Does it matter how we survey demand for food?

Evidence from Kenya and the Philippines

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This article examines the reliability of food quantity information collected from expenditure surveys, and finds that measurement errors will very often be systematically correlated with income, such that the response of food intakes to increases in income is seriously overstated. This may be, firstly, because food quantities are not measured independently of income if total expenditures are the proxy used for income, and secondly, because food transfers in the form of guest and hired worker meals are under-recorded. These biases are illustrated using household surveys from Kenya and the Philippines.

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Household expenditure surveys are the foundation of a large majority of food demand, nutrition and poverty studies found in the economic literature. Such surveys, which record food and non-food expenditures at the household level along with their demographic composition, are thought to provide a relatively low-cost and reliable measurement of permanent income. In developing countries food expenditures exceed non-food expenditures, often by a multiple of two even at mean income levels, so that measurements of food purchases (including food consumed from own-farm production) and income overlap substantially.

Because so much of what we know about food demand, nutrition and poverty relationships is based on expenditure surveys, it is perhaps surprising that so little effort has been spent on validating this widely used data collection technique. This article focuses on the reliability of food quantity information collected from expenditure surveys. In particular, the claim is made that measurement errors will very often be systematically correlated with income, such that the response of food intakes to increases in income is seriously overstated. Two factors may account for this. First, food quantities (and/or food expenditures) are not measured independently of income, if total expenditures are the proxy used for income, which is often the case. Second, food transfers from high-income to low-income households in the form of guest and hired worker meals are under-recorded.

These systematic biases are illustrated using household surveys from Kenya and the Philippines. These two data sets are somewhat unusual in that, for each population, food quantities consumed are recorded using two data collection techniques: (i) a standard food expenditure survey (widely used by economists), and (ii) a 24-hour recall of food intakes (developed by nutritionists). Cross-checking permits some attempt at validation of the accuracy of the food consumption information.

The article first examines differences in nutrition relationships be-

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Table 1. Daily per capita calorie availability and intake by total expenditure quartile for Kenya and the Philippines.

Per capita total expenditure quartile	Per capita total expenditure[a]	Calorie intake			Calorie availablity			N
		Family (C1)	Household (C2)	Non-family share	Family (C3)	Household (C4)	Non-family share	
				Kenya				
1	1517	1651	1706	3.2	na	1441	na	289
2	2143	1839	1948	5.6	na	1759	na	292
3	2766	1912	2026	5.6	na	2043	na	289
4	4317	2045	2232	8.3	na	2293	na	291
All	2687	1862	1978	5.9	na	1884	na	1161
				Philippines				
1	1206	1625	1726	5.9	1350	1385	2.5	448
2	1700	1762	1877	6.2	1639	1684	2.7	448
3	2324	1876	2035	7.8	1919	2029	5.4	448
4	4321	1983	2196	9.7	2312	2540	9.0	448
All	2387	1811	1959	7.5	1805	1909	5.5	1792

[a]Per capita total expenditures are in shillings per year for Kenya and in pesos per year for the Philippines, both expressed in 1984 prices.

tween the two data collection techniques. Calorie–income elasticities are compared for Kenya and the Philippines using four different calorie variables (total expenditures are used as a proxy for income in all estimations). These are: family calorie intakes (C1) from a 24-hour recall of food intakes; household calorie intakes (C2) from the same 24-hour recall of foods prepared, which includes food fed to non-household members and waste; family calorie availability (C3) from a food expenditure survey; and household calorie availability (C4) from the same food expenditure survey, which includes food fed to non-household members (see Table 1). The range of calorie–income elasticity estimates for each population is quite large, from 0.40 to 0.19 for Kenya and from 0.52 to 0.13 for the Philippines (see Table 2). The lower estimates are generated by the calorie intake data and the higher estimates are generated by the calorie availability data. That the results are so similar between Kenya and the Philippines, two countries with very different cultures and rural economies, reinforces previous findings of Bouis and Haddad.[1]

Second, food demand relationships are examined. Calorie and other nutrient demand elasticities are simply linear mappings of demand elasticities for individual foods. If food expenditure and food intake surveys give dissimilar estimates of calorie–income elasticities, then it should come as no surprise that the two survey methods generate dissimilar patterns of demand for individual foods. Individual food consumption patterns are compared between Kenya and the Philippines for the two survey methods and, again, the differences between survey methods are found to be quite similar between the two countries.

In part because the effect of income-generating policies on calorie intake (until recently thought to be the binding constraint upon better health and nutrition) has been overestimated in the past, policy research in other areas related to health and nutrition have been relatively neglected. A third section discusses some of the implications of these findings for future work on (i) intra-household distribution of food, (ii) demand for micronutrients, and (ii) non-nutrient health inputs.

[1]Howarth E. Bouis and Lawrence J. Haddad, 'Are estimates of calorie–income elasticities too high? A recalibration of the plausible range', *Journal of Development Economics*, forthcoming.

Income and the demand for calories

The positive response of calorie consumption to increased income is a

Table 2. Calorie–total expenditure elasticity estimates for Kenya and the Philippines, by calorie variable, for OLS and 2SLS.

Calorie dependent variable	Kenya OLS (1)	Kenya 2SLS (2)	Philippines OLS (3)	Philippines 2SLS (4)
(1) C1	0.20	0.19	0.14	0.13
	(0.032)	(0.094)	(0.014)	(0.023)
(2) C2	0.23	0.24	0.16	0.17
	(0.032)	(0.093)	(0.014)	(0.024)
(3) C3	na	na	0.46	0.40
			(0.013)	(0.022)
(4) C4	0.37	0.40	0.52	0.48
	(0.031)	(0.093)	(0.013)	(0.023)

Notes:
1. Detailed regression results are available from the authors.
2. Standard errors for elasticity estimates are reported in parentheses.
3. C1 = family calories from 24-hour recall of meals prepared; C2 = total calories from 24-hour recall of meals prepared (less waste for Kenya); C3 = family calories from food expenditure survey; C4 = total calories from food expenditure survey.
4. The Kenyan estimates are based on an unbalanced panel of 1161 observations from 488 households. Here only the left-hand-side variables vary by round and the observations are averaged across rounds for the regression analysis. The Philippine estimates are based on a balanced panel sample of 1792 observations from 448 households. Here total expenditure does vary by round, and we stack the four rounds of observations for the regression analysis.
5. Identifying instruments for the Kenyan 2SLS estimates are: area owned, quality of walls, floor, roof, water, and the ownership of a plough, latrine, cattle, oxen and a sewing machine. Identifying instruments for the Philippine 2SLS estimates are: farm area owned and cultivated, net worth of assets, quality of floor, walls, water and roof, and the use of electricity. An appendix of regression results is available from the authors on request.

core assumption underlying many poverty alleviation initiatives. The response of household calorie consumption to changes in the level of income is captured by the calorie–income elasticity, evaluated at different levels of income. Until quite recently calorie–income elasticities for low-income populations throughout the developing world were reported to be in the range of 0.4 to 0.8, suggesting that increases in income alone were sufficient for substantial improvements in the nutrition of the poor.[2]

However, several new studies have reported calorie–income elasticities which are substantially lower than 0.4; a number of estimates are below 0.2.[3] This has generated considerable debate over whether calorie intakes of low-income households are responsive to increases in income after all.[4] Drawing on evidence from farm household surveys in the Philippines, Bouis and Haddad argue that the primary reason for the wide range of estimates found in the literature is very simply the particular calorie variable chosen to represent calorie consumption.[5] Use of food expenditure surveys (typically used in economic analysis) has led to severely upwardly biased estimates, while using food intake survey techniques (developed by nutritionists) gives more accurate estimates of nutrient demand parameters. Other factors that may also contribute to the wide range of estimates are summarized below.

Why do estimates vary so much?

The choice of calorie variable

In gathering data for estimation of nutrient and food demand, generally the least-cost method is the collection of food and non-food expenditures. Total expenditures give a reliable proxy for permanent income. Food expenditure information gives a measure of the availability of calories and other nutrients. Information is often (but not always)

[2]Harold Alderman, *The Effect of Food Price and Income Changes on the Acquisition of Food by Low-Income Households*, International Food Policy Research Institute, Washington, DC, 1986.
[3]The results from 25 separate studies are summarized in Bouis and Haddad, *op cit*, Ref 1. Estimates ranged from 0.01 to 1.18.
[4]Jere R. Behrman, *Nutrition and Incomes: Tightly Wedded or Loosely Meshed?*, PEW/Cornell Lecture Series on Food and Nutrition Policy, Cornell Food and Nutrition Policy Program, Ithaca, NY, 1988.
[5]The argument is also made that elasticities depend secondarily on the variable chosen to represent income, either current income or current total expenditure.

collected on meals fed to non-household members; however, rarely is information collected on how these meals might vary from what is typically eaten by household members.

A few household surveys have collected information on both food availability and food intake. Recall of food ingested in the previous 24 hours is the least time-intensive food intake methodology available, although techniques involving direct weighing of foods prepared and eaten have also been developed and used. For example, the US Department of Agriculture's Nationwide Food Consumption Surveys have used seven-day food expenditure data as well as 24-hour recalls of household food consumption.[6] The estimates of calorie and nutrient intake vary tremendously across these two survey techniques. Calorific consumption per adult male equivalent derived from food expenditures is 3998 calories per day,[7] compared to 2297 calories per day based on a 24-hour recall.[8]

For calorie consumption, 24-hour recall data are more time consuming and therefore more costly to collect than food purchase (availability) data. Use of this technique requires recording of recipes and weight (or volume) of ingredients for individual meals, and more than one household member may have to be interviewed. Ideally this method captures food eaten outside the home, food given to non-household members (guests and hired workers) and plate waste.

Population from which the sample is drawn

One obvious explanation for the wide variation in calorie–income elasticity from the literature is the different preferences, levels of income and availability of food in the areas in which the surveys were taken. As we will demonstrate, control of community effects by using the same sample for the series of estimations still permits an extremely wide variation in elasticity estimates.

Level of food group aggregation

If the food groups used for the calorie conversion are very aggregated and if only expenditure information is available (and not price or quantity data), then as income rises any substitution within the food group towards more expensive calorie sources goes undetected.[9] To illustrate this, consider an extreme case where data are available only for total food expenditures. A 10% increase in income that leads to a 5% increase in expenditure on food will also be accompanied by a 5% increase in calories, if we are restricted to a single calorie conversion factor for this one food. However, perhaps without exception, empirical studies show that more expensive calorie sources are purchased at higher income levels.

Method of estimation

Because time spent in income-generating activities is a choice variable, only under near-ideal conditions of market competitiveness can income or total expenditure be considered exogenous to the food consumption decision.[10] The endogeneity of income as an explanatory variable in the calorie equation will result in 'simultaneous equations' bias. The estimated coefficient on income is biased as it no longer represents the independent effect of income, but incorporates some error-term effects.

Measurement error on total expenditure (but not the calorie consumption variables) will also result in biased estimates. Random

[6]Marguerite C. Burke and Eleanor M. Pao, *Methodology for Large-scale Surveys of Household and Individual Diets*, Home Economics Research Report No 40, United States Department of Agriculture, Washington, DC, 1976.

[7]Barbara Devaney and Robert Moffitt, 'Dietary effects of the food stamp program', *American Journal of Agricultural Economics*, Vol 73, No 1, 1991, pp 202–210.

[8]US Department of Agriculture, Science and Education Administration, *Food and Nutrient Intakes of Individuals in One Day in the United States, Spring 1977*, Nationwide Food Consumption Survey 1977–78, Preliminary Report No 2, USDA, Washington, DC, September 1980.

[9]Jere R. Behrman and Anil B. Deolalikar, 'Will developing country nutrition improve with income? A case study for rural South India', *Journal of Political Economy*, Vol 95, No 3, 1987, pp 492–507.

[10]If the household is a producer-consumer *and* output and input markets exist and are efficient, production decisions can take place independently of consumption decisions, although not vice versa. In this case production and consumption can be modelled as a recursive system and consistently estimated with ordinary least squares, applied sequentially. However, even this recursivity could break down if food consumption affects physical productivity: see for example Lawrence Haddad and Howarth Bouis, 'The impact of nutritional status on agricultural productivity: wage evidence from the Philippines', *Oxford Bulletin of Economics and Statistics*, Vol 53, No 1, 1991, pp 45–68.

measurement error on total expenditure will ensure that the observed total expenditure term (composed of true total expenditure plus random error) is correlated with the composite error term, thus violating the conditions for consistent estimation. The direction of the bias due to measurement error will usually result in estimates that are closer to zero than they should be, although this effect is only clear when one variable is measured with substantially more error than any of the remaining right-hand-side variables.

An important exception to this 'bias-towards-zero' rule of thumb occurs when food availability and total expenditure are used in the same estimating equations. Because both variables are constructed from the same expenditure data and so any measurement errors will be common to both, it can be shown that this will almost certainly bias OLS estimates upwards, although in theory this bias can be eliminated using instrumental variable techniques.[11]

Two additional measurement issues relate to food purchased which is given to guests and hired workers. Such expenditures can be expected to rise with income and so to give an incorrect impression of rapidly rising family food consumption if underestimated. First, to avoid the misclassification of production expenses on food for hired labour as consumption expenses, it is necessary to distinguish between household food expenditures for (i) family members and guests and (ii) hired workers. Second, if high-income households consistently underestimate monies spent for either guest or worker meals (or, worse, if no information at all is collected for such expenditures), the family component of household food expenditure will be overestimated by higher-income respondents. This systematic measurement error is much less easily corrected with instrumental variable techniques because the measurement error is correlated with the variable (income) that is being instrumented.

Finally, unobserved effects at the household level are not accounted for by either OLS or instrumental variables. It is necessary to account for any unmeasured/unmeasurable variables that may be driving both income and calorie intake, making their association appear stronger than it really is.[12]

Absolute income changes and curvature

An additional possible explanation for the low elasticities reported in the literature is the tendency to calculate them at the mean of the consumption and income data. There may be a monotonic decline in calorie–income elasticities moving from the lowest value to the highest income groups.[13] But does an elasticity value of (say) 0.1 really represent a low response of calorie intake to income changes? To some degree the answer depends on the feasible ranges of absolute calorie intakes *vis-à-vis* the feasible ranges of absolute incomes.

Calorie–income elasticities represent the ratio of percentage changes in caloric intake over percentage changes in income. In the numerator, on average intake per adult equivalent will typically fall between 1500 and 3000 calories per day for most population groups, a maximum possible increase of 100% from very low to very high incomes. By contrast, in the denominator quite large percentage increases in income are possible as low-income households move from (say) $100 per capita to $200 and then to $400, and so on. Maximum calorific intake is physiologically constrained while income is not, so that 'low' calorie–income elasticities can be expected *a priori*.

[11] Bouis and Haddad, *op cit*, Ref 1.

[12] No panel estimates are undertaken in this article for two reasons. First, previous analysis shows the unobservable effects for the Philippine data to be relatively unimportant (Bouis and Haddad, *op cit*, Ref 1). Second, in contrast to the Philippine sample, the panel for Kenya is unbalanced (a variable number of observations is generated by each household). In order to obtain a comparably balanced sample it would be necessary to substantially reduce the sample size for Kenya.

[13] Strauss and Thomas show that this is indeed the case for a Brazilian data set: John Strauss and Duncan Thomas, *The Shape of the Calorie-Expenditure Curve*, Economic Growth Center Discussion Paper 595, Yale University, New Haven, CT, 1989. Ravallion suggests that although calorie–income elasticities are low, they are not capturing the threshold effects of individuals attaining energy adequacy. That is, the effect on health status to a move from (say) 0.6 to 0.8 energy adequacy and 0.9 to 1.1 are not equivalent even if they involve identical calorie increments: Martin Ravallion, 'Income effects on undernutrition', *Economic Development and Cultural Change*, Vol 38, No 3, 1990, pp 489–515.

Moreover, with respect to the plausible range that percentage changes in the numerator may take, additional evidence is provided by the relationship between calorie intakes and body weights. Controlling for differences between income groups in activity patterns, rates of metabolism and adaptation to energy stress, and assuming constant weights within income groups, there is roughly a linear relationship between calorie intakes and body weights.[14] Thus, if average body weights of high-income groups are 20% higher than those of low-income groups (to pick a number at the high end of the plausible range), as a rough order of magnitude one would expect that calorie intake of high-income groups would be a *maximum* of 20% higher than calorie intakes of low-income groups, *unless* there was evidence that: (i) high-income groups worked substantially harder than low-income groups, (ii) average rates of metabolism were significantly different between high- and low-income groups, (iii) body weights within a specific income range were increasing (or decreasing) over time, and/or (iv) adaptation to energy stress was a significant phenomenon for low-income groups. It is only this last factor of adaptation to energy stress which may be important over a broad range of developing country situations. Even then, Payne and Lipton suggest a magnitude of maximum energy savings of only 10%.[15]

Calorie-income elasticities for Kenya and the Philippines

The Kenyan data were collected over four rounds from December 1985 through March 1987 in the South Nyanza region, for 617 households. The Philippine data were collected over four rounds at four-month intervals from July 1984 through July 1985 at Bukidnon province, for 448 households.[16]

In both regions farm households primarily engaged in maize and sugarcane production were surveyed, sugarcane being a newly introduced crop in each region. In South Nyanza agricultural production can be characterized as labour-constrained; sugarcane production led to an expansion of area cultivated by adopting farm households. In Bukidnon agricultural production can be characterized as land-constrained; sugarcane was produced on land formerly devoted to maize production.

In both the Kenyan and Philippine settings a food expenditure survey and 24-hour recall of food intakes was conducted. For the food expenditure surveys a comprehensive list of foods eaten in each region was compiled. The respondent mothers were asked, for each of these foods, if the food had been consumed or purchased in the past week (Kenya) or past month (Philippines). If so, information was obtained on the source of acquisition (market purchase, own-farm production, in-kind wages, gifts/loans, or some combination of these four), quantity consumed/purchased by source of acquisition, and (where appropriate) the total expenditure and/or unit price.[17]

This information was used to obtain a measure of household food availability, from which C4 may be calculated. The Philippine survey included questions on number of meals served to guests and workers (separately) over the past month, including the age and sex composition of these guests and workers. This permitted a proportional downward adjustment of C4 to obtain C3, family food availability.[18]

In the 24-hour recalls the general procedure was to ask the mother to provide a complete listing of ingredients that went into each meal and

[14]This relationship is discussed in more detail in Howarth E. Bouis, 'The effect of income on demand for food in poor countries: are our databases giving us reliable estimates?', paper prepared for presentation at the conference on Data Base for Development Analysis held at Yale University, 15–16 May 1992, International Food Policy Research Institute, Washington, DC, 1992. Bouis draws on analysis by Christopher Bliss and Nicholas Stern, 'Productivity, wages, and nutrition. Part II: Some observations', *Journal of Development Economics*, Vol 5, No 4, 1978, pp 363–398; and World Health Organization, Food and Agriculture Organization and United Nations University, *Energy and Protein Requirements*, Report of the Joint Consultative Meeting of Experts from FAO/WHO/UNU, World Health Organization, Geneva, 1985.

[15]Philip R. Payne and Michael Lipton, *How Third World Households Adapt to Dietary Energy Stress: Statement of Issues, Outline of Literature, Research Protocol*, International Food Policy Research Institute, Washington, DC, 1990.

[16]The data collection procedures are fully described for Kenya in Eileen Kennedy and Bruce Cogill, *Income and Nutritional Effects of the Commercialization of Agriculture in Southwestern Kenya*, Research Report 63, International Food Policy Research Institute, Washington, DC, 1987, and Eileen Kennedy, *The Effects of Sugarcane Production on Food Security, Health and Nutrition in Kenya: A Longitudinal Analysis*, Research Report 78, International Food Policy Research Institute, Washington, DC, 1989; and for the Philippines in Howarth E. Bouis and Lawrence J. Haddad, *Agricultural Commercialization, Nutrition, and the Rural Poor: A Study of Philippine Farm Households*, Lynne Rienner, Boulder, CO, 1990.

[17]In the Philippines, for each food a question was asked about the usual frequency of purchase; the quantity and expenditure information collected referred to the most recent purchase. Also in the case of the Philippines, unfortunately (in retrospect), no distinction was made between in-kind food wages and food gifts/loans (i) which were eaten at home and (ii) which were prepared by another household and eaten away from home. Making this distinction would have provided valuable information on the nature and magnitude of various channels of inter-household transfers of food; and, as a general rule, more focused questions reduce a tendency to underreporting (forgetting), although this increases the length of interview and respondent fatigue. Both survey areas are relatively remote and provide few opportunities for purchase of prepared meals.

[18]No specific information was obtained on how meals served to non-family members might differ from meals served to family members. No information is available to calculate C3 for Kenya. For all of the four

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snack prepared during the previous day. Amounts for each ingredient were determined in various ways. For example, the capacities of pots and utensils used in cooking were measured by the enumerators. Respondents were asked to identify which of various-size drawings corresponded to the size of (say) a vegetable or fruit used in a recipe. It was necessary also to determine how each ingredient was prepared and cooked (eg served raw, boiled, skin/seeds removed before cooking), and how much of each recipe was (i) eaten by individual family members, or (ii) served to guests, saved as leftovers, given to animals, and wasted.

In the Kenyan 24-hour recall, information was collected on foods prepared at the household level (the C2 variable described above; for Kenya this excludes food waste, ie food not eaten by family members or guests/workers) and number of non-household members, including their age and gender composition, present at each meal. This non-household member information allows a proportional downward adjustment of C2 to obtain C1, food eaten by family members.[19]

In the Philippine 24-hour recall, information was collected on foods prepared at the household level (however, C2 includes food waste). Information on individual intakes of all family members was also obtained, giving a direct measure of C1. The difference between C2 and C1 is a residual measure of food fed to non-household members and waste.[20]

Elasticity estimates

Table 1 presents the four measures of calorie consumption for Kenya and the Philippines by per capita total expenditure quartile. The patterns of increased calorie consumption across income groups for each type of measure are very similar for both countries. C2 and C4 increase more rapidly with income as compared with C1 and C3, respectively, because of the inclusion of food fed to guests and hired workers, which increases as a proportion of total calories as income increases. C3 increases more rapidly with income than C1, and C4 increases more rapidly with income than C2 for two reasons. First, for the C3 and C4 food expenditure data, households which randomly overestimate (underestimate) food expenditures by construction overestimate (underestimate) caloric consumption and by construction tend to be filtered to the high (low) end of the income distribution. Second, it appears that there is an underestimation of meals served to non-household members (in the Philippine food expenditure survey) by high-income groups.[21]

The calorie–income elasticity estimates presented in Table 2 reflect the patterns just described. These estimates increase when guests and worker meals are not purged (rows 2 and 4), an indication that these calorie components account for a larger share of total calories in the better-off households.

The elasticity estimates for calorie availability (rows 3 and 4) are much higher (by a factor of three for the Philippines and by a factor of two for Kenya) than the elasticity estimates for calorie intake (rows 1 and 2). For the Philippine data set, we argue that this results from a systematic underreporting of guest and worker expenditures by richer households.[22] To find such similar results for the Kenyan data set supports this argument. An additional reason to think that the row 3 and 4 estimates are implausibly high is that they are incompatible with

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calorie measures for both countries, *quantity* information is available for a highly disaggregate bundle of foods, so that possible bias due to aggregation discussed in the previous section is not thought to be a problem.

[19]In Kenya information was also collected on individual intakes of mothers and preschoolers, but not for all family members.

[20]For both Kenya and the Philippines C2 is adjusted for food eaten away from home by excluding family members absent from meals (whom the wife reported ate that meal away from home) in the calculation of household size and its demographic composition. Implicitly this is an assumption that, on average, meals taken outside the home have the same composition as meals eaten at home.

[21]For details, see Bouis and Haddad, *op cit*, Ref 1.

[22]*Ibid*. If an instrumental variable estimator such as 2SLS were to remove this measurement error bias, the instrument would be required (i) to be uncorrelated with reporting errors on guest and worker expenditures, and yet for the estimator to be efficient, (ii) to be correlated with total expenditure. If guests and worker expenditure are correlated with total expenditure, as suggested in Table 1, it is not likely that a valid instrument can be found.

observed weight differences across income groups. These weight differences suggest that, if anything, the row 1 and 2 estimates may themselves be somewhat high.[23]

Income and the demand for individual foods

Having established the 24-hour recall information as a reasonably accurate set of data with respect to measuring food intakes for the South Nyanza and Bukidnon populations and having come to the opposite conclusion for the food expenditure information, an obvious question to ask is how reliable are food expenditure surveys for estimating food demand relationships that are not directly related to nutrition? From the perspective of those involved in providing food policy analysis to governments and international agencies, this is a tremendously important question in that the use of food intake surveys is the exception rather than the rule. Such surveys are difficult and expensive to administer. Most demand analysis in the past has relied on food expenditure surveys.

Table 3 disaggregates the calorie availability and calorie intake data by broad food group. It is evident from Table 3 that it is the food staples that are driving the different income elasticity estimates for calorie availability and calorie intakes. The calorie intake data suggest that staple calorie consumption remains virtually constant as income increases, while the calorie availability data indicate that staple calorie consumption increases substantially with income. Unless care is taken (the row 3 and 4 estimates in Table 2 suggest that such precaution might be of little help), use of the food expenditure information leads to gross overestimates of the income elasticities for food staples. Where these staple income elasticities are estimated using a demand system framework which imposes Cournot and Engel aggregation restrictions, biases are transmitted to other elasticities in the food demand matrix as well.

While this article has focused so far on calories, recently in the nutrition literature considerable attention has been given to the problem of deficiencies in intakes of micronutrients, in particular vitamin A, iron and iodine. For example, for vitamin A Table 3 again indicates very different effects of income on consumption between the food expenditure and 24-hour recall data. In analysis presented elsewhere using these data, it is shown that vegetables are the primary source of vitamin A.[24] Note the very strong relationship between income and vegetable consumption for the food expenditure data (calories for individual food groups in Table 3 and quantities for those food groups are strongly correlated) and the weak relationship for the food intake data. Even estimates of average levels of consumption are quite different for some food groups. The food expenditure data for both populations indicate much higher consumption of fruits than the food intake data.

While it is clearly essential to distinguish between nutrients eaten by family members and those consumed by guests/workers in undertaking policy analysis related to nutrition, it could be argued that income elasticities generated for individual foods by food expenditure data (purged of the common measurement error between food quantities and total expenditures) may still be used in making standard projections of aggregate national food demand. That is, higher-income households purchase this extra food for guests and workers; the accounting system

[23]Bouis, *op cit*, Ref 14. The sample of 448 households used here, which includes 42 households whose primary occupation is not maize or sugar production, is somewhat larger than the 406 households used there. All eight of the calorie–income elasticities reported here for the expanded sample are marginally higher than reported in Bouis and Haddad (*ibid*), but the relative magnitudes between the calorie intake and calorie availability data remain very much intact.

[24]Eileen Kennedy and Ellen Payongayong, *Patterns of Macronutrient and Micronutrient Consumption and Implications for Monitoring and Evaluation*, International Food Policy Research Institute, Washington, DC, 1991; Howarth E. Bouis, *The Determinants of Household-Level Demand for Micronutrients: An Analysis for Philippine Farm Households*, International Food Policy Research Institute, Washington, DC, 1991.

Table 3. Family calorie availability and calorie intakes per capita by food group and expenditure quartile for Kenya and the Philippines.

Data source and food group	Average	Expenditure quartile 1	2	3	4	Quartile 4 minus Quartile 1
				Kenya		
Calorie intakes[a]						
Maize	1 130	1 098	1 149	1140	1 130	+32
Other staples	230	185	222	248	264	+79
Meat/fish	145	112	120	161	187	+75
Vegetables	43	39	39	48	46	+7
Fruits	21	19	16	11	37	+18
Others	293	197	292	303	381	+184
Maize/other staples	1 360	1 283	1 371	1 388	1 394	+111
All others	502	368	468	524	651	+283
All	1 862	1 651	1 839	1 912	2 045	+394
Calorie availability[b]						
Maize	926	799	878	990	1 037	+238
Other staples	411	259	374	471	540	+281
Meat/fish	138	90	123	148	192	+102
Vegetables	50	37	44	57	63	+26
Fruits	129	100	125	125	165	+65
Others	230	155	216	251	296	+141
Maize/other staples	1 337	1 058	1 252	1 461	1 577	+519
All others	547	383	507	582	716	+333
All	1 884	1 441	1 759	2 043	2 293	+852
				Philippines		
Calorie intakes[a]						
Rice	424	207	357	384	749	+542
Corn	982	1 154	1 074	1 070	632	−522
Other staples	114	86	93	120	159	+73
Meat	124	67	102	118	207	+140
Vegetables	28	25	25	31	31	+6
Fruits/desserts	52	35	48	56	68	+33
Cooking ingredients	87	50	63	96	139	+89
Rice and corn	1 406	1 361	1 431	1 454	1 381	+20
All others	405	264	331	422	602	+338
All	1 811	1 625	1 762	1 876	1 983	+358
Calorie availability[b]						
Rice	559	269	419	577	973	+704
Corn	828	852	894	905	661	−191
Other staples	128	88	108	138	177	+89
Meat	89	38	64	86	166	+128
Vegetables	16	9	12	17	27	+18
Fruits/desserts	90	51	75	101	133	+82
Cooking ingredients	95	44	68	94	176	+132
Rice and corn	1 387	1 121	1 313	1 482	1 634	+513
All others	418	229	326	437	678	+449
All	1 805	1 350	1 639	1 919	2 312	+962

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

is merely based on the food that enters the house (food expenditures) rather than based on food that is eaten by family members (food intakes).

A basic flaw in this argument, however, is that it implicitly assumes that the absolute magnitude of these transfers of food to guests and workers in lower-income groups will increase as all income groups (low and high) move up the income scale. This is implausible. Rather the solution to making accurate food demand projections lies in using a food *intake* accounting system which either (i) relies on data gathered from food intake survey techniques developed by nutritionists, or (ii) asks very detailed questions in food expenditure surveys about food fed to non-household members and eaten outside the home. In general, cross-section estimates of income elasticities for food staples in developing countries found in the literature[25] imply quite high calorie–income elasticities and gains in body weights which are inconceivable.

Directions for future nutrition policy research

In using the high calorie–income estimates for policy formulation, the effect of income-generating policies on household food security is overestimated. Policies focus on calories as the prime input in the health production function. Attention and resources are drawn away from work on intrahousehold issues and micronutrient consumption, non-income effects on nutrient intakes, and non-nutrient inputs into the production of health at the household and community levels.

Intrahousehold issues

The stronger the response of household calorie consumption to increased income, the fewer the incentives for examining how this response affects different members of the household. Improvement in welfare measured at the household level need not be shared equally and is not sufficient to ensure even an absolute improvement in the welfare of each individual in the household. Indeed, for Kenya and the Philippines, individual calorie adequacy shows considerable variation across various age and gender groups.[26] Possible explanations for such variation are: (i) a pure investment decision (in the short run, those best able to translate the extra calories into further household income will be allocated the largest share), (ii) a bargaining outcome (different household members have different levels of economic dependence on the household structure), or (iii) simply an ignorance of differential nutrient requirements across age, gender and activity patterns within the household.

While the systematic variation in calorie adequacy across different household members is intrinsically interesting, what are the direct policy consequences of treating the household as a homogenous collection of individuals? Haddad and Kanbur found that although the neglect of intrahousehold calorie adequacy in the Philippines resulted in few dramatic ranking differences across various household groupings in terms of their levels of calorie poverty and calorie inequality, targeting errors were costly for programmes aimed at individuals (preschooler feeding programmes, for example).[27] In Kenya, where a significant share of households is polygamous, intrahousehold allocation of calories is also problematic. Household calorific adequacy for all households is 93%, compared to only 60% of calorific adequacy for preschool-aged children.[28]

Micronutrients

High calorie–income elasticities diminish interest in studies of the response of micronutrient intake to income. Is micronutrient consumption a bottleneck to the production of health? If so, what would be the most cost-effective strategies for relaxing these constraints: education, supplementation, fortification, increasing incomes, lowering food prices?

The nearly exclusive focus of economists on protein in the mid to late 1970s gave way to a similar concentration on calories in the 1980s that has only now begun to recede as interest in micronutrients – particularly vitamin A, iron and iodine – has increased. In fact, in a number of

[25] Alderman, *op cit*, Ref 2.
[26] Kennedy and Payongayong, *op cit*, Ref 24; Bouis and Haddad, *op cit*, Ref 16.
[27] Lawrence Haddad and Ravi Kanbur, 'How serious is the neglect of intra-household inequality?', *Economic Journal*, Vol 100, No 402, 1990, pp 866–881; Lawrence Haddad and Ravi Kanbur, *The Value of Intra-household Survey Data for Age-Based Nutritional Targeting*, PRE Working Paper WPS 684, World Bank, Washington, DC, May 1991.
[28] Kennedy and Cogill, *op cit*, Ref 16.

developing countries vitamin A and/or iron deficiencies are more prevalent than protein-energy malnutrition.[29]

The nutritional benefits of programmes and projects which have raised incomes with small concurrent increases in calories may have been understated because of a failure to evaluate the effects on micronutrient intakes. Nevertheless, even if calorie–income elasticities are high, other nutrient deficiencies might still exist. Analysis of the Kenyan data indicates that for both households and preschoolers, vitamin A dietary deficiency exists in households at or above 100% of calorific adequacy; 30% of preschoolers had vitamin A consumption levels chronically less than 100%, yet the average calorific intake for the vitamin A deficient and non-deficient children was similar.[30]

In the Philippines, vitamin A adequacy dropped from 95% above adequacy to 30% below adequacy over a 12-month period, during which the price of green, leafy vegetables (the major source of vitamin A in the diet) doubled. Calorie intakes fell by only 12% over the same period, while morbidity increased markedly. Regression analysis showed the increased morbidity to be related to the drop in vitamin A intakes, but not the decline in calorie intakes.[31]

Non-nutrient health inputs

The two major causes of malnutrition in preschoolers are inadequate food consumption and infectious diseases. Food-linked malnutrition is often emphasized, particularly in Africa, because of the emphasis placed on famine and drought.

However, one of the strongest conclusions coming out of extensive analyses of the Kenyan and Philippine data[32] was that incomes did not translate into significantly improved preschooler nutritional status as measured by anthropometric indicators, because there was no concurrent improvement in the health and sanitation environment. Despite the better anthropometric measurements recorded at birth by preschoolers from sugar households in the Philippines (due in part to altered female labour allocation), higher morbidity levels after weaning led to a more rapid decline in their Z-scores as compared to corn-household preschoolers. At five years old no significant differences existed across the two groups of households, despite the higher incomes of the sugar households.

The Kenyan baseline study found percentage of time ill with diarrhoea in the last two weeks to have a large impact on preschooler weight-for-age and weight-for-height. In addition, only 61% of all baseline survey households had latrines, despite the fact that their presence had a significant beneficial effect on decreasing the total time ill for preschoolers. These studies emphasize that knowledge of the determinants of morbidity is important for effecting improvements in preschooler growth in combination with increases in household income.

Conclusions

Depending on the survey method used to measure food consumption, we have shown that estimated calorie–income elasticities and demand patterns for specific foods in two very different survey locations exhibit wide differences for the same household sample. The food expenditure data in both locations give estimates of calorie–income elasticities which are upwardly biased, but which are broadly in conformance with

[29] Kennedy and Payongayong, *op cit*, Ref 24.
[30] *Ibid*. Chronic is defined as preschoolers who on each dietary measure during December 1985 to March 1987 had vitamin A levels less than 100%.
[31] Bouis, *op cit*, Ref 24.
[32] Kennedy and Cogill, *op cit*, Ref 16; Kennedy, *op cit*, Ref 16; Bouis and Haddad, *op cit*, Ref 16.

elasticities found in the literature generated by other food expenditure data sets. The 24-hour food recall data in both locations give much lower estimates of calorie–income elasticities, which also are broadly in conformance with calorie–income elasticity estimates generated by other 24-hour food recall data sets, which have become available to economists only relatively recently.[33]

If these broad differences in food demand patterns between survey techniques continue to hold for other studies as well, and if it can be shown in a definitive way that the 24-hour recall data give generally unbiased estimates of food demand relationships (as we have argued here), the implications for food policy are profound. Projections of aggregate food demand, in particular for food staples, based on assumptions of aggregate income growth and using food income elasticities generated from expenditure surveys, have overstated requirements. The benefits of various income-generating policies on household food security have been exaggerated. Very likely, insufficient policy emphasis has been placed on intrahousehold issues, micronutrient consumption and non-nutrient health inputs such as infection, sanitation and water quality. Much research on poverty relationships and income distribution is called into question.

In summary, we have endeavoured to provide a better appreciation of the importance of understanding how household survey data are collected and what such data measure. Such an appreciation, we believe, will minimize the risk of inappropriate policy decisions and research directions.

[33]Bouis and Haddad, *op cit*, Ref 1.