©The Pakistan Development Review
54:1 (Spring 2015) pp. 17–33

From Chronic Disease to Food Poverty: Evidence from Pakistan

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While poverty and its causes have long been studied by economists, the link between chronic disease and food poverty has been a neglected area of research. This article investigates the impact of chronic disease on food poverty by using two rounds of panel data of Pakistan and linear probability regression framework. Chronic disease is defined to include diabetes, arthritis, heart disease, AIDS, cancer and asthma. The regression results show that on average the effect of chronic disease on food poverty is statistically equal to zero, but this effect significantly varies by income groups categorised by three non-income based classifications. We note that the incidence of chronic disease is significantly higher among non-poor when permanent income of the household is incorporated into the model, most notably among individuals coming from low- and middle-income backgrounds. Thus public health policies that seek awareness, prevention and treatment of chronic diseases have the potential to alleviate poverty in a high poverty environment.

1. INTRODUCTION

That chronic disease and poverty are interconnected in a vicious cycle has long been recognised in medical science literature [Brundtland (1999)], however, the causal pathway of disease and poverty has not been so simple and clear cut. Human capital literature suggests a positive relation between health and productivity where healthy workers can work, produce and earn more [Becker (2007); Adams, *et al.* (2003); Wagstaff (2007)]. On the contrary, a vast medical science literature concludes that the major direction of influence is from poverty to chronic disease [Phipps (2008)]; however, there are few exceptions [e.g., Schofield, *et al.* (2012)].

Becker (1964) points to the similarity between investment in health and investment in education both as forms of human capital while this idea was further developed by Grossman (1972) and Currie and Madrian (1999), among others. The point they make is that, just like education, health is valued by employers and employees alike because health and the ability and capacity to adequately perform a job are tied together. Apparently, ill health adversely affects the performance of workers and leads to lower levels of productivity, which in turn decreases their earnings potential and enthusiasm to remain in the labour force. By this logic, chronic disease drastically increases the chances of these households falling into abject poverty.

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Severe illness or death of primary income earner is found to be a key factor explaining poverty in low and middle income countries. A World Bank study concludes on the basis of 125 case studies that chronic disease and death are the most common causes of households' impoverishment [Narayan, *et al.* (2000)]. Chronic diseases may impose huge economic burden on vulnerable groups by ruining their economic prospects and pushing them into poverty because people with chronic diseases spend a high proportion of their incomes on health care.[1] People who suffer from chronic diseases often face a terrible choice: either to avoid medical treatment (e.g., for heart attack and stroke) and face early death, or seek health care by making out-of-pocket payments and plunge their family into poverty.

Unfortunately, this approach (poor health causes poverty) has long been discredited in the medical science literature where it is widely believed that the direction of causation is from poverty to chronic disease [Benzeval and Judge (2001); Phipps (2008)]. Similarly, poverty is also considered as the key determinant of child health [see, among others, Nikiema, *et al.* (2010)]; child poverty is also believed to render an adverse impact on adult health [e.g., Lynch and Davey (2005)]. The possibility of reverse causation, i.e., from poverty to chronic disease, makes this relationship complicated.

Emerging data from various sources suggests that the burden of chronic disease is increasing worldwide [Bartley, *et al.* (1999); Chaturvedi, *et al.* (1998); Stronks, *et al.* (1998); White (2000)].While the impact of health status on labour market participation and macroeconomic losses has been explored in many recent studies [e.g., Cai and Kalb (2006); WHO (2005); Bound, *et al.* (1999); Kahn (1998); Stern (1989)],[2] still the association between chronic disease and food poverty is unclear.

This paper investigates the connection between chronic disease and food poverty. We use individual level panel data of Pakistan where the nature of illness and its impact on poverty corresponds well with other developing countries [Narayan, *et al.* (2000)]. Like some other studies [e.g., Bastida and Pagan (2002); Brown, *et al.* (2005); Zhang, *et al*. (2009)], we define chronic disease as occurrence of cardiovascular disease, asthma, arthritis, AIDS, cancer and diabetes to at least one member of the household. The paper employs two rounds of individual-level household panel data from the Micro Impact of Macro Adjustment Policies (MIMAP) conducted by the Pakistan Institute of Development Economics (PIDE), Islamabad. We adopt an empirical framework for the panel data, which controls for systematic shocks to food poverty that are not due to chronic disease.[3]

Due to the suspicion raised by medical science literature that direction of causation is from poverty to chronic disease, we follow the advice of Davidson and MacKinnon (1993) and use Durbin-Wu-Hausman test to verify if instrumental variables (IVs) are necessary. However, we find convincing evidence to conclude that least square estimates

[1]Chronic diseases may lead to reduced worker productivity, unemployment, premature retirement, disability and death.

[2]The role of specific diseases in impairing labour productivity and efficiency has mostly been studied in the perspective of developed countries. For studies on diabetes, [see Brown, *et al.* (2005); Bastida and Pagan (2002) for asthma, see Smyth, *et al.* (1999); for cardiovascular disease, see Zhang, *et al.* (2009); for arthritis, see Gorin, *et al.* (1999), Lerner, *et al.* (2004); and for mental illnesses, see Adler, *et al.* (2006), Butterworth, *et al.* (2006) and Zhang, *et al.* (2009)].

[3] For empirical evidence on consumer preferences for food items in Pakistan, see Burki (1997).

are consistent on our data. Our results also suggest that chronic disease is higher among non-poor and that chronic disease in the household renders most harmful effects on low- and middle-income individuals by increasing their food poverty.

The paper has the following layout. Before turning to the detailed analysis, we explain the methodology in Section 2. Section 3 describes data source, definition of variables and summary statistics. Section 4 discusses the empirical results and examines the underlying reasons for incidence of food poverty. Section 5 presents conclusions and policy implications.

2. METHODOLOGY

To investigate the impact of chronic disease on food poverty we use the regression of poverty incidence on relevant explanatory variables. By defining x_{it} as a vector of observable variables representing individual and household factors affecting food poverty, the empirical relationship can be expressed as

$$y_{it} = \beta x_{it} + \varepsilon_{it} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (1)$$

where y_{it} is an index for individual i, in survey year t and where y_{it} equals 1 if the individual is below the official food poverty line; β are parameters to be estimated and ε_{it} is the usual error term. Since poverty is measured at the individual level, we also take individual rather than household poverty levels.

Estimation of this model with panel data points to some unobserved differences that are likely to be present in the cross-sectional units that need to be accounted for. A general approach to control for unobserved differences in panel setting is to introduce a common intercept across cross sectional units. This can be accommodated by amending the functional relationship in Equation (1) as follows:

$$y_{it} = \alpha + \beta x_{it} + w_{it} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (2)$$

where the composite error term w_{it} is defined as $w_{it} = e_i + \varepsilon_{it}$ where e_i is the random error characterising the ith unit and is constant over time and ε_{it} is the usual error term. In this setting, the estimation of the model would depend upon whether e_i is best modeled by a random or a fixed effects estimator.[4] In the random effects model, it is assumed that the observations are randomly sampled from a much larger universe of such individuals or households, which implies that statistical inferences can be generalised for the entire population. Since our sample is drawn from a much larger population, the random effects model is more appropriate for our purposes.

Our dependent variable, y_{it}, is a latent variable that equals 1 if the individual is below food poverty line and equals zero otherwise. In this paper, our preferred regression framework is the linear probability model[5] (LPM), which not only provides remarkably

[4]The random effects estimator provides unbiased and efficient estimates when $E(e_i \mid x)$ is zero. If true, it indicates that the unobserved effects are uncorrelated with each explanatory variable and the random effects model is more appropriate. However, if the true effects are fixed then a standard least squares dummy variables model or the fixed effects model is more appropriate because the random effects estimator would produce biased parameter estimates.

[5]A probitor a logit are alternative models, but our results are not sensitive to the choice of assumption about the distribution of the error term.

similar estimates to the probit or the logit specification, it is also convenient to interpret because estimated coefficients directly indicate marginal probabilities.

Because the variance covariance matrix of the disturbance term, w_{it}, in the random effects model is not known, we use the feasible generalised least squares (FGLS) estimator, which is the most appropriate method. The estimated linear probability regressions are written as

$$y_{it} = \alpha + \gamma CD_{it} + \beta x_{it} + \tau_t + \delta_j + \eta_k + w_{it} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (3)$$

where in addition to the variables defined above, we have *CD* as the variable of interest, which measures chronic disease if at least one member is suffering from chronic disease in household *i* in time period *t*. Because *CD* varies at the household level-year dimension, the estimated standard errors account for clustering at the household/survey year level, in addition to accounting for general form of heteroskedasticity. τ_t controls for differences across time periods in the probability that a household suffers from *CD* and equals 1 if the survey year is 2000-01 and zero if the survey year is 1998-99. Districts vary in many characteristics that are time-invariant (such as pollution levels (determined by proximity to cities, industrial clusters, forest cover, rainfall, etc.) and integration to the economy, which might independently affect the incidence of chronic disease and food poverty and hence might bias our estimated coefficient on *CD*. To the extent that these district characteristics are time-invariant, we include δ_j in Equation (3) to capture them by district-fixed effects. Finally, η_k is for province effects that capture variation in general economic conditions that independently affect food poverty across provinces.

Due to strong belief on reverse causation in the medical science literature, we suspect but are not sure whether endogeneity arises from poverty to chronic disease. In such cases, Instrumental Variables (IV) may or may not be the appropriate model to cure the endogeneity problem. For example, Davidson and MacKinnon (1993) note that even if chronic disease and poverty are endogenous variables, their correlation with error term should be great enough to suggest that using the least squares method may lead to serious bias. And because least squares offer more efficient estimates than IV, we apply Durbin-Wu-Hausman test to decide whether IV estimates are necessary for our data set.[6]

We also test whether chronic disease renders different effects on poverty due to income levels. We do not include household income, which may be endogenous to food poverty. In its place, we use three categories of household socioeconomic variables as proxies for permanent income of the individuals. These proxy variables are mean household education; number of rooms in the house; and presence of sanitation facility in the house. We incorporate permanent income into the model by interacting socioeconomic categories, denoted by λ_{it}, with chronic disease to find differences in respective slopes. The modified regression models take the following form

[6]To illustrate, the Wu-Durbin-Hausman test measures a systematic difference between the least square and instrumental variable estimates. The null hypothesis H_0 : plim $(1/n\ X^T \varepsilon) = 0$ is a test of exogeneity of explanatory variables. If the null hypothesis holds, it suggests that the least squares are preferred estimates since the asymptotic covariance of least square estimator is never larger than that of the IV estimator. Thus there is no further need to report IV estimates.

$$y_{it} = \alpha + \gamma(CD_{it} \times \lambda_{it}) + \beta x_{it} + \tau_t + \delta_j + \eta_k + w_{it} \quad \ldots \quad \ldots \quad \ldots \quad (4)$$

Where λ_{it} represents a vector of dummy variables that capture socioeconomic characteristics of individuals. In this specification, the effect of chronic disease on poverty in low-, medium-, and high-income individuals is measured by the γ-coefficients.

3. THE DATA

We use two rounds of panel data from the Pakistan Socio-economic Survey (PSES) collected by the Pakistan Institute of Development Economics (PIDE), Islamabad under the project on Micro Impact of Macroeconomic Adjustment Policies (MIMAP). Round I of the survey was carried out in 1998-99 and Round II was conducted in 2000-01. The sample was drawn from rural and urban areas of the four provinces of Pakistan. The survey adopted a two-stage stratified random sampling design where the enumeration blocks in urban and rural domains were taken as primary sampling units (PSUs). Within a PSU, a sample of 8 households was drawn for data collection from urban domain and 12 households from rural domain. Survey in Round I consisted of 3564 households (2268 households from rural and 1296 households from urban domains). About 80 percent of the sampled households in Round I (or 2850 households) were re-interviewed in Round II of the survey. In Round II, more than 1000 new households were also included for data collection under the sampling frame suggested by the Federal Bureau of Statistics, Government of Pakistan. Total sample of Round II was 4021 households (2577 from rural and 1444 from urban domains).

Our working sample consists of 55,222 individuals from some 7558 households (3546 from Round I and 4012 from Round II), after deleting 27 households (18 from Round I and 9 from Round II) with missing values on food expenditure. Two separate questionnaires, one each for males and females, were administered to each household for data collection. Health section was included only in the female questionnaire to elicit detailed information on illness status and related behaviour of each member of the household including children and adults. This is because females usually attend to the sick members of the household and hence are in a much better position to provide this information.

We define "food poverty" by "the food energy intake method" rather than "the cost of basic needs method".[7] We do not take basic needs poverty because expenditure on basic needs also include expenditure on health that is endogenous to poverty. We calculate food poverty by taking the official food poverty line for 2350 calories per adult equivalent of Rs 361.66 per month in 1998-99 prices and Rs 393.66 in 2000-01 prices [Pakistan (2006)]. In poverty calculations, we account for price differentials across rural and urban areas. In our sample, food poverty was 28 percent in 1998-99, which increased to 40 percent in 2000-01. These estimates favourably compare with the estimates of food poverty obtained by Qureshi and Arif (2001) from the same data set.

[7]Food energy intake method refers to amount of energy obtained from food, expressed in calories. The basic needs method defines absolute minimum resources needed for physical wellbeing, e.g., food, shelter, clothing, education and healthcare, etc.

Like other studies in the literature [e.g., Bastida and Pagan (2002); Brown, *et al.* (2005); Zhang, *et al.* (2009)], we define "chronic disease" to include diabetes, arthritis, heart disease, AIDS, cancer and asthma. Education is a key determinant of food poverty because households with more education are likely to be more productive and have greater income earning opportunities.[8] We construct "mean household education" variable as average years of schooling of all household members ranging from no education to 16 years of education. To reflect the quality of life of a household, we use "rooms in the house" variable. We assume that households occupying fewer rooms are more likely to be poor. Poor households are less likely to have access to sanitation facilities. Our indicator of sanitation facility is the presence of latrine with flush facility connected to underground sewerage line or to a septic tank. Therefore, we construct the variable namely, "household lacks sanitation facility", as a dummy variable.

Access to gas, telephone and electricity is considered a major determinant of economic status. To examine this effect, we construct three dummy variables on availability of electricity, gas, and telephone connection in the house namely, "household has electricity connection", household has telephone connection" and household has gas connection". Household size may also matter in determining poverty. Therefore, we construct "household size" variable to examine this impact; we expect larger households to be poorer than smaller households. Availability of drinking water inside the house makes life comfortable and is a feature of better quality of life. We construct 12 dummy variables to control for the effect of source of drinking water on poverty. Other household and individual control variables are "head worked at least 1 hour last month" and age of the individual, which is a continuous variable. Year of the survey is a dummy to control for the time period.

Five asset variables included are "real value of animal assets", "real value of durable assets", "land operated", "real value of real estate" and "real value of farm machinery". District dummy variables for rural and urban districts are included to control for time-invariant district specific characteristics that may affect poverty. All nominal variables are normalised by consumer price index (CPI) using 2000-01 as base year. Definition of variables is found in Table 1 while Table 2 reveals descriptive statistics.

4. ESTIMATION RESULTS

In Table 3 we present estimation results for the LPM regression in Equation (3) by using panel data.[9] Because our interest is to separate the effect of chronic disease on food poverty from factors that might independently affect the incidence of food poverty, the regression equations include household/individual attributes, regional and inter-temporal variables to control for time-invariant and time-variant factors on food poverty. We do not include household income as an explanatory variable because this variable is endogenous to food poverty. However, we proxy for household income by including a number of variables directly related to the socioeconomic position of the household, viz., mean household education, number of rooms in the house and availability of sanitation facility in the house.

[8]For rates of return to education in the formal sector of Pakistan, see Guisinger, *et al.* (1984); for returns in the informal sector, see Burki and Abbas (1991).

[9]The fitted values from the LMP regression suggest that only 4 percent of the values were outside the 0-1 range. Hence the estimated coefficients of the LMP model were almost same as the predicted probabilities obtained from a probit regression.

Table 1

Definition of Variables

Names of Variables	Definition
Dependent Variable	
Poverty	=1 if the individual falls below the food poverty line
Household/Individual Attributes Affecting Food Poverty	
Mean household education (years)	Mean years of education of the household
No mean household education	=1 if the individual belongs to a household with no mean household education
Below 5 years of mean household education	=1 if the individual belongs to a household with 1 to 4 years of mean education
5 to 6 years of mean household education	=1 if the individual belongs to a household with 5 to 6 years of mean education
More than 6 years of mean household education	=1 if the individual belongs to a household with more than 6 years of mean education
Rooms in the house	Number of rooms in the house
1-2 rooms household	=1 if the individual belongs to a household with 1 to 2 rooms
3-5 rooms household	=1 if the individual belongs to a household with 3 to 5 rooms
More than 5 rooms household	=1 if the individual belongs to a household with more than 5 rooms
Household lacks sanitation facility	=1 if the individual belongs to a household where no sanitation facility exists
Real value of animal assets	Real value of animal assets owned by a household in million rupees
Real value of durable assets	Real value of durable assets owned by a household in million rupees
Log of land operated	Natural logarithm of land operated by a household in acres
Real value of real estate	Real value of assets of the household in million rupees
Real value of farm machinery	Real value of farm machinery owned by a household in million of rupees
Tap water inside house	=1 if the individual belongs to a household which has tap water inside the house as a source of drinking water
Open well inside house	=1 if the individual belongs to a household which has open well inside house as a source of drinking water
Hand pump inside house	=1 if the individual belongs to a household which has hand pump inside house as a source of drinking water
Motor pump inside house	=1 if the individual belongs to a household which has motor pump inside house as a source of drinking water
Other sources of drinking water inside house	=1 if the individual belongs to a household which has sources other than mentioned above as a source of drinking water
Open well outside house	=1 if the individual belongs to a household which has open well outside house as a drinking water source

Continued—

Table 1—(*Continued*)

Hand pump outside house	=1 if the individual belongs to a household which has hand pump outside house as a drinking water source
Canal outside house	=1 if the individual belongs to a household which has canal outside house as a drinking water source
Other sources of drinking water outside house	=1 if the individual belongs to a household which has sources other than mentioned above of water outside house as a drinking water source
Household has electricity connection	=1 if the individual belongs to a household with electricity connection
Household has telephone connection	=1 if the individual belongs to a household with telephone connection
Household has gas connection	=1 if the individual belongs to a household with gas connection
Head worked at least 1 hour last month	=1 if household worked for at least 1 hour for pay or profit during the last month
Household size	Number of family members in a household
Individual is a male	=1 if the individual is a male
Chronic Disease Variables of Interest	
Chronic disease	=1 if at least one individual in the household is suffering from chronic disease
Low income by mean education × chronic disease	=1 if mean household education is 0 years and HH is suffering from chronic disease
Lower middle-income by mean education × chronic disease	=1 if mean household education is 1-4 years and HH is suffering from chronic disease
Upper middle-income by mean education × chronic disease	=1 if mean household education is 5-6 years and HH is suffering from chronic disease
High income by mean education × chronic disease	=1 if mean household education is more than 6 years and HH is suffering from chronic disease
Low income by rooms × chronic disease	=1 if the individual belongs to a household with 1 to 2 rooms and HH suffers from chronic disease
Middle income by rooms × chronic disease	=1 if the individual belongs to a household with 3 to 5 rooms and HH suffers from chronic disease
High income by rooms × chronic disease	=1 if the individual belongs to a household with more than 5 rooms and HH suffers from chronic disease
Low income by sanitation facility × chronic disease	=1 if the individual belongs to a household with no sanitation facility and household is suffering from chronic disease
Period Fixed-effects	
Survey year is 1998-99	=1 if the survey year is 1998-99
Survey year is 2000-01	=1 if the survey year is 2000-01
District and Province Fixed-effects	
130 district dummy variables	=1 if the individual belongs to one of the 130 urban, rural and metropolitan urban areas
Punjab	=1 if individual belongs to Punjab province
Sindh	=1 if individual belongs to Sindh province
KP	=1 if individual belongs to Khyber Pakhtunkhwa province
Balochistan	=1 if individual belongs to Balochistan province

Table 2

Descriptive Statistics

Names of Variables	Mean	SD	Min	Max
Household/Individual Attributes Affecting Poverty				
Mean household education	2.440	2.44	0	16.00
No mean household education	0.329	0.47	0	1.00
Below 5 years of mean household education	0.466	0.50	0	1.00
5 to 6 years of mean household education	0.116	0.32	0	1.00
More than 6 years of mean household education	0.089	0.28	0	1.00
Rooms in the house	2.700	1.56	0	15.00
1-2 rooms household	0.549	0.50	0	1.00
3-5 rooms household	0.446	0.50	0	1.00
More than 5 rooms household	0.004	0.07	0	1.00
Household lacks sanitation facility	0.414	0.49	0	1.00
Real value of animal assets	0.011	0.05	0	5.14
Real value of durable assets	0.099	0.22	0	7.04
Land operated	0.062	2.96	0	256
Real value of real estate	0.240	0.97	0	50.80
Real value of farm machinery	0.012	0.07	0	2.17
Tap water inside house	0.251	0.43	0	1.00
Open well inside house	0.041	0.20	0	1.00
Hand pump inside house	0.365	0.48	0	1.00
Motor pump inside house	0.137	0.34	0	1.00
Other sources of drinking water inside house	0.205	0.40	0	1.00
Open well outside house	0.032	0.17	0	1.00
Hand pump outside house	0.039	0.19	0	1.00
Canal outside house	0.029	0.17	0	1.00
Other sources of drinking water outside house	0.890	0.36	0	1.00
Household has electricity connection	0.795	0.40	0	1.00
Household has telephone connection	0.127	0.33	0	1.00
Household has gas connection	0.224	0.42	0	1.00
Head worked at least 1 hour last month	0.274	0.45	0	1.00
Household size	9.038	4.28	1	35.00
Individual is a male	0.513	0.49	0	1.00
Chronic Disease Variables				
Chronic disease (yes=1, no=0)	0.122	0.33	0	1.00
Low income by mean education × chronic disease	0.031	0.17	0	1.00
Lower middle-income by mean education × chronic disease	0.061	0.24	0	1.00
Upper middle-income by mean education × chronic disease	0.014	0.12	0	1.00
High income by mean education × chronic disease	0.015	0.12	0	1.00
Low income by rooms × chronic disease	0.063	0.24	0	1.00
Middle-income by rooms × chronic disease	0.057	0.23	0	1.00
High income by rooms × chronic disease	0.001	0.03	0	1.00
Low income by sanitation facility × chronic disease	0.041	0.20	0	1.00
Period Fixed-effects				
Survey year is 1998-99	0.0.521	0.46	0	1.00
Survey year is 2000-01	0.573	0.49	0	1.00
District and Province Fixed-effects				
130 district dummy variables	–	–	–	–
Punjab	0.532	0.50	0	1.00
Sindh	0.227	0.42	0	1.00
KP	0.149	0.36	0	1.00
Balochistan	0.092	0.29	0	1.00
Number of Observations	55222	–	–	–

To test whether all the explanatory variables included in regressions are exogenous of households' poverty status, we apply Durbin-Wu-Hausman test on the basic model in column (1) and find that all $\hat{\beta}$ estimates are consistent, which indicates absence of endogeneity of the explanatory variables and thus IV estimates are not necessary on our data.[10] The consistency of the estimated coefficients confirms that there is no reverse causation going from poverty to chronic disease.

The asset variables are not endogenous, which effectively rule out the possibility of "landlessness" and "lack of assets" variables being the consequences rather than the causes of poverty. To this effect, the estimation results presented in Table 3, column (1) and (2), are obtained by including and excluding land operated variable while estimation results in column (3) are obtained by deleting from the regression 9 sources of drinking water dummy variables. The results reveal that the parameter estimates presented in columns (1) – (3) are highly robust to alternative empirical specifications.

In general, the parameter estimates in Table 3 reveal that increase in mean household education significantly decreases food poverty; this result corroborates the findings of some other studies in the literature [e.g., Jalan and Ravallion (1998, 2000) for rural China, Mehta and Shah (2001) for India, and World Bank (2002) and Burki (2011) for Pakistan]. Likewise, number of rooms in house is also negatively correlated with food poverty; the probability of food poverty significantly decreases by 5.1 percent for one additional room in the house. Lack of access to sanitation facilities is another socioeconomic indicator. We find that individuals lacking access to sanitation facilities are more likely to be poor than otherwise. Increased household size places additional burden on household assets due to which food poverty increases in larger households.[11] Ownership of animal assets, land assets, real estate, farm machinery and other durable assets is negatively and significantly correlated with poverty.[12] However, the negative effect on food poverty of animal assets and durable assets dominates as compared with other asset categories. Telephone, electricity and gas connections are all significant, but individuals with telephone connection are relatively much less likely to be poor. To the extent that land-line telephone connection is a luxury in poor households while electricity and gas are necessities, this is an expected result. Likewise, employment of household head is negatively correlated with poverty as expected. Males are somewhat more likely to be poor and poverty is 16.4 percent higher in Round 2 as compared with Round 1.

Our key variable of interest is chronic disease, which indicates that on average chronic disease is more common in non-poor households but this effect is statistically insignificant. This is not a surprising result because it shows average effect of chronic disease on individuals of all incomes. To separate this effect by income groups, we use modified specifications in Table 4 where we interact chronic disease by classifying individuals into socioeconomic groups to test whether this effect varies by income groups.

[10]Our empirical results do suggest that there is no systematic difference between the least squares and IV estimates and hence we have not reported the IV estimates and have only reported the least square estimates. See also footnote 5.

[11]Others who report similar results are McCulloch and Baulch (2000) for Pakistan, Jalan and Ravallion (1998, 2000) for rural China, and Aliber (2001) for South Africa.

[12]See, for example, Adam and He (1995), McCulloch and Baulch (2000), Gaiha and Deolaiker (1993), Jalan and Ravallion (2000), Mehta and Shah (2001).

Table 3

GLS Regressions on Food Poverty with the Random Effects

Variable Name	(1)	(2)	(3)
Chronic disease (yes=1, no=0)	0.001	0.001	0.0001
	(0.18)	(0.19)	(0.03)
Mean household education (years)	–0.016***	–0.016***	–0.018***
	(–15.96)	(–15.97)	(–17.21)
Rooms in house (numbers)	–0.051***	–0.051***	–0.054***
	(–33.53)	(–33.55)	(–35.24)
Household lacks sanitation facility (yes=1,	0.061***	0.061***	0.066***
no=0)	(12.54)	(12.52)	(13.76)
Real value of animal assets (Rs million)	–0.400***	–0.400***	–0.411***
	(–10.36)	(–10.38)	(–10.36)
Real value of durable assets (Rs million)	–0.146***	–0.146***	–0.148***
	(–14.49)	(–14.50)	(–14.70)
Log of land operated	–0.001**	–	–0.001**
	(–1.93)		(–2.07)
Real value of real estate (Rs million)	–0.003	–0.003	–0.003*
	(–1.26)	(–1.26)	(–1.61)
Real value of farm machinery (Rs million)	–0.221***	–0.222***	–0.234***
	(–8.83)	(–8.84)	(–9.31)
Household has electricity connection (yes=1,	–0.042***	–0.043***	–0.044***
no=0)	(–7.55)	(–7.59)	(–7.94)
Household has telephone connection (yes=1,	–0.089***	–0.089***	–0.094***
no=0)	(–13.00)	(–12.99)	(–13.66)
Household has gas connection (yes=1, no=0)	–0.040***	–0.040***	–0.049***
	(–5.37)	(–5.36)	(–6.52)
Head worked for at least 1 hour last month	–0.016***	–0.016***	–0.015***
(yes=1, no=0)	(–3.96)	(–3.95)	(–3.74)
Household size (numbers)	0.031***	0.031***	0.031***
	(59.73)	(59.74)	(58.98)
Individual is a male (yes=1, no=0)	0.151***	0.151***	0.157***
	(11.99)	(11.97)	(12.41)
Survey year is 2000–01 (yes=1, no=0)	0.164***	0.165***	0.146***
	(38.04)	(38.08)	(35.08)
9 source of drinking water dummy	Yes	Yes	No
District fixed-effects included	Yes	Yes	Yes
Province fixed-effects included	Yes	Yes	Yes
No. of Observations	55222	55222	55222
R^2	0.2075	0.2075	0.2012

Notes: All regression models are estimated using LPM model, which include intercept terms, but they are not reported. Dependent variable is food poverty. Numbers in parenthesis are *t*-statistics based on robust standard errors corrected for household-year clustering. *** and ** denote statistical significance at the 1 percent and 5 percent level, respectively.

In Table 4, we segment individuals into low-, middle- and high-income by using three non-income classification schemes namely, (1) mean household education, (2) number of rooms in the house, and (3) absence/presence of sanitation facility in the house. These non-income classifications serve as proxy for permanent income where, as illustrated below, the differences in slopes are captured by interaction terms with chronic disease.

Table 4

GLS Regressions on Food Poverty by Income Groups with the Random Effects

Variable Name	With mean HH Education as Proxy for Income (1)	With Number of Rooms in the House as Proxy for Income (2)	With Sanitation Facility in the House as Proxy for Income (3)
Chronic disease in HH (yes=1, no=0)	–0.043***	–0.328***	–0.024***
	(–2.76)	(–5.95)	(–3.44)
Low income by mean education × chronic disease	0.081***	–	–
	(4.32)		
Lower middle-income by mean education × chronic disease	0.042***	–	–
	(2.45)		
Upper middle-income by mean education × chronic disease	–0.017	–	–
	(–0.78)		
Low income by rooms × chronic disease	–	0.373***	–
		(6.72)	
Middle income by rooms × chronic disease	–	0.279***	–
		(5.02)	
Low income by sanitation facility × chronic disease	–	–	0.066***
			(5.82)
Mean household education (years)	–	–0.023***	–0.019***
		(–22.12)	(–18.54)
Rooms in house (numbers)	–0.057***	–	–0.054***
	(–38.01)		(–35.60)
Household lacks sanitation facility (yes=1, no=0)	0.074***	0.072***	–
	(15.49)	(14.75)	
Survey year is 2000-01 (yes=1, no=0)	0.129***	0.166***	0.142***
	(31.98)	(39.98)	(34.29)
9 sources of drinking water dummy included	Yes	Yes	Yes
5 household asset variables included	Yes	Yes	Yes
3 electricity, telephone and gas connection variables included	Yes	Yes	Yes
3 dummy variables for head employment, household size and gender of the individual included	Yes	Yes	Yes
Province dummy variables included	Yes	Yes	Yes
District fixed-effects included	Yes	Yes	Yes
No of Observations	55222	55222	55222
R^2	0.1974	0.1848	0.1989

Notes: All regression models are estimated using LPM model, which include intercept terms, but they are not reported. Dependent variable is food poverty. Numbers in parenthesis are *t*-statistics based on robust standard errors corrected for household-year clustering. *** and ** denote statistical significance at the 1 percent and 5 percent level, respectively.

First, we use household education as a proxy for permanent income and estimate Equation (4) to test whether the impact of chronic disease on food poverty varies by income groups. Lower income individuals are defined as those where mean household education is zero; lower-middle income individuals are those where mean household education is up to 4 years; upper-middle income refers to those where mean household education is 5 to 6 years; and high-income refers to individuals where mean household education is more than 6 years. We use these categories to interact them with chronic disease variable to incorporate permanent income into the model, which allows us to capture differences in their slopes.

Column 1 of Table 4 presents the results of the modified specification, which reveals that the incidence of chronic disease is significantly higher for the non-poor. Relative to high income individuals, chronic disease increases the probability of food poverty to 8 percent for individuals coming from low-income households and 4 percent for lower-middle income individuals. As expected, the probability of poverty of upper-middle income individuals is not affected by the chronic disease. These results suggest that chronic disease renders most harmful effects on the poor who suffer from lost labour time and increased health expenditures leading to decline in food expenditure and rise in food poverty. These results can be verified by considering other proxies for income groups.

Secondly, number of rooms in the house is used as a good proxy for permanent income. We assume that most low-income households live in one or two-room houses while middle- and high-income households live in houses with more than two rooms. Therefore, low-income individuals are defined as those who have up to two rooms in the house; middle-income refers to individual who has three to five rooms in the house; and high-income individuals refer to those who have more than five rooms in the house. As before, we incorporate permanent income of the household into the model by interaction terms of these dummy variables with chronic disease. Regression results are presented in column 2 of Table 4. We see that the incidence of chronic disease is disproportionately higher among the non-poor. We also observe strong positive coefficients of the interaction terms of low-income and middle-income individuals with chronic disease. Compared with high-income individuals, chronic disease increases the probability of poverty of low-income and middle-income individuals by 37 percent and 28 percent, respectively. Thus government policies that seek prevention and cure of chronic diseases through increased investments have a stronger power to reduce poverty.

Finally, lack of sanitation facility is taken as a proxy for households' permanent income. Here our assumption is that lack of sanitation facility is negatively correlated with household's income. Therefore, we use presence or absence of sanitation facility to distinguish low-income from high-income individuals and interact it with chronic disease variable. The estimation results are displayed in column 3 of Table 4. The estimated coefficient of the interaction term reveals that chronic disease in the household increases the probability of poverty of low-income individuals by 6.6 percent. This result further confirms the view that individuals from low income households are especially vulnerable to these health shocks. The effect of chronic disease on food poverty of low and middle income individuals may be explained by the possibility of income earning opportunities for households to fall and treatment costs to rise with occurrence of chronic disease.

5. CONCLUSIONS AND POLICY IMPLICATIONS

The association between chronic disease and food poverty has long been a neglected area of research. This paper investigates the impact of chronic disease on food poverty by using two rounds of the individual level panel data of Pakistan. The nature of data used in this study indicates superiority of the random effects estimation procedure over other alternatives. Chronic disease is defined to include diabetes, arthritis, heart disease, AIDS, cancer and asthma. Despite ambiguity in medical science literature on reverse causation going from poverty to chronic disease, Dubrin-Wu-Hausman test confirms that all explanatory variables included in the regression are exogenous. Our estimation results confirm findings that already exist in the empirical literature on the determinants of poverty in Pakistan [World Bank (2002)]. For example, food poverty is negatively correlated with household education; number of rooms in the house; access to sanitation facilities; employment of household head; ownership of land, animal, real estate and durable assets; and negatively to household size.

Classifying individuals into socioeconomic groups on the basis of non-income classification schemes, e.g., mean household education, number of rooms in the house, and absence of sanitation facility in the house, we find that chronic disease is statistically higher among non-poor, but it renders most harmful effects on low-income and middle-income individuals by significantly increasing their probability of food poverty. These results suggest that public health policies designed to promote prevention and awareness as well as treatment/cure of these diseases have the potential to alleviate poverty in an otherwise high poverty environment in the country. Therefore, an increase in government expenditure on health needs to be considered especially by the provincial governments since the health sector has largely been devolved to the provinces after the passage of the 18th Constitutional Amendment. Finally, the results suggest that non-poor individuals in Pakistan are more likely to suffer from chronic disease, an effect that warrants improved awareness to affluent groups in the country.

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