten by higher income groups are richer in iron and vitamin C. These mixes are not richer in beta-carotene, so that vitamin A intake does not increase markedly with income. Fat intake increases rapidly with income due to high income elasticities for cooking oil and a number of other foods.

5. SEASONAL FLUCTUATIONS IN NUTRIENT INTAKE

The previous two sections have discussed how food and nutrient intake patterns vary by income group. This section will investigate seasonal fluctuations in food and nutrient intake and how food demand might be influenced by changes in food prices. A priori, it would be expected that consumers as much as possible would protect calorie intake from fluctuating seasonally. In contrast, those nutrients concentrated in a few specific nonstaple foods (e.g., vitamin A and vitamin C) might vary a great deal more.

Table 22 presents average adequacy ratios by round. Calorie adequacy levels remained fairly uniform from one season to the next. However, the vitamin A adequacy level increased in the third round just as iron and vitamin C adequacy levels decreased.

Iron intake decreased from about 15 milligrams in the second round to 11 milligrams in the third round.[6] Table 23 shows that about half of this decline is due to a substitution from parboiled, hand pounded rice and wheat to milled rice. Milled rice has only one-fifth the iron content of whole wheat flour and one-third that of hand pounded rice (Gopalan, Rama Sastri, and Balasubramanian 1994). Table 23 shows a 60 percent decrease in the consumption of whole wheat flour and an 80 percent decrease in the consumption of parboiled, hand pounded rice in the third round.

Much of this substitution can be by the decline in the price of milled rice, which is preferred to wheat.[7] The fall in the price of rice, from Tk 11.46 per kilogram in the second

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[6] That the price of rice was lower during September-November (Round 3), in the midst of the Boro harvest, than in January-March (Round 2), after the Aman harvest, is unusual for Bangladesh. The price of rice peaked earlier than usual in July, 1992, and continued to fall through the following the Aman harvest in 1993.

Haggblade and Rahman (1993) attribute this unusual price behavior to a combination of factors. First, the size of the Boro harvest was above average; moreover, the dry weather reduced postharvest losses. Second, speculation that the government procurement system would pay above-market prices caused traders and millers to stockpile early in the season. However, they did not anticipate the sudden cessation of government purchases due to the suspension of the Rural Rationing (RR) program. Thus, later in the season, these traders and millers flooded the market with their unwanted stocks, resulting to a 20 percent drop in the price of rice.

The implication for this analysis is that the seasonal pattern of iron intake presented in Appendix Table 22 may look somewhat different other years of more normal rice price fluctuations.

[7] Hand pounded rice is prepared and consumed by farm households from their own production. It is most readily available right after harvest (during the second round) and could not be easily obtained from the market afterwards.

round to Tk 9.32 per kilogram in the third round, shown in Table 24, induced even the largest consumers of wheat, the low-income groups, to shift to milled rice.

The remaining decline in iron intake can be attributed to the seasonality of vegetable consumption. Cauliflower greens, khesari leaves, broad beans, and onion stalks are winter crops, and thus, plentiful in the second round. Pui hak and lal shak are summer crops, consumed in the third round. The iron obtained from these summer vegetables was not sufficient to offset the iron lost due to the decline in consumption of winter vegetables.

The same pattern holds for vitamin C intake, as shown in Table 25. Winter vegetables (importantly, including, now, potatoes) are rich in vitamin C, while summer vegetables are not. Pui shak and lal shak, on the other hand, are rich sources of beta-carotene, while many winter vegetables (albeit relatively high in iron and vitamin C) are not. This explains the significant rise in vitamin A intake in Round 3, also shown in Table 25.

6. NUTRIENT DEMAND FUNCTION ESTIMATES

With the discussion in Sections 3, 4, and 5 as background, demand functions for calories, iron, vitamin A, and vitamin C are estimated in this section. The objective is to measure the magnitudes of price and income responses. It should already be clear from the discussion in previous sections what are the expected directions of the income and price elasticities to be estimated.

Per capita total expenditures (PCTOTEXP) is used as the measure of income. Rice (VPRRICE) and potato (VPRPOTAT) were selected to measure the influences of food staple and vegetable prices. With respect to vegetables, green, leafy vegetables are of great importance as well, but price data for these foods are sparse in seasons when consumption is low (see Table 24) and this off-season information is deemed unreliable. Food prices were obtained from the food expenditure module of the survey and averaged at the village level.

Household size (HHSIZE) is included to account for the possible economies of scale, which are widely reported in the literature. The level of nutritional knowledge in the household may be captured by the variables FEMLHEAD (whether the household is female-headed or not), AGEHEAD (the age of the household head), and EDUCHEAD (the level of education of the household head). Coefficients for the last two variables are hypothesized to be positive. In Bangladesh, it is common practice for the household head (usually male) to do the food shopping.

Because production and consumption decisions often are determined simultaneously in poor, rural areas, food consumption may be influenced by the type of economic activity of the household. Variables pertaining to the main occupation of the household head (FARMER and AGLABOR) may capture these effects. The list of all variables used and their description and mean values are provided in Table 26.

A two-stage least squares (2SLS) estimating procedure is used due to the endogeneity of the income variable. The 2SLS results are shown in Table 26. Income is significantly greater than zero for four out of five nutrients. The one exception is vitamin A. The elasticity for vitamin C (0.81) is much higher than those for calories and iron (0.18 and 0.27, respectively). The fat income elasticity (1.21) is highest.

The price of rice has a positive relationship with household iron intake. This is due to substitution between milled rice for wheat and hand pounded rice, as discussed above. As expected, the price of potato is inversely related to vitamin C intake. A 10 percent increase in potato price would reduce household vitamin C intake by about 4 percent. Because of the switching between vitamin C- and iron-rich vegetables in the winter months and vitamin A-rich foods in the summer months, as the relative price of various vegetables shift, the potato price is positively related to vitamin A intake (and, it turns out, fat intake as well).

The demographic variables, for the most part, are insignificantly related to nutrient intake.

7. RELATING FLUCTUATIONS IN NUTRIENT INTAKE TO MORBIDITY

The primary motivation for studying demand behavior for micronutrients is a presumption (based on findings in the nutrition literature) that as micronutrient intake improves, health will improve. This section investigates possible links between variation in micronutrient intake, which have been shown to fluctuate widely by season, and health outcomes as measured by recent morbidity.

Table 27 shows the proportion of individuals in each age group who reported being sick of diarrhea, flu, and colds in the three months prior to the survey. There is no difference in the trends exhibited by the different age groups. The highest incidences are of diarrhea and flu. Incidence of diarrhea remained fairly uniform between the seasons. However, incidence of flu and colds declined in the third round. Preschoolers and adults tend to be more susceptible to diarrhea and flu than the remaining two age groups. As discussed previously and shown again in Table 27, iron and vitamin C intake declined from the second to the third round at the same time that vitamin A intake increased.

In order to investigate variations in nutrient intake to morbidity outcomes, a series of regressions were run for various age groups and dependent variables. The results for incidence of sickness among children up to five years old and incidence of flu among adults is shown in Tables 28 and 29, respectively. A logistic estimator was used with the dependent variable, defined as equal to one if sickness (or flu) was reported for the individual in the three months prior to the survey and zero if not.[8]

The set of explanatory variables included income, several demographic variables, and the household-level intake of calories, iron, vitamin A, vitamin C, and fat, taken separately or in combination.[9] Iron and vitamin C are analyzed together because of the possible importance of vitamin C in the bioavailability of iron. Similarly, bioavailability of vitamin A may depend on fat intake.

[8] It should be noted that since the logistic regression is of the nonlinear form, the marginal effect of any explanatory variable is not simply given by the sign and magnitude of its coefficient but depends on the level of the other variables in the equation.

[9] In attempting to establish a causal relationship between nutrient intake and morbidity, it would be preferable to use individual nutrient intake rather than the average household intake as the explanatory variable. However, because morbidity and appetite are closely related, it is presumed that simultaneity problems between the two are considerable, which raises a number of statistical problems. It is presumed here that use of household intake substantially reduces this simultaneity problem; the implied direction of causality is that lower (higher) household intake implies generally lower (higher) individual intake, which, in turn, (may or may not) affects individual morbidity.

For preschoolers, the regression results in Table 28 indicate that average household calorie intake, and intakes of iron, vitamin C, and fat are all inversely related to the probability of a child being sick with diarrhea, flu, or a cold. Older preschoolers are sick less often than younger preschoolers, as might be expected. Children with older mothers (possibly due to more experience in child care) are sick less often, as are children from households that cultivate more land.

For adults, Table 29 also indicates a negative relationship between morbidity and fat intake. However, vitamin A and iron intakes are positively associated with prevalence of adult flu. Adults in distressed villages and male adults have a higher incidence of flu. Again, adults in households with more cultivated land have lower incidences of flu and those from higher income households have flu more often.

In summary, the regression results are consistent with a hypothesis that fat is important for the bioavailability of provitamin A, presuming that better vitamin A status is associated with lower morbidity. The other consistent result between the child and adult regressions is that lower morbidity occurs in households that cultivate more land.

8. INTRAHOUSEHOLD DISTRIBUTION OF NUTRIENTS

This section presents analysis on the intrahousehold distribution of food and the consequences of the allocation of specific foods to particular family members for individual nutrient intake. The discussion focuses on the distribution of food by age and gender. The measure of equality used for this analysis, referred to as Food Share to Energy Share Ratios (FS/ES), is discussed in the Appendix.

Table 30 shows the percent of households with positive consumption of various food groups and specific foods and, for those households with positive consumption, the percent of individuals having positive intake of those foods. This table indicates that rice, some type of vegetable, and at least one cooking ingredient all are eaten at least once every day by every household member.

The least frequently consumed foods are eggs, meat, fruits, wheat, pulses/beans, and milk, all of which tend to have high relatively high-income elasticities, with the exception of wheat. Even this simple frequency information suggests some age and gender discrimination in the consumption of some foods. For example, the percentage frequency for adult males of egg consumption is far higher than for any other age and gender group. Frequencies for adult males for these seven food categories are always higher for adult males as compared with adult females. However, for some of these seven food categories, frequencies are highest for female children (e.g., for meat and fruits).

FS/ES ratios for various food groups or specific foods are defined only for members of *households* with positive consumption. Thus, there are relatively many observations for rice, vegetables, and cooking ingredients, and relatively few observations for meat, eggs, and fruits, for example.

For members of households with positive consumption of a specific food or food group, FS/ES ratios may be zero (an individual receives none of that food even though the intake of other families members is positive) or greater than zero. Table 31 presents FS/ES ratios only for those individuals with *non-zero* values. Relative averages across age and gender groups address the question of whether specific groups are allocated more of food, *given that their intake is positive*. Thus, for example, even though intake frequencies for various foods between male and female preschoolers do not appear to be substantially different across various foods, it may be that the proportion given boys is larger, resulting in a higher FS/ES ratio.

Table 31 shows a much stronger picture of male favoritism in the intrahousehold distribution of food. For milk, meat, and eggs, FS/ES ratios are substantially higher for male preschoolers than female preschoolers and for adult males than adult females. Fruits are somewhat disproportionately given to females. With the exception of preschoolers, wheat is given more to males.

Rice, vegetables, fish, potatoes, and cooking ingredients are distributed more or less equally. The only food that goes disproportionately to adult females are green, leafy vegetables, which have low-income elasticities (and are presumed to be low-status foods). Interestingly, among school-aged children, there is no apparent consistent pattern of favoritism based on age and gender. In fact, several FS/ES ratios are highest for adolescent girls (e.g., for pulses/beans, milk, and eggs).

A double-hurdle regression technique was used to estimate the two-step process implied in Tables 30 and 31 to test these conclusions more formally. The results are summarized in Table 32. To investigate the intrahousehold distribution of food, dummy variables for various age and gender groups are used with adolescent boys excluded, who serve as a reference.

Various other demographic and occupation-related variables are also included as explanatory variables, which are defined at the bottom of Table 32.

In Table 32, *for households with positive consumption*, the signs of the coefficients in the columns labeled "Probability" indicate whether a positive intake for a specific individual (a dichotomous variable) is more likely or less likely.[10] The signs of the coefficients in the column labeled "Level" indicate, *given positive consumption for that individual*, whether the proportion (as measured by the FS/ES ratio) given that individual is relatively high (positive) or relatively low (negative).

For adult males, it is seen in Table 32 that all coefficients for all foods selected in the table for both stages are positive and that several are statistically significant. The only other statistically significant dummy age and gender dummy variables are for preschool boys (four positive, one negative), preschool girls (one negative), and adult women (two positive and two negative). Adult men and preschool boys are clearly favored in the intrahousehold distribution of food, particularly adult men. The only positive coefficients for females are for adult women for green, leafy vegetables, a low-status food.

Turning to other explanatory variables, a negative coefficient in the first (probability) column in conjunction with a positive coefficient in the second (level) column suggests increasing inequality in intrahousehold distribution associated with that variable. For example, for household size for milk and green, leafy vegetables, a negative coefficient in the first column implies a higher proportion of nonconsumers and a positive coefficient in the second

[10] Inequity in intrahousehold distribution of a specific food or food group is not an issue where no family member consumes the food.

column implies a higher average FS/ES ratio for members of larger households. The more skewed the distribution among positive consumers of a food in a family, the higher will be the simple average of the FS/ES ratios for the members of this family. Thus, fish are distributed more equitably in farm households that cultivate more land, but less equitably where the head of household is older and has more education.

Table 33 presents FS/ES ratios for all individuals in households with positive consumption of various foods and food groups (this table includes individuals with no consumption, i.e., with FS/ES ratios equal to zero), which indicates the net result of the two-stage process implied in Table 32. Adult men have the highest or second highest FS/ES ratios for milk, other foods, meat/eggs, wheat, pulses/beans, fish, and potatoes. Preschool boys have the highest or second highest FS/ES ratios for meat/eggs, milk, fruits, potatoes, and fish. Adult women have among the lowest ratios for milk, meat/eggs, fish, pulses/beans, and wheat, but among the highest ratios for vegetables and other foods.

A summary of Tobit estimations, which combine zero FS/ES ratios for some individuals and positive ratios for other individuals, is presented in Table 34. Again, all coefficients are positive for adult men and several are significant. However, these figures, which represent a net aggregation of a two-step process, show fewer significant coefficients for other age and gender groups. For example, most coefficients for adult women are negative but statistically insignificant. Moreover, it is difficult to interpret the coefficients on the variables not related to age group and gender. For example, a negative coefficient on household size for milk may mean fewer individuals consume milk (a more skewed distribution) or that average ratios of positive consumers are lower (a more equitable distribution). The interpretation from Table 32 was an unambiguous conclusion that distribution was more skewed.

What does this inequality in food distribution imply about the distribution of nutrients among household members? This is shown by Table 35. Except for the retinol and carotene (and thus, vitamin A), nutrients are fairly evenly distributed among household members, although preschoolers are getting slightly more fat, calcium, iron, and riboflavin than other age and gender groups.[11]

Preschooler boys and male adults are getting more retinol as a result of their larger shares in the meat/eggs and milk groups. Similarly, the higher FS/ES ratio for carotene exhibited by female adults is due to their shares in the green, leafy vegetables and fruits groups. Because of relatively low retinol intake and high carotene intake, FS/ES ratios for vitamin A are highest for female adults.

In no way do the FS/ES ratios for nutrients take into account differences in nutritional requirements (typically invisible, with the exception of calories, as a factor in the household resource allocation process) among members of a household. Table 36 presents the energy, iron, vitamin A, vitamin C, and fat adequacy ratios by age and gender group by income group.

As might be expected, ratios are highest for adult males. Ratios tend to be better for adult females than preschoolers. These differences are a function of the levels at which RDAs are set.

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[11] The FS/ES ratios shown in Table 35 may be interpreted as showing the ***relative*** nutrient density of calories consumed across various age and gender groups. For example, per calorie consumed, women's intake of provitamin A is relatively high and of retinol relatively low. Men's total intake of provitamin A, however, might be higher if their calorie intake is substantially higher than those of women.

9. POLICY CONCLUSIONS AND DIRECTIONS FOR FUTURE RESEARCH

FOOD AND NUTRIENT DEMAND BEHAVIOR

The essential difference between demand for calories and demand for micronutrients is that consumers are keenly aware of and take measures to avoid declines in calorie consumption, while fluctuations in micronutrient intake goes unnoticed for the most part. Thus, despite the fact that calorie consumption typically is concentrated in a single staple food (rice in Bangladesh), consumers react to increases in prices of rice either by switching to other calorie-dense staples (e.g., wheat) or reducing expenditures for nonstaples and nonfoods to protect (to a large extent, if not completely) acceptable levels of calorie consumption.

Staple grains are an important source of iron, but not of vitamin A and vitamin C. Therefore, even at low-income levels, a minimal amount of iron is consumed (although not a highly bioavailable form of iron). Despite the fact that consumers are likely unaware of their iron consumption, iron consumption is also relatively immune to food price fluctuations because food staples provide a high proportion of iron, and because iron sources are somewhat diverse.

Calorie income elasticities are positive, although relatively low, because of the high propensities at the margin to consume nonstaple foods.

In Bangladesh, vegetables are important sources of iron. Even though overall vegetable income elasticities are low in Bangladesh, the mix of specific vegetables eaten by higher income groups are more iron dense than the mix of vegetables eaten by lower income groups, resulting in a positive iron income elasticity.

The effects of income and price on intake of vitamin A and vitamin C is fundamentally different as compared with calories and iron. This is because (1) staple grains have virtually no vitamin A, (2) intake of vitamin A and vitamin C tends to be concentrated in specific vegetables and fruits whose consumption varies with price changes for these specific foods, and (3) vegetables have low income elasticities, perhaps because they are relatively inexpensive sources of variety in the diet. Because of this concentration and because consumers are unaware of their intake, vitamin A and vitamin C intake may fluctuate widely with prices, even though it is possible to satisfy daily requirements relatively inexpensively.

Vitamin A-income elasticities are low. The vitamin C-income elasticity is relatively high in Bangladesh, because the specific mix of vegetables eaten by high-income groups is more dense in vitamin C than the mix of vegetables eaten by low-income groups.

POLICY CONCLUSIONS

Programs to educate consumers about the importance of meeting recommended daily allowances of vitamin A and vitamin C and about commonly eaten sources of these nutrients has the *potential* for improving intake. Because a high proportion of vitamin A and vitamin C intake apparently comes from own-production, extension programs to promote growing specific vitamin A and vitamin C rich foods not only would provide households with a ready supply of these nutrients, but increased production could bring the local price down. The question of whether such nutrition education and home-garden programs would be accepted and followed by target households could not be addressed with the data used for this analysis.

For example, households may increase their production of vitamin A and vitamin C dense foods, but sell a high proportion of their production when vegetable prices are high.

In contrast, it is much more difficult to see how these types of education and extension programs could be effective in increasing iron intake, because sources of bioavailable iron are expensive. Fortification or supplementation may be the best policies for solving the low iron intake problem in the short to medium run, depending on the costs and feasibility of successful implementation in specific circumstances.

There is clear evidence that adult males are given preference in the intrahousehold distribution of certain micronutrient-dense foods (milk, eggs, and meat) while other micronutrient-dense foods (e.g., fish and vegetables) are more equitably distributed. Ceteris paribus, agricultural production programs aimed at more equitably distributed foods (e.g., fish and vegetables) will have a greater impact on the nutrient intake of women and children who are at greatest risk for micronutrient deficiencies.

FUTURE RESEARCH

Even with this detailed information on food intake by type of household member, by season, and by socioeconomic status of the household, because of data limitations, such policy recommendations require qualification.

More so than is the case with calories, measuring intake of various micronutrients may not provide accurate measures of nutrients that are actually utilized for better nutrition and health. There are two reasons for this. First, values in the food composition tables for micronutrients are less reliable than values for calories. From a technical perspective, micronutrient content is more expensive and more difficult to measure than calories, so that there are fewer and less reliable values in the food composition tables. Also, the variance in micronutrient content for samples of the same food is greater than for calories.

Biological utilization of nutrients depends (1) on the presence of inhibiting (e.g., phytates) and promoting (e.g., high quality proteins) substances in the diet, (2) whether an individual is sick and/or infected with parasites, and (3) micronutrient interactions (e.g., vitamin C may promote iron absorption). Thus, it is particularly important to collect information on micronutrient status, such as blood serum analysis, which can be correlated (or found not to be correlated) with nutrient intake. For example, vitamin A ***status*** may have a high income elasticity and may be difficult to attain at low incomes (as contrasted with vitamin A ***intake***), if fat consumption is an important determinant, given the dietary pattern of the poor in Bangladesh, of the utilization of provitamin A intake.

A further motivation for collection of serum retinal is that vitamin A is stored in the liver, so that seasonal fluctuations in beta-carotene intake below recommended daily allowances may not have had any adverse nutritional consequences.

Even if a rise in green, leafy vegetable consumption and an improvement in vitamin A status through blood analysis were to be firmly established, in the case of a program to promote home gardens, one would still need to show that (1) a significant number of nutritionally-vulnerable adopting households increased their vegetable production as a result of this program and (2) the increased vegetable production was actually consumed and not sold in the market, even as market vegetable prices fluctuated upward.

A high priority is needed for research related to improved food-based programs and policies for reducing micronutrient malnutrition that link detailed information on socioeconomic variables and impacts of the adoption of livestock, vegetable, and other agricultural technologies, to food intake and micronutrient status as measured through blood analysis. A small number of rigorous studies of such food-based approaches can make an important contribution toward reaching a consensus on the cost-effectiveness of such food-based strategies.

TABLES

Table 1 Topics covered by questionnaires A and B in each round: Bangladesh Food Consumption and Nutrition Survey, 1991/92

Topics	Recall Period	Sample Covered
Socioeconomic status		
1.0 Household composition		
2.0 Description of house		
3.0 Landholding and tenancy		
4.0 Agricultural production and distribution	Last season	
5.0 Storage of agricultural products		
6.0 Ownership of assets		
7.0 Loss of assets last three months		
8.0 Mortgage of assets	Last year	
9.0 Credit		
10.0 Household savings		
11.0 Household income	Various	
12.0 Household expenditure	Various	
13.0 Public Food Distribution System (PFDS) participation		
14.0 Time allocation	Last week	Members over five years old
Health, food consumption, nutritional status		
1.0 Household composition		
2.0 Water source and use, sanitation		
2.1 Water source, use, and purification		
2.2 Sanitation		
2.3 Flood related		
2.4 Cleanliness		
3.0 Maternity, child care, and morbidity		
3.1 General knowledge		
3.2 Maternity		
3.3 Child health and morbidity	Various	Members up to five years old
3.4 Morbidity of household members	Last three months old	Members over five years
4.0 Death record	Last year	
5.0 Food preparation and intake	Current 24 hours	All household members
6.0 Anthropometry		All household members

Source: International Food Policy Research Institute/Bangladesh Consumption and Nutrition Survey, 1991/92.

Table 2 Calorie sources, by distressed and nondistressed villages and food group

Food Group	Distressed Area Calorie Intake	Distressed Area Percent	Nondistressed Area Calorie Intake	Nondistressed Area Percent
	(per adult equivalent per day)		(per adult equivalent per day)	
Rice	1,848	80.0	2,059	80.1
Wheat	131	5.7	73	2.8
Pulses/beans	25	1.1	30	1.2
Vegetables	100	4.3	127	4.9
Potatoes	60	2.6	47	1.8
Fish	27	1.2	50	1.9
Meat/eggs	5	0.2	15	0.6
Fruits	4	0.2	12	0.5
Milk	8	0.3	9	0.3
Cooking ingredients/spices	77	3.3	136	5.3
Other	24	1.0	15	0.6
ALL	2,309	100.0	2,572	100.0
Food expenses (taka per capita per month)	209.79		223.29	

Source: International Food Policy Research Institute/Bangladesh Consumption and Nutrition Survey, 1991/92.

Table 3 Characteristics of households in the sample

Category	Number of Households	Household Size	Age	Education	Expenditures Total	Expenditures Food	Ratio of Food to Total Expenses
				(years)	(taka per month)		(percent)
Village location							
Distressed area	648	6.0	41.8	2.4	298.55	209.79	70.3
Nondistressed area	532	6.1	41.6	2.0	333.41	223.29	67.0
Gender of household head							
Male	1,140	6.1	41.6	2.3	316.99	217.20	68.5
Female	40	4.5	42.7	0.2	236.68	178.26	75.3
Main occupation of household head							
Farmer	330	7.0	47.5	3.6	433.70	276.94	63.9
Agricultural laborer	359	5.6	39.0	0.8	226.32	175.08	77.4
Others	491	5.7	39.7	2.3	298.30	204.66	68.6
Expenditure quintile							
1	236	6.2	42.3	0.9	152.40	118.90	78.3
2	236	5.9	40.2	1.4	214.00	165.80	77.5
3	236	5.6	39.5	1.5	268.40	198.40	74.0
4	236	5.9	40.2	2.2	341.20	239.90	70.4
5	236	6.5	46.2	4.9	595.40	356.30	62.2
All	1,180	6.0	41.7	2.2	314.27	215.88	68.7

Source: International Food Policy Research Institute/Bangladesh Food Consumption and Nutrition Survey, 1991/92.

Table 4 Average per capita calorie intake, weight, weight change, and age, by age group, gender, and selected household characteristics

Category		Calorie Intake Per Day	Weight	Calorie Intake Per Kilogram Weight	Seasonal Change in Weight	Age
			(kilograms)		(kilograms)	(years)
Age group and gender						
0 – 6 years	Male	1,184	13.73	86.2	0.64	4.9
	Female	1,074	13.17	81.5	0.87	4.8
7 – 12 years	Male	1,729	22.47	76.9	1.08	9.8
	Female	1,565	22.32	70.2	1.38	9.8
13 – 18 years	Male	2,351	39.43	59.6	1.63	15.9
	Female	1,888	38.77	48.7	0.96	15.8
19 years and older	Male	2,742	47.47	57.8	−0.84	39.3
	Female	1,960	40.22	48.7	−0.24	35.2
Gender of household head						
Male		1,951	32.75	59.6	0.27	22.9
Female		1,487	30.51	48.7	0.49	21.9
Village location						
Distressed area		1,850	32.64	56.7	0.43	22.9
Nondistressed area		2.045	32.77	62.4	0.09	22.8
Main occupation of household head						
Farmer		2,204	35.68	61.8	0.38	25.7
Agricultural laborer		1,749	29.80	58.7	0.29	20.3
Others		1,845	32.20	57.3	0.16	22.2
Expenditure quintile						
1		1,570	28.92	54.3	0.42	20.3
2		1,771	30.43	58.2	0.20	20.9
3		1,913	32.49	58.9	0.37	23.6
4		2,096	33.66	62.3	0.22	23.7
5		2,286	37.23	61.4	0.17	25.4
All		1,939	32.7	59.3	0.27	22.9

Source: International Food Policy Research Institute/Bangladesh Food Consumption and Nutrition Survey, 1991/92.

Table 5 Food expenditures, food prices, and kilograms consumed, by expenditure quintile and food group

Food Group	Expenditure Quintile 1	2	3	4	5	All
Household food expenditures (taka/capita/week)						
Rice	25.94	31.13	32.96	36.19	40.64	33.37
Wheat	1.93	1.77	2.28	2.04	1.08	1.82
Pulses/beans	0.43	0.53	0.72	1.14	1.96	0.96
Vegetables	3.80	3.47	4.47	4.83	5.33	4.38
Potatoes	0.89	1.41	1.39	1.34	1.65	1.34
Fish	2.37	4.00	4.62	5.40	7.68	4.81
Meat/eggs	0.99	1.79	1.56	1.73	4.61	2.14
Fruits	0.13	0.34	0.19	0.29	0.93	0.37
Milk/milk products	0.13	0.68	0.36	0.87	2.04	0.82
Cooking ingredients/spices	3.40	4.42	5.57	6.23	9.16	5.75
Other foods	0.34	0.38	0.82	0.71	1.52	0.75
All	40.34	49.90	54.93	60.76	76.60	56.51
Food prices (taka per kilogram)						
Rice	10.22	10.44	10.53	10.60	10.84	10.55
Wheat	9.41	10.30	10.13	10.64	12.15	10.31
Pulses/beans	20.97	22.20	21.76	19.77	22.80	21.62
Vegetables	3.73	3.77	3.87	3.90	4.23	3.91
Potatoes	3.71	4.41	4.34	4.19	4.58	4.19
Fish	26.60	26.67	28.27	29.65	33.26	29.51
Meat/eggs	44.41	45.90	43.24	54.35	56.21	50.57
Fruits	7.44	14.21	8.37	10.09	17.74	12.95
Milk	12.31	15.36	14.31	11.27	11.06	11.94
Cooking ingredients/spices	26.30	23.47	27.20	27.24	28.46	26.82
Other foods	9.47	5.52	4.83	12.05	7.25	6.94
All	9.31	10.11	10.03	10.41	11.55	10.38
Kilograms (per capita per week)						
Rice	2.54	2.98	3.13	3.41	3.75	3.16
Wheat	0.20	0.17	0.23	0.19	0.09	0.18
Pulses/beans	0.02	0.02	0.03	0.06	0.09	0.04
Vegetables	1.02	0.92	1.15	1.24	1.26.	1.12
Potatoes	0.24	0.32	0.32	0.32	0.36	0.32
Fish	0.09	0.15	0.16	0.18	0.23	0.16
Meat/eggs	0.02	0.04	0.04	0.03	0.08	0.04
Fruits	0.02	0.02	0.02	0.03	0.05	0.03
Milk	0.01	0.04	0.02	0.08	0.18	0.07
Cooking ingredients/spices	0.13	0.19	0.20	0.23	0.32	0.21
Other foods	0.04	0.07	0.17	0.06	0.21	0.11
All	4.33	4.93	5.48	5.84	6.63	5.44

Source: International Food Policy Research Institute/Bangladesh Consumption and Nutrition Survey, Survey, 1991/92.

Table 6 Sources of calories and calories purchased per taka, by expenditure quintile and food group

Food Group	Expenditure Quintile 1	2	3	4	5	All
	(calories per adult equivalent per day)					
Rice	1,626	1,859	1,905	2,083	2,243	1,943
Wheat	126	104	134	111	50	105
Pulses/beans	13	15	20	35	52	27
Vegetables	118	114	116	110	103	112
Potatoes	44	57	54	55	60	54
Fish	21	36	36	41	53	37
Meat/eggs	5	9	8	8	20	10
Fruits	2	6	5	9	15	7
Milk	1	5	3	9	22	8
Cooking ingredients/spices	55	85	96	111	172	103
Other foods	14	18	28	14	26	20
Rice and wheat	1,752	1,963	2,039	2,194	2,293	2,048
All other foods	273	344	366	392	522	380
All	2,025	2,307	2,405	2,586	2,815	2,428
Percent of RDA	70	80	84	90	98	84
	(calories per taka)					
Rice	346	339	335	332	326	336
Wheat	350	308	317	280	274	304
Pulses/beans	172	161	169	178	156	166
Vegetables	189	170	143	136	111	149
Potatoes	285	232	238	225	206	235
Fish	58	59	53	55	51	55
Meat/eggs	32	34	32	35	29	32
Fruits	118	109	147	193	133	144
Milk	61	59	62	61	61	61
Cooking ingredients/spices	85	99	97	101	110	98
Other foods	145	130	113	103	100	114
All	287	270	261	251	224	259

Source: International Food Policy Research Institute/Bangladesh Food Consumption and Nutrition Survey, 1991/92.

Table 7 Recommended dietary allowances for Indians (average per day)

Group	Age	Energy	Protein	Fat	Calcium	Vitamin A	Vitamin C	Thiamine	Riboflavin	Niacin
	(years)	(kilocalories)	(grams)	(grams)	(milligrams)	(µg RE)	(milligrams)	(milligrams)	(milligrams)	(mg NE)
Infants[a]	0 - 6 mo	108/kg	2.05/kg	25	500	350	25	55 µg/kg	65 µg/kg	710 µg/kg
	6 – 12 mo	98/kg	1.65/kg	25	500	350	25	50 µg/kg	60 µg/kg	650 µg/kg
Children	1 – 3	1,240	22	25	400	400	40	0.6	0.7	8
	4 – 6	1,690	30	25	400	400	40	0.9	1.0	11
	7 – 9	1,950	41	25	400	600	40	1.0	1.2	13
Males	10 – 12	2,190	54	22	600	600	40	1.1	1.3	15
	13 – 15	2,450	70	22	600	600	40	1.2	1.5	16
	16 – 18	2,640	78	22	500	600	40	1.3	1.6	17
	Adult	2,875	60	20	400	600	40	1.4	1.6	18
Females	10 – 12	1,970	57	22	600	600	40	1.0	1.2	13
	13 – 15	2,060	65	22	600	600	40	1.0	1.2	14
	16 – 18	2,060	63	22	500	600	40	1.0	1.3	14
	Adult	2,225	50	20	400	600	40	1.1	1.3	14
	Pregnant	2,525	65	30	1,000	600	40	1.3	1.5	16
	Lactating	2,775	75	45	1,000	950	80	1.4	1.6	18

Source: Indian Council of Medical Research 1994.

[a] Recommendations for infants less than 1 year old are based on the weight of the child.

Table 8 Estimated dietary requirements for iron-low bioavailability diet (5 percent)

Group	Age	Iron
		(milligrams)
Infants	0 – 0.25	...
	0.25 – 1	17
Children	1 – 2	10
	2 – 6	11
	6 – 12	19
Boys	12 – 16	29
Girls	12 – 16	32
Men	16 + 18	...
Women	Menstruating	25
	Post-menopausal	15
	Pregnant	33
	Lactating	21

Source: FAO 1988.

Table 9 Nutrient adequacy ratios, by expenditure quintile

Nutrient	Expenditure Quintile 1	2	3	4	5	All
Calories	0.70	0.80	0.84	0.90	0.98	0.84
Protein	0.75	0.86	0.91	0.96	1.05	0.90
Fat	0.24	0.30	0.39	0.44	0.72	0.42
Iron	0.63	0.61	0.74	0.83	0.91	0.74
Vitamin C	0.93	0.83	1.18	1.26	1.49	1.14
Vitamin A	0.51	0.35	0.64	0.46	0.61	0.51
Calcium	0.58	0.77	0.84	0.93	1.13	0.85
Niacin	1.18	1.33	1.39	1.48	1.58	1.39
Riboflavin	0.34	0.34	0.39	0.38	0.45	0.38
Thiamine	1.00	1.08	1.16	1.21	1.27	1.14

Source: International Food Policy Research Institute/Bangladesh Consumption and Nutrition Survey, 1991/92.

Table 10 Percent of households below 80 percent of requirements, on average, over the two survey periods, by expenditure quintile

Nutrient	Expenditure Quintile 1	2	3	4	5	All
Calories	73.7	57.6	43.2	30.5	25.4	46.1
Protein	61.9	41.5	34.7	27.1	19.5	36.9
Fat	100.0	98.3	96.6	94.1	69.5	91.7
Iron	76.3	83.1	65.3	57.6	55.1	67.5
Vitamin C	61.9	67.8	45.8	48.3	30.5	50.8
Vitamin A	77.1	86.4	73.7	78.0	78.0	78.6
Calcium	81.4	74.6	63.6	62.7	44.9	65.4
Niacin	9.3	1.7	0.8	0.8	0.0	2.5
Riboflavin	97.5	97.5	98.3	99.2	95.8	97.6
Thiamine	29.7	14.4	7.6	6.8	5.1	12.7
Vitamin A and iron	65.3	73.7	55.9	50.8	50.0	59.2
Vitamin A and vitamin C	56.8	66.1	43.2	46.6	29.7	48.5

Source: International Food Policy Research Institute/Bangladesh Consumption and Nutrition Survey, 1991/92.

Table 11 Percent of households below 80 percent of requirements in both survey rounds, by expenditure quintile

Nutrient	Expenditure Quintile 1	2	3	4	5	All
Calories	52.5	35.6	24.6	20.3	11.0	28.8
Protein	44.1	26.3	18.6	14.4	11.0	22.9
Fat	96.6	93.2	87.3	90.7	58.5	85.3
Iron	55.9	66.1	46.6	40.7	38.1	49.5
Vitamin C	42.4	46.6	29.7	32.2	15.3	33.2
Vitamin A	67.8	78.8	63.6	70.3	61.0	68.3
Calcium	67.8	62.7	45.8	47.5	28.8	50.5
Niacin	5.9	1.7	0.8	0.0	0.0	1.7
Riboflavin	93.2	94.1	87.3	93.2	84.7	90.5
Thiamine	11.9	4.2	3.4	3.4	1.7	4.9
Vitamin A and iron	43.2	56.8	37.3	34.7	28.8	40.2
Vitamin A and vitamin C	39.8	42.4	28.0	30.5	15.3	31.2

Source: International Food Policy Research Institute/Bangladesh Consumption and Nutrition Survey, 1991/1992.

Table 12 Sources of iron and milligrams of iron purchased per taka, by expenditure quintile and food group

Food Group	Expenditure Quintile 1	2	3	4	5	All
	(milligrams of iron per adult equivalent per day)					
Rice	4.91	5.24	5.65	6.08	6.63	5.70
Wheat	1.34	1.08	1.43	1.13	0.43	1.08
Pulses/beans	0.17	0.21	0.27	0.45	0.71	0.36
Vegetables	3.00	1.85	3.45	4.38	5.13	3.56
Potatoes	0.16	0.21	0.21	0.20	0.22	0.20
Fish	0.26	0.69	0.35	0.69	0.76	0.55
Meat/eggs	0.02	0.03	0.04	0.07	0.10	0.05
Fruits	0.01	0.03	0.03	0.03	0.07	0.03
Milk	0.00	0.01	0.01	0.02	0.05	0.02
Cooking ingredients/spices	1.30	1.38	1.50	1.83	2.12	1.63
Other foods	0.13	0.19	0.33	0.08	0.21	0.19
All	11.30	10.92	13.27	14.96	16.44	13.38
Percent of RDA	63	61	74	83	91	74
	(milligrams of iron per taka)					
Rice	1.37	1.25	1.25	1.22	1.24	1.27
Wheat	4.88	3.82	4.09	3.42	2.96	3.79
Pulses/beans	2.90	2.86	3.01	3.11	2.81	2.93
Vegetables	5.94	4.19	5.78	6.62	7.93	6.11
Potatoes	1.41	1.15	1.18	1.11	1.02	1.16
Fish	1.28	1.69	0.96	1.28	1.02	1.23
Meat/eggs	0.27	0.22	0.33	0.40	0.24	0.29
Fruits	1.91	0.93	2.43	1.28	1.76	1.65
Milk	0.18	0.17	0.18	0.18	0.18	0.18
Cooking ingredients/spices	2.89	2.51	2.18	2.22	1.95	2.35
Other foods	1.72	1.47	1.10	0.75	0.83	1.08
All	2.10	1.71	1.85	1.83	1.68	1.84

Source: International Food Policy Research Institute/Bangladesh Consumption and Nutrition Survey, 1991/92.

Table 13 Primary food sources of iron, by expenditure quintile

	Expenditure Quintile					
Food Group	1	2	3	4	5	All
	(milligrams of iron per adult equivalent per day)					
Rice						
Parboiled, milled	2.78	3.49	3.53	3.95	4.11	3.57
Parboiled, hand pounded	1.73	1.35	1.60	1.31	1.14	1.43
Puffed rice	0.17	0.21	0.28	0.47	0.63	0.35
Wheat						
Whole wheat flour	1.34	0.95	1.41	0.98	0.38	1.01
Vegetables						
Cauliflower greens	0.61	0.28	0.41	1.36	1.63	0.86
Pui shak	0.44	0.20	0.72	0.66	0.88	0.58
Lal shak	0.35	0.22	0.43	0.26	0.37	0.33
Khesari leaves	0.10	0.09	0.54	0.42	0.39	0.31
Broad beans	0.32	0.18	0.22	0.23	0.28	0.25
Onion stalks	0.30	0.04	0.17	0.19	0.43	0.23
Fish						
Chingra	0.06	0.47	0.07	0.32	0.35	0.25
Cooking ingredients/spices						
Tumeric	1.15	1.18	1.30	1.58	1.79	1.40
All foods	11.30	10.92	13.27	14.96	16.44	13.38

Source: International Food Policy Research Institute/Bangladesh Consumption and Nutrition Survey, 1991/92.

Table 14 Sources of vitamin A and micrograms of vitamin A purchased per taka, by expenditure quintile and food group

Food group	Expenditure Quintile 1	2	3	4	5	All
	(micrograms retinol equivalent of vitamin A per adult equivalent per day)					
Rice	0.97	0.76	0.92	0.75	0.72	0.82
Wheat	1.35	1.19	1.46	1.30	0.45	1.15
Pulses/beans	0.70	1.02	1.24	1.81	3.57	1.67
Vegetables	293.68	196.04	354.98	251.93	332.95	285.91
Potatoes	1.38	1.84	1.77	1.79	2.06	1.77
Fish	0.26	0.21	0.16	0.39	0.31	0.27
Meat/eggs	1.52	1.54	14.95	5.66	6.48	6.03
Fruits	1.08	0.56	0.36	0.49	1.94	0.89
Milk	0.85	3.01	1.97	5.93	13.78	5.11
Cooking ingredients/spices	2.12	2.53	3.42	3.90	4.80	3.36
Other foods	0.01	0.03	0.13	0.03	0.13	0.07
All	303.91	208.72	381.36	273.99	367.20	307.03
Percent of RDA	51	35	64	46	61	51
	(micrograms retinol equivalent of vitamin A per taka)					
Rice	0.22	0.17	0.18	0.13	0.10	0.16
Wheat	4.80	3.96	4.11	3.61	3.00	3.86
Pulses/beans	10.96	12.46	12.22	11.79	12.26	12.02
Vegetables	579.43	418.27	635.55	426.78	492.49	509.40
Potatoes	11.77	9.55	9.82	9.28	8.48	9.67
Fish	2.33	1.08	0.48	0.70	0.83	0.99
Meat/eggs	34.95	28.39	111.40	44.60	34.57	48.50
Fruits	21.45	10.81	10.08	14.10	12.65	13.49
Milk	48.06	45.73	47.39	47.64	48.04	47.52
Cooking ingredients/spices	4.36	4.30	4.35	4.48	3.68	4.24
Other foods	0.13	0.13	0.22	0.09	0.18	0.15
All	53.57	34.56	53.95	33.88	37.05	42.60

Source: International Food Policy Research Institute/Bangladesh Consumption and Nutrition Survey, 1991/92.

Table 15 Primary food sources of vitamin A, by expenditure quintile

Food Group/Item	Expenditure Quintile 1	2	3	4	5	All
	(micrograms retinol equivalent per adult equivalent per day)					
Vegetables						
Pui shak	59.22	27.01	93.77	90.39	123.19	78.72
Lal shak	49.30	27.49	59.61	37.63	54.35	45.68
Radish leaves	37.68	52.35	45.10	13.98	37.95	37.41
Khesari leaves	8.24	6.57	40.10	32.39	29.14	23.29
Helencha shak	27.04	17.25	15.21	0.00	0.00	11.90
Betel leaves	14.07	6.22	5.03	11.65	15.34	10.47
Colocasia leaves	1.68	10.53	29.04	12.46	.	10.74
Coriander leaves	6.75	4.59	13.71	12.16	12.63	9.97
Spinach	8.36	5.68	6.12	0.98	15.05	7.24
Wild yam	4.70	3.98	4.92	2.32	5.73	4.33
Data shak	5.71	6.31	1.82	3.85	1.99	3.93
Motor shak	9.43	0.00	8.58	0.00	1.40	3.88
Onion stalks	4.52	0.68	2.48	2.75	6.78	3.44
Milk						
Cow's milk	0.70	2.48	1.63	5.65	13.39	4.77
All foods	303.91	208.72	381.36	273.99	367.20	307.03

Source: International Food Policy Research Institute/Bangladesh Consumption and Nutrition Survey, 1991/92.

Table 16 Sources of carotene and micrograms of carotene purchased per taka, by expenditure quintile and food group

	Expenditure Quintile					
Food Group	1	2	3	4	5	All
	(micrograms retinol equivalent of carotene per adult equivalent per day)					
Rice	0.97	0.76	0.92	0.75	0.72	0.82
Wheat	1.35	1.19	1.46	1.30	0.45	1.15
Pulses/beans	0.70	1.02	1.24	1.81	3.57	1.67
Vegetables	293.68	196.04	354.98	251.93	332.95	285.91
Potatoes	1.38	1.84	1.77	1.79	2.06	1.77
Fish	0.00	0.00	0.00	0.00	0.00	0.00
Meat/eggs	0.26	0.26	0.62	1.13	1.23	0.70
Fruits	1.08	0.56	0.36	0.49	1.94	0.89
Milk	0.01	0.05	0.03	0.11	0.25	0.09
Cooking ingredients/spices	2.04	2.36	3.05	3.38	4.29	3.02
Other foods	0.01	0.03	0.13	0.03	0.13	0.07
All	301.46	204.10	364.55	262.73	347.59	296.09
	(micrograms retinol equivalent of carotene per taka)					
Rice	0.22	0.17	0.18	0.13	0.10	0.16
Wheat	4.80	3.96	4.11	3.61	3.00	3.86
Pulses/beans	10.96	12.46	12.22	11.79	12.26	12.02
Vegetables	579.43	418.27	635.55	426.78	492.49	509.40
Potatoes	11.77	9.55	9.82	9.28	8.48	9.67
Fish	0.00	0.00	0.00	0.00	0.00	0.00
Meat/eggs	6.74	5.58	10.19	8.69	7.06	7.64
Fruits	21.45	10.81	10.08	14.10	12.65	13.49
Milk	0.80	0.83	0.82	0.87	0.89	0.86
Cooking ingredients/spices	4.04	4.02	3.87	3.97	3.28	3.84
Other foods	0.13	0.13	0.22	0.09	0.18	0.15
All	53.19	33.97	51.99	32.66	35.32	41.42

Source: International Food Policy Research Institute/Bangladesh Consumption and Nutrition Survey, 1991/92.

Table 17 Sources of retinol and micrograms of retinol purchased per taka, by expenditure quintile and food group

Food Group	Expenditure Quintile 1	2	3	4	5	All
	(micrograms of retinol per adult equivalent per day)					
Rice	0.00	0.00	0.00	0.00	0.00	0.00
Wheat	0.00	0.00	0.00	0.00	0.00	0.00
Pulses/beans	0.00	0.00	0.00	0.00	0.00	0.00
Vegetables	0.00	0.00	0.00	0.00	0.00	0.00
Potatoes	0.00	0.00	0.00	0.00	0.00	0.00
Fish	0.26	0.21	0.16	0.39	0.31	0.27
Meat/eggs	1.26	1.28	14.33	4.53	5.25	5.33
Fruits	0.00	0.00	0.00	0.00	0.00	0.00
Milk	0.84	2.96	1.94	5.82	13.53	5.02
Cooking ingredients/spices	0.09	0.17	0.37	0.52	0.52	0.33
Other foods	0.00	0.00	0.00	0.00	0.00	0.00
All	2.45	4.62	16.81	11.26	19.60	10.95
	(micrograms of retinol per taka)					
Rice	0.00	0.00	0.00	0.00	0.00	0.00
Wheat	0.00	0.00	0.00	0.00	0.00	0.00
Pulses/beans	0.00	0.00	0.00	0.00	0.00	0.00
Vegetables	0.00	0.00	0.00	0.00	0.00	0.00
Potatoes	0.00	0.00	0.00	0.00	0.00	0.00
Fish	2.33	1.08	0.48	0.70	0.83	0.99
Meat/eggs	28.21	22.81	101.21	35.91	27.50	40.87
Fruits	0.00	0.00	0.00	0.00	0.00	0.00
Milk	47.27	44.90	46.57	46.77	47.15	46.66
Cooking ingredients/spices	0.32	0.28	0.48	0.51	0.40	0.40
Other foods	0.00	0.00	0.00	0.00	0.00	0.00
All	0.39	0.59	1.96	1.23	1.73	1.18

Source: International Food Policy Research Institute/Bangladesh Consumption and Nutrition Survey, 1991/92.

Table 18 Sources of vitamin C and milligrams of vitamin C purchased per taka, by expenditure quintile and food group

Food Group	Expenditure Quintile 1	2	3	4	5	All
	(milligrams of vitamin C per adult equivalent per day)					
Rice	0.00	0.00	0.00	0.00	0.00	0.00
Wheat	0.00	0.00	0.00	0.00	0.00	0.00
Pulses/beans	0.00	0.01	0.01	0.02	0.02	0.01
Vegetables	28.69	22.52	35.30	37.94	42.67	33.42
Potatoes	5.16	6.95	6.78	6.93	8.32	6.83
Fish	1.13	1.40	2.12	2.39	3.65	2.14
Meat/eggs	0.02	0.05	0.06	0.02	0.05	0.04
Fruits	0.67	0.37	0.76	0.44	1.42	0.73
Milk	0.02	0.10	0.06	0.20	0.48	0.17
Cooking ingredients/spices	1.37	1.85	2.20	2.36	3.02	2.16
Other foods	0.00	0.00	0.00	0.00	0.00	0.00
All	37.08	33.25	47.29	50.31	59.64	45.51
Percent of RDA	93	83	118	126	149	114
	(milligrams of vitamin C per taka)					
Rice	0.00	0.00	0.00	0.00	0.00	0.00
Wheat	0.00	0.00	0.00	0.00	0.00	0.00
Pulses/beans	0.08	0.12	0.03	0.10	0.08	0.08
Vegetables	67.00	55.95	73.93	65.10	62.10	64.78
Potatoes	50.02	40.58	41.72	39.44	36.05	41.11
Fish	2.85	3.25	3.46	4.42	3.91	3.66
Meat/eggs	0.17	0.20	0.23	0.07	0.09	0.14
Fruits	53.22	39.78	47.80	42.43	25.85	39.04
Milk	1.69	1.71	1.72	1.78	1.80	1.76
Cooking ingredients/spices	3.32	3.57	3.20	3.26	2.78	3.22
Other foods	0.00	0.00	0.00	0.04	0.00	0.01
All	7.26	5.49	6.98	6.48	6.04	6.45

Source: International Food Policy Research Institute/Bangladesh Consumption and Nutrition Survey, 1991/92.

Table 19 Primary food sources of vitamin C, by expenditure quintile

Food Group/Item	Expenditure Quintile 1	2	3	4	5	All
	(milligrams per adult equivalent per day)					
Vegetables						
Cabbage	6.95	4.21	6.56	11.05	9.82	7.72
Pui shak	3.68	1.68	5.82	5.75	8.24	5.03
Radish leaves	2.89	4.18	3.76	1.16	3.26	3.05
Radish	1.89	2.05	2.36	3.14	2.09	2.31
Green chillies	1.90	1.87	1.94	2.34	2.98	2.20
Begun	1.86	1.52	1.98	2.24	2.78	2.08
Broad beans	2.48	1.44	1.75	1.80	2.47	1.99
Khesari leaves	0.61	0.49	3.00	2.39	2.30	1.76
Lal shak	1.53	0.77	1.85	1.22	1.77	1.43
Coriander leaves	0.72	0.49	1.47	1.26	1.40	1.07
Potatoes	5.16	6.95	6.78	6.93	8.32	6.83
Cooking ingredients/spices						
Dried chillies	1.13	1.37	1.66	1.80	2.02	1.59
All foods	37.08	33.25	47.29	50.31	59.64	45.51

Source: International Food Policy Research Institute/Bangladesh Consumption and Nutrition Survey, 1991/92.

Table 20 Sources of fat and grams of fat purchased per taka, by expenditure quintile and food group

Food Group	Expenditure Quintile 1	2	3	4	5	All
	(grams of fat per adult equivalent per day)					
Rice	1.23	1.41	1.53	1.65	1.97	1.56
Wheat	0.37	0.30	0.41	0.35	0.15	0.32
Pulses/beans	0.02	0.04	0.04	0.08	0.11	0.06
Vegetables	0.52	0.49	0.62	0.56	0.48	0.53
Potatoes	0.03	0.04	0.04	0.04	0.05	0.04
Fish	0.34	0.48	0.63	0.60	0.98	0.61
Meat/eggs	0.10	0.23	0.15	0.26	0.62	0.27
Fruits	0.01	0.10	0.15	0.21	0.54	0.20
Milk	0.05	0.20	0.14	0.39	0.93	0.34
Cooking ingredients/spices	2.01	2.62	3.84	4.11	7.56	4.03
Other foods	0.20	0.17	0.29	0.46	0.92	0.41
All	4.88	6.08	7.84	8.71	14.31	8.37
Percent of RDA	24	30	39	44	72	42
	(grams of fat per taka)					
Rice	0.44	0.42	0.42	0.40	0.40	0.41
Wheat	1.71	1.35	1.43	1.21	1.03	1.33
Pulses/beans	0.53	0.54	0.44	0.54	0.51	0.51
Vegetables	1.55	1.18	1.13	1.19	0.74	1.15
Potatoes	0.29	0.24	0.25	0.23	0.21	0.24
Fish	1.19	1.40	1.25	1.38	1.33	1.32
Meat/eggs	1.53	1.39	1.72	1.69	1.57	1.59
Fruits	0.70	1.04	2.57	9.81	6.33	5.01
Milk	3.77	3.66	3.84	3.77	3.79	3.77
Cooking ingredients/spices	5.47	6.04	6.68	6.34	7.40	6.38
Other foods	6.97	5.95	6.50	7.68	6.74	6.81
All	2.53	2.47	2.73	3.05	3.02	2.79

Source: International Food Policy Research Institute/Bangladesh Consumption and Nutrition Survey, 1991/92.

Table 21 Primary food sources of fat, by expenditure quintile

Food Group/Item	Expenditure Quintile 1	2	3	4	5	All
	(grams per adult equivalent per day)					
Rice						
Parboiled, milled	0.90	1.13	1.17	1.34	1.61	1.23
Parboiled, hand pounded	0.30	0.23	0.28	0.24	0.24	0.26
Wheat						
Whole wheat flour	0.37	0.26	0.41	0.31	0.13	0.30
Vegetables						
Dried colocasia leaves	0.23	0.23	0.21	0.15	0.01	0.17
Fish						
Ilish	0.14	0.15	0.23	0.20	0.41	0.23
Fruits						
Fresh coconut	0.00	0.09	0.14	0.20	0.51	0.19
Milk						
Cow's milk	0.04	0.15	0.10	0.36	0.89	0.31
Cooking ingredients/spices						
Cooking oil	1.76	2.30	3.37	3.61	6.92	3.59
Dried chillies	0.12	0.15	0.19	0.20	0.23	0.18
Other foods						
Almond	0.12	0.07	0.14	0.32	0.75	0.28
All foods	4.88	6.08	7.84	8.71	14.31	8.37

Source: International Food Policy Research Institute/Bangladesh Consumption and Nutrition Survey, 1991/92.

Table 22 Household calorie, iron, vitamin A, vitamin C, and fat adequacy ratios and percent of households below 80 percent of requirements, by survey round

Survey Round	Calories	Iron	Vitamin A	Vitamin C	Fat
			(adequacy ratio)		
2	0.86	0.86	0.38	1.42	0.41
3	0.83	0.62	0.64	0.85	0.43
All	0.84	0.74	0.51	1.14	0.42
	(percent of households below 80 percent of requirements)				
2	46	60	87	45	91
3	48	79	79	70	91
All	47	69	83	57	91

Source: International Food Policy Research Institute/Bangladesh Consumption and Nutrition Survey, 1991/92.

Table 23 Intake from top food sources of iron, by survey round

	Iron		
	Round 2	Round 3	Difference
	(milligrams per adult equivalent per day)		
Consumed more in Round 3			
Parboiled, milled rice	3.21	3.94	0.73
Pui shak	0.03	1.13	1.10
Lal shak	0.10	0.55	0.45
Subtotal	3.34	5.62	2.28
Consumed more in Round 2			
Parboiled, hand pounded rice	2.41	0.44	−1.97
Whole wheat flour	1.43	0.59	−0.84
Cauliflower greens	1.72	0.00	−1.72
Khesari leaves	0.62	0.00	−0.62
Broad beans	0.49	0.01	−0.48
Onion stalks	0.45	0.00	−0.45
Tumeric	1.56	1.23	−0.33
Subtotal	8.68	2.27	−6.41
Total	12.02	7.89	−4.13
All foods	15.51	11.25	−4.26

Source: International Food Policy Research Institute/Bangladesh Consumption and Nutrition Survey, 1991/92.

Table 24 Prices of selected food items, by survey round

Food Item	Round 2 n	Round 2 Taka per Kilogram	Round 3 n	Round 3 Taka per Kilogram
Milled rice	386	11.46	364	9.32
Wheat flour	145	9.65	73	8.81
Potato	466	4.27	234	7.69
Milk	107	10.26	121	11.02
Green, leafy vegetables				
Lal shak	2	3.00	31	3.61
Pui shak	...	...	21	2.38
Radish leaves	1	1.00	14	2.93

... = Information is not available.

Table 25   Intake from top food sources of vitamins A and C, by survey round

	Vitamin A (Micrograms per Adult Equivalent per Day)			Vitamin C (Milligrams per Adult Equivalent per Day)		
	Round 2	Round 3	Difference	Round 2	Round 3	Difference
Consumed more in Round 3						
Pui shak	3.78	153.65	149.87	0.23	9.83	9.60
Lal shak	14.73	76.63	61.90	0.49	2.37	1.88
Radish leaves	18.77	56.06	37.29	1.51	4.59	3.08
Subtotal	37.28	286.34	249.06	2.23	16.79	14.56
Consumed more in Round 2						
Coriander leaves	19.84	0.09	−19.75	2.12	0.01	−2.11
Helencha shak	23.80	0.00	−23.80	0.00	0.00	0.00
Cabbage	2.74	0.00	−2.74	15.42	0.02	−15.40
Broad beans	0.55	0.01	−0.54	3.92	0.06	−3.86
Green chillies	0.88	0.40	−0.48	3.03	1.38	−1.65
Begun	2.59	2.12	−0.47	2.28	1.87	−0.41
Potato	3.15	0.38	−2.77	12.19	1.47	−10.72
Subtotal	53.55	3.00	−50.55	38.96	4.81	−34.15
Total	90.83	289.34	198.51	41.19	21.60	−19.59
All foods 229.10	385.00	155.90	57.00	34.00	−23.00	

Source: International Food Policy Research Institute/Bangladesh Consumption and Nutrition Survey, 1991/92.

Table 26 Determinants of household-level demand for calories, iron, vitamin A, vitamin C, and fat: 2SLS results

	Dependent Variable									
Explanatory	PAEQKCAL		PAEQIRON		PAEQVITA		PAEQVITC		PAEQFAT	
Variables	Coefficient	t-Statistic	Coefficient	t-Statistic	Coefficient	t-Statistic	Coefficient	t-Statistic	Coefficient	t-Statistic
CONSTANT	1,935.5223	5.93	−5.2484	−1.10	44.3980	0.15	20.6287	0.80	−1.8089	−0.63
PCTOTEXP[a]	1.3326	3.21	0.0113	1.87	0.4392	1.14	0.1172	3.57	0.0322	8.77
HHSIZE	−1.7627	−0.15	0.0738	0.42	−3.0187	−0.27	0.9570	1.01	0.0401	0.38
FEMLHEAD	−266.0383	−2.17	−3.5694	−2.00	−57.5509	−0.51	−5.8443	−0.60	−1.1573	−1.07
AGEHEAD	−2.7686	−1.40	−0.0092	−0.32	1.6995	0.93	0.2320	1.48	0.0243	1.39
EDUCHEAD	−14.8691	−1.36	−0.1643	−1.03	−15.1733	−1.50	−1.6756	−1.94	−0.3123	−3.24
FARMER	217.3013	2.93	0.9969	0.92	−9.4163	−0.14	−9.0632	−1.55	−0.1326	−0.20
AGLABOR	1.6324	0.03	−0.1672	−0.21	23.4611	0.46	−0.6391	−0.14	0.2340	0.48
VPRRICE	11.4567	0.40	1.4273	3.45	−11.3895	−0.43	−0.0589	−0.03	−0.2652	−1.06
VPRPOTAT	10.1196	0.66	0.0739	0.33	36.8590	2.61	−3.3665	−2.79	0.3753	2.78
Income elasticity	0.18		0.27[b]		not significant		0.81		1.21	
Price elasticities										
Rice	not significant		1.11		not significant		not significant		not significant	
Potato	not significant		not significant		0.72		−0.44		0.19	

Source: International Food Policy Research Institute/Bangladesh Food Consumption and Nutrition Survey, 1991/92.

[a] Variable treated as endogenous.
[b] Significant at 10 percent but not 5 percent level.

Variable Description			Mean
PAEQKCAL	=	Household calorie intake per adult equivalent (kilocalories)	2,427.64
PAEQIRON	=	Household iron intake per adult equivalent (milligrams)	13.38
PAEQVITA	=	Household vitamin A intake per adult equivalent (ug ret. eq.)	307.03
PAEQVITC	=	Household vitamin C intake per adult equivalent (milligram)	45.51
PAEQFAT	=	Household fat intake per adult equivalent (grams)	8.36
PCTOTEXP	=	Per capita total expenditures (taka per month)	314.27
HHSIZE	=	Household size (number)	6.03
FEMLHEAD	=	1=female-headed household, 0=otherwise	0.03
AGEHEAD	=	Age of household head (years)	41.68
EDUCHEAD	=	Education of household head (years)	2.19
FARMER	=	1=if household head is a farmer, 0=otherwise	0.28
AGLABOR	=	1=if household head is an agricultural laborer, 0=otherwise	0.30
VPRRICE	=	Village-level average price of rice (taka per kilogram)	10.39
VPRPOTAT	=	Village-level average price of potato (taka per kilogram)	5.99

Table 27 Morbidity during the three months prior to survey, by age group and survey round

Age Group	Survey Round	Number Individuals	Incidence			Adequacy Ratio				
			Diarrhea	Flu	Colds	Calories	Iron	Vitamin A	Vitamin C	Fat
Preschoolers (0 - 6 years)	2	541	0.18	0.21	0.17	0.71	0.75	0.31	0.89	0.22
	3	631	0.17	0.14	0.10	0.73	0.62	0.66	0.60	0.25
Children (7 - 12 years)	2	639	0.12	0.15	0.08	0.81	0.72	0.31	1.37	0.33
	3	652	0.09	0.09	0.03	0.83	0.51	0.55	0.80	0.36
Adolescents (13-18 years)	2	313	0.11	0.16	0.05	0.94	0.82	0.48	1.93	0.49
	3	333	0.10	0.11	0.02	0.86	0.50	0.62	0.93	0.49
Adults	2	1,459	0.16	0.19	0.06	0.91	1.07	0.42	1.74	0.57
	3	1,491	0.15	0.10	0.04	0.84	0.74	0.70	1.00	0.60
All	2	2,952	0.15	0.18	0.08	0.86	0.86	0.38	1.42	0.44
	3	3,107	0.13	0.11	0.05	0.82	0.62	0.64	0.85	0.47

Source: International Food Policy Research Institute/Bangladesh Consumption and Nutrition Survey, 1991/92.

Table 28 Determinants of the incidence of sickness among children five years old and under alternative hypotheses of dominant nutrient intake: Logistic regression results

Explanatory variables	Calories		Iron		Vitamin C		Iron*Vitamin C	
	Coefficient	Chi-square*	Coefficient	Chi-square*	Coefficient	Chi-square*	Coefficient	Chi-square*
CONSTANT	1.9023	3.32	1.3657	1.88	0.9602	0.95	1.1352	1.32
SEASON	0.4409	6.58	0.5007	8.30	0.4960	8.09	0.5118	8.62
GENDER	−0.0534	0.10	−0.0409	0.06	−0.0399	0.05	−0.0238	0.02
FAGE	−0.1765	3.06	−0.1670	2.75	−0.1585	2.51	−0.1687	2.80
AGEMOM	−0.0366	7.43	−0.0372	7.68	−0.0335	6.39	−0.0360	7.22
EDUCMOM	0.0422	0.80	0.0297	0.40	0.0281	0.36	0.0248	0.28
BMIMOM	0.0154	0.12	0.0126	0.08	0.0209	0.22	0.0162	0.13
PCTOTEXP	0.0009	2.04	0.0007	1.55	0.0006	1.14	0.0007	1.33
TLAND	−0.0024	8.21	−0.0023	7.91	−0.0024	8.71	−0.0023	7.63
DISTRVIL	−0.0457	0.07	0.0034	0.0004	0.0345	0.04	0.0122	0.01
PAEQKCAL	−0.0004	7.36						
PAEQIRON			−0.0235	6.11				
PAEQVITC					−0.0037	4.20		
PAEQIRON * PAEQVITC							−0.0002	8.96
Chi-square**	40.82		40.80		37.71		43.99	

Explanatory variables	Vitamin A		Fat		Vitamin A * Fat	
	Coefficient	Chi-square*	Coefficient	Chi-square*	Coefficient	Chi-square*
CONSTANT	0.9895	1.02	1.2943	1.69	11.0211	1.08
SEASON	0.4060	5.55	0.3905	5.14	0.4072	5.62
GENDER	−0.0483	0.08	−0.0576	0.11	−0.0496	0.08
FAGE	−0.1617	2.62	−0.1630	2.64	−0.1628	2.65
AGEMOM	−0.0328	6.20	−0.0362	7.32	−0.0330	6.26
EDUCMOM	0.0288	0.38	0.0492	1.05	0.0311	0.44
BMIMOM	0.0158	0.13	0.0125	0.08	0.0144	0.11
PCTOTEXP	0.0006	0.95	0.0010	2.48	0.0006	1.06
TLAND	−0.0024	9.12	−0.0023	8.18	−0.0024	8.82
DISTRVIL	0.0485	0.08	−0.0067	0.002	0.0418	0.06
PAEQVITA	−0.0001	1.00				
PAEQFAT			−0.0402	4.01		
PAEQVITA * PAEQFAT					−0.00002	1.62
Chi-square**	34.33		35.00		37.52	

Source: International Food Policy Research Institute/Bangladesh Food Consumption and Nutrition Survey, 1991/92.
* Critical values with 1 df are 3.84 at 5 percent and 2.71 at 10 percent.
** Critical values with 10 df are 16.92 at 5 percent and 14.68 at 10 percent.

Means of variables used in child morbidity regression

Variable		Definition	Mean
SICK	=	1=if child had diarrhea, flu, or colds, 0=otherwise	0.48
SEASON	=	1=Round 2, 0=Round 3	0.51
GENDER	=	1=male, 0=female	0.51
FAGE	=	Age (years)	3.84
AGEMOM	=	Age of mother (years)	29.46
EDUCMOM	=	Education of mother (years)	0.92
BMIMOM	=	Body mass index of mother	18.11
PCTOTEXP	=	Per capita monthly total expenditures (taka)	279.86
TLAND	=	Total cultivable land of household (decimal)	65.27
DISTRVIL	=	1=if village located in distressed area, 0=otherwise	0.52
PAEQKCAL	=	Household calorie intake per adult equivalent (kilocalories)	2,358.70
PAEQIRON	=	Household iron intake per adult equivalent (milligrams)	12.86
PAEQVITC	=	Household vitamin C intake per adult equivalent (milligrams)	42.66
PAEQIRON * PAEQVITC	=	Interaction of iron and vitamin C	764.84
PAEQVITA	=	Household vitamin A intake per adult equivalent (micrograms ret. eq.)	286.22
PAEQFAT	=	Household fat intake per adult equivalent (grams)	7.14
PAEQVITA * PAEQFAT	=	Interaction of vitamin A and fat	2,291.52

Table 29 Determinants of flu incidence among adults under alternative hypotheses of dominant nutrient intake: Logistic regression results

Explanatory variables	Calories		Iron		Vitamin C		Iron*Vitamin C	
	Coefficient	Chi-square*	Coefficient	Chi-square*	Coefficient	Chi-square*	Coefficient	Chi-square*
CONSTANT	−1.8615	11.50	−1.8548	12.07	−1.7840	11.20	−1.7905	11.30
SEASON	0.5988	28.91	0.5662	24.99	0.6119	28.87	0.6072	29.23
GENDER	0.2913	4.34	0.2948	4.44	0.2901	4.31	0.2890	4.27
FAGE	−0.0003	0.01	−0.0004	0.01	−0.0003	0.01	−0.0003	0.01
EDCTN	−0.0173	0.74	−0.0175	0.76	−0.0170	0.72	−0.0171	0.73
FARMER	−0.2403	1.69	−0.2467	1.79	−0.2305	1.57	−0.2292	1.55
AGLABOR	0.0560	0.09	0.0584	0.10	0.0546	0.09	0.0562	0.09
BMI	−0.0423	2.37	−0.0427	2.43	−0.0409	2.24	−0.0408	2.23
PCTOTEXP	0.0011	12.33	0.0011	12.67	0.0011	13.14	0.0011	13.05
TLAND	−0.0013	12.88	−0.0013	13.28	−0.0013	12.64	−0.0013	12.66
DISTRVIL	0.3033	7.60	0.3121	8.13	0.2939	7.29	0.2928	7.21
PAEQKCAL	0.0004	0.27						
PAEQIRON			0.0080	3.12				
PAEQVITC					−0.0004	0.16		
PAEQIRON * PAEQVITC							−0.00001	0.10
Chi-square**	72.56		75.26		72.46		72.40	

	Vitamin A		Fat		Vitamin A * Fat	
	Coefficient	Chi-square*	Coefficient	Chi-square*	Coefficient	Chi-square*
CONSTANT	−1.8644	12.14	−1.7450	10.68	−1.7812	11.16
SEASON	0.6241	31.00	0.5736	26.25	0.5977	28.66
GENDER	0.2910	4.32	0.2823	4.06	0.2884	4.25
PAGE	−0.0004	0.01	0.0002	0.002	−0.0003	0.01
EDCTN	−0.0165	0.67	−0.0128	0.41	−0.0172	0.74
FARMER	−0.2393	1.69	−0.2032	1.21	−0.2276	1.53
AGLABOR	0.0557	0.09	0.0437	0.06	0.0570	0.10
BMI	−0.0402	2.16	−0.0370	1.82	−0.0412	2.27
PCTOTEXP	0.0011	13.14	0.0014	18.10	0.0011	13.16
TLAND	−0.0013	12.86	−0.0013	12.61	−0.0013	12.72
DISTRVIL	0.2965	7.41	0.2599	5.61	0.2935	7.26
PAEQVITA	0.0001	3.40				
PAEQFAT			−0.0252	5.89		
PAEQVITA * PAEQFAT					−0.000003	0.16
Chi-square**	75.49		78.76		72.46	

Source: International Food Policy Research Institute/Bangladesh Food Consumption and Nutrition Survey, 1991/92.

* Critical values with 1 df are 3.84 at 5 percent and 2.71 at 10 percent.
** Critical values with 11 df are 19.68 at 5 percent and 17.28 at 10 percent.

Means of variables used in adult morbidity regression

			Mean
FLU	=	1=if adult had flu, 0=otherwise	0.15
SEASON	=	1=Round 2, 0=Round 3	0.50
GENDER	=	1=male, 0=female	0.49
FAGE	=	Age (years)	36.98
EDCTN	=	Education (years)	1.80
FARMER	=	1=if main occupation is farmer, 0=otherwise	0.16
AGLABOR	=	1=if main occupation is agricultural laborer, 0=otherwise	0.12
BMI	=	Body mass index	18.09
PCTOTEXP	=	Per capita monthly total expenditures (taka)	338.14
TLAND	=	Total cultivable land of household (decimal)	126.14
DISTRVIL	=	1=if village located in distresses area, 0=otherwise	0.53
PAEQKCAL	=	Household calorie intake per adult equivalent (kilocalories)	2,484.29
PAEQIRON	=	Household iron intake per adult equivalent (milligrams)	13.98
PAEQVITC	=	Household vitamin C intake per adult equivalent (milligrams)	48.25
PAEQIRON * PAEQVITC	=	Interaction of iron and vitamin C	965.05
PAEQVITA	=	Household vitamin A intake per adult equivalent (micrograms ret. eq.)	309.64
PAEQFAT	=	Household fat intake per adult equivalent (grams)	9.12
PAEQVITA * PAEQFAT	=	Interaction of vitamin A and fat	3,357.69

Table 30 Percentage of households and individuals with positive consumption of food, by type of household member

Food Group	Percent of Households with Positive Consumption	Of Households with Positive Consumption, Household Member Type							
		Ages 0 - 6		Ages 7 - 12		Ages 13 - 18		Adults	
		Boys	Girls	Boys	Girls	Boys	Girls	Male	Female
		(percent of individuals with positive consumption)							
Rice	99	100	100	100	100	100	100	100	100
Wheat	22	55	60	58	59	49	43	73	52
Pulses/beans	25	69	63	72	69	77	73	81	69
Vegetables	96	95	95	97	96	97	96	98	98
Green, leafy vegetables	59	61	62	62	62	62	64	82	83
Root and tubers	34	81	84	87	91	89	92	89	88
Other vegetables	80	93	89	93	94	96	94	95	95
Potatoes	49	85	79	85	84	85	78	88	82
Fish	61	85	84	90	88	90	88	93	87
Meat	11	53	78	61	51	56	59	74	52
Eggs	7	56	57	60	37	41	52	54	34
Fruits	16	73	75	79	67	63	79	68	60
Milk	25	28	35	33	26	33	38	69	29
Cooking ingredients/spice	100	99	100	100	100	100	100	100	100
Other foods	45	22	21	21	16	25	16	67	59

Table 31 FS/ES ratios for food groups for individuals with positive consumption, by type of household member

	Household Member Type							
	Ages 0 - 6		Ages 7 - 12		Ages 13 - 18		Adults	
Food Group	Boys	Girls	Boys	Girls	Boys	Girls	Male	Female
Rice	0.97	0.99	1.00	1.00	1.01	1.00	0.99	1.01
Wheat	2.07	2.08	1.68	1.26	1.90	1.07	2.20	1.20
Pulses/beans	1.49	1.55	1.31	1.44	1.09	1.60	1.59	1.22
Vegetables	1.02	1.07	1.01	1.03	1.10	1.20	1.01	1.11
Green, leafy vegetables	1.31	1.31	1.07	1.10	1.17	1.14	1.41	1.70
Root and tubers	1.04	1.09	1.11	1.19	1.21	1.13	1.13	1.17
Other vegetables	1.08	1.14	1.05	1.04	1.10	1.03	1.08	1.11
Potatoes	1.32	1.29	1.15	1.21	1.35	1.10	1.28	1.18
Fish	1.26	1.12	1.11	1.09	1.08	1.12	1.23	1.09
Meat	2.68	1.47	1.67	1.80	1.37	2.04	1.95	1.25
Eggs	4.63	1.84	2.18	2.00	2.43	3.07	2.77	1.60
Fruits	2.64	3.22	1.56	1.75	1.26	1.22	1.71	2.36
Milk	4.96	2.76	2.12	1.33	2.29	2.02	2.87	1.77
Cooking ingredients/spice	1.12	1.08	1.01	1.01	0.99	1.05	1.03	0.99
Other foods	3.54	2.69	2.23	1.35	1.86	1.69	2.33	2.56

Table 32 Sign and significance of regression coefficients of FS/ES ratios for five food groups: Double-hurdle results

Variable	Milk Probability	Milk Level	Meat Probability	Meat Level	Eggs Probability	Eggs Level	Green Vegetables Probability	Green Vegetables Level	Fish Probability	Fish Level
BOY0_6	(−)	(+)*	(−)	(+)*	(+)	(+)**	(−)	(+)	(−)	(+)**
GIRL0_6	(−)	(+)	(+)	(+)	(−)	(+)	(−)	(+)	(−)	(+)
BOY7_12	(−)	(+)	(+)	(+)	(+)	(−)	(−)	(−)	(−)	(+)
GIRL7_12	(−)	(−)	(−)	(+)	(−)	(−)	(−)	(−)	(−)	(+)
GIRL13_18	(+)	(−)	(+)	(+)	(+)	(+)	(+)	(−)	(−)	(+)
MEN	(+)*	(+)*	(+)*	(+)	(+)	(+)	(+)*	(+)*	(+)	(+)**
WOMEN	(−)	(−)	(−)	(−)	(−)	(−)	(+)*	(+)*	(−)	(+)
HHSIZE	(−)	(+)*	(+)	(+)	(−)	(+)	(−)	(+)*	(−)	(+)
FEMLHEAD	[a]	[a]	(−)	(+)	(+)	(−)	(−)	(+)	(−)	(+)
AGEHEAD	(+)	(−)	(−)	(+)*	(−)	(+)	(−)	(+)	(−)	(+)
EDUCHEAD	(+)	(−)	(−)	(+)*	(+)	(+)	(+)	(+)	(−)	(+)
FARMER	(+)*	(−)	(−)	(+)*	(−)	(+)	(+)	(−)	(−)	(−)
AGLABOR	(+)	(−)	(−)	(−)	(−)	(+)	(−)	(+)	(+)	(+)
TLAND	(−)	(+)	(+)	(−)	(−)	(+)**	(−)	(+)	(+)*	(−)

[a] No household is female-headed.

* = Coefficient significant at 10 percent level.
** = Coefficient significant at 5 percent level.

Variables:
BOY0_6 = 1=if individual is male, age 0 - 6, 0=otherwise
GIRL0_6 = 1=if individual is female, age 0 - 6, 0=otherwise
BOY7_12 = 1=if individual is male, age 7 - 12, 0=otherwise
GIRL7_12 = 1=if individual is female, age 7 - 12, 0=otherwise
GIRL13_18 = 1=if individual is female, age 13 - 18, 0=otherwise
MEN = 1=if individual is male adult, 0=otherwise
WOMEN = 1=if individual is female adult, 0=otherwise
HHSIZE = Household size (number)
FEMLHEAD = 1=female-headed household, 0=otherwise
AGEHEAD = Age of household head (years)
EDUCHEAD = Education of household head (years)
FARMER = 1=if household head is a farmer, 0=otherwise
AGLABOR = 1=if household head is an agricultural laborer, 0=otherwise
TLAND = Total cultivable land of household (decimal)

Table 33 FS/ES ratios for food groups, by type of household member

	Household Member Type							
	Ages 0-6		Ages 7-12		Ages 13-18		Adults	
Food Group	Boys	Girls	Boys	Girls	Boys	Girls	Male	Female
Rice	0.97	0.99	1.00	1.00	1.01	1.00	0.99	1.00
Wheat	1.15	1.24	0.97	0.74	0.93	0.46	1.60	0.63
Pulses/beans	1.02	0.98	0.95	1.00	0.84	1.18	1.28	0.84
Vegetables	0.97	1.01	0.97	0.99	1.07	0.98	0.99	1.10
Green, leafy vegetables	0.80	0.81	0.66	0.69	0.72	0.73	1.16	1.42
Root and tubers	0.85	0.91	0.96	1.09	1.08	1.04	1.01	1.04
Other vegetables	1.00	1.02	0.98	0.97	1.06	0.96	1.03	1.06
Potatoes	1.12	1.03	0.98	1.02	1.14	0.86	1.13	0.96
Fish	1.07	0.94	1.00	0.96	0.97	0.99	1.14	0.95
Meat	1.43	1.14	1.02	0.92	0.76	1.19	1.44	0.65
Eggs	2.61	1.04	1.30	0.73	1.00	1.60	1.50	0.54
Fruits	1.94	2.41	1.23	1.17	0.79	0.96	1.16	1.41
Milk	1.41	0.97	0.71	0.35	0.75	0.77	1.98	0.52
Cooking ingredients/spices	1.11	1.08	1.01	1.01	0.99	1.05	1.03	0.99
Other foods	0.79	0.56	0.46	0.22	0.46	0.26	1.57	1.50

Source: International Food Policy Research Institute/Bangladesh Consumption and Nutrition Survey, 1991/92.

Table 34 Sign and significance of regression coefficients of FS/ES ratios for five food groups: Tobit regression results

	Dependent Variable				
Explanatory Variables	Milk	Meat	Eggs	Green Vegetables	Fish
BOY0_6	(+)	(+)	(+)*	(+)	(+)
GIRL0_6	(+)	(+)	(−)	(+)	(−)
BOY7_12	(−)	(−)	(−)	(−)	(+)
GIRL7_12	(−)*	(−)	(−)	(−)	(−)
GIRL13_18	(+)	(+)	(+)	(+)	(+)
MEN	(+)**	(+)**	(+)	(+)**	(+)**
WOMEN	(−)	(−)	(−)	(+)**	(−)
HHSIZE	(−)**	(+)	(−)	(+)	(+)
FEMLHEAD	[a]	(−)	(+)	(−)	(−)
AGEHEAD	(+)	(−)	(−)	(−)	(−)
EDUCHEAD	(+)	(−)	(+)	(+)	(−)
FARMER	(+)**	(−)	(−)	(−)	(−)
AGLABOR	(+)	(−)	(−)	(−)	(+)
TLAND	(−)	(−)	(−)	(−)	(+)

[a] No household is female-headed.

* = Coefficient significant at 10 percent level.
** = Coefficient significant at 5 percent level.

Variables:

BOY0_6 = 1=if individual is male, age 0 - 6, 0=otherwise
GIRL0_6 = 1=if individual is female, age 0 - 6, 0=otherwise
BOY7_12 = 1=if individual is male, age 7 - 12, 0=otherwise
GIRL7_12 = 1=if individual is female, age 7 - 12, 0=otherwise
GIRL13_18 = 1=if individual is female, age 13 - 18, 0=otherwise
MEN = 1=if individual is male adult, 0=otherwise
WOMEN = 1=if individual is female adult, 0=otherwise
HHSIZE = Household size (number)
FEMLHEAD = 1=female-headed household, 0=otherwise
AGEHEAD = Age of household head (years)
EDUCHEAD = Education of household head (years)
FARMER = 1=if household head is a farmer, 0=otherwise
AGLABOR = 1=if household head is an agricultural laborer, 0=otherwise
TLAND = Total cultivable land of household (decimal)

Table 35 FS/ES ratios for nutrients, by type of household member

	Household Member Type							
	Ages 0-6		Ages 7-12		Ages 13-18		Adults	
Food Group	Boys	Girls	Boys	Girls	Boys	Girls	Male	Female
Protein	1.00	1.00	1.00	1.00	1.00	1.02	1.01	1.00
Fat	1.06	1.05	0.98	0.98	0.97	1.01	1.03	1.02
Calcium	1.11	1.06	0.99	0.99	0.96	1.03	1.03	1.00
Iron	1.03	1.04	0.99	1.02	0.99	1.00	1.00	1.01
Thiamine	0.99	1.00	0.99	1.00	1.01	1.00	1.00	1.00
Riboflavin	1.03	1.03	0.98	1.00	1.01	0.99	1.01	1.01
Niacin	0.98	0.99	1.00	1.00	1.01	1.00	1.00	1.00
Vitamin C	1.00	1.04	1.01	1.03	1.01	1.02	1.00	1.06
Retinol	1.34	0.98	0.87	0.57	0.87	1.03	1.68	0.63
Carotene	0.96	0.97	0.89	0.92	0.95	0.90	1.05	1.17
Vitamin A	1.02	1.02	0.91	0.90	0.96	0.92	1.07	1.14

Source: International Food Policy Research Institute/Bangladesh Consumption and Nutrition Survey, 1991/92.

Table 36 Calorie, iron, vitamin A, vitamin C, and fat adequacy levels, by type of household member and expenditure quintile

	Ages 0-6		Ages 7-12		Ages 13-18		Adults	
Expenditure Quintile	Boys	Girls	Boys	Girls	Boys	Girls	Male	Female
Calorie adequacy ratio								
1	0.69	0.64	0.69	0.71	0.55	0.72	0.84	0.67
2	0.75	0.71	0.82	0.72	0.86	0.74	0.88	0.75
3	0.70	0.70	0.81	0.81	0.83	0.89	0.95	0.77
4	0.78	0.67	0.93	0.88	0.99	0.89	1.01	0.87
5	0.86	0.77	0.95	0.90	1.10	1.03	1.02	0.91
All	0.75	0.69	0.84	0.80	0.93	0.87	0.95	0.80
Iron adequacy ratio								
1	0.66	0.60	0.48	0.53	0.43	0.44	1.02	0.61
2	0.59	0.63	0.57	0.43	0.50	0.40	0.87	0.55
3	0.69	0.62	0.61	0.58	0.68	0.51	1.04	0.66
4	0.84	0.73	0.75	0.75	0.94	0.52	1.27	0.79
5	0.75	0.79	0.75	0.72	1.05	0.59	1.23	0.85
All	0.70	0.66	0.63	0.60	0.80	0.50	1.11	0.70
Vitamin A adequacy ratio								
1	0.53	0.44	0.29	0.47	0.28	0.30	0.77	0.46
2	0.34	0.37	0.38	0.27	0.29	0.39	0.38	0.28
3	0.85	0.69	0.71	0.49	0.30	0.98	0.75	0.59
4	0.45	0.40	0.34	0.61	0.86	0.43	0.60	0.40
5	0.44	0.51	0.37	0.45	0.90	0.46	0.67	0.66
All	0.51	0.48	0.41	0.46	0.63	0.47	0.64	0.49
Vitamin C adequacy ratio								
1	0.71	0.67	0.88	0.86	0.76	0.93	1.62	0.79
2	0.62	0.69	0.99	0.84	1.03	0.84	1.20	0.72
3	0.81	0.77	1.20	1.03	1.21	1.48	1.73	1.06
4	0.93	0.60	1.32	1.31	1.80	1.22	1.94	1.18
5	0.80	0.86	1.32	1.17	2.30	1.43	1.83	1.37
All	0.76	0.71	1.14	1.03	1.64	1.18	1.69	1.05
Fat adequacy ratio								
1	0.16	0.16	0.23	0.22	0.22	0.28	0.53	0.22
2	0.21	0.20	0.29	0.26	0.47	0.26	0.55	0.28
3	0.26	0.22	0.32	0.35	0.49	0.39	0.67	0.37
4	0.24	0.25	0.41	0.37	0.63	0.40	0.79	0.42
5	0.40	0.41	0.52	0.50	0.76	0.59	1.10	0.64
All	0.24	0.23	0.36	0.33	0.57	0.40	0.77	0.40

Source: International Food Policy Research Institute/Bangladesh Consumption and Nutrition Survey, 1991/92.

APPENDIX

A MEASURE OF EQUALITY OF INTRAHOUSEHOLD FOOD DISTRIBUTION

If all individuals required identical amounts of nutrients regardless of age, gender, physiology, and activity pattern, and if all individuals had identical taste preferences and knowledge of their nutritional requirements, it would be relatively simple to measure inequality in the intrahousehold distribution of foods. That is, if all of these conditions were to hold, favoritism in the allocation of a particular food or nutrient reasonably could be defined as

$$\frac{\dfrac{X_i}{\sum_{i=1}^{n} X_i}}{\dfrac{1}{n}},$$

where n is the number of household members, X_i is consumption by the i^{th} household member of food or nutrient X, and

$$\sum_{i=1}^{n} X_i$$

is total household consumption of food or nutrient X. In this example, $1/n$ may be interpreted as the index of an individual's "fair share" of household consumption.

Precisely because none of the above conditions ever hold, it has proven difficult to define an empirically acceptable index (denominator). Most attempts to do so have used calorie intake in the numerator, correcting for differences in calorie requirements due to age, gender, weight, pregnancy-lactation, and activity patterns (depending on data availability), as shown below where n_i is calorie intake expressed in adult equivalent form:

$$\frac{n_i}{\sum_{i=1}^{n} n_i}.$$

This generally is considered to be an unsatisfactory solution in that (1) recommended calorie intake for these various criteria is still the subject of considerable debate, (2) some critical information (for example, activity patterns) is difficult to measure, and (3) once all relevant criteria are accurately taken into account, calorie adequacy in theory measures whether an individual is in energy balance (possibly at below average weight), which is not necessarily a measure of relative welfare.[12] Nevertheless, use of calorie intake has the advantage that individuals know, to some extent, when their requirements are not being met (they experience hunger), and avoiding hunger is widely presumed to be of high priority to most individuals.[13]

It is reasonable to assume that necessities are more equitably distributed within households than are luxuries. Therefore, calorie intake (a necessity) is a rather insensitive (and so, inadequate) empirical measure of inequality, as compared with consumption of foods with

[12] In theory, if the calorie adequacy ratio is correctly measured and is chronically below 1.0, an adult is in deficit energy balance and will lose weight, with the opposite result if the calorie adequacy ratio is chronically above 1.0. Thus, ceteris paribus, an "overweight" adult may be eating more than an "underweight" adult, but would have a calorie adequacy ratio lower than that of the underweight adult if the overweight adult was currently losing weight and the underweight adult was currently gaining weight. If both had stable weights, then both adults would have calorie adequacy ratios of 1.0. For children, in theory, calorie adequacy ratios measure energy intake required to maintain "normal" growth, given the child's observed weight.

[13] This similarity of preference for hunger satiation across cultures may be contrasted with the utility associated with any specific food or food group. A food may be highly prized in some societies and disliked in others. The awareness of shortfalls in consumption of calories (hunger) may be contrasted with, say, deficiencies in vitamin A or iron intake.

higher income elasticity (nonstaples). However, this particular property of relative equity makes it a good candidate for use as an index to replace 1/*n* in the expression above.

An alternative expression for measuring inequality in the intrahousehold allocation of food is developed below, using both nonstaple food consumption and energy intakes as arguments. This expression is used to examine favoritism/discrimination in the intrahousehold distribution of food for the survey populations in Bangladesh, India, and the Philippines and to identify various factors that influence the intrahousehold distribution of food.

A MEASURE OF AN INDIVIDUAL'S "FAIR SHARE" OF FOOD

In order to provide an intuitive basis for an alternative measure of discrimination in intrahousehold food distribution, it is instructive to recall how food consumption patterns change at the household level as income increases. At the margin, as income and food expenditures increase, consumers buy nonstaple foods in relatively large quantities. Expenditures for primary food staples and vegetables increase with income, but the percentage increases are far smaller than for the other food groups.

The data in Tables 37 and 38 on household-level food expenditures and calorie intake for the Philippines can be used to illustrate the derivation of the proposed

Table 37 Food expenditures, food prices, and kilograms consumed, by expenditure quintile and food group

Food Group	Food Expenditures: Expenditure Quintile 1	2	3	4	5	All
	(pesos per capita per week)					
Rice	2.30	3.74	4.73	4.49	9.91	5.03
Corn	9.56	9.65	9.13	8.71	4.36	8.29
Other staples	1.45	1.64	1.58	2.46	3.69	2.16
Meat, fish	7.21	8.91	10.71	15.58	23.64	13.20
Vegetables	2.70	2.84	3.55	3.73	3.78	3.32
Fruits, snacks	0.87	2.58	5.25	7.52	10.51	5.35
Cooking ingredients	2.10	3.14	3.44	4.72	4.75	3.63
All	26.19	32.51	38.40	47.21	60.64	40.98
	Food Prices					
	(pesos per kilogram)					
Rice	5.75	5.98	5.76	5.67	5.59	5.75
Corn	4.36	4.52	4.50	4.46	4.46	4.46
Other staples	2.80	3.39	2.34	3.73	5.32	3.51
Meat, fish	19.58	18.81	20.80	20.63	23.40	20.64
Vegetables	6.37	5.52	7.15	5.96	5.94	6.19
Fruits, snacks	2.83	5.45	11.32	15.24	16.04	10.18
Cooking ingredients	17.25	21.70	19.70	21.56	20.74	20.19
All	6.04	6.70	7.42	8.59	10.15	7.78
	Kilograms					
	(per capita per week)					
Rice	0.40	0.63	0.82	0.79	1.77	0.88
Corn	2.19	2.14	2.03	1.95	0.98	1.86
Other staples	0.52	0.48	0.68	0.66	0.69	0.61
Meat, fish	0.37	0.47	0.52	0.76	1.01	0.62
Vegetables	0.42	0.51	0.50	0.63	0.64	0.54
Fruits, snacks	0.31	0.47	0.46	0.49	0.66	0.48
Cooking ingredients	0.12	0.14	0.17	0.22	0.23	0.18
All	4.33	4.85	5.18	5.50	5.98	5.17

Source: International Food Policy Research Institute-Research/Institute for Mindanao Culture survey, 1984/85.

Table 38 Family calorie availability and calorie intake per adult equivalent and calories purchased per peso of food expenditure by expenditure, and current income quintiles, and by food group

Data Source and Food Group	Expenditure Quintile 1	2	3	4	5	Quintile 5 minus Quintile 1
Calorie availability[a]						
Rice	359	472	682	790	1,475	+21,127
Corn	1,132	1,259	1,220	1,209	776	−365
Other staples	117	147	166	205	226	+109
Meat	49	77	94	142	228	+179
Vegetables	12	16	18	25	38	+26
Fruits/desserts	66	93	118	150	185	+119
Cooking ingredients	54	80	114	146	254	+200
Rice and Corn	1,491	1,731	1,902	1,999	2,262	+771
All others	299	412	509	667	931	+632
All	1,790	2,143	2,411	2,666	3,193	+1,403
Calorie intake[b]						
Rice	251	393	490	490	1,149	+898
Corn	1,520	1,488	1,397	1,356	649	−871
Other staples	117	188	168	157	200	+83
Meat	82	108	133	176	268	+186
Vegetables	30	36	36	41	39	+9
Fruits/desserts	43	66	64	73	90	+47
Cooking ingredients	62	80	96	147	179	+117
Rice and corn	1,771	1,881	1,887	1,846	1,798	+27
All others	337	407	497	593	777	+440
All	2,108	2,288	2,384	2,439	2,575	+467
						All Quintiles
Calories purchased per peso[c]						
Rice	570	563	582	570	604	582
Corn	872	846	858	858	847	857
Other staples	623	526	584	470	396	508
Meat, fish	87	79	84	72	69	77
Vegetables	79	89	72	75	67	76
Fruits, snacks	407	363	351	278	193	300
Cooking ingredients	145	171	180	214	268	197
All	492	440	414	344	286	395

Source: International Food Policy Research Institute/Research Institute for Mindanao Culture survey, 1984/85.

[a] Calories computed from food expenditure survey.

[b] Calories computed from 24-hour recall survey.

[c] Calorie information from 24-hour recall survey and price information from food expenditure survey.

formula for measuring inequality in intrahousehold food distribution. Suppose that the data in these two tables, presented by expenditure quintile, represent, instead, individual food consumption information for a five-member household in which food consumption is highly skewed. That is, this hypothetical household spends 40 pesos per capita per week for food, on average, with 60 pesos being spent on the most highly favored member and only 25 pesos being spent on the least favored member.

Assume that, given this distribution of total expenditures (designated, say, by household member 5, who is the recognized dictator), each individual member is allowed the freedom to allocate her own total food expenditure as she wishes among various individual foods. Whatever food allocation decisions are subsequently taken by individual members might be termed Pareto optimal, in the sense that whatever allocation each chooses maximizes her own individual utility without affecting the utility of other household members.

Assuming that the preferences of these individuals reflect those of the Philippine sample population (and, by extension, other poor populations as well), household member 5 will choose a diet that is "beverage-, dairy-, and meat-intensive" relative to household member 1, whose diet will be relatively "staple-intensive." Member 1 will not choose to spend her 25 pesos in the same proportion on individual foods as household member 5, simply because satisfying hunger will take precedence over the tastes of more preferred foods. These allocation outcomes can be modeled in terms of a lexicographic utility function (Encarnacion 1990), in which satiation of hunger is given top priority, or in terms of a marginal utility curve that is quite steep (relative to marginal utility curves for other goods/characteristics) up to a certain level of satiation, and then abruptly levels off as if "kinked." It is the cruel dictator, indeed, who will not allow individual household members to satisfy hunger first (to the extent possible within a given individual's budget constraint) before satisfying other wants.

The linking of the assumptions of individual Pareto optimality (as just defined) and the primal desire for hunger satiation leads to a conclusion that one of the most equitably distributed "commodities" within households will be hunger satiation. Consequently, hunger satiation (which will be highly correlated with staple food consumption, calorie intake, and body weights) will be one of the least sensitive empirical indicators of discrimination in the intrahousehold distribution of resources. Foods, nutrients, or even nonfoods with high income elasticities should provide much more sensitive measures of such discrimination.

The measure of inequality in the intrahousehold distribution of food presented here uses a presumption of relative equality in hunger satiation across individual household members as the basis for calculating an index for what would be an individual's "fair share" in the consumption of nonstaple foods. This measure is given below:

$$R_i = \frac{\dfrac{X_i}{\sum_{i=1}^{n} X_i}}{\dfrac{C_i}{\sum_{i=1}^{n} C_i}},$$

where:

X_i = consumption by individual i of food/nutrient X, where X is measured in kilograms, units of a nutrient, or total expenditures;

C_i = calorie intake of individual i;

$\sum_{i=1}^{n} C_i$ = total household calorie intake;

$\sum_{i=1}^{n} X_i$ = total household consumption of X.

The denominator is the proportion of total household calories that an individual consumes. The denominator takes account of interindividual differences (within a specific household) in metabolic rates, heights, activity patterns, and physiological status (pregnancy, breast-feeding), so that persons who require more calories than other family members to satiate hunger for these reasons, receive a higher proportion of household calories.[14]

The numerator is the individual proportion out of total household consumption (measured in kilograms, units of a nutrient, or expenditures) of any specific food or nutrient. For favored persons in a family, the FS/ES (food share over energy share) ratios will be greater than 1.0 for "preferred" foods (foods with relatively high income elasticities) and less than 1.0 for "low status" foods (foods with relatively low income elasticities).

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[14] However, there are some economies of scale in calories needed for maintaining body weights. Ceteris paribus, an adult weighing 10 percent more requires fewer than 10 percent more calories to maintain that weight; returns to scale for young children are more nearly constant (FAO/WHO/UNU 1985) (see Bouis [1995] for a discussion). Thus, some downward revision of adult calorie proportions may be advisable relative to child proportions.

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