AFFORDABILITY OF NUTRITIOUS FOODS FOR COMPLEMENTARY FEEDING IN **BANGLADESH**

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For more details and full sources, see the following article from which this brief is drawn:

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KEY MESSAGES
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- Several foods commonly available to households in Bangladesh are rich in nutrients lacking in young children's diets. In particular, for most children of complementary feeding age, their needs for vitamin A and vitamin B_{12} can be affordably met through consumption of beef liver (both nutrients), chicken liver (both nutrients), dark green leafy vegetables (vitamin A), orange-fleshed fruits and vegetables (vitamin A), and fresh fish (vitamin B_{12}).

- Dark green leafy vegetables are the most affordable source of iron, folate, and calcium. Pulses are the most affordable source of zinc and the second most affordable source of iron. However, 25–50% of households in Bangladesh are likely unable to afford pulses or dark green leafy vegetables in quantities large enough to meet children's iron and zinc needs.

- Animal-source protein is another challenging nutrient, and even the most affordable sources (fresh fish, eggs, milk) are unaffordable for 30–50% of households.

- The most affordable foods for supplying multiple commonly lacking nutrients are beef liver, dark green leafy vegetables, chicken liver, fresh milk, and eggs.

- Efforts to reduce prices and/or encourage home production of foods like dark green leafy vegetables, pulses, fish, eggs, and milk will likely be needed. Other beneficial interventions could include behaviour change communication on the potential for dark green leafy vegetables and liver to provide nutrients with persistent gaps, fortification or supplementation for the least affordable nutrients (zinc and iron), and programmes to boost the incomes of the lowest-resource households.

- Future research could explore these interventions and also focus on liver, where there is little evidence on current consumption levels, and animal-source foods more broadly, which apart from liver tend to be unaffordable sources of individual nutrients for most households.

WHY DOES AFFORDABILITY OF COMPLEMENTARY FOODS MATTER IN BANGLADESH?

Bangladesh is a lower-middle-income country with a gross national income per capita of $1,470 and a population of about 168 million people, making it the eighth most populous country in the world.[1–3] It has one of the highest population densities of any country in the world and has experienced rapid urbanization over the past several decades; more than half of the urban population lives in slum areas.[2,3] Bangladesh maintained strong and increasing rates of economic growth from 2009 to 2019 (averaging over 6% and exceeding the growth rates of other countries in the region).[4] Agriculture accounts for about 42% of the labour force and 11% of gross domestic product (GDP). Poverty rates fell from 40% in 2005 to 32% in 2010 to 24% in 2016.[5] Bangladesh has also shown improvement in key health indicators such as maternal mortality, infant mortality, and life expectancy—it ranks highest among its neighbours on the latter two—as well as in child immunization indicators such as DTP3 coverage.[6] Despite these gains, almost one in three children under five is stunted, and only about 34% of children aged 6–23 months consume an adequately diverse diet.[7]

Many children in the complementary feeding period—the period when infants and young children are 6–23 months old and breast milk alone is no longer sufficient to meet their nutritional needs—do not consume enough iron, vitamin A, calcium, zinc, folate, vitamin B_{12}, and animal-source protein, and these shortfalls hinder their growth and development.[8,9] Unaffordability is an important barrier, among others, to the consumption of foods rich in these important nutrients. However, the extent to which unaffordability is a barrier for specific nutrients and which foods are the most affordable sources of these nutrients are unclear. This brief summarizes the affordability of nutritious foods that could fill important nutrient gaps during the complementary feeding period and discusses implications for policy and programmes.

METHODS

Using household expenditure data from Bangladesh's 2016–17 Household Income and Expenditure Survey (HIES)[10] and price data estimated from the HIES and the Bangladesh Bureau of Statistics,[11] we benchmarked the cost of foods that could meet nutrient requirements against current household food expenditures to assess affordability, using a previously developed method.[12] Because nutrients are generally obtained from a combination of foods, we analysed whether households could afford to meet half of the daily requirements for protein, iron, vitamin A, calcium, zinc, folate, and vitamin B_{12} for

their children under age two through specific foods. These foods were chosen because of their nutrient content and availability in Bangladesh. For protein, only animal-source foods were used since plant-based sources of protein are generally not complete in essential amino acids critical for child growth and development.[13] We calculated the cost of realistic portion sizes required to meet 50% of nutrient needs from complementary foods (since nutrient requirements are met through a combination of foods), adjusting for refuse, cooking yield, and bioavailability where applicable.[12] To assess the relative affordability of nutrients and foods, these costs were compared with current food spending per adult equivalent (a method of adjusting for household size and composition) for each household with children under age two surveyed. To assess absolute affordability, we established a threshold of 10% of household food spending per adult equivalent, based on previous analysis.[12] We also assessed foods in terms of their affordability for meeting needs for several micronutrients in combination. In this joint micronutrient analysis of six key micronutrients commonly lacking in the diets of infants and young children, we calculated which foods are most affordable at providing an average of one-third of a young child's daily nutrient requirements from complementary foods. Finally, we compared the relative costs of energy among those foods that provide at least 100 kilocalories (kcal) of energy in a 100 g portion (a threshold of 50 g was used for milk). It is important to note that this research contains several limitations, which are described in Ryckman et al. (2021).[12]

HOUSEHOLD FOOD EXPENDITURE AND CONSUMPTION PATTERNS

On average, households in Bangladesh with children under age two spent just over half of total annual expenditures on food (that is, the total value of food consumption from purchases, home production, and in-kind sources), with most expenditures coming from purchases (89% on average). Households devoted about half of their food expenditures toward just two categories of food: meat, fish, and eggs (30%); and cereal products (27%). At least 95% of households in Bangladesh had consumed items from these food groups—as well as vegetables, pulses, and roots and tubers—in the two weeks preceding the survey. Smaller shares of households consumed fruits (67%) and dairy products (60%). Vegetables made up 11% of food expenditures on average, while pulses, roots and tubers, fruits, and dairy products accounted for 3–4% each. Lower-resource households tended to allocate more expenditures toward cereal products and consume less dairy and fruits.

Of the specific foods chosen for this analysis as possibilities to meet one or more likely nutrient gaps, the most commonly consumed were fresh fish, pulses, and dark green leafy vegetables (consumed by 90% or more of households), although all were consumed less frequently than cereal products (Figure 1). Fifty to 75% of households consumed eggs, chicken, pumpkin, and/or milk, while 20–47% consumed peas, okra, beef, and/or mango. Twenty per cent of households consumed dark green leafy vegetables, and 10% consumed fish from home production.
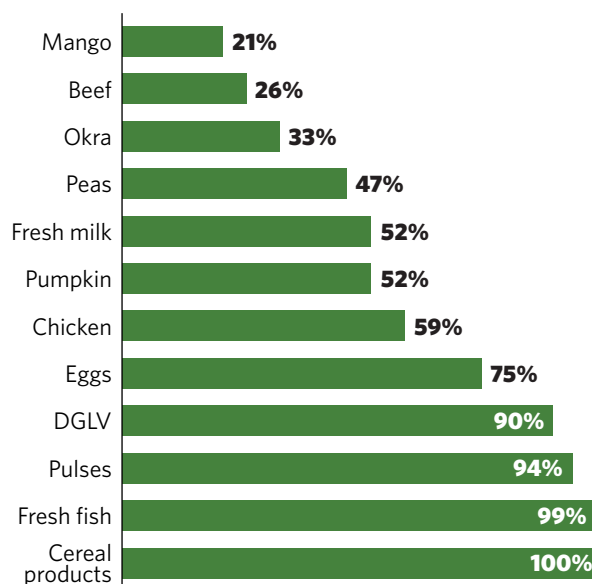
FIGURE 1. Percentage of surveyed households that had consumed selected foods in the past two weeks. Data are from 5,813 households in the 2016–17 Bangladesh Household Income and Expenditure Survey.[10] DGLV = dark green leafy vegetables.

AFFORDABILITY BY NUTRIENT

Animal-source protein: Eggs, fresh fish, fresh milk, and beef are all close to the affordability threshold of 10% (Figure 2), although eggs are the only food that falls below the threshold (at 9% of adjusted weekly household food expenditure). Eggs would be still unaffordable for 36% of households at a 10% threshold, and fish, milk, and beef would be unaffordable for 47–79% of households (Figure 3).

Calcium: Calcium is the nutrient with the fewest options to fill nutrient gaps. However, dark green leafy vegetables—accounting for 6% of adjusted food expenditures—are likely an affordable source of calcium for most households (92%). Fresh fish (assuming very small fish with bones consumed) are another option close to the 10%

ANIMAL-SOURCE PROTEIN

Eggs	**9%**
Fresh fish	**10%**
Fresh milk	**13%**
Beef	**15%**
Chicken	**25%**

CALCIUM

DGLV	**6%**
Fresh fish	**12%**
Fresh milk	**18%**

FOLATE

DGLV	**4%**
Okra	**6%**
Pulses	**7%**
Peas	**12%**
Chicken liver	**18%**
Beef liver	**18%**
Mango	**19%**
Eggs	**33%**

IRON

DGLV	**7%**
Pulses	**11%**
Beef liver	**42%**
Chicken liver	**50%**
Beef	**120%** →

VITAMIN A

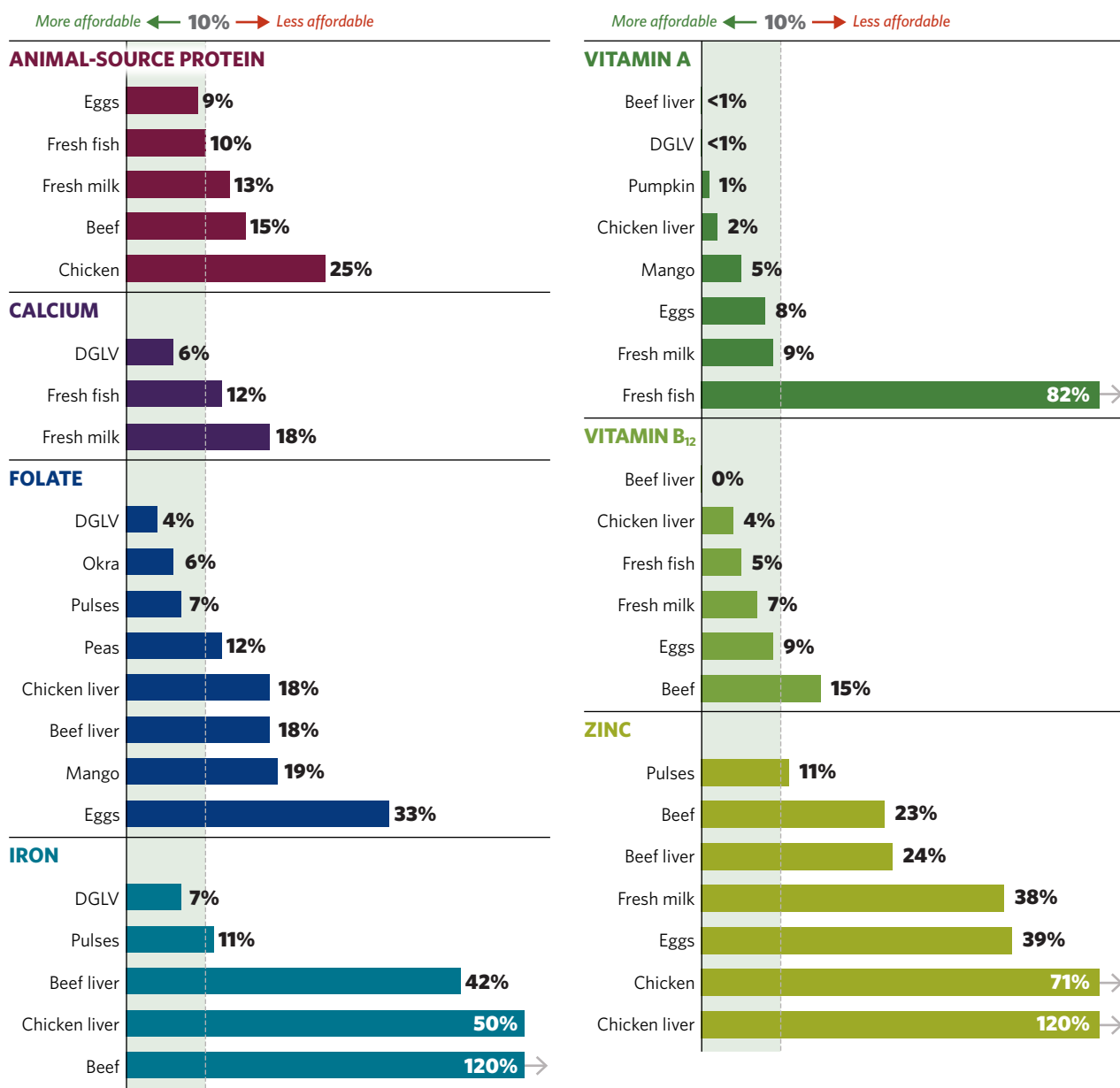|	
Beef liver	**<1%**
DGLV	**<1%**
Pumpkin	**1%**
Chicken liver	**2%**
Mango	**5%**
Eggs	**8%**
Fresh milk	**9%**
Fresh fish	**82%** →

VITAMIN B$_{12}$

Beef liver	**0%**
Chicken liver	**4%**
Fresh fish	**5%**
Fresh milk	**7%**
Eggs	**9%**
Beef	**15%**

ZINC

Pulses	**11%**
Beef	**23%**
Beef liver	**24%**
Fresh milk	**38%**
Eggs	**39%**
Chicken	**71%** →
Chicken liver	**120%** →

FIGURE 2. Share of food expenditures per adult equivalent needed to meet half of nutrient requirements from complementary foods. The dashed line represents the affordability threshold of 10% of food expenditures. Bars below the dashed line are considered affordable. Household expenditure data are from 5,813 households in the 2016–17 Household Income and Expenditure Survey.[10] Nutrient densities are mostly from the United States Department of Agriculture food composition database as well as regional food composition tables and published studies.[14–17] Nutrient requirements from complementary foods are from Ryckman et al. (2021).[12] DGLV = dark green leafy vegetables.

threshold, but they would be unaffordable for more than half of households.

Folate: Several foods could contribute to folate requirements for less than 10% of adjusted food expenditure. Dark green leafy vegetables, okra, and pulses cost 4–7% of adjusted food expenditures, whereas peas cost 12%. Dark green leafy vegetables are a particularly promising food, since they would be affordable for 98% of

households at a 10% affordability threshold, while 11–13% of households may struggle to purchase adequate quantities of okra and pulses.

Iron: Dark green leafy vegetables are the most affordable source of iron, costing 7% of adjusted household food expenditure on average. However, at a 10% threshold, adequate quantities to meet 50% of the iron needs for children under age two from complementary foods would
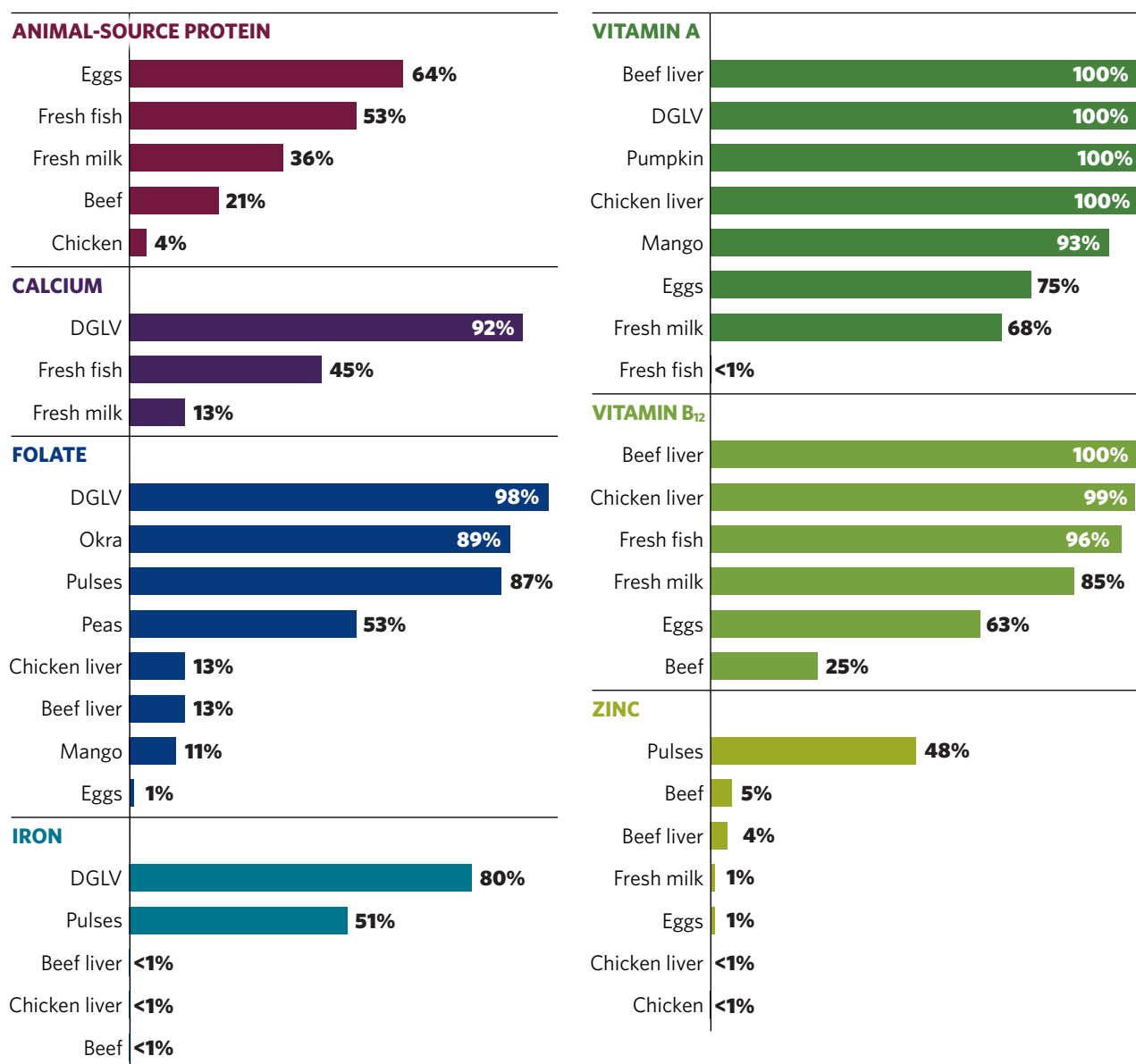
ANIMAL-SOURCE PROTEIN

Food	%
Eggs	64%
Fresh fish	53%
Fresh milk	36%
Beef	21%
Chicken	4%

CALCIUM

Food	%
DGLV	92%
Fresh fish	45%
Fresh milk	13%

FOLATE

Food	%
DGLV	98%
Okra	89%
Pulses	87%
Peas	53%
Chicken liver	13%
Beef liver	13%
Mango	11%
Eggs	1%

IRON

Food	%
DGLV	80%
Pulses	51%
Beef liver	<1%
Chicken liver	<1%
Beef	<1%

VITAMIN A

Food	%
Beef liver	100%
DGLV	100%
Pumpkin	100%
Chicken liver	100%
Mango	93%
Eggs	75%
Fresh milk	68%
Fresh fish	<1%

VITAMIN B$_{12}$

Food	%
Beef liver	100%
Chicken liver	99%
Fresh fish	96%
Fresh milk	85%
Eggs	63%
Beef	25%

ZINC

Food	%
Pulses	48%
Beef	5%
Beef liver	4%
Fresh milk	1%
Eggs	1%
Chicken liver	<1%
Chicken	<1%

FIGURE 3. Percentage of households able to afford portion sizes meeting half of nutrient requirements from complementary foods. Foods were considered affordable if their required share of food expenditures per person was below the affordability threshold of 10%. Household expenditure data are from 5,813 households in the 2016–17 Household Income and Expenditure Survey.[10] Nutrient densities are mostly from the United States Department of Agriculture food composition database as well as regional food composition tables and published studies.[14-17] Nutrient requirements from complementary foods are from Ryckman et al. (2021).[12] DGLV = dark green leafy vegetables.

be unaffordable for one in five households. Pulses are the next most affordable source of iron but would be unaffordable for half of households, and animal sources (chicken liver, beef liver, beef) are unaffordable for all households.

Vitamin A: Several foods could affordably fill gaps in vitamin A consumption: beef liver, dark green leafy vegetables, pumpkin, and chicken liver all cost 2% or less of adjusted household food expenditures, while mango costs 5%. These foods would be considered affordable for 93–100% of households. Eggs and milk could also be affordable options for many households.

Vitamin B$_{12}$: All foods that could fill likely gaps in vitamin B$_{12}$ consumption cost 15% or less of adjusted food expenditure, on average. Beef liver is the most affordable food (for 100% of households), followed by chicken liver, fresh fish, and milk, which are affordable for 85–99% of households at a 10% threshold.

Zinc: Pulses are the lowest-cost food to meet 50% of zinc requirements from complementary feeding, at 11% of adjusted food expenditure, but they would be unaffordable for 52% of households at a 10% threshold. Other options cost much more, making pulses the only feasible option for most households in Bangladesh.

AFFORDABILITY ACROSS MULTIPLE MICRONUTRIENTS

When all six micronutrients with likely consumption gaps among children of complementary feeding age are considered jointly, the most affordable foods are beef liver, dark green leafy vegetables, and chicken liver, followed by fresh milk and eggs (Figure 4). Many more animal-source foods than plant-source foods are able to achieve one-third of micronutrient requirements with daily portion sizes of less than 100 g, so dark green leafy vegetables are the only plant-source food considered in the analysis. Notably, fresh fish is a relatively affordable source of vitamin B_{12} and calcium (as well as protein), but it lacks high densities of the remaining four micronutrients or is an unaffordable source of those nutrients. For the other foods, findings from the single nutrient and joint nutrient affordability analyses are broadly similar.

DIETARY ENERGY AFFORDABILITY

Pulses, which are among the most affordable sources of zinc, iron, and folate, are also the lowest-cost nutritious food on a per kilocalorie basis, although they still cost almost three times as much as rice, a lower-cost but nutrient-poor staple (Figure 5). Milk and eggs are the next lowest cost foods to meet daily energy needs, while fresh fish, beef, and chicken cost much more to achieve energy requirements.

CONCLUSIONS

Gaps in vitamin A and vitamin B_{12} consumption are unlikely to be caused by unaffordability, since requirements for these nutrients can be affordably met with chicken and beef liver (both nutrients), dark green leafy vegetables (vitamin A), pumpkin (vitamin A), mango (vitamin A), and/or fresh fish (vitamin B_{12}) for most households in Bangladesh. Dark green leafy vegetables are also the lowest-cost source of iron (though unaffordable for one in five households), are an affordable source of folate and calcium for most households (the only affordable option for many households), and are considered affordable in meeting multiple micronutrient needs in combination.

Other options to fill folate gaps include okra and pulses. While pulses were also the most affordable source of zinc and the second most affordable source of iron,

these two nutrients are likely to present affordability challenges to 25–50% of households in Bangladesh.

Several foods could meet half of animal-source protein needs at close to 10% of adjusted food expenditure on average, but animal-source protein was unaffordable for 30–50% of households. Eggs, milk, and in some cases
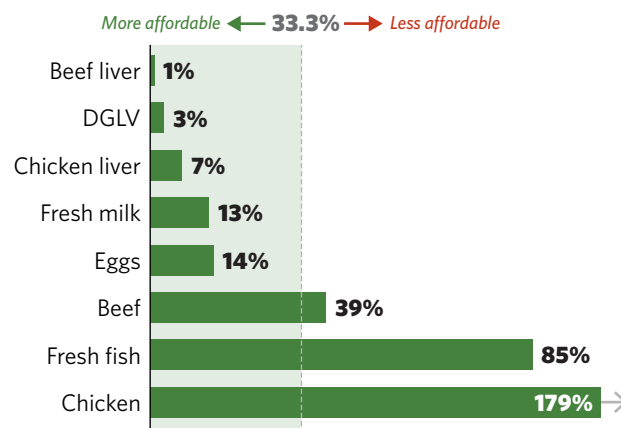

FIGURE 4. Share of food expenditures per person needed to provide an average of one-third of a young child's requirements for iron, vitamin A, zinc, folate, vitamin B_{12}, and calcium. The affordability threshold (dashed line) was set at one-third (33.3%) of food expenditures because this analysis is based on meeting an average of one-third of requirements for six micronutrients from complementary foods. The share of daily requirements of each nutrient provided by the specified quantity of food was capped at 100%. Household expenditure data are from 5,813 households in the 2016–17 Household Income and Expenditure Survey.[10] Nutrient densities are mostly from the United States Department of Agriculture food composition database as well as regional food composition tables and published studies.[14–17] Nutrient requirements from complementary foods are from Ryckman et al. (2021).[12] DGLV = dark green leafy vegetables.
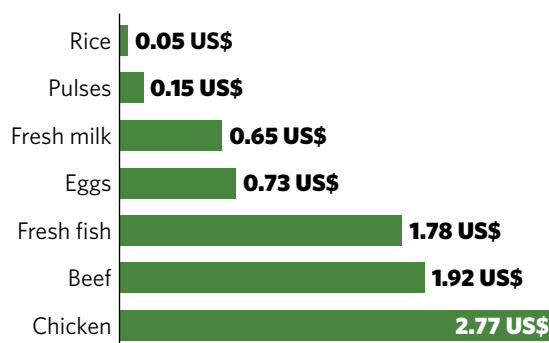

FIGURE 5. Cost of daily dietary energy requirements from complementary foods (450 kilocalories). Price data are estimated from the 2016–17 Household Income and Expenditure Survey and from statistical reports released by the Bangladesh Bureau of Statistics.[10,11] Dietary energy densities are mostly from the United States Department of Agriculture food composition database as well as regional food composition tables.[14,15] The cost of 450 kilocalories is shown because this is the average daily dietary energy requirement for a child aged 6–23 months.

fresh fish were the lowest-cost animal foods (apart from liver), but in general animal-source foods tend to cost substantially more than plant-source foods. However, animal-source foods were more affordable when their contributions to jointly fulfilling several micronutrient requirements were considered. In this respect, apart from dark green leafy vegetables, the most affordable foods were all animal-source foods (beef liver, chicken liver, milk, eggs).

Interventions to address nutrient affordability gaps among children of complementary feeding age in Bangladesh could include efforts to reduce the prices of the more affordable foods that are out of reach for some households—dark green leafy vegetables and pulses—or encourage more home production of those foods. It will also be important to reduce the prices of some animal-source foods (fish, eggs, and/or milk). Social behaviour change interventions and other efforts to increase the desirability of dark green leafy vegetables (and other affordable foods) and spread knowledge about how to prepare and feed these foods to young children, including practices that increase the bioavailability of nutrients, may also be needed, since there is evidence of gaps in young children's consumption of vitamin A and folate even when consumption at the household level is high.

Beef liver and chicken liver are considered affordable, but there is little evidence on the consumption of these foods in the survey data, so more research on their potential as nutrient sources for young children is needed. Future research could also explore iron supplementation and iron or zinc fortification or biofortification, since these were the least affordable nutrients and are likely to remain unaffordable for the lowest-resource households even with price reductions. For these households, safety net programmes, such as cash transfers or food subsidies, may also be needed to reduce the prevalence of complementary feeding gaps among children in Bangladesh.

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