Determinants of Ill Health in Uganda - Is it Just the Wealthy Who Are More Healthy?

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1. Introduction

The health status of individuals is of great importance not only because of the direct utility health can provide but because of productivity losses and large indirect costs, caused by ill-health, which places demands on already stretched health systems and family support networks (Strauss et al. 1998). This is particularly the case in Sub Saharan Africa, and especially in Uganda, where high prevalence levels of HIV/AIDS over the last two decades has had a debilitating effect on many families and their ability to escape poverty. Despite this however, and although the importance of income on health status is quite well established in economic literature, evidence from SSA countries is relatively sparse. Furthermore, little effort has been directed at understanding the importance of income, relative to other determinants and, perhaps of greater importance, little if any economic literature has examined how health determinants vary when different health measures are used.

Of the general literature looking at the link between health and welfare, there is quite strong empirical evidence, such as Strauss (1990) and Thomas et al. (1990), which has found a positive relationship between income and health status, and thus providing support for Pritchett and Summers (1996) findings that the wealthy are indeed more healthy. Mackinnon (1995) and Hutchinson (2001) for Ugandan, using early household data and looking at child sickness have also found health status to respond positively to welfare. All findings of which are in line with the general interpretation that increased income should allow individuals to generally lead healthier lifestyles, whether this be through eating properly or other reasons.

However, for a more complete understand the socio economic characteristics associated with ill health we must also consider the importance of non income factors and, establish how consistent the results across different health measures. For example, although previous literature has found the impact of education on morbidity to have produced mixed results, the impact of parental education on the anthropometric health status of children has been found to be almost universally positive (Behrman and Wolfe 1987 for Nicaragua, Merrick 1985 for Brazil, Boulier and Paqueo 1988 for Sri Lanka). However, little, if any, developing country research has compared both morbidity and anthropometric determinants, although one study of note is that by Wolfe and Behrman (1987), for Nicaragua. Although different health measures were not directly compared they found the impact of women's schooling on nutrition to be quite robust, but with mortality this declines substantially or even evaporates.[i] The current study further explores the apparent differences across health measures. These findings have important policy implications.

The study focuses on Uganda, a country that was at the centre of Africa's AIDS pandemic. The lack of previous research is therefore not only surprising given the huge impact of HIV/AIDS, but also because the Ugandan government's emphasis, over the last decade, on poverty reduction through economic reforms has been primarily aimed at creating an enabling environment for economic agents to exploit by using their endowment of capabilities. Despite success in reducing poverty levels, from 56% of the population in 1992 to 38% in 2002, ill health appears to play a major role in keeping people poor (UPPAP 2002).

This paper begins to fill the void in understanding the main socio-economic causes of sickness for all Ugandans and, in particular, the influence wealth has on health status. It provides the most comprehensive and up to date empirical work on this research area and by comparing the socio-economic determinants of children using anthropometric and self reported data, we are also able to draw some conclusions regarding the robustness of the results when different health measures. The following section provides a broad background on health in Uganda, before outlining the underlying methodology for analysing the determinants of health, the data and variables required and previous literature. Building on this, section four highlights some trends for both self reported and anthropometric descriptive data. Section five, covers the econometric analysis of the determinants of health before concluding in section six.

2. Health in Uganda

Uganda's health sector was perhaps one of the sectors to suffer most from the turmoil of the 1970s and early 1980s, when civil wars and the 'Amin era' dominated Uganda's world profile. Despite impressive levels of poverty reduction over the last decade, the health status of adults appears to have dramatically reduced. Government statistics (Table 1) show that the proportion of people reporting illness, at any point in the previous 30 days, increased from 17% in 1992 to 28% in 1999. Figures which largely reflect the higher numbers of people now in the advanced stages of AIDS, and the fall in the effectiveness of chloroquine in the treatment of malaria.[ii]

Table 1: Population Reported Ill During The Last 30 Days

	1992/3			1997			1999/00		
	Male	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**
Uganda	16%	17%	17%	31%	35%	33%	26%	30%	28%
Urban	16%	18%	17%	32%	36%	34%	26%	30%	28%
Rural	18%	17%	17%	27%	29%	28%	24%	29%	27%

Source : p 35, Republic of Uganda (2001).

Disaggregating sickness by age also shows that as at 1999, pre school children have even higher levels of sickness, than adults. Approximately 42% (20%) of Ugandan pre school aged children (school children) reported sickness within the last month, with very little variation by rural/urban or gender categorisations. (Table A1).

Anthropometric data also indicate stunting in Uganda to be very common, with over a third of children below the internationally accepted -2 Z-score. Ugandan children exhibit a relatively 'normal' distribution of weight for age z-scores, with wasting, on average, affecting approximately 5% of children under the age of five years and 91% are close to the reference population Table A4 and A5). Such levels are relatively close to the international average for wasting in developing/transitional country levels.[iii]

As might be expected, given such high rates of morbidity, current health sector reforms are largely based on encompassing a sector wide approach (Health Sector Strategic Plan) in the attainment of a reduction of morbidity and mortality caused by the major illnesses.[iv] As the health sector is now projected to have the fastest growing share of government expenditure over the next few years, this only further accentuates the need to establish which factors are the key determinants in affecting health status.

3. Methodology and Data

a. Methodology

Our modelling of the determinants of health is based on a standard Becker (1964) type economic model of the household in which a utility function is maximised subject to a health production function, earnings function and income constraint, and leads to a set of demand equations for all household choices as functions of all the exogenous variables. A reduced form demand function for health, for each individual in the household can be represented as follows:

$$(1) \qquad H^i = H(P, T, u, I, d^i, \alpha^i \lambda^i)$$

An individual's health status is therefore a function of individual specific observable personal characteristics, such as gender and age (d). time devoted to health related activities (T), regional health specific variable (μ), individuals health endowment (λ) price of health or consumption related goods (P), and household public health goods, such as water source (I). Adopting a reduced form approach allows for the capturing of both direct and indirect effects of policies, such as health or education, on health related behaviour. The defined prices used are the effective prices paid by the consumer, thus they include travel expenses, etc., and can be included directly as an observed exogenous variable.

In estimating health reduced form, it is normal to adopt either a self reported or anthropometric based health measure as the dependant variable. In this instance, both will be used. Firstly, for self reported health analysis, a binary probit will be used, for analysing a dichotomous variable which represents if an individual has either been ill or not, over the last 30 days. Secondly, anthropometric estimations will be undertaken for both the Weight for Height and Height for Age measure.

In line with Behrman and Deolalikar's (1988) discussion concerning the endogeneity between welfare and health, two stage least squares will be used for the quasi reduced form estimations with the first stage estimating a predicted value for welfare.[v] The predicted welfare regression will have a community fixed effects element, avoiding problems of missing community variables and allowing for predicted welfare values to be obtained for the entire sample. Following this, each of the probit regressions will involve two lots of regressions. The first variant will regress sickness on the full samples of individuals, and therefore exclude the variables with missing observations (i.e. the community variables). A second variant, which includes the community observations, will use a reduced sample. The two lots of results will then be compared to see if the reduced sample significantly affects the influence of the individual and household variables.

b. Data and Variables

Uganda has a relatively rich source of data upon which microeconometric analysis can be based, with there having been two Demographic Health Surveys (DHS) and a series of household surveys since 1989. The most useful of these is the 1999 Ugandan National Household Survey (UNHS), which is particularly rich in community and health data and interviewed 10,696 households. It is this data that will be used for our analysis.

Of the previous empirical work looking at health determinants, the usage of self reported health measures as dependant variables has often been found to be a favourable method of analysing sickness. For instance, Idler and Kasl (1991), Idler and Benyamini (1997), Ferraro and Farmer (1999), all found the self reported health status to be a reliable indicator of future mortality.[vi] However there are some problems associated with their usage. For example, self reported health measures in economic datasets are not usually clinically diagnosed and consequently the measure might be correlated with socio-economic status i.e. increased educational levels might increase illness recognition because of heightened awareness of symptoms (Pitt and Rosenweig 1986; Schultz and Tansel 1997). If this is the case, then the self reported illness data is subject to systematic reporting bias.

Such problems can to some extent be overcome by listing the types of illness, therefore avoiding the individual being able to give the general answer of, 'yes I was ill', without thinking about the nature of the illness. This technique should also help reduce mis-reporting, allow the specific illnesses to be known, and avoid the interviewer having to guess what sickness might be associated with a specific symptom.[vii] Combining an illness and symptoms approach, as in the 1999 Ugandan data, helps minimise such disadvantages.

However, one alternative to using self reported morbidity is to use the less subjective, and more quantitatively orientated, anthropometric measures of height-for-age and weight-for-height. Where a low height for age (stunting) is considered to be a long-term measure of chronic malnutrition, whilst a low weight for height (wasting) is considered a measure of acute malnutrition. Although, the data is commonly only available for pre-school aged children.

Of the major determinants of health, outlined in the quasi reduced form, we will adopt real expenditure as the income measure, as in accordance with permanent life cycle methodology, this has the axiom of being a smoother long term welfare measure (Barrett et al. 2000). More specifically, the expenditure data used for this analysis will be adopted from Appleton (2001) which has been adjusted for regional price differences and deflated by consumer price index to a base year of 1989 and is expressed per adult equivalent. Education will be measured by the number of years completed at each level. For household public goods, as prices are not available, the existence of these goods, such as drinking water, will be used. Price and availability data for the most common drugs, such as anti-malarial and antibiotics will also be included. However, as a higher price might reflect a higher quality of service,[viii] this will be controlled for by using community data, removing quality bias from estimates.[ix] Distance to the nearest health clinic acts as a good proxy for the opportunity cost incurred in visiting the health centre, and will also be used.

4. Descriptive Statistics

As noted earlier (Table 1), self reported sickness levels in Uganda, as at 1999, have increased to approximately 30% and represents a 65% increase in levels since 1992. Moreover, stunting in Ugandan children is very common, but this is particularly the case for children in their second year of life, with almost a half of the one to two year old boys below the international reference point. Child wasting is also higher for children in the two years of age range, with the most likely explanation being that the nutritional deficiency is associated with an increased disease exposure that a child encounters as they change from breast feeding to baby food.[x]

Disaggregating health status by income levels we can see, perhaps the most start example of higher income benefiting health comes from child nutritional figures which appear to positively benefit from increased household welfare (Table 2). For instance, there are 6% more children, in the lowest quartile of expenditure, below the international reference point for stunting compared to children in the highest expenditure quartile. This would seem logical given that families with higher incomes are more likely to spend more (in absolute terms) on food expenditure, resulting in healthier nutritionally measured babies. Such results are also in agreement with previous Ugandan evidence, from Mackinnon (1995) and Hutchinson (2001), where the latter found children in the lowest income quartiles to respond particularly positively to increased welfare.

Table 2: Height for Age and Weight for Height Z Scores – Pre School Aged Children

	Z scores					
Expenditure Quartiles	**<-3**	**-3 to -2**	**-2 to -1**	**-1 to +1**	**+1 to +2**	**>+2**
Height for Age (HAZ)						
1st (Lowest)	15.1	21.8	27.8	30.0	3.1	2.2
2nd	13.5	20.9	27.4	31.9	3.6	2.6
3rd	13.7	18.8	27.8	32.4	5.1	2.2
4th (Highest)	9.2	17.0	26.6	39.3	5.5	2.5
Weight for Height (WHZ)						
1st (Lowest)	2.1	4.6	16.6	65.4	7.7	3.6
2nd	1.3	4.2	16.2	64.1	10.4	3.9
3rd	1.7	3.9	14.2	66.4	9.2	4.7
4th (Highest)	1.3	2.9	12.6	66.3	12.8	4.1

Attainment of increased levels of personal education also appear to be associated with lower adult morbidity (Table 3). Over 30% (37%) of all males (females) who have not had any schooling, reported sickness. This compares with an overall average of 23% (30%) for all male (females). Completing secondary education has the largest benefit in the lowering of sickness levels, with illness levels generally at 70% of the overall average for both males and females. In contrast maternal education appears to have little influence on the levels of child sickness, although for school aged girls the completion of secondary education by their mothers is associated with higher levels of illness prevalence.

Table 3 :Adult, School and Pre-School Sickness by Educational Achievement

	Adults		School Aged Children		Pre School Children	
Personal/Maternal Education	**Men**	**Women**	**Boys**	**Girls**	**Boys**	**Girls**
All	23.6%	30.5%	19.5%	19.4%	41.6%	43.4%
Missed	30.3%	37.0%	18.9%	18.0%	40.4%	42.4%
Some Primary	24.9%	29.2%	20.3%	20.4%	43.2%	45.2%
Primary Completed	22.7%	25.7%	19.2%	20.0%	41.4%	43.5%
Some Secondary	18.6%	24.7%	20.6%	19.1%	41.0%	40.7%
Secondary Completed	17.3%	21.1%	20.6%	25.5%	41.3%	43.1%

Paradoxically, and in contradiction to the pre school self reported health data, increased levels of maternal education appear to have beneficial stunting and wasting effects. For example, there are 10% fewer children below the –2 HAZ score with mothers who have some secondary education, compared to children with mothers who have no or some primary education.[xi] This might therefore suggest that the awareness interpretation is better than the time cost one and is a suggestion of the existence of over-reporting of child sickness, the more educated the parents.

Of the other variables appearing to influence morbidity, data for household public goods (Table A3) suggest the quality and source of drinking water, and type of toilet facility, are all of significant influence, and in some cases have large interregional variations. For example, adult sickness is most prevalent in the households which have uncovered pit latrines, with almost 40% of adults reporting morbidity, compared with 26% in the Central Region.

5. Econometric Results

Tables 4 to 6 provide the findings for all three age samples of adults, school and pre-school children, with the results interpreted in terms of the marginal effects of each variable. Furthermore, as the preliminary results showed some interesting gender differences, and the LR tests rejected pooling, all samples used are disaggregated by gender, with the econometric results for adults being discussed first.

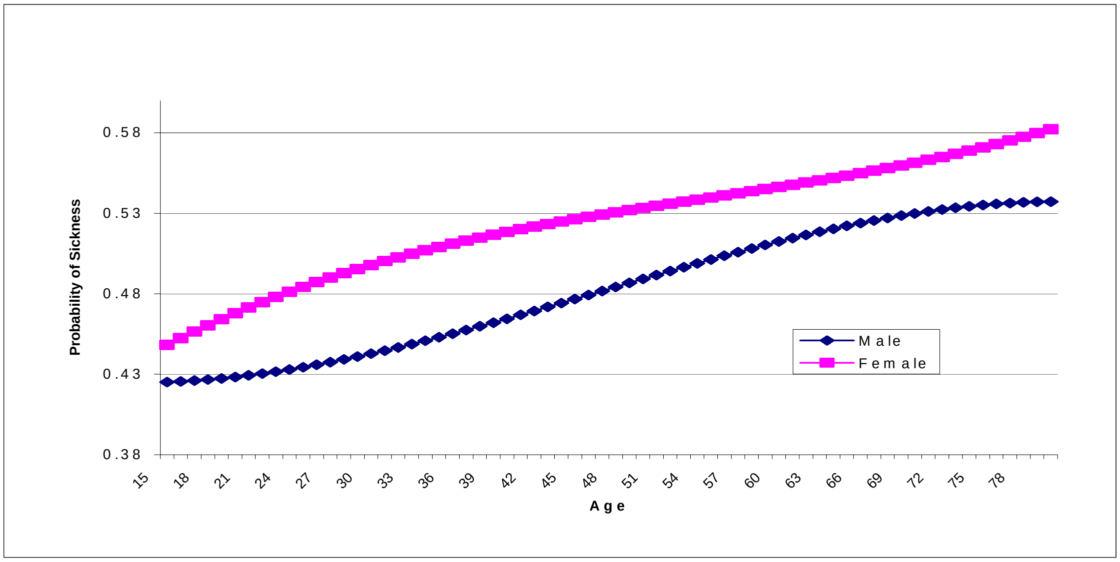
a. Adults and School Aged Children

For the self reported health of adults and school aged children increased levels of income significantly lowers the probability of sickness for male adults and female school aged children. Such findings are in line with the interpretation outlined earlier, that increased income should allow individuals to generally lead healthier lifestyles. Furthermore, previous empirical evidence, such as Strauss (1990) and Thomas et al. (1990), who also analysed the impact of income on health via an instrumented approach, found similar results.

The strength of the income results are furthered when we consider that this predicted income measure passes the tests associated with it being a good measure. Perhaps most importantly the predicted log measure passes the Sargan test (Table A10) which justies the use of the predicted measure of income as opposed to the non instrument approach. In other words sufficiently good instruments have been found to use the predicted measure as opposed to the actual income measure. This is the case for both the adult and child samples.

It is however, apparent that factors other than increased income are extremely important determinants of ill health. For adults, in particular, age effects on illness probability are significant for both males and females. As can be seen from Figure 1 the former of these depicts a quadratic relationship with the probability of sickness being at its lowest for male adults at the age of 13 before gradually flattening out at the age of 81 years. For females the curve is monotonic, and the highest point of sickness probability is at 27 years of age, although sickness levels are either at their peak (for females), or increasing most rapidly (for males) during the HIV/AIDS dominant years of 25-40 year olds. Such findings are understandable given the high incidence of HIV/AIDS in Uganda, but especially in relation to female sickness, as the highest probability of falling sick also coincides with the peak child bearing years.

Figure 1: Probability of Adult Sickness – By Age and Gender



For school aged children, the probability of boys being ill reduces, in a linear form, as adulthood approaches. This effect seems reasonable given that a child's immunity levels build as they mature to adulthood (Childrensmedgroup 2002). However, Figure A1 shows that in contrast to the boys, the effect of age on the probability of girls falling sick is non-linear. Sickness is at its lowest at 11 years of age, before rising as girls go through puberty and start experiencing the increased probability of sickness associated with pregnancy (Futureofchildren, 2002).

The most striking result of the educational impact on health is the clear distinction between the positive health influences from primary and secondary education on adults, and the negative effects of parental primary and secondary education on the health of school aged children. For example, the completion of secondary education reduces the probability of sickness by approximately 8 (5) percentage points for men (women) whilst for school aged children, increases in self reported sickness are associated with increased years of parental primary and secondary schooling (Appleton 1992, Thomas et al. 1991).[xii]

One explanation for adult health benefiting from increased years of education could be due to increased symptom awareness or partly through beliefs (Mackinnon 1995). This awareness then enables adults to become more accurate in diagnosing sickness, allowing them to discount many mild ailments as non-sickness. Given this, and in line with both Mackinnons' findings for Uganda and Strauss (1990) for Cote d'Ivoire, it would be interesting to find out what exactly is being taught in schools.

Results for school aged children suggest increased levels of parental education are associated with increased sickness levels. These findings are supported by both the descriptive statistics and previous empirical evidence (Appleton 1992, Thomas et al. 1991). Furthermore the results are also understandable from the perspective of the household production framework, where it would seem sensible that as mothers become more educated, this might result in them being out of the house more, working.[xiii] As a result, less time is spent monitoring a child's health and higher illness levels result.

For household public goods, and specifically for the water source used, school aged children's health appears to be significantly affected by several of the water sources, with benefits arising particularly from the usage of protected water sources.[xiv] This is especially the case for school aged boys (Table 4, column 3) using boreholes, piped water or protected wells, all of which are statistically significant in reducing boys morbidity levels. Regression results suggest that using either of the first two of these water sources reduces the probability of school aged boys falling sick by 6 percentage points. Further results indicate significant benefits for school aged boys using protected water sources, in general, compared to the unprotected sources (Table A10).

Table 4: Determinants of Health of Adults and School Aged Children - Marginal Effects for Health Status

	Adults		School Aged Children (Aged 6-14 Years)	
	Males	**Females**	**Males**	**Females**
	(1)	(2)	(3)	(4)
	Obs 13216	*Obs 14278*	*Obs 8864*	*Obs 8623*
Variable	*Log likelihood -6757.095*	*Log likelihood -8248.933*	*Log likelihood -4283.136*	*Log likelihood -4098.690*
Constant	-0.1567 (-2.375)**	-0.3414 (-5.429)***	-0.1184 (-3.621)***	0.2821 (0.381)
Age	-0.0055 (-1.664)*	0.0177 (4.859)***	-0.0110 (-6.703)***	-0.0491 (-3.450)***
Age squared	0.0003 (3.307)***	-0.0003 (-3.067)***		0.0021 (2.992)***
Age cubed	0.0000 (-3.448)***	0.0000 (2.65)***		
Age of head	-0.0044 (-2.641)***	-0.0042 (-2.633)***	0.0004 (1.290)	0.0001 (0.195)
Female head	-0.0200 (-1.548)	0.0148 (1.643) *	0.0132 (1.234)	0.0199 (1.839)*
Age of head squared	0.0000 (2.194)**	0.0000 (2.295)**	0.0000 (-0.299)	0.0000 (-1)
Household size	-0.0119 (-8.479)***	-0.0118 (-8.752)***	-0.0055 (-4.076)***	-0.0080 (-5.665)***
Personal Education				
Primary	-0.0025 (-1.461)	-0.0040 (-1.35)	- -	- -
Secondary	-0.0123 (-3.955)***	-0.0022 (-1.809)*	- -	- -
University	0.0022 (0.206)	0.0440 (0.5)	- -	- -
Child ordering	- -	- -	0.0017 (0.475)	0.0036 (0.961)
Parental Education				
Fathers Primary	- -	- -	0.0029 (1.665)*	0.0011 (0.401)
Fathers Secondary	- -	- -	0.0038 (0.627)	0.0071 (1.775)*
Mothers Primary	- -	- -	0.0018 (0.966)	0.0062 (2.955)***
Mothers Secondary	- -	- -	0.0110 (1.307)	0.0078 (1.423)
Fathers University	- -	- -	-0.0658 (-1.349)	0.0183 (0.368)
Mothers University	- -	- -	0.0238 (0.132)	-0.1465 (-0.983)
Toilet Type				
Flush Toilet & Urban	0.1124 (1.739)*	-0.0286 (-0.424)	0.1833 (2.056)**	0.1688 (1.673)*
Flush Toilet & Rural	0.1106 (1.469)	-0.0437 (-0.491)	0.0323 (0.342)	0.0788 (0.927)
Covered Latrine&Urban	0.0067 (0.136)	-0.0377 (-0.682)	0.0657 (0.862)	0.0654 (0.728)
Covered Latrine &Rural	0.0303 (1.543)	0.0081 (0.383)	0.0199 (0.841)	0.0636 (2.542)**
Uncovered Latrine & Urban	-0.0082 (-0.147)	-0.0257 (-0.417)	0.0927 (1.133)	0.0765 (0.772)
Uncovered Latrine & Rural	0.0524 (2.944)***	0.0548 (2.731)***	0.0369 (1.825)*	0.0668 (3.184)***
Other Toilet	0.0564 (1.864)*	0.0612 (1.966)**	0.0339 (0.937)	0.0881 (2.504)**
Source Of Water				
Piped	0.0187 (0.535)	-0.0516 (-1.488)	-0.0637 (-1.666)*	-0.0845 (-1.128)
Borehole	0.0232 (1.362)	0.0037 (0.205)	-0.0597 (-3.249)***	0.0105 (0.539)
Public Tap	0.0256 (1.041)	-0.0169 (-0.677)	-0.0352 (-1.32)	-0.0016 (-0.055)
Protected	0.0018 (0.105)	-0.0241 (-1.334)	-0.0370 (-2.054)**	-0.0131 (-0.678)
Unprotected	0.0230 (1.458)	-0.0104 (-0.603)	-0.0297 (-0.282)	0.0000 (-0.003)
Rain	-0.0650 (-1.165)	-0.1740 (-2.82)***	-0.0844 (-1.235)	-0.1028 (-1.195)
Vendor	0.0528 (1.252)	-0.0567 (-1.304)	-0.0345 (-0.595)	0.0433 (0.776)
Region				
Urban Central	0.0133 (0.738)	-0.0431 (-2.343)**	0.0142 (0.699)	0.0047 (0.223)
Rural Central	-0.0108 (-0.925)	-0.0403 (-3.187)***	-0.0403 (-3.073)***	-0.0678 (-4.94)***
Urban East	0.0844 (4.42)***	0.1179 (5.822)***	0.0551 (2.436)**	0.0757 (3.404)***
Rural East	0.1030 (9.029)***	0.1078 (8.813)***	0.0810 (6.247)***	0.0894 (6.914)***
Urban North	0.0003 (0.014)	-0.0338 (-1.354)	0.0272 (0.998)	-0.0054 (-0.194)
Rural North	0.0326 (2.403)**	0.0108 (0.745)	0.0061 (0.388)	0.0123 (0.78)
Urban West	-0.0055 (-0.253)	-0.0272 (-1.229)	-0.0411 (-1.64) *	-0.0040 (-0.156)
Distance to Preventative Clinic	-0.0007 (-0.998)	-0.0015 (-1.857)*	0.0001 (0.101)	-0.0007 (-0.748)
Income	-0.0949 (-2.524)**	-0.2244 (-0.048)	-0.0436 (-0.62)	-0.1315 (-2.443)**
Community Variables From Reduced Sample Probit Regressions				
Malaria drugs	-0.0591 (-0.594)	-0.2547 (-2.198) **	-0.3352 (-2.553)**	-0.1447 (-1.265)
Antibiotics	0.0030 (0.082)	0.0144 (0.379)**	-0.0214 (-0.484)	-0.0060 (-0.142)
Consultancy price	0.0000 (-0.761)	0.0000 (-0.662)	0.0000 (-0.152)	0.0000 (-2.043)**
Price of malaria drugs	0.0000 (1.731)*	0.0000 (1.228)	0.0000 (0.446)	0.0000 (-0.515)
Antibiotic price	0.0000 (0.271)	0.0000 (2.02) **	0.0000 (1.879)*	0.0000 (0.966)
Consumer market	-0.0008 (-0.532)	0.0015 (0.965)	-0.0001 (-0.093)	0.0029 (1.653)*
Input market	-0.0020 (-1.399)	-0.0030 (-2.14)**	-0.0001 (-0.048)	-0.0018 (-1.145)
Producer market	0.0021 (1.208)	0.0005 (0.275)	0.0009 (0.455)	-0.0020 (-1.088)

* Significant at 10% level
** Significant at 5% level
*** Significant at 1% level

Defaults – Missed Education (for all education variables), Toilet – bush, Water – River, Urban West

Of the other significant variables the use of uncovered latrines, increased malaria drug availability and higher antibiotic prices increase morbidity levels in the female adult and school aged boy samples. Although this latter finding infers sex bias in the allocation of drugs/household medical expenditure, in favour of both adult males and female children, wald test results do not reject the null hypothesis that the male and female samples are equal. Furthermore, when testing the relationship between individuals who are ill and the proportions of household expenditure spent on health expenditure, no bias across gender of adults or children was found.[xv] Distance to clinic was also significant in the adult female sample but the relationship was opposite to what was expected. One reason that might explain this is the quality care offered by the 'local' health units might be substandard and therefore bypassing might be present (Akin and Hutchinson 1999).

b. Pre-School Children

Focusing on both the self reported and anthropometric health measures in Tables 5 and 6, we see that increase incomes are particularly significant in lowering self reported sickness, and improving nutritional levels. Five out of the six income coefficients for pre school children indicating increased income to be significantly associated with less sickness and better nutrition. Only for girls self reported sickness was income not significant. The strength of the income and health relationship is particularly evident for the anthropometric data with reduced stunting and wasting, for girls and boys, thus corroborating descriptive statistics and previous Ugandan evidence (Mackinnon 1995, and Hutchinson 2001).

Descriptive data for the anthropometrics also highlighted that the period immediately following weaning can be particularly damaging to the nutritional status of both boys and girls of pre school age. Regression results confirm this impression. Both nutritionally deprived states of being 'stunted' and 'wasted' and higher levels of self reported sickness are more likely in children who are one to one and half years of age. Apparent increases in a child's state of health during the second year of life may reflect a boost in the immune system, once a child gets 'used to' new feeding methods. A hypothesis which is supported by medical evidence (Childrensmedgroup 2002).

Evidence on the health effect of a child's birth order for pre-school children is extremely strong. A higher birth order is significantly associated with a deterioration of both nutrition and self reported health measures. Such a result holds for both stunting and wasting where a later birth order, particularly for girls, is significantly associated with lower nutrition levels (Tables 6, columns 2 and 3). Such evidence implies that the 'first born' in families is at a significant nutritional advantage compared to children, and particularly girls, born later (Lewis and Britton 1998, Horton 1988). Hence, any benefits that might arise from increased maternal knowledge, acquired from the processes of giving birth and raising children, appear to be outweighed by this 'early baby' bias. Results which are, to some extent, supported by participatory evidence which has highlighted difficulties in educating women of the benefits of giving birth in maternal units, particularly those that already have children (Republic of Uganda, 2000).

As with the school aged child self reported sickness regression results, parental education appears at first glance not to significantly influence the health of pre school children. Nevertheless the anthropometric results reassuringly have the expected positive signs of influence on nutrition, re-enforcing both the descriptive results and previous empirical evidence (Behrman and Wolfe 1987 for Nicaragua, Merrick 1985 for Brazil, Boulier and Paqueo 1988 for Sri Lanka ,and Bhuiya et al. (1986) for Bangladesh). More specifically, for both girls and boys extra years of maternal secondary education is significantly associated with taller children, with each additional year benefiting height for age Z-score by at least 5 percentage points. Primary and secondary education of the father also appears to significantly increase nutritional levels of boys, although in contrast to Thomas's findings for Ghana, in this instance Wald tests reject the hypothesis that paternal education is more important for boys than for girls.

Table 5: Determinants of Health of Pre School Boys –Marginal Effects for Health Status

Variable	Self Reported Sickness (1) Obs 4652 Log likelihood -3010.569	Height For Age Z-Score (2) HAZ Mean= -1.39 Obs 3702 R-squared= .097958	Weight For Height Z-Score (3) WHZ Mean= -.115 Obs 3702 R-squared= .032858
Constant	-0.0237 (-0.299)	-0.9824 (-3.29)***	0.1681 (0.698)
Agehalf	0.1516 (4.722)***	-0.5629 (-4.547)***	-0.5484 (-5.492)***
Ageone	0.1550 (5.165)***	-1.2203 (-10.525)***	-0.6300 (-6.737)***
Ageone5	0.1601 (4.775)***	-1.4550 (-11.421)***	-0.6103 (-5.939)***
Agetwo	0.0645 (2.273)**	-0.9179 (-8.211)***	-0.5868 (-6.509)***
Agetwo5	0.0237 (0.691)	-0.9749 (-7.649)***	-0.3864 (-3.759)***
Agethree	0.0035 (0.122)	-1.0847 (-9.902)***	-0.3211 (-3.635)***
Agethre5	-0.0795 (-2.2)**	-1.3465 (-10.229)***	-0.2724 (-2.565)**
Agefour	-0.0354 (-1.256)	-1.2465 (-11.389)***	-0.4005 (-4.537)***
Agefour5	-0.0291 (-0.73)	-1.4723 (-10.084)***	-0.4040 (-3.431)***
Age of head	-0.0074 (-2.423)**	0.0087 (0.807)	0.0091 (1.058)
Female Head	-0.0182 (-0.874)	0.1561 (2.122)**	0.0249 (0.42)
Age of head squared	0.0001 (2.648)***	0.0000 (-0.231)	-0.0001 (-1.036)
Household size	-0.0096 (-3.489)***	0.0071 (0.744)	0.0053 (0.698)
Child ordering	0.0067 (1.797)*	0.0112 (0.87)	-0.0137 (-1.827)*
Parental Education			
Fathers Primary	0.0071 (2.126)**	0.0208 (1.793)*	0.0063 (0.679)
Fathers Secondary	0.0035 (0.551)	0.0358 (1.646)*	0.0303 (1.687)*
Fathers University	-0.1081 (-1.077)	-0.0471 (-0.137)	0.1206 (0.436)
Mothers Primary	0.0027 (0.764)	0.0031 (0.259)	0.0137 (1.417)
Mothers Secondary	0.0018 (0.19)	0.0523 (1.639)*	-0.0103 (-0.393)
Mothers University	0.0265 (0.085)	0.9076 (0.951)	-0.5215 (-0.678)
Toilet Type			
Flush Toilet	-0.0666 (-0.819)	-0.3804 (-1.417)	0.1273 (0.588)
Covered Latrine	0.0433 (1.483)	-0.2855 (-2.879)***	0.0386 (0.483)
Uncovered Latrine	0.0575 (1.888)*	-0.0966 (-0.899)	0.0620 (0.715)
Other Toilet	0.0412 (0.697)	-0.5866 (-2.883)***	0.1626 (0.991)
Source Of Water			
Piped	0.0238 (0.343)	0.3355 (1.375)	-0.4039 (-2.053)**
Borehole	-0.0261 (-0.772)	0.1700 (1.36)	-0.2452 (-2.432)**
Public Tap	0.0189 (0.399)	-0.0940 (-0.563)	-0.3306 (-2.452)**
Protected	-0.0873 (-2.534)**	0.0754 (0.596)	-0.2202 (-2.159)**
Unprotected	-0.0251 (-0.771)	-0.0035 (-0.029)	-0.1505 (-1.541)
Rain	-0.1565 (-1.308)	0.1738 (0.453)	0.7211 (2.33)**
Vendor	-0.0254 (-0.311)	0.0950 (0.307)	-0.3442 (-1.379)
Region			
Urban Central	0.0270 (0.735)	0.2714 (1.983)**	0.0096 (0.087)
Rural Central	0.0011 (0.047)	0.1097 (1.317)	-0.0726 (-1.081)
Urban East	0.1868 (4.397)***	0.1318 (0.849)	-0.0450 (-0.36)
Rural East	0.1852 (8.117)***	-0.0181 (-0.222)	-0.0126 (-0.192)
Urban North	0.1090 (2.255)**	0.1048 (0.6)	0.0144 (0.102)
Rural North	0.1219 (4.419)***	-0.0441 (-0.439)	-0.1934 (-2.386)**
Urban West	-0.0852 (-1.739)*	-0.0603 (-0.368)	0.0393 (0.297)
Distance to Preventative Clinic	-0.0028 (-1.997)**	-0.0057 (-1.269)	0.0054 (1.473)
Income	-0.2025 (-1.975)**	0.5716 (3.248)***	0.4463 (3.144)***
Community Variables From Reduced Sample Probit Regressions			
Malaria drugs	-0.0625 (-0.286)	0.8008 (1.048)	0.6488 (1.124)
Antibiotics	-0.0443 (-0.622)	0.4087 (1.613)	-0.2318 (-1.211)
Consultancy price	0.0000 (0.561)	-0.0001 (-0.544)	0.0001 (1.097)
Price of malaria drugs	0.0000 (-2.209)**	0.0000 (0.179)	0.0001 (1.774)*
Antibiotic price	0.0000 (1.706)*	0.0001 (1.225)	-0.0001 (-2.089)**
Consumer market	-0.0020 (-0.647)	-0.0121 (-1.095)	0.0038 (0.459)
Input market	0.0029 (0.935)	-0.0048 (-0.412)	-0.0102 (-1.153)
Producer market	-0.0007 (-0.176)	0.0173 (1.252)	0.0053 (0.504)

* Significant at 10% level
** Significant at 5% level
*** Significant at 1% level
Defaults – Missed Education (for all education variables), Toilet – bush, Water – River, Urban West

Table 6: Determinants of Health of Pre School Girls –Marginal Effects for Health Status

Variable	Self Reported Sickness (1)		Height For Age Z-Score (2)		Weight For Height Z-Score (3)	
	Obs	4576	HAZ	Mean= -1.23	WHZ	Mean= -.1211
	Log likelihood	-2971.953	Obs 3605		Obs 3605	
			R-squared= .089703		R-squared= .046457	
Constant	-0.0769	(-0.946)	-1.2004	(-3.951)***	0.0719	(0.296)
Agehalf	0.1979	(5.94)***	-0.4597	(-3.662)***	-0.5676	(-5.665)***
Ageone	0.1951	(6.389)***	-0.9921	(-8.519)***	-0.7960	(-8.562)***
Ageone5	0.1336	(4.012)***	-1.3067	(-10.376)***	-0.5933	(-5.902)***
Agetwo	0.0768	(2.567)**	-0.7835	(-6.778)***	-0.6893	(-7.47)***
Agetwo5	0.0863	(2.438)**	-1.1867	(-9.083)***	-0.5339	(-5.119)***
Agethree	0.0248	(0.866)	-1.0546	(-9.491)***	-0.4841	(-5.458)***
Agethre5	-0.0214	(-0.574)	-1.3161	(-9.794)***	-0.3930	(-3.664)***
Agefour	-0.0433	(-1.483)	-1.0910	(-9.685)***	-0.3973	(-4.418)***
Agefour5	-0.0021	(-0.053)	-1.2687	(-8.75)***	-0.4966	(-4.29)***
Age of head	-0.0061	(-1.875)*	0.0175	(1.521)	0.0049	(0.534)
Female Head	0.0393	(1.85)*	0.1006	(1.363)	-0.0157	(-0.267)
Age of head squared	0.0001	(1.841)*	-0.0001	(-0.665)	-0.0001	(-0.53)
Household size	-0.0069	(-2.363)**	-0.0112	(-1.117)	0.0066	(0.832)
Child ordering	0.0076	(1.951)*	-0.0312	(-2.39)**	-0.0292	(-2.806)***
Parental Education						
Fathers Primary	-0.0004	(-0.118)	0.0166	(1.436)	0.0165	(1.789)*
Fathers Secondary	0.0036	(0.328)	-0.0001	(-0.005)	-0.0033	(-0.18)
Fathers University	-0.0599	(-0.571)	-0.2491	(-0.683)	0.0389	(0.134)
Mothers Primary	0.0019	(0.309)	0.0030	(0.251)	-0.0057	(-0.596)
Mothers Secondary	0.0103	(1.11)	0.0870	(2.679)***	0.0708	(1.742)*
Toilet Type						
Flush Toilet	-0.0607	(-0.774)	-0.0904	(-0.328)	-0.3668	(-1.667)*
Covered Latrine	0.0109	(0.354)	-0.1706	(-1.649)*	0.0873	(1.057)
Uncovered Latrine	0.0423	(1.339)	-0.1107	(-1.016)	0.0368	(0.422)
Other Toilet	0.0251	(0.408)	0.0532	(0.264)	0.0098	(0.061)
Source Of Water						
Piped	-0.0138	(-0.209)	-0.1583	(-0.704)	-0.3574	(-1.992)**
Borehole	-0.0660	(-1.296)	0.1432	(1.279)	0.0298	(0.333)
Public Tap	0.0039	(0.082)	-0.0018	(-0.011)	-0.3686	(-2.848)***
Protected	-0.0151	(-0.464)	-0.0474	(-0.417)	-0.0156	(-0.172)
Unprotected	0.0366	(1.198)	0.0679	(0.633)	0.0294	(0.343)
Rain	-0.2459	(-2)**	-0.1352	(-0.325)	0.7523	(2.27)**
Vendor	-0.1035	(-1.092)	-0.6754	(-2.029)**	-0.2160	(-0.813)
Region						
Urban Central	0.0420	(1.113)	0.5155	(3.642)***	0.0377	(0.333)
Rural Central	-0.0002	(-0.01)	0.3175	(3.855)***	-0.0542	(-0.824)
Urban East	0.1938	(4.497)***	0.2891	(1.817)*	-0.0792	(-0.623)
Rural East	0.2159	(9.199)***	0.1224	(1.532)	-0.1163	(-1.823)*
Urban North	-0.0238	(-0.464)	0.0732	(0.408)	-0.3276	(-2.287)**
Rural North	0.0902	(3.223)***	0.1941	(1.961)**	-0.1355	(-1.715)*
Urban West	-0.0185	(-0.373)	0.4192	(2.451)**	0.0534	(0.391)
Distance to Preventative Clinic	-0.0005	(-0.382)	-0.0055	(-1.171)	0.0059	(1.571)
Income	-0.0794	(-0.675)	1.0287	(4.997)***	0.3044	(1.852)*
Community Variables From Reduced Sample Probit Regressions						
Malaria drugs	-0.3061	(-1.696)*	0.4137	(0.808)	-0.1471	(-0.37)
Antibiotics	0.0241	(0.37)	-0.0823	(-0.369)	0.0421	(0.242)
Consultancy price	0.0000	(-0.208)	0.0001	(0.85)	0.0001	(1.249)
Price of malaria drugs	0.0000	(-0.62)	0.0001	(1.095)	0.0000	(-0.059)
Antibiotic price	0.0000	(0.469)	0.0000	(0.52)	0.0000	(-0.76)
Consumer market	0.0049	(1.518)	-0.0271	(-2.622)***	-0.0047	(-0.586)
Input market	0.0036	(1.301)	0.0152	(1.782)*	-0.0061	(-0.922)
Producer market	-0.0093	(-2.737)***	0.0078	(0.711)	0.0096	(1.123)

* Significant at 10% level
** Significant at 5% level
*** Significant at 1% level
Defaults – Missed Education (for all education variables), Toilet – bush, Water – River, Urban West

Of the other results, usage of unprotected water sources, once again, is particularly significant in increasing levels of wasting for both boys and girls. However in contradiction to the school aged child results, the use of piped water for both boys and girls appears to be particularly damaging, in terms of wasting. This result is perplexing, and can only be explained by assuming that children perceive such sources as safe and therefore take fewer precautions, such as boiling water. But this would not explain the apparent anomaly between the children of different age groups. For young children there also appear to be significant benefits to living in the central and west (urban) region, as this is significantly associated with increased child height age Z-scores. Increased distances to the local clinic significantly increase stunting and is of particular concern when considering young children as the frequency with which clinic visits are made, is likely to be higher.

6. Conclusions

For the past decade Uganda has been faced with rapidly rising levels of morbidity, mostly as a results of the AIDS pandemic of the 1980's. In this article we provide the first analysis which investigates the importance of income, compared to other determinants, across all age ranges of the population. Furthermore, by adopting different health measures we are able to not only examine how such determinants might vary, but provide insights on the robustness of these results across health measures.

Overall, the estimated results add substantial support to the hypothesis that the wealthier are indeed healthier. Increased welfare consistently decreases the probability falling sick and the probability of being stunting and wasting. Results which are robust across all age ranges, and after controling for endogeneity issues. The second major finding is the impact birth order has on child health. This is particularly the case for pre school children, with the results adding to the growing evidence that children born later are less healthy, than older brothers and sisters. For Uganda, this is particularly the case for later born girls who have a higher probability of being stunted or wasted than lower parity children. Such a result raises some interesting public health education issues, none more so than highlighting the need for Ugandan women to be made aware of the fact that despite knowledge benefits arising from child birth, such benefits appear not to outweigh the need to maintain good care and health for later births.

Household public goods also appear to play a significant role in determining health status. This is particularly the case regarding the impact protected water sources have on the wasting of pre school aged children. There is a strong significant influence associated with the use of public tap and piped water sources, and decreasing nutrition levels. The result adds to a list of empirical evidence (Appleton 1992 for Kenya, Tanzania and Cote d'Ivoire, Olsen and Wolpin 1984 and Pitt and Rosenweig 1986 for Malaysia) that suggests piped water usage can have negative effects on health.

Finally, we find some support for the finding that education has a beneficial influence on health status. For adults, secondary education (only) appears to benefit health status. This is an interesting finding in itself given that there are no government plans to follow the implementation of universal primary education with universal secondary education. For children, education of either parent at primary or secondary level has positive impacts on nutrition. This result is consistent with previous empirical research and raises a question mark over the estimated negative impact of education on self reported sickness of children. This suggests a serious reporting bias with the reported illness variables for children, and raises questions regarding the reliability of such data for future use.

7. Appendices

Table A1: Descriptive Statistics for All Age Ranges

	Adults		School Aged Children		Pre-School Children	
Variable	**Mean**	**St. Dev**	**Mean**	**St. Dev**	**Mean**	**St. Dev**
Self Report Sickness	0.277	0.445	0.195	0.396	0.429	0.495
Weight for Height Z-score	-	-	-	-	-0.119	1.277
Height for Age Z score	-	-	-	-	-0.939	1.637
Age	33.608	16.590	9.809	2.614	28.185	16.876
Age of Household Head	45.793	15.620	45.426	13.657	38.678	13.155
Sex of Household Head	0.214	0.410	0.238	0.426	0.178	0.382
Household Size	6.880	4.197	8.032	3.870	7.162	3.508
Child Ordering	-	-	-	-	2.941	2.457
Primary	4.092	2.813	-	-	-	-
Secondary	0.626	1.410	-	-	-	-
University	0.005	0.068	-	-	-	-
Father primary	-	-	4.437	2.828	4.654	2.685
Father secondary	-	-	0.747	1.529	0.707	1.494
Father university	-	-	0.020	0.100	0.015	0.079
Mother primary	-	-	3.084	2.938	3.501	2.843
Mother secondary	-	-	0.288	0.963	0.315	0.976
Mother university	-	-	0.013	0.034	0.012	0.025
Flush toilet	0.035	0.184	0.022	0.148	0.019	0.137
Covered latrine	0.698	0.459	0.719	0.449	0.677	0.468
Uncovered latrine	0.147	0.354	0.149	0.356	0.175	0.380
Other toilet type	0.021	0.142	0.018	0.133	0.020	0.140
Piped	0.049	0.215	0.037	0.188	0.027	0.163
Borehole	0.247	0.431	0.253	0.435	0.269	0.443
Public tap	0.073	0.260	0.064	0.244	0.059	0.236
Protected	0.228	0.420	0.234	0.423	0.214	0.410
Unprotected	0.319	0.466	0.333	0.471	0.346	0.476
Rain	0.006	0.077	0.004	0.064	0.004	0.066
Vendor	0.014	0.118	0.009	0.092	0.011	0.105
Urban Central	0.079	0.27	0.068	0.252	0.064	0.244
Rural Central	0.193	0.395	0.208	0.406	0.199	0.399
Urban East	0.057	0.232	0.050	0.218	0.046	0.209
Rural East	0.208	0.406	0.210	0.407	0.255	0.436
Urban North	0.035	0.185	0.031	0.172	0.030	0.170
Rural North	0.130	0.336	0.137	0.344	0.139	0.346
Urban West	0.043	0.203	0.039	0.193	0.031	0.173
Rural West	0.254	0.435	0.258	0.438	0.237	0.425
Distance to clinic	3.951	5.411	3.985	4.904	4.227	5.977
Malaria drugs	0.996	0.062	0.997	0.055	0.995	0.068
Antibiotics	0.963	0.188	0.965	0.183	0.957	0.203
Consultancy price	574.099	503.633	555.571	477.486	549.414	462.026
Malaria price	905.568	1533.448	920.944	1544.541	836.661	1417.200
Antibiotic price	941.760	1636.193	958.436	1668.528	859.386	1467.647
Consumer market	8.718	11.626	8.733	11.317	9.484	12.122
Input market	10.084	12.059	9.980	11.686	10.745	12.467
Product market	9.630	11.929	9.488	11.491	10.187	12.309

Table A2 :Adult, School and Pre-School Sickness by Educational Achievement

Personal/Maternal Education	Adults		School Aged Children		Pre School Children	
	Men	Women	Boys	Girls	Boys	Girls
All	23.6%	30.5%	19.5%	19.4%	41.6%	43.4%
Missed	30.3%	37.0%	18.9%	18.0%	40.4%	42.4%
Some Primary	24.9%	29.2%	20.3%	20.4%	43.2%	45.2%
Primary Completed	22.7%	25.7%	19.2%	20.0%	41.4%	43.5%
Some Secondary	18.6%	24.7%	20.6%	19.1%	41.0%	40.7%
Secondary Completed	17.3%	21.1%	20.6%	25.5%	41.3%	43.1%

Table A3: Adult Sickness (Individuals Aged 15+ years) by Region

Type of Toilet	Central		Eastern		Western		Northern	
	Healthy	Sick	Healthy	Sick	Healthy	Sick	Healthy	Sick
Flush	84.8%	15.2%	75.1%	24.9%	81.1%	18.9%	70.1%	29.9%
Covered Latrine	78.1%	21.9%	64.6%	35.4%	77.0%	23.0%	76.2%	23.8%
Uncovered latrine	73.8%	26.2%	60.5%	39.5%	70.1%	29.9%	68.5%	31.5%
Bush	75.3%	24.7%	63.8%	36.2%	74.2%	25.8%	69.7%	30.3%
Other	70.5%	29.5%	58.5%	41.5%	69.8%	30.2%	81.7%	18.3%

Table A4 : Height for Age Z Scores – Children Aged <=5 years

	Height For Age – Z scores					
	<-3	**-3 to -2**	**-2 to -1**	**-1 to +1**	**+1 to +2**	**>+2**
Male	14.1	20.3	27.9	30.9	4.5	2.3
Female	11.1	19.0	27.5	35.8	4.2	2.5
Urban	12.5	18.4	28.2	33.9	4.5	2.5
Rural	13.0	20.0	27.6	33.0	4.3	2.4
Age (years)						
Boys						
0	5.5	9.9	24.0	49.4	7.3	4.0
1	19.3	27.7	29.7	18.7	2.3	2.3
2	15.2	18.6	26.2	30.3	6.1	3.6
3	16.4	21.2	29.7	27.5	4.2	1.2
4	15.0	24.0	28.3	29.4	2.7	0.8
Girls						
0	3.9	10.0	21.5	54.5	6.1	4.0
1	13.1	21.1	31.5	29.1	3.3	2.1
2	12.6	18.1	25.5	36.4	4.4	3.0
3	12.5	22.6	29.6	29.6	4.0	1.8
4	13.4	21.4	28.1	32.2	3.7	1.3
Maternal Education						
Missed	15.2	20.9	26.3	31.2	3.7	2.9
Some Primary	13.3	20.8	28.3	31.8	3.9	2.1
Completed Primary	11.2	17.7	28.5	35.4	4.9	2.2
Some Secondary	8.1	15.1	27.7	42.0	5.7	2.4
Completed Secondary	10.3	19.2	24.8	35.0	7.9	3.3

Source:- Authors Calculations based on UNHS data

Table A5: Weight for Height Z Scores – Children Aged <=5 years

	Weight For Height - Z scores					
	<-3	**-3 to -2**	**-2 to -1**	**-1 to +1**	**+1 to +2**	**>+2**
Male	1.7	4.0	14.6	66.0	9.9	3.9
Female	1.5	3.8	15.3	65.3	10.1	4.2
Urban	2.4	4.6	13.6	65.3	10.5	3.7
Rural	1.4	3.7	15.4	65.7	9.9	4.2
Age (years)						
Boys						
0	2.0	5.2	16.0	54.9	12.9	9.1
1	2.6	6.8	19.0	57.3	9.8	4.5
2	1.4	2.9	14.7	71.2	8.7	1.1
3	1.2	2.8	10.7	72.6	9.6	3.1
4	1.4	2.7	12.6	71.4	9.3	2.8
Girls						
0	2.1	4.0	13.2	57.1	14.5	9.0
1	2.2	6.4	23.2	52.3	9.1	6.8
2	1.0	3.7	16.0	71.9	6.4	1.0
3	0.8	3.3	12.7	69.7	10.8	2.8
4	1.6	2.1	10.6	73.1	10.1	2.5
Maternal Education						
Missed	2.1	4.0	16.5	64.3	8.9	4.3
Some Primary	1.7	4.2	14.9	64.9	10.8	3.6
Completed Primary	1.0	3.7	13.6	67.0	11.0	3.7
Some Secondary	1.4	3.2	14.3	68.8	7.6	5.2
Completed Secondary	1.4	2.3	10.7	68.2	12.1	5.6

Source:- Authors Calculations based on UNHS data

Figure A1: School Aged Children – Age/Gender Probability of Sickness

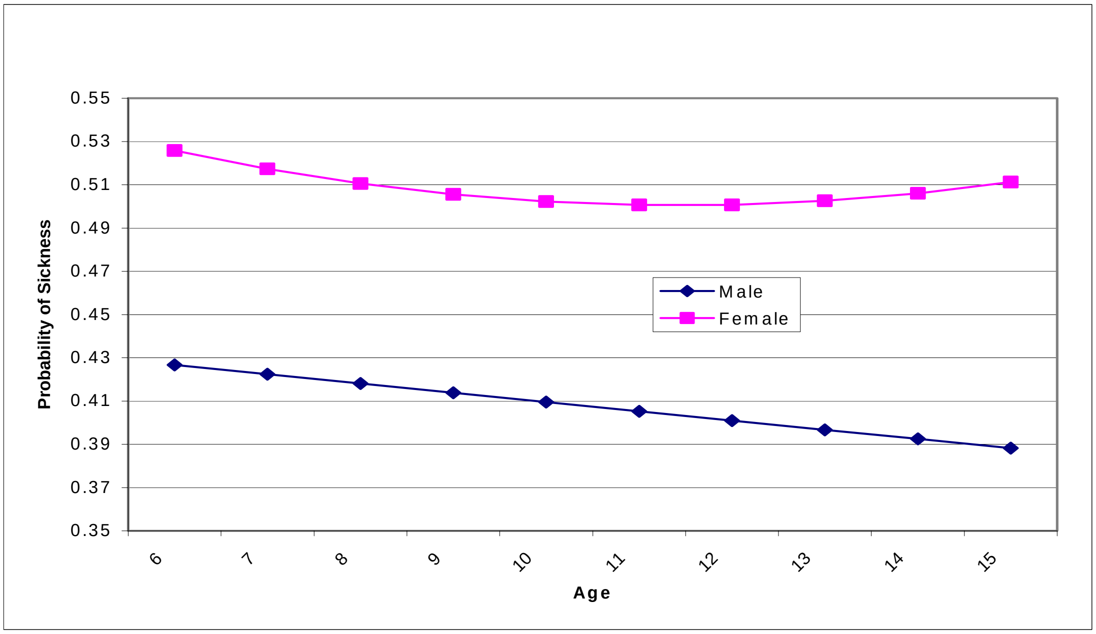


Table A6: Likelihood Ratio (LR) Test - Justification of Adult and Child Split Samples

	Test	p-value	df
Self Reported Sickness Samples			
Adults	102.68	0.000	38
School Aged Children	62.74	0.016	41
Children Less than 5 years	82.67	0.001	47

Note:- Test statistics asymptotically distributed as chi sq,, under the null hypothesis that the samples are equal

Table A7: Wald Tests for Medical Prices/Availability Variables - Across Adult/Child Gender Split (Self-Reported Sickness)

	Adults		School Aged Children		Children Less than 5 years	
	Test	p-value	Test	p-value	Test	p-value
Malaria Drug Availability	1.28	0.257	1.22	0.269	0.71	0.399
Consultancy Price	-	-	0.42	0.517	-	-
Malaria Price	4.36	0.036	-	-	4.03	0.045
Antibiotic Price	1.42	0.233	0.36	0.548	0.88	0.348

Note:- Test statistics asymptotically distributed as chi sq, with 1 d.f. under the null hypothesis that the samples are equal

Table A8: Wald Tests for Parental Education - Child Gender Split (Anthropometric Data)

	Children Less than 5 years			
	(Height for Age)		Weight for Height	
	Test	p-value	Test	p-value
Child Birth Order	1.198	0.274	0.012	0.912
Fathers Primary	1.738	0.187	-	-
Father Secondary	0.423	0.515	-	-

Note:- Test statistics asymptotically distributed as chi sq, with 1 d.f. under the null hypothesis that the samples are equal

Table A9: Results For Log of Consumption

	Adult
Overidentification Test	6.51 (df=8) (pass)
Hausman Test on log of exp	p=5.3
Instruments (9)	Cultivatable Land pae,Value of Electrical Goods,Value of Bicycles,Value of Chickens/Livestock, Electricity as lighting, Solar as lighting ,Gas as lighting ,Charcoal as Cooking, Parafin as Cooking, Electricity as Cooking
	School Aged Children
Overidentification Test	11.40 (df=9) (pass)
Hausman Test on log of exp	p=5.5
Instruments (10)	Log Room pae, Cultivatable Land pae,Value of Electrical Goods,Value of Bicycles,Value of Chickens/Livestock, Solar as lighting ,Gas as lighting ,Charcoal as Cooking, Parafin as Cooking, Electricity as Cooking
	Pre School Children
Overidentification Test	7.42 (df=8) (pass)
Hausman Test on log of exp	p=7.9
Instruments (9)	Log Room pae, Cultivatable Land pae,Value of Electrical Goods,Value of Bicycles,Value of Chickens/Livestock, Solar as lighting ,Gas as lighting , Parafin as lighting, Candle as lighting
	Anthropomteric Data - HAZ/WHZ
Overidentification Test	3.61 (df=8) (pass)/7.55 (df=8) (pass)
Hausman Test on log of exp	p=3.7/4.6
Instruments (9)	Cultivatable Land PAE,Value of Electrical Goods,Value of Bicycles,Value of Chickens/Livestock, Solar as lighting , Parafin as lighting, Candle as lighting, Charcoal as Cooking, Electricity as Cooking

Table A10: School Aged Boys Probit Regression –Testing the impact of Protected Water

Variable		Obs. 8864 Log likelihood -10679.4441	
Constant		0.0613	(0.208)
Age		-0.0677	(-0.713)
Age squared		0.0053	(0.53)
Age cubed		-0.0002	(-0.465)
Age of head		0.0010	(0.562)
Female head		0.0117	(1.108)
Household size		-0.0057	(-4.214)***
Child Ordering		-0.0001	(-0.049)
Parental Education			
	Fathers Primary	0.0030	(1.662)*
	Fathers Secondary	-0.0004	(-0.095)
	Mothers Primary	0.0021	(1.158)
	Mothers Secondary	-0.0014	(-0.271)
	Fathers University	-0.0652	(-1.336)
	Mothers University	0.0341	(0.19)
Toilet Type			
	Flush Toilet	0.1158	(2.611)***
	Covered Latrine	0.0264	(1.44)
	Uncovered Latrine	0.0426	(2.294)**
	Other Toilet	0.0391	(1.089)
Source Of Water			
	Protected	-0.0477	(-2.803)***
	Public Tap	-0.0300	(-1.175)
	Unprotected	-0.0376	(-2.192)**
	Rain	-0.0828	(-1.21)
	Vendor	-0.0233	(-0.418)
Region			
	Urban Central	0.0107	(0.54)
	Rural Central	-0.0431	(-3.323)***
	Urban East	0.0488	(2.189)**
	Rural East	0.0754	(6.012)***
	Urban North	0.0183	(0.682)
	Rural North	0.0009	(0.06)
	Urban West	-0.0430	(-1.675)*
Distance to Preventative Clinic		0.0000	(-0.007)
Income		-0.0168	(-0.497)
Community Variables			
Malaria drugs		-0.1321	(-1.156)
Antibiotics		-0.0176	(-0.398)
Consultancy price		0.0000	(-0.154)
Price of malaria drugs		0.0000	(0.325)
Antibiotic price		0.0000	(1.971)**
Consumer market		-0.0003	(-0.168)
Input market		-0.0003	(-0.199)
Producer market		0.0012	(0.657)

* Significant at 10% level, ** Significant at 5% level, *** Significant at 1% level

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[i] Wolfe and Behrman (1987), for Nicaragua, who controlled for unobserved common childhood family background characteristics shared by the sisters and found the impact of women’s schooling on nutrition to be quite robust, but with mortality this declines substantially or even evaporates.

[ii] AIDS prevalence figures fell between 1992 and 1997 (and 2000), however the number of individuals in the advanced stages of aids (i.e. the stages that would more frequently result in sickness) actually increased.

[iii] The average wasting figures for five developing/transitional countries (Jamaica, Kenya, Romania, Vietnam, Nepal,) in research by Appleton and Song (1999), found the average wasting level to be 6.46. Although this was skewed to some degree by the high level of wasting in Nepal, the first four countries mentioned all had wasting levels between 3.9% and 5.6% (mean average of 4.9%).

[iv] The HSSP is estimated to cost US$ 954 million over 5 years. Specific health targets include reducing; IMR from .97 to .68, Under 5 Child Mortality Rate from 147 to .103 per 100 live births, Maternal Mortality Rate from 506 to 354 per 100,000 live births, Levels of HIV (9.7% prevalence as at 2000) by 25%, Total Fertility Rate from 6.9 to 5.4 and stunting due to malnutrition in under 5’s from 38% to 28% (HSSP 2000a).

[v] Table A.10 confirms the validity of the instruments used

[vi] “Furthermore, Gerdthan et al. (1999) have demonstrated that a continous health status measure

constructed from a categorical response by the method of Wagstaff and van Doorslair (1994) is highly correlated with other continuous measures of health", p1 Crossley and Kennedy (2002).

[vii] In areas where certain types of disease are known to be widespread then it might be beneficial to use a list of reported health symptoms such as fever or diarrhoea. This has the advantage that symptoms are likely to be recorded more accurately by respondents than the types of self diagnosed sickness. Symptoms could then easily be cross referenced with the disease, i.e. fever - malaria. The biggest disadvantage to this symptom based approach is that there might be an incorrect association made between the symptom and sickness (i.e. having a fever does not always mean that you have malaria).

[viii] Other problems include; the actual fee paid may not represent the full fee required for the service, i.e. unofficial tip and bribes might be required, there might be a financial and time (opportunity) cost of travelling to and from the health facility (distance to health centre is used in our analysis to combat this problem).

[ix] An alternative method of controlling for possible bias of higher prices is to specify quality as a (health) provider fixed effect. However, given the relatively rich community data, in this instance such an approach was considered unnecessary.

[x] Increase in the prevalence of wasting as a result of weaning could mean the incorrect baby foods are being chosen. Though this could also represent children becoming more mobile and putting things into their mouths which might assist the transmission of germs (Childrensmedgroup 2002). Unreported descriptive statistics support such a hypothesis – Diarrhoea accounts for 5% of sickness for all one year olds and the figure almost doubles (8%) for two year olds, before declining to 3% and 2% for three and four year olds, respectively.

[xi] Higher levels of wasting are also present in children whose mothers have missed or possess some primary education.

[xii] All coefficients for parental primary and secondary schooling indicate a positive association with increased self reported sickness, although only three of coefficients are significant at the 10% level: Fathers secondary education for boys, fathers secondary and mothers primary education for girls. In addition, for pre-school boys and fathers primary education significantly increases morbidity.

[xiii] Primarily because higher levels of education raise the monetary value of individual's (parents) time and therefore more time is spent in formal employment.

[xiv] For school aged children, 10 of the 14 coefficients which represented more protected and/or natural water sources, compared to the river default, exhibited a positive influence on health. These results compare to just over half the coefficients which were significant for the adults sample.

[xv] This latter test enables us to see if higher proportions of certain groups, who are sick, are associated with households who allocating higher proportions of their household expenditure to health. Results available on request.