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UNDERNUTRITION IN RURAL PAKISTAN: Measurement, Determinants and Some Policy Implications

Salim CHISHTI and Haroon JAMAL*

The paper assesses the extent of undernutrition in the poorest segments of society in Pakistan and identifies its determinants. It evaluates the impact of various income and price policies followed. The data for this study is drawn from a longitudinal survey of rural Pakistan. Simple headcount index shows that about 25 per cent of the households in the sample are undernourished. However, this percentage drops to a very low level when it is measured by intensity-sensitive indicators because the proportion of severely undernourished is quite low. The estimated income and price elasticities are low and are comparable to earlier studies. Sensitivity analysis results indicate that a small subsidy on wheat price to the poor may be quite effective in improving their nutritional status.

Introduction

During the last two decades economists have taken a keen interest in issues related to malnutrition and undernutrition mainly in search of feasible policy interventions to alleviate poverty, hunger, and illness. Broadly speaking there are three sets of issues on which research is currently on-going. The first relates to the methods of estimating prevalence and depth of nutritional insufficiency. The second identifies variables and quantifies their responsiveness to nutritional intake. The third assesses the relationship between nutrition, health and productivity.

This paper estimates the extent of undernutrition in some selected areas of Pakistan using a relatively recent methodology. It also assesses the effectiveness of policy interventions relating to undernourishment. The paper is laid out in the following way. Section I reviews estimation and policy responsiveness issues. Section II consists of the methodology. Section III describes the data. Section IV reports and discusses the results. Section V consists of sensitivity analysis while Section VI presents some concluding remarks.

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I. Issues

Economists find it difficult to accurately measure the extent of undernutrition. Some of the problems which make the measurement of the extent of undernourishment difficult relate to the differences in the degree of adaptability of individuals to variations in food intake [Hegsted (1974)], inter-individual differences in calorie requirements [Sukhatme (1982), Srinivasan (1981), and Waterlow (1986)], defining a level of physical activity and the individual's health and sanitary environment [Beherman and Wolfe (1984), and Osmani (1987)]. Furthermore, when the nutrition status of individuals/households has been measured, the problem has been to aggregate this information into a single index to proxy the status of a group of individuals. All individuals who are undernourished are not equally undernourished. Therefore, the issues in this regard primarily relate to assigning weights to differing intensities of undernutrition [Foster et. al., (1984), Sen (1979)]. The most popular measure of the level of undernourishment of a group of individuals is the Head-Count index. This index assigns equal weights to all those undernourished regardless of the extent of undernourishment, therefore, it ignores the intensity of undernourishment. However, assignment of equal weights to those who are only marginally undernourished and those who are significantly undernourished tends to overstate the status of undernourishment. There are several other measures which have been suggested, which are sensitive to the intensity of undernourishment among the undernourished. A class of functional forms which has been suggested by Foster, Greer, and Thorbeke, which is known as the FGT function uses various powers of the proportional gap between the observed and the required nutrition intake as the weights to indicate the level of intensity of undernourishment. The higher the power the greater the weight assigned to a given level of undernourishment. Therefore, the relatively more undernourished receive a higher weight in aggregating the undernourished group of individuals. In this way, the FGT function combines both the incidence and intensity of undernourishment. The function may be written as follows:

$$P_\alpha = \int_0^Z \left[\frac{Z - X}{X} \right]^\alpha f(x)dx \qquad (1)$$

where Z is the required and X is the observed level of a nutrient, and α is a parameter indicating the distributional sensitivity. This class of functions is additively separable. For $\alpha = 1$, it represents the proportional gap index. As α increases, the relatively larger undernutrition gaps assume increasingly higher weights. A higher value of α is consistent with the social sense of justice which is more sensitive to those who are significantly undernourished. For $\alpha > 0$ the FGT function satisfies Sen's monotonicity axiom, and for $\alpha > 1$, his transfer axiom [Sen (1976), (1979)]. For $\alpha > 2$ it satisfies

Kakwani's transfer-sensitivity axiom [Kakwani (1980)].[1] Furthermore, the FGT function has an asymptotic sampling distribution given by:

$$P_\alpha \overset{Asum}{\sim} N\left[\hat{P}_\alpha, \frac{1}{n}\left(\hat{P}_{2\alpha} - \hat{P}^2_\alpha\right)\right] \quad (2)$$

Therefore, parametric inferences may be made on the FGT based indices. Kakwani has also demonstrated that more sensitive measures with higher values of α are estimated with lower levels of precision, which means that there is a trade-off between sensitivity and precision [Kakwani, (1990)]. This is because the larger the value of α, the larger the weight attached to the poorest and therefore precision becomes a monotonically decreasing function of α.

The second set of issues relates to price and income responsiveness to nutrition intake. The empirical evidence indicates that these have a weaker link with nutrition intake than what intuition would suggest, provided these effects are directly estimated [Reutlinger and Selowsky (1976), Behrman and Wolfe (1984)]. However, if the relation between nutrition and budgetary variables is indirectly estimated through food elasticities then they show a stronger relationship [Pitt (1983), Timmer and Alderman (1979), Strauss (1984), Bouis and Haddad (1988)]. Several reconciliatory arguments have been offered. They relate mostly to the potential biases due to the mis-specification of the demand functions, the presence of errors in included variables and the use of inappropriate estimation techniques. Behrman and Deolalikar (1987) have presented another explanation in terms of the difference between the demand for food quantity and the demand for food quality. Recently, it has also been demonstrated that even if the nutrition intakes are less sensitive to income changes, the aggregate index may still be quite sensitive provided the interpersonal distributions are dense at the minimum required level [Ravallion (1990)].

Moreover, since most of the empirically estimated demand functions for food/ nutrients are based on cross-sectional data which usually do not have enough price variations, the appropriate assessment of the price effects has been tenuous. There are also many channels, which may influence the price effect and therefore it has been argued that a positive or negative impact is a statistical matter [Beherman, Deolalikar, and Wolfe (1988)].

There have been only a few studies estimating price and income elasticities for Pakistan. McCarthy, using 1968-72 Household Income and Expenditure Survey (HIES) data reports expenditure elasticity of calories as 0.41. Knudsen and Scandizzo

[1] The monotonicity axiom says that, given other things, a reduction in income of someone below the poverty line must increase the poverty measure. The transfer axiom says that a pure transfer of income to a poor person below the poverty line from a richer person, without making either cross the poverty line, must reduce the poverty measure. Kakwani's transfer-sensitivity axiom states that if a transfer of income takes place from a poor person with income X to a poor person with income (X + h), then for a given h > 0, the magnitude of increase in poverty measure decreases as X increases.

(1982) have estimated price and income elasticities for the lowest income quartiles to be -0.48 and 0.53 respectively. Alderman's (1989) income elasticities for calorie demand range from 0.124 to 0.393 for various districts of Pakistan.

II. Methodology

As mentioned above controlling inter and intra-personal variations in responses to various quantities of nutrition intakes poses a serious problem in measuring nutrition status. One possible approach to assess the nutritional impact of changes in budgetary variables is by controlling for household heterogeneity through non-budgetary variables, i.e., estimating consumption of each household as if it had fixed non-budgetary characteristics of some 'reference' household. This approach was developed by Ravallion (1990) and has been replicated in this study. Briefly, the approach consists of first estimating a demand equation for a given nutrition level. This demand equation includes both budgetary variables such as income and prices and non-budgetary variables such as age and weight composition of the households, their educational background etc. In the second step, this estimated equation is used to re-estimate the demand for nutrition at the household level, but this time replacing the heterogenous non-budgetary variables by their corresponding averages. Since the non-budgetary variables are replaced by their averages, this function represents the demand for the nutrient as a function of the budgetary variables for each household as if all of them have the same non-budgetary characteristics. This procedure attempts to hold the heterogeneity caused by variables other than the budgetary variables constant, and therefore, isolates the effects of only budgetary variables on the demand for the nutrient. Finally, to evaluate the nutritional status of a given household, its estimated nutritional status at the average level of non-budgetary variables is compared with the nutrition requirements of a 'reference' household.[2]

Following this approach, we have first estimated a standard demand function through a Two-stage Least Squares Method. This demand function has been estimated for two nutrients, namely, Calorie and Protein. The choice of independent variables used in the demand function are described below.

Researchers have used several variables including current income, several versions of expenditure and permanent income to proxy the capacity to purchase a nutrient. We have preferred annual household expenditure (ANNEXP), because reported incomes are less reliable.[3] ANNEXP includes all cash expenditures plus

[2] For more details, see Ravallion (1990).

[3] This is because these are apprehensions among respondents that information regarding income may be used for purposes beyond academic research. Many anomalies in incomes with expenditures were encountered in the data. We have used annual expenditures which minimizes the seasonality factor.

expenditures imputed for consumption from own production. Besides household expenditure, prices of two staple food items, namely Wheat (WHEATPR) and Rice (RICEPR) have been used. Since wheat and rice together account for 52 per cent of the total food expenditure, therefore, their prices are appropriately included in the demand function. The prices used are village level prices which were collected independently, through a separate module. Some variation in the quality of rice across the sample area was observed. The effect of this has been captured by including an area dummy variable. Milk is also an important dietary component, but the proportion of milk consumed within the household is very high. Moreover, its price is regulated by the government with almost no variation across the sample areas and therefore its price has not been included.[4]

In addition to the budgetary variables, several non-budgetary variables have also been included in the demand equation such as family size (HSIZE), the differences in family composition which is represented by the proportion of adults (PADULT), the education level of the household which is represented by the highest number of years of schooling by any member of the household (HEDUC). In order to account for possible differences in the dietary habits of the farm and non-farm households, a dummy variable (NONFARMD) has been included. To test the hypothesis whether land ownership affects the consumption pattern and nutrient intake, a dummy variable (TENANTD) has also been included. Village electrification (VELECT) has been included to reflect the effect of village modernisation on demand patterns. Two locational dummies (FAISALD) and (BADIND) have also been included to account for the area specific effects. A log-log function has been used to avoid possible bias due to hetroscadisticity instead of using a linear relationship between nutrient intake and its determinants.

In the second step, the above estimated demand functions are used to estimate the jth 'reference' nutrient consumption by the ith household (Q^r_{ij}) as if it had reference characteristics fixed across all households. The implicit assumption in estimating this reference consumption is that all those non-budgetary variables which influence intake also influence the requirements. Substitution of non-budgetary characteristics of a reference household in the estimated demand function will enable it to capture only the price and income effects.

In step three, the intakes of individual households as if they all had the same non-budgetary characteristics are compared with the intake for the jth nutrient of a 'reference' household (Q^r_j). A household is undernourished with regard to the jth nutrient only if $Q^r_{ij} < Q^r_j$. This implicitly assumes that minimum nutrient requirements are those of a 'reference' household.

[4] Income or expenditure usually yield biased estimates because of measurement errors. To avoid these biases, an instrumental variable approach is used which is strongly related to the total expenditure in the hope that it is not correlated with errors in measurement.

The estimated nutrition status of individual households are combined to obtain an aggregate index to represent the whole group. As mentioned in the previous section, the FGT function is estimated to allow for the differential in the intensity of those who are undernourished.

Finally the impact of changes in income and prices on nutrition intake are simulated.

III. The Data

The data for this study is drawn from a longitudinal survey of rural Pakistan conducted jointly by International Food Policy Research Institute, Applied Economics Research Center, Punjab Economics Research Institute and Center for Applied Economics Studies, between 1986 and 1989. The sample was selected from the most underdeveloped areas of rural Pakistan. However, a prosperous district (Faisalabad) in Punjab province was also selected for the purpose of comparison. The underdeveloped areas were chosen on the basis of the Composite Development Index prepared by Pasha and Hasan (1982). The data used was from the districts of Badin in Sindh, Attock and Faisalabad in Punjab and consists of 560 households. Data from Balochistan and NWFP is not included because of quite frequent inconsistencies encountered during the cleaning process. Once the districts were selected the selection of households was based on stratified random sampling.[5] Price data has been obtained independently of households data.

The nutrition intakes are derived from the quantities of food consumed by households. Twenty-eight food items have been translated into different nutrients by applying the conversion factors taken from the Food Composition Table for Pakistan (Peshawar, 1985).[6] The longitudinal survey consisted of twelve repeat observations on the same households spread over a period of three years. In this study an average consumption of the first six rounds has been used.

IV. Demand Functions

Table 1 shows the descriptive statistics of the variables, while the estimated demand function is presented in Table 2. Some interesting observations emerge. The expenditure coefficients are positive, and significant but for both the nutrients, elasticity is low. This supports earlier findings on the subject, that the link between

[5] It may be mentioned at the outset that the sample is not representative of Pakistan or even rural Pakistan. However, it reasonably represents the poorest rural areas of Pakistan. Given the objective of the study, namely the assessment of the extent of undernourishment, it is of interest to focus on this segment because this is the one which is likely to be the most undernourished.

[6] There were 36 food categories in the original data. But the conversion for eight items was not possible because of aggregation - for instance other vegetables, other fruits, spices, etc.

income and nutrition intake is weak. The two commodities, rice and wheat, (prices of which are included in the demand functions), together account for approximately 66 per cent of calorie and 62 per cent of protein intake. The wheat price elasticities for both the nutrients are significant. The rice price elasticities are low and significant at the10 per cent level. The price elasticity of wheat is higher than of rice which is quite understandable as wheat is the main staple food in the sample area, accounting for approximately 40 per cent of food expenditure. A change in its price also significantly affects the budget constraint. Part of the explanation also lies with tastes. Households with rice as their normal staple food, usually do not make substitutions, whereas households taking exclusively wheat are relatively small in our sample. Our findings are consistent with Ravillion (1990) who obtained a high rice price elasticity of calorie intake for East Java, where rice is the main staple food. The results also indicate a significant difference in nutrients intake between farm households and non-farm households. This may reflect a relatively higher energy requirement of farm workers and/or higher propensity to consume from own-production, because a significant proportion of wheat consumption by farm households in our sample is from own production.

Our sample also indicates the average income of non-farm households to be lower than that of farm households. The variables relating to the household size and proportion of adults are included primarily to control inter-household heterogeneity

TABLE 1

Summary Statistics of the Variables

Variable Name	Mean	Standard Deviation
CALORIE (Weekly Household)	129120.67	58282.50
PROTEIN (Weekly Household)	3292.51	1618.30
ANNEXP (Annual Household)	28330.66	29428.64
WHEATPR (Rs. per 40 kg)	88.02	8.00
RICEPR (Rs. per 40 kg)	213.71	137.02
HSIZE (Nos.)	9.19	4.60
PADULT (Ratio)	0.87	0.11
HEDUC (Year of Schooling)	4.51	2.64
NONFARMD	0.17	0.37
TENANTD	0.24	0.43
VELECT	0.42	0.49
FAISALD	0.28	0.45
BADIND	0.43	0.50

TABLE 2

Estimated Demand Functions
(Weekly Household Nutrient intake as the Dependent Variable)

Variable Name	Calorie	Protein
ANNEXP	0.228	0.251
	(6.49)	(6.55)
WHEATPR	-0.606	-0.660
	(-2.503)	(-2.51)
RICEPR	-0.136	-0.139
	(-1.73)	(-1.62)
HSIZE	0.595	0.565
	(19.76)	(17.23)
PADULT	0.944	0.914
	(9.86)	(8.77)
HEDUC	0.013	0.017
	(2.36)	(2.86)
NONFARMD	-0.214	-0.235
	(-7.04)	(-7.12)
TENANTD	-0.035	-0.049
	(-1.37)	(-1.79)
VELECT	0.058	0.061
	(2.37)	(2.29)
FAISALD	-0.104	-0.110
	(-3.45)	(-3.38)
BADIND	-0.146	-0.325
	(-1.09)	(-2.21)
ADJUSTED R^2	0.744	0.737
DEGREES OF FREEDOM	547	547

Notes:

1. Values in parentheses are t-ratios.
2. All variables are used after log transformations and thus the coefficients represent the nutrient elasticity with respect to variables.
3. Two-stage least square has been used. The instruments include age of head, distance from main market, land ownership, assets and remittances, besides the above variables.

and reduce possible bias in the coefficients of the budgetary variables. These variables are all significant with expected signs.

Results corresponding to the education variable confirm the point that it plays a significant role in the decision regarding nutrient intake. Village modernization, which is represented by village electrification, indicates a positive and significant association with nutrient intake. It is plausible to argue that electrified villages are relatively more prosperous or more nutrient conscious. The coefficient corresponding to land ownership also yields expected results. It is significant for calories but not for protein intake, which means that while calories may be obtained, both from expensive and cheap sources, protein sources are generally more expensive.

V. Measures of Undernutrition

As mentioned earlier, Ravillion's approach has been followed in the next step. Nutrient demand of a household is estimated as if all the non-budgetary characteristics are fixed across households and therefore, presumably the variation in calorie consumption is attributable to the variation in income and prices among the households. This is given by:

$$Q^{r}_{ij} = \bar{Q}_j + \beta_1 (y_i - \bar{y}) + \beta_2(\bar{P}_{i,R} - P_R) + \beta_3(P_{i,W} - \bar{P}_W) \qquad (3)$$

where Q^{r}_{ij} is the reference intake of the jth nutrient by the ith household; Y_i is the annual expenditure of the ith household; $P_{i,R}$, $P_{i,W}$, are the prices of rice and wheat respectively which the ith household pays.

Once Q^{r}_{ij} has been estimated, the following functional form is evaluated for $\alpha = 1$, and $\alpha = 2$.

$$P^{\alpha} = \frac{1}{n} \Sigma \left[\frac{(Q^{r}_{ij} - Q^{r}_{j})}{Q^{r}_{j}} \right]^{\alpha} \qquad (4)$$

The summation is for all i's for which $Q^{r}_{ij} < Q^{r}_{j}$, where Q^{r}_{j} is the minimum requirement of the jth nutrient by the reference household, computed on the basis of daily recommended allowances of calories, and protein per adult equivalent unit to be 2550 and 65 respectively.

Table 3 presents various measures of undernourishment corresponding to the above nutrients. If one takes the traditional head-count index as the measure of undernutrition then there is a significant prevalence of undernutrition to the extent of 24 and 25 per cent for calories and protein respectively.[7] However, since a large

[7] Since the data is on household basis, this relates the household-count index, representing the proportion of households rather than individuals.

TABLE 3

Measures of Malnutrition

	Calorie	Protein
HEAD COUNT	0.24	0.25
	(13.45)	(13.58)
PROPORTIONATE GAP (a=1)	0.0386	0.039
	(9.94)	(9.90)
FGT (a=2)	0.010	0.010
	(6.57)	(6.12)

Value in parentheses are t-ratios.

proportion of those undernourished, are only marginally undernourished, intensity-sensitive measures indicate a very low prevalence of undernourishment. For $\alpha = 1$ it drops to about 4 per cent and for $\alpha = 2$ to only one per cent, indicating a low level of severely undernourished. These results indicate the shortcoming of the head-count index as a measure of undernourishment of a group of individuals. While the traditional head-count index shows quite a high proportion of households to be undernourished the intensity-sensitive FGT index shows only little undernourishment in rural Pakistan with regard to calorie and protein in-take. However, there may be malnutrition with regard to other nutrients. On the basis of the small sample used inferences cannot be drawn for all the rural areas of Pakistan. However, since most of the households in the sample belong to the highly depressed areas, individual cases apart, this should generally be true for rural Pakistan.

It may also be observed that the t-values, though all of them significant, consistently drop as the value of α increases. This reflects the trade-off between the intensity of undernourishment and the precision of the indices.

V. Sensitivity of the Income and Price effects on Calorie Intake

Table 4 presents the simulation results of income and price effects on calorie demand. It shows that a 10 per cent increase in income will reduce the head count index for calories by 2 per cent, the proportionate index by 0.36 per cent and the FGT index by 0.1 per cent. This means that the head-count index would improve from its base by 8 per cent, the proportionate index by 9 per cent and the FGT index also by approximately 9 per cent. Similarly a 10 per cent decrease in the price of

TABLE 4

Sensitivity Analysis of Income and Price Effects on Calorie Demand

	Head Count Index	Proportionate Gap Index (a=1)	FGT Index (a=2)
Original	0.24	0.039	0.010
	(13.45)	(9.94)	(6.57)
10% Increase in Income	0.22	0.035	0.009
	(12.73)	(9.25)	(5.25)
10% Increase in Wheat Price	0.30	0.054	0.015
	(15.59)	(11.78)	(7.69)
10% Decrease in Wheat Price	0.18	0.028	0.007
	(11.29)	(8.37)	(5.65)
10% Increase in Rice Price	0.26	0.041	0.011
	(14.16)	(10.38)	(6.72)
10% Decrease in Rice Price	0.23	0.037	0.009
	(12.86)	(9.61)	(6.46)

Values in parentheses are t-ratios.

wheat would reduce the head count index by 6 per cent, the proportionate index by 1.1 per cent and the FGT index by 0.4 per cent. A 10 per cent decrease in rice price would reduce the head count index by 1.0 per cent, the proportionate index by 0.22 per cent and the FGT index by less then 0.1 per cent. Since the elasticities for protein are very similar to those for calories, the results for protein are also very similar (not reported here).

VI. Conclusion

Average daily per capita calorie availability in Pakistan is estimated as 102 per cent of the requirements in 1993 [Economic Survey (1993)]. Our head count index shows that about 25 per cent of the rural households are undernourished. This is because a high proportion of our sample belongs to the poorest rural areas. Secondly, our data pertains to the year 1989, since then there have been improvements in data collection.Thirdly, the majority of the undernourished is at the border line, and therefore a simple head count index over-estimates the status of undernourishment. Intensity-sensitive measures in our analysis also indicate the depth of severe undernutrition to be very limited.

The income and price elasticities are low and are reasonably comparable with earlier studies in which nutrition demand functions have been estimated directly. A comparison of the sensitivity analysis results indicates that a small subsidy on wheat price to the poor may be relatively more effective in improving their nutrition status.

Applied Economics Research Centre
University of Karachi

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