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Fever and its treatment among the more and less poor in Sub-Saharan Africa.

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Abstract

This paper explores the relationship between household poverty and the incidence and treatment of fever – as an indicator of malaria – among children in Sub-Saharan Africa. The paper uses household Demographic and Health Survey data collected in the 1990s data from 22 countries that have climates suitable to stable malaria. The results show a positive, but weak, relationship between reported fever and poverty, across geographic space. The association between fever and household wealth is insignificantly different from zero after controlling for cluster attributes. In Eastern and Southern Africa, children in wealthier communities are less likely to have had a fever. Treatment or advice from the modern sector is more likely in Eastern and Southern Africa than in Western and Central Africa. In both regions, the percent who seek care in the modern sector is larger for richer than poorer households. In Western and Central Africa those from richer households are substantially more likely to seek care from government hospitals than those from poorer households. In Eastern and Southern Africa the rich are equally as likely as the poor to seek care from lower level public facilities but they are significantly more likely to seek care from private commercial sources. In both regions there is substantial use of private facilities – usage that increases with wealth. Almost all of these associations become insignificant after controlling for the level of wealth of other households in the cluster. These cluster levels of wealth are strongly statistically significantly associated with treatment choices however. For example, children with fever from richer communities in both regions are more likely to seek care from government hospitals or private medical sources (such as doctors or nurses). In Eastern and Southern Africa children from richer communities are less likely to seek care in lower level public facilities.

Fever and its treatment among the more and less poor in Sub-Saharan Africa.

Introduction

This paper explores the relationship between household and community poverty and the incidence and treatment of fever – as an indicator of malaria – among children in Sub-Saharan Africa. The data used are Demographic and Health Survey household-level data collected in the 1990s data from 22 countries that have climates suitable to stable malaria. The results show a positive, but weak, association between reported fever and poverty, across geographic space. The association becomes insignificant, however, after controlling for mother's education. Fever is also not statistically significantly associated with wealth across households, although in Eastern and Southern Africa higher levels of wealth of other households in the cluster in which the household lives are associated with lower levels of reported fever.

The results show associations between poverty and the type of care sought (or not sought) for an episode of fever. Treatment or advice from the modern sector is more likely in Eastern and Southern Africa than in Western and Central Africa. In both regions, the percent who seek care in the modern sector is larger in the richest than in the poorest quintile. In Western and Central Africa those from richer households are more likely to seek care from higher-level public facilities (such as government hospitals), as well as lower level public facilities (such as health clinics), than those from poorer households. In Eastern and Southern Africa the rich are equally as likely as the poor to seek care from lower level public facilities but they are significantly more likely to seek care from private facilities. In both regions there is substantial use of private facilities – usage that increases with wealth. Almost all of these statistically significant household level associations become insignificant when controlling for the level of wealth of other households in the cluster. These cluster levels of wealth are strongly statistically significantly associated with treatment choices however. For example, children with fever from richer communities in both regions are more likely to seek care from public higher level facilities or private medical personnel (such as doctors or nurses). In Eastern and Southern Africa children from richer communities are less likely to seek care in lower level public facilities.

Fever is highly geographically concentrated: even after controlling for a variety of individual, household, and cluster attributes (including wealth), the average level of fever in the cluster in which a child lives is a strong determinant of their own probability of reporting fever in both regions. In addition, the higher the overall level of fever in a cluster, the more likely that care is sought from lower level public facilities or from private commercial sources in Eastern and Southern Africa. In Western and Central Africa the average level of fever is unrelated to treatment patterns.

The paper is divided into three main parts: Section 1 discusses issues related to measuring fever (and fever as a proxy for malaria) and poverty using DHS data, Section 2 describes the results of an analysis of the relationship of the incidence of fever and poverty for all the countries in the sample, and Section 3 describes the results of the analysis of the correlates of the treatment (or non-treatment) of fever for the subset of countries where these data are available.

1) Measuring fever and poverty

Data source

The data used in this paper are Demographic and Health Survey (DHS) data collected in Sub-Saharan African countries in the 1990s. These data are nationally representative household surveys with large sample sizes ranging from 2,252 households in Comoros to 9,282 in Mozambique. Table 1 reports the countries, the survey years, and the number of households from each country included in the analysis. All the countries in the study are poor, with nationally defined headcount poverty rates ranging from 26 percent in Zimbabwe to 86 percent in Zambia (with poverty data from World Bank, 1999). In a cross-country unweighted average (for the countries for which the data are available) the median percentage of the population living on under $1 a day in purchasing power parity terms is 38 percent and the median living on under $2 a day is 84 percent. Under-five mortality is high in these countries, with a cross-country unweighted average of 171 under-five mortality per 1000 births (as derived from the DHS data) ranging from 90 per 1000 in Zimbabwe to 318 per 1000 in Niger. Note that the selection of countries into this analysis is driven by data available. All countries that had the relevant questions in the survey instrument were included.

Table 1: Summary and background information of data used from DHS surveys

	Year of survey	Number of households	GNP per capita-1990s average (PPP, $1995)	Under-5 mortality	Popula-tion below the poverty line	Year	Popula-tion below $1 a day	Popula-tion below $2 a day	Year	Analysis of incidence	Analysis of treatment
Benin	1996	4,499	798	184	33	1995				√	
Burkina Faso	1992/3	5,143	813	187			61	86	1994		√
Burkina Faso	1999	4,812	813	224						√	
Cameroon	1991	3,358	1412	126	40	1984					√
Cameroon	1998	4,697	1412	146						√	
C.A.R.	1994/5	5,551	1085	157			67	84	1993	√	
Chad	1996	6,840	829	201	64	1995/6				√	
Cote d'Ivoire	1994	5,935	1372	150			12	49	1995	√	√
Ghana	1993	5,822	1646	119	31	1992					√
Ghana	1998	6003	1646	110						√	
Mali	1995/6	8,716	653	252			73	91	1994	√	
Niger	1992	5,242	723	318	63	1989/93	61	85	1995		√
Niger	1997	5,242	723	303						√	
Nigeria	1999	7,647	737	133	34	1992/3	70	91	1997	√	√
Senegal	1992/3	3,528	1223	131	33	1991	26	68	1995	√	√
Togo	1998	7,517	1337	144	32	1987/9				√	
Comoros	1996	2,252	1586	113						√	
Kenya	1998	8,380	948	105	42	1992	27	62	1994	√	√
Madagascar	1992	5,944	751	163	70	1993/4	60	89	1993		√
Madagascar	1997	7,171	751	164						√	
Malawi	1996	2,798	526	234	54	1990/1				√	√
Mozambique	1997	9,282	612	219			38	78	1996	√	
Rwanda	1992	6,252		150	51	1993	36	85	1983/5	√	√
Tanzania	1991/2	8,327	446	141	51	1991	20	60	1993		√
Tanzania	1996	7,969	446	145						√	
Uganda	1995	7,550	934	156	55	1993	37	77	1992	√	
Zambia	1992	6,209	703	191	86	1993	73	92	1996		√
Zambia	1996/7	7,286	703	192						√	
Zimbabwe	1999	6,369	2460	90	26	1990/1	36	64	1990/1	√	√
Average*		6,081	1,003	171	48		46	77			
Std. dev.*		1,785	461	56	17		21	14			
Median*		6,003	813	156	47		38	84			
Maximum		9,282	2,460	318	86		73	92			
Minimum		2,252	446	90	26		12	49			

*Sources: GNP per capita from World Development Indicators (World Bank, 1999). Poverty rates from World Bank (2000). DHS information from DHS Final reports and updates from www.measuredhs.com (Macro International, various years). * Unweighted.*

Data on the incidence of fever

In general the DHS in Sub-Saharan Africa interview all women 15-49 about a variety of issues relating to their fertility preferences, contraceptive behavior, and reproductive and child health. The data analyzed here on the incidence of fever are derived from questions asked of mothers of all children born in the past three or five years, depending on the survey. For consistency, the analysis this paper is restricted to children under the age of three. The exact formulation of the question about fever varies somewhat across countries, but the typical questionnaire will ask whether the child had an episode of fever in the past 2 weeks. Subsequently, the respondent will be asked whether the episode of fever was accompanied by a cough and shortness of breath.

The focus on self-reported episodes of fever in this paper is completely data driven. The DHS data offer a unique large database in order to analyze patterns of incidence and treatment in a consistent way across countries. The price to pay though is that defining fever as the outcome to study is the closest proxy to malaria one can get consistently across countries.

All fever is clearly not malaria. Brinkmann and Brinkmann (1991), after reviewing a substantial volume of literature, estimate that malaria is responsible for 40 percent of episodes of all fever in Africa. Focusing on fever as a marker for malaria in areas or seasons of high malaria endemicity is not without justification however. The World Health Organization (WHO) recommends that in such areas all patients with fever or history of fever be treated with anti-malarials (Schapira, 1994). A recent review of the guidelines for Integrated Management of Childhood Illness (IMCI) (Gove, 1997) summarizes the recommended sequence leading to the delivery of oral antimalarials in the presence of fever that is not classified as very severe febrile disease. The recommendations (reproduced in Appendix Table 1) are to treat presumptively for malaria if (1) in high malaria-risk areas, the patient presents with fever, without any general danger sign or stiff neck and without cough with fast breathing and (2) in low malaria-risk areas, the patients presents with fever, without any general danger sign or stiff neck, and without runny nose, measles, other known cause of fever, no cough with fast breathing. In order to be encompassing, this paper uses all episodes of fever as the outcome measure. In some cases results for fever without a cough are presented as well. While there is a difference in the incidence of fever and fever without a cough, the patterns across groups are not substantively different. As the figure (reproduced from MARA, 1998) in Annex 1 shows, the areas of Sub-Saharan Africa under study here are virtually all in areas which are suitable to stable malaria).[1]

Although this approach to identifying malaria is in line with the IMCI recommendations, it is certainly not perfect. For example, a validation of the IMCI protocol for minimally trained health workers was compared to a physician's assessment in a high malaria transmission area of Kenya (Perkins et al, 1997). That study found that of 1674 patients presenting with fever, all but one were classified as having malaria or as having "fever requiring referral" with 96 percent in the former category. A physicians assessment (based on measurement of temperature, hemoglobin determination, blood smear for malarial parasites and chest X-ray) determined that 456 (27 percent) were unlikely to have malaria, and that as many as 16 percent of cases had "fever requiring referral".

The DHS rely not on third-party health worker or doctor assessments of health status, but on the report of mothers on the fever episodes of their children. This introduces two additional potential sources of error. Do mothers recognize fever in their children, and is there a systematic bias in which mothers recognize fever – and in particular, is this related to household wealth?

First, do mothers (or care-givers) recognize fever in their children? A recent exchange in The Lancet set off by Einterz and Bates (1997) comes to no firm conclusion, and this paper will certainly not resolve the issue. Table 2 summarizes the main results pertaining to children to come out of the exchange. While the studies are not entirely comparable (e.g. differences in study methodology, differences in overall percentage of population with fever) they are consistent in finding that among children with measured fever (actual temperature of 37.5^{o}C or higher) parents (or carers) tend to report fever accurately most of the time, in the cases here between 78 and 98 percent of the time. On the other hand, among children without fever, anywhere from almost none to almost all of the children are reported to have a fever. Note that so far this is consistent with a bias towards reporting fever, even when it isn't true. Since such a

[1] Northern regions of Chad, Mali, and Niger are notable exceptions. Northern Mali is excluded by virtue of DHS sample design, and northern Chad and Niger are excluded in the geographic analysis in this paper. In the

bias would tend to reduce the variation in reported fever, this would tend to dampen any subsequent study of the correlation of fever with other factors.

Table 2: Summary of results on sensitivity and specificity of reported and measured fever in three studies.

	Number of children	Overall percentage with measured fever	Percentage with measured fever who are reported to have fever ("sensitivity")	Percentage without measured fever who are reported to have fever (100-"specificity")
Patients, district hospital in northern Cameroon, children under 5.	494	34	92	56
Two communities in southern Ghana, children under 5.	1714	3.5	78	0.8
Health Center in the outskirts of Bissau, Guinea-Bissau, "children" with symptoms compatible with malaria.	203	81	98	97

Sources: Einterz and Bates (1997), Dunyo et al (1997), Verhoef et al (1998), Koefoed et al (1998).

An additional complication is the fact that individuals of different socio-economic backgrounds might report a true episode of fever differently, and that a subsequent analysis of the correlation of fever with these socio-economic variables would be biased in the direction of the selective reporting. While the issue of self-selective reporting is frequently cited as a cause for worry, there has been little systematic investigation of how severe a problem this might be. Studies typically conclude that more easily observed symptoms are less likely to suffer from self-selection (for examples of studies addressing this issue see Butler et al 1987 for an example from the United States and Deolalikar 1998, Sindelar and Thomas 1991, and Strauss and Thomas 1996 for discussions relating to poor countries). The DHS data cannot be used to test or correct for whether fever is recognized more systematically by mothers from richer households which would dampen a relationship between fever and poverty. However, the multivariate analysis will control for mother's education which would likely capture a large part of the self-selective nature of reporting.

The sample-wide percentage of children reporting any fever in the past two weeks is high (Table 3).[2] The average for Western and Central African countries is 35 percent with a rural-

multivariate analysis, dummy variables for national sub-region will adjust for this.

[2] DHS surveys frequently use a weighting scheme to adjust sample to population averages. These weights are used in this analysis. See discussion below on cross-country weights.

urban differential on the order of 6 percentage points. Among these countries, Ghana has the lowest reported level of fever (29 percent) and Benin has the highest (55 percent). In the Eastern and Southern African countries the overall level is slightly higher, with a smaller rural-urban difference. The range is narrower, with Zimbabwe at the low end (31 percent) and Uganda at the high end (50 percent). While the average rural-urban differential is smaller than that in Western and Central Africa it is still large in some countries. For example in Malawi and Uganda it is about ten percentage points.

Table 3: Percentage of children under 3 who are reported to have had an episode of fever (and fever without a cough) in the past two weeks

		Any fever			Fever without a cough		
Country	Year	Total	Rural	Urban	Total	Rural	Urban
Benin	1996	54.5	57.8	47.3	26.1	27.9	22.4
Burkina Faso	1999	41.0	41.8	34.1	14.4	14.5	13.2
C.A.R.	1994-95	35.7	36.3	34.8	5.0	6.0	3.4
Cote d'Ivoire	1994	44.2	46.3	39.8	19.5	20.8	16.8
Cameroon	1998	30.8	31.1	30.2	11.7	12.1	10.5
Ghana	1998	29.0	29.8	26.4	14.9	15.4	13.5
Mali	1995-96	39.3	41.2	34.1	19.8	20.8	17.0
Niger	1997	49.4	51.1	41.2	28.9	30.1	22.9
Nigeria	1999	31.2	32.6	27.3	17.6	18.5	15.3
Senegal	1992-93	45.7	48.3	40.8	17.8	18.4	16.8
Chad	1996	36.9	36.9	36.6	19.9	20.0	19.5
Togo	1998	37.7	37.7	37.8	15.9	16.5	14.0
All		35.3	36.8	31.3	17.8	18.7	15.5
Comoros	1996	48.7	48.8	48.4	17.9	18.5	16.0
Kenya	1998	42.9	42.9	43.2	16.8	16.6	17.5
Madagascar	1997	32.7	33.1	31.0	9.8	10.2	8.1
Mozambique	1997	44.7	43.2	50.4	19.2	21.2	11.8
Malawi	1998	47.6	48.8	37.5	12.0	12.1	11.2
Rwanda	1992	48.6	49.0	39.2	11.8	11.7	14.2
Tanzania	1996	35.8	35.7	36.1	12.8	13.0	12.0
Uganda	1995	50.3	51.5	40.6	14.6	14.8	13.0
Zambia	1996-97	46.4	47.6	44.5	17.2	19.1	14.2
Zimbabwe	1999	31.1	32.5	28.2	8.3	7.4	10.2
All		41.9	42.4	39.3	14.1	14.4	12.7

Sources: Author's calculations from DHS data. Notes: Data are weighted. See next section for discussion of weights.

In Western and Central Africa roughly half of all fevers are unaccompanied by a cough, and this ratio does not vary substantially across urban and rural areas. There is some variation in this ratio across countries, mostly between 35 percent in Burkina Faso and 59 percent in Niger and Ghana. The exception is C.A.R. where only 14 percent of all fevers are reported to be without a cough.[3] In Eastern and Southern Africa roughly one-third of all fevers are unaccompanied by a cough, ranging from 24 percent in Rwanda to 43 percent in Mozambique.

Methodological issues: aggregating over regions and ranking by households wealth.

Before proceeding with the analysis of the correlates of fever (and subsequently of its treatment) two methodological issues need to be addressed. First, the analysis will be undertaken for "Western and Central Africa" and "Eastern and Southern Africa" as regions – pooling the data across countries – and in order to do so the data needs to be weighted appropriately. Second, although DHS data include very detailed and useful health data, the traditional measure of household long-run income, consumption expenditures, is not collected in the data.

First on the issue of pooling data. Many DHS collect weights in order for sample averages to represent nationwide averages. For example in some countries urban areas are over-sampled and weights will adjust for this. In pooling the data across countries one needs to adjust, in addition, for the fact that the sample size relative to the population varies in the different countries. Observations from a country where the sample is only a very small percentage of the population need to be inflated relative to those in a country where a relatively large percentage of the population was sampled, and *vice versa*. For example, the Nigeria 1999 sample corresponded to 0.031 percent of Nigeria's population whereas the Togo 1998 sample equaled 1.016 percent of Togo's population. Annex 2 describes the derivation of weights in more detail.

The second methodological issue that needs to address is the lack of consumption expenditures in DHS data. Standard studies of the correlates of poverty use consumption expenditures as a measure of long-run income (see discussion in Deaton, 1997). In work analyzing inequalities in outcomes, differences in outcomes across consumption-expenditure quintiles are typically compared. Such an analysis is impossible using the DHS data. This paper uses an approach based on an index of assets owned by household members as well as housing

[3] C.A.R. has a slightly different questionnaire design. If treatment was sought then respondents were asked how much was spent on treatment. It is unlikely though that this would have affected the percentage reporting no cough

characteristics advocated and applied in Filmer and Pritchett (1999, 2001) for the analysis of inequalities in education outcomes. A similar wealth asset index approach has also been used by others to analyze health outcomes in DHS data, for example child mortality in Bonialla-Chacin and Hammer (1999), child survival in Uganda in Stecklov et al (1999), child anthropometric outcomes in Wagstaff and Watanbe (1999), and to document inequalities in a variety of health outcomes and behaviors in Gwatkin and others (2000). Sahn and Stifel (2000) use a similar approach to analyze poverty directly.

The DHS typically collect information on whether or not any household members own each of a set of basic assets (radio, refrigerator, television, bicycle, motorcycle, car) and basic characteristics of the dwelling in which the household lives (whether or not the house has electricity, the number of rooms per person, and whether or not the dwelling has floors made of a "finished" surface). In order to use these variables to rank households by their economic status, they need to be aggregated into an index, and a major problem in constructing such an index is choosing appropriate weights.[4] This is done here using the statistical technique of principal components. Principal components is a technique for summarizing the information contained in a large number of variables to a smaller number by creating a set of mutually uncorrelated components of the data. Intuitively, the first principal component is that linear index of the underlying variables that captures the most common variation among them.

The details of the methodology are in Filmer and Pritchett (2001). That paper also describes how in three datasets (from Indonesia, Nepal, Pakistan) where there was both consumption expenditure and asset data, Spearman rank correlation coefficients between ranking households by the asset index and ranking them by expenditures adjusted for household size were 0.64 in Nepal, 0.56 in Indonesia, and 0.43 in Pakistan. Additional work using Living Standards Measurement Study (LSMS) data for 7 countries (Filmer and Scott, 2001) found that rank correlation coefficients between a similar wealth index and household per capita consumption expenditures were 0.72 in Brazil, 0.25 in Ghana, 0.72 in Panama, 0.67 in South

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with a fever.

[4] If these assets were only to be used to examine the impact of some other factor (e.g., maternal education) as a "control" for wealth in a multivariate regression we would not need to aggregate the variables (see Montgomery et al. 2000)

Africa, 0.59 in Vietnam, and -0.41 in Kyrgyzstan. Except for Kyrgyzstan, which may have a different structure of its economy, and Ghana, where the data are somewhat suspicious, the rank correlations hover around 0.6 in most of the countries. In the context of education outcomes, Filmer and Pritchett (2001) argue that in the three countries studied the wealth index performs as well as household-size-adjusted consumption expenditures, in predicting educational enrollment and attainment.[5]

Table 4 reports the "factor scores" for the first principal component in the analysis of the Western and Central Africa and Eastern and Southern Africa data. In both regions, the first principal component captures about 30 percent of the variation in the data. The factor scores, which are in essence the weights in the aggregation of the assets into the index, all have the expected sign (except for owning a bicycle in Western and Central Africa, which could reflect the fact that poorer households are more likely to own a bicycle whereas richer households may be more likely to own a motorcycle or a car instead). Although the results imply that the second eigenvalue is greater than one (the usual value used as a cutoff for "relevant" components) the difference between the first and second eigenvalues is large, lending support to the notion that the first is capturing a significantly larger part of the important information in the asset and housing variables.[6]

In order to define quintiles, *individuals* are sorted by the wealth index within each region, and cutoff values for the quintiles of the population are derived. Households are then assigned to each of these groups on the basis of their value of the asset index.[7] The interpretation is therefore that the poorest quintile is the group in which the poorest 20 percent of the population live. Note that the use of the term "poor" here differs from the usual notion derived from being

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[5] Unlike Filmer and Pritchett (2001) water and sanitation variables have not been included in the set of variables used to derive the index as these likely have direct effects on health status. They are included as individual variables in the multivariate analysis however.

[6] Principal components in typically derived for continuous variables. Monte Carlo simulations comparing the first principal component derived from (1) continuous variables to (2) dummy variables with the same mean (derived from the ranking of the continuous variables) yields very similar factor loadings across the different types of variables, and the pairwise correlation (across replications) between the loading from a continuous variable and weight on the corresponding dichotomous variable are very high as well, on the order of .9.

[7] This method of ranking households is analogous to fairly standard approaches which use consumption expenditure quintiles.

below a poverty line. In this analysis, it refers to the population that lives in households with low values of the wealth index.

Table 4: Factor scores for first principal component from analysis of pooled Western and Central Africa and Eastern and Southern Africa data

	Western and Central Africa	Eastern and Southern Africa
Own a radio	0.346	0.351
Own a refrigerator	0.431	0.461
Own a television	0.479	
Own a bicycle	-0.047	0.072
Own a motorcycle	0.169	0.185
Own a car	0.292	0.396
House has electricity	0.453	0.507
Number of rooms per person	0.046	
Floor is made of "finished" surface	0.376	0.459
Proportion of variation explained by first principal component	33.1	34.7
Value of first eigenvalue	2.98	2.43
Difference between first and second eigenvalue	1.75	1.28
Number of households	71,673	65,309

Source: Author's calculation from pooled and weighted DHS data.

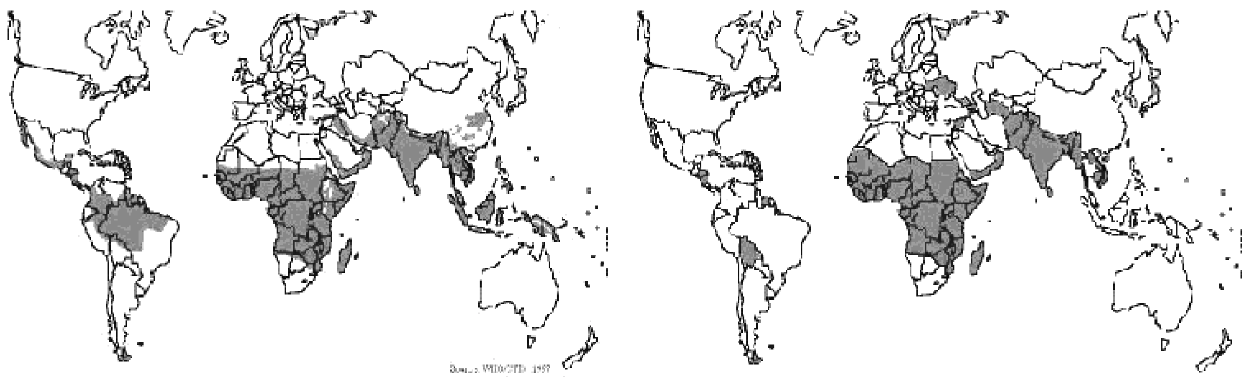
2) Fever and poverty: Bivariate and multivariate analysis.

This analysis uses both a bivariate and a multivariate approach to analyzing the links between poverty and fever (and subsequently its treatment). The bivariate approach allows us to investigate to what extent fever and its treatment "move" with poverty, that is investigate the proposition that the rich suffer less from illness, or seek treatment more if ill. The multivariate approach allows one to disentangle the partial association of fever and its treatment with poverty after controlling for factors which may be correlated with household wealth and have independent relationships to fever. This approach allows one to investigate the degree to which the observed association is determined by other variables – such as mother's education for example.

At the global level, there is no doubt that malaria and poverty go together. As Figure 1 shows dramatically (a point made by Gallup and Sachs, 1998): in general, the countries where malaria is transmitted are also poor countries. While the relationship is not perfect, it does show that a focus on malaria is a focus on the world's poor.

Figure 1: In general, countries with malaria are also poor countries.

Malaria transmission areas | Countries with GNP per capita of less than $3000 (PPP)



Sources: WHO/CTD (1997) and World Bank (1999).

Geographic distribution of fever and poverty

Turning back to the DHS data, now that we have an indicator of fever and a measure of wealth, we can look at the relationship between the two within the two large regions of Sub-Saharan Africa. First, analogously to the world map, consider the geographic distribution of fever and poverty. Overall the numbers do not support the notion that there is a strong association between the incidence of fever and the wealth of the area in which the child lives. Figure 2 shows the distribution of the incidence of fever in the past two weeks among children under 3 and of the proportion of the population in the by poorest quintile by geographic sub-regions.[8]

While there are some sub-regions that are both poor and have a lot of fever, there is not an overwhelming resemblance between the figures in either of the regions. This impression is confirmed by examining the correlation between the two variables in each region (Table 5).

Table 5: Correlation coefficients between percentage poor and incidence of fever (and fever without a cough) in children under 3 in sub-region.

	Any fever		Fever without a cough	
	Correlation coefficient	P-value	Correlation coefficient	P-value
Western and Central Africa	.035	.760	.217	.052*
Eastern and Southern Africa	.218	.059*	.215	.062*
Excluding Madagascar	.300	.012**	.345	.003**

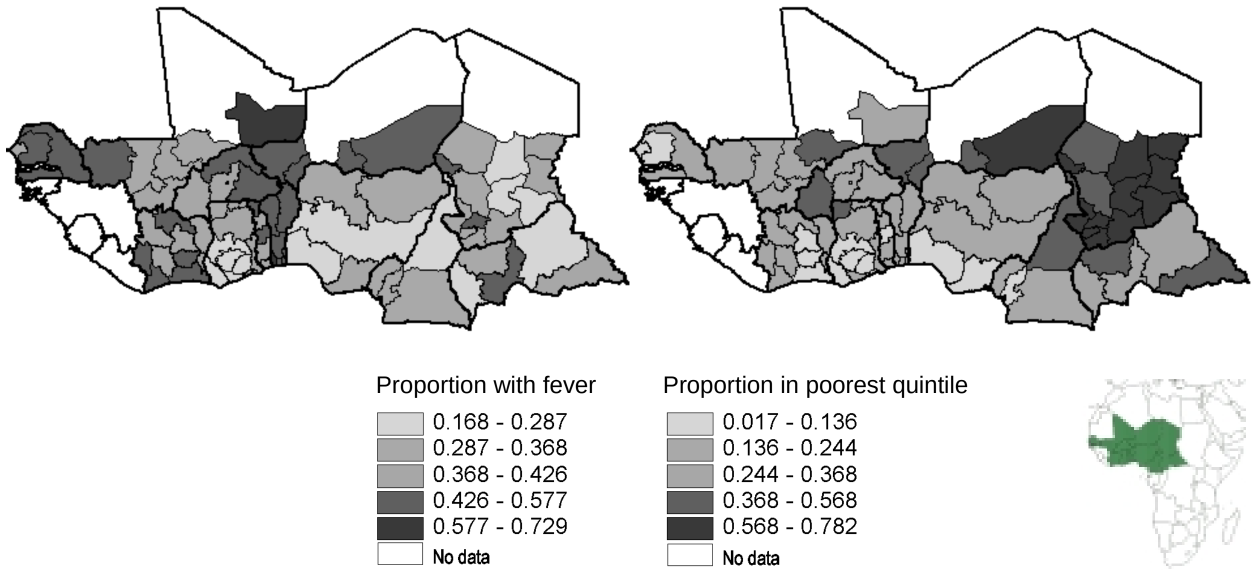
*Source: Author's calculations from pooled and weighted DHS data. **(*) Significantly different from zero at 5(10) percent level.*

[8] Geographic sub-regions are generally administrative provinces or regions of countries reported in the surveys. The breakdown is reported in Annex 3.

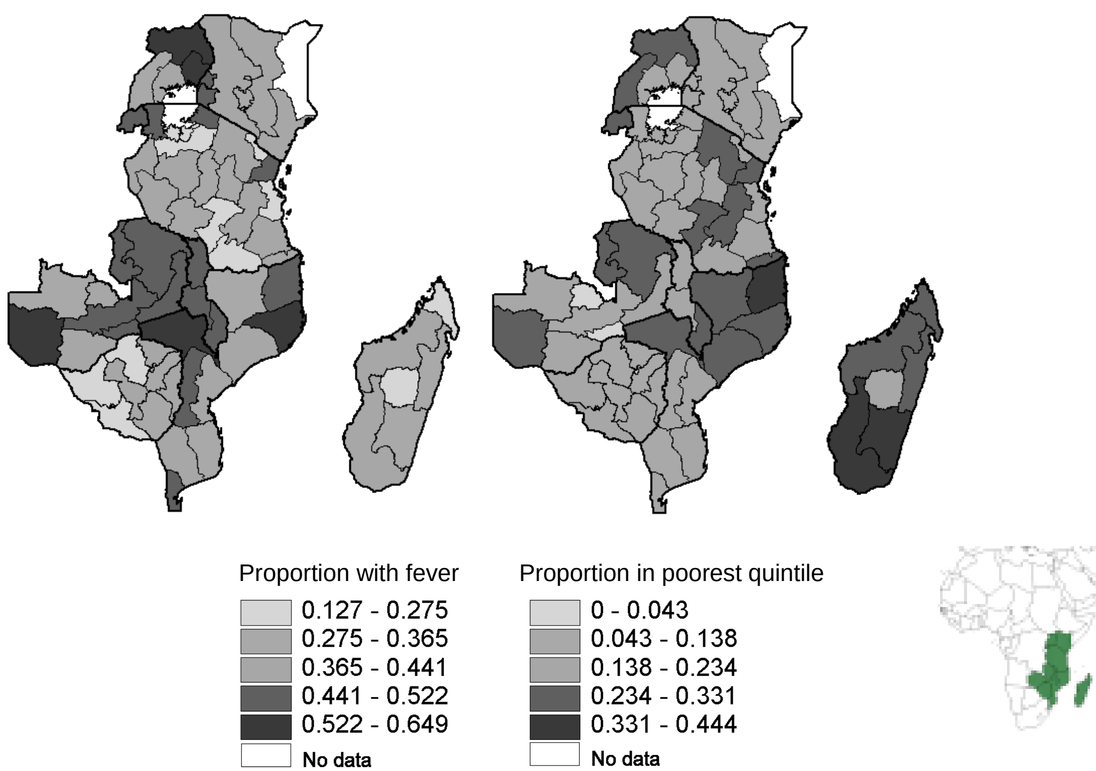
Figure 2: Fever and poverty in Sub-Saharan Africa:
Proportion of children under 3 who had a fever in the past two weeks and proportion of population in the poorest quintile.

Fever | Poverty

Western and Central Africa



Eastern and Southern Africa



Western and Central Africa and is significant at the 10 percent level in Eastern and Southern Africa, but small in magnitude. Since Madagascar stands out on the map as an area with a low level of fever but a high level of poverty, it was temporarily removed from the sample on the theory that it may be capturing a different relationship than on the continent. When it is removed the magnitude of the correlation increases, and the relationship becomes significant at the 5 percent level. Of course, this two-way relationship is picking up many confounding factors. For example, in a simple regression that includes the average years of schooling of the mothers in the sample the association becomes negative and significant in Western and Central Africa and insignificant in Eastern and Southern Africa (Table 6). After excluding Madagascar, the relationship is positive but insignificant in Eastern and Southern Africa. The relationship with average education of mothers is statistically significant in the expected direction: higher education is associated with a reduction in the reported incidence of fever.

Table 6: OLS regressions of average incidence of fever in sub-region on average poverty and average mothers' education.

	Fever			Fever without a cough		
	Western and Central Africa	Eastern and Southern Africa	Eastern and Southern Africa Excl. Madagas car	Western and Central Africa	Eastern and Southern Africa	Eastern and Southern Africa Excl. Madagas car
Proportion in poorest quintile	-0.134	-0.058	0.059	0.008	-0.019	0.083
	(2.25)*	(0.35)	(0.33)	(0.20)	(0.22)	(0.88)
Average years of schooling of mothers	-0.027	-0.021	-0.020	-0.011	-0.010	-0.009
	(4.19)**	(2.70)**	(2.51)*	(2.38)*	(2.46)*	(2.16)*
Constant	0.479	0.504	0.484	0.196	0.189	0.169
	(16.91)**	(8.17)**	(7.67)**	(9.96)**	(5.77)**	(5.08)**
Observations	81	76	70	81	76	70
R-squared	0.18	0.13	0.17	0.11	0.12	0.18

*Source: Author's calculations from pooled, and weighted and aggregated DHS data. Note: Absolute value of t-statistics in parentheses; * significant at 10%; ** significant at 5%.*

Bivariate relationship between fever and poverty at the individual level

Abstracting from geography, Table 7 reports the percentage of children under 3 who have had a fever in the past two weeks by quintile. This bivariate relationship conforms to the geographic results: although the incidence is generally larger in the poorest quintile than in the richest quintile, there is not a strong relationship between fever and poverty in either region. In Western and Central Africa, 28 percent of children in the richest quintile are reported to have had a fever in the past two weeks whereas almost 38 percent of children in the poorest quintile are. In Eastern and Southern Africa the percentage is 36 percent for the richest quintile and 42 for the poorest.

Table 7: Percentage of children under 3 who are reported to have had a fever (and fever without a cough) in the past two weeks by quintile ranking of household.

	Poorest	Quintile 2	Quintile 3	Quintile 4	Richest	Poorest-Richest
Western and Central Africa						
Any fever	37.6	39.5	37.7	32.1	27.9	9.7
Fever without a cough	19.1	19.8	18.2	17.2	13.9	5.2
Eastern and Southern Africa						
Any fever	41.7	42.6	43.5	43.9	36.4	5.3
Fever without a cough	13.4	14.0	14.3	15.5	12.7	0.7

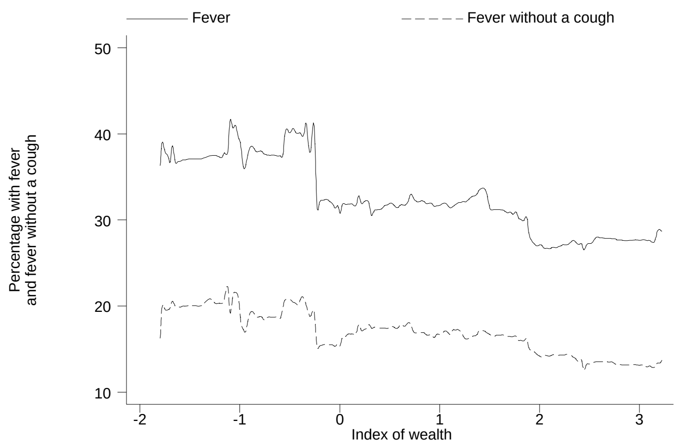
Source: Author's calculation from pooled and weighted DHS data.

The change does not appear to be uniform across the distribution. In Western and Central Africa the percentage with a fever goes from 38 to 32 percent between the third and fourth quintiles, and in Eastern and Southern Africa it goes from 44 to 36 percent between the fourth and fifth (richest) quintiles. Across the remainder of the distribution the level is almost flat – with a slight increase between the first and second quintile. Because differences in absolute levels of wealth can be small between one quintile and the next, quintiles can distort one's impression of the relationship. Figure 3 shows a non-parametric estimate of the incidence of fever (and fever without a cough) for each value of the wealth index.[9] The visual impression of these graphs is that of a weak downward slope suggesting that the quintiles may indeed lead one to understate the differential across the distribution.

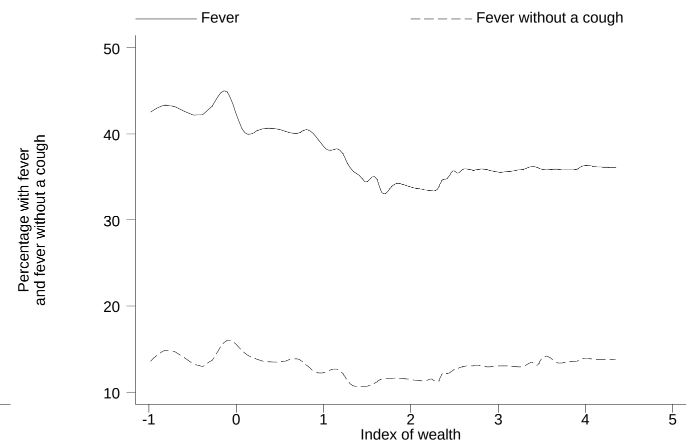
[9] The estimate is a moving average estimate of the percentage who report fever across the wealth distribution and includes about 5 percent of the sample for each estimate (2501 observations in Western and Central Africa and 2001 observations in Eastern and Southern Africa). Point estimates are then connected with a cubic spline.

Figure 3: Percentage of children under three who were reported to have a fever (and fever without a cough in the dotted line) in the previous two weeks: moving average estimates across the wealth distribution.

Western and Central Africa



Eastern and Southern Africa



Multivariate relationship between fever and poverty at the individual level

The results so far indicate a weak (although sometimes statistically significant) relationship between the geographic distribution of fever and poverty and in the bivariate relationship across the wealth distribution. The analysis has not, however, controlled for background characteristics and location of residence: that is, given a set of individual and household background characteristics, is being from a richer or poorer household associated with a lower the incidence of fever for a given child? In order to investigate this proposition, the following model was estimated for each of the regions:

$$F_{icr}^* = b_1 \times W_{icr} + b_2 \times W^2_{icr} + c_1 \times CW_{icr} + c_2 \times CW^2_{icr} + f \times CF_{cr}$$
$$+ a \times X_{icr} + \sum_{k=2,R} d_r \times D_r + u_{icr} \qquad (1)$$

where F_{ir}^* is an unobserved variable whose observed counterpart, whether or not a child – indexed by *i*, in cluster *c*, in sub-region *r* – had an episode of fever, is defined as

$F_{icr} = 1$ if $F_{icr}^* >= 0$

$= 0$ otherwise.

Wealth effects are specified by including the child's household wealth index (W) and its square (W^2). An additional specification includes the average level of wealth of other households in the cluster in which the child lives (CW) and its square (CW^2) as well as the average level of fever among children from other households in the cluster (CF) to control for the overall local level of fever.[10] Child and household background variables (X) include the child's age in months, age in months squared, the child's gender, the child's mother's years of schooling, her husband's (or partner's) years of schooling, a dummy variable equal to one if the household gets its drinking water from a covered source (such as a tap or a pipe as opposed to a well or a stream), a dummy variable equal to one if the household has a flush toilet or a pit latrine (as opposed to no toilet facilities), and a dummy variable equal to one if the child resides in an urban area. Last, in order to control for district level variables, a set of dummy variables D_r

for each of the R sub-regions (the areas shown in Figure 2) is included in the regression as well (one excluded sub-region constitutes the reference category). These will capture general area effects, and the resulting partial relationships for the other variables are therefore estimated conditional on the sub-region of residence.

Table 8: Probit estimates of the relationship between fever, wealth and background characteristics

	Western and Central Africa		Eastern and Southern Africa	
	(1)	(2)	(3)	(4)
Wealth index	-0.024	-0.029	-0.011	0.004
	(1.33)	(1.60)	(0.62)	(0.22)
Wealth index squared	-0.000	0.004	-0.003	-0.002
	(0.01)	(0.54)	(0.91)	(0.61)
Cluster mean wealth index		0.017		-0.057
		(0.72)		(2.17)**
Cluster wealth index squared		-0.016		0.001
		(1.61)		(0.10)
Cluster proportion with fever		0.794		0.585
		(9.07)**		(8.68)**
1 = Male	0.055	0.055	0.030	0.028
	(2.48)**	(2.46)**	(1.56)	(1.45)
Age (months)	0.065	0.066	0.065	0.066
	(12.35)**	(12.55)**	(16.88)**	(16.93)**
Age squared (months)	-0.002	-0.002	-0.002	-0.002
	(12.33)**	(12.51)**	(16.97)**	(17.02)**
Mother's schooling (yrs)	-0.001	-0.001	-0.012	-0.010
	(0.18)	(0.15)	(3.03)**	(2.64)**
Husband's schooling (yrs)	-0.000	-0.001	0.001	0.001
	(0.04)	(0.22)	(0.38)	(0.37)
1= Drinking water covered	-0.003	0.010	0.024	0.024
	(0.08)	(0.28)	(0.93)	(1.03)
1= Toilet flush or pit latrine	0.057	0.055	0.004	0.011
	(1.44)	(1.65)*	(0.13)	(0.38)
1 = Urban	-0.085	-0.069	0.007	0.057
	(1.63)	(1.55)	(0.19)	(1.65)*
Constant	-0.781	-1.084	-0.207	-0.582
	(7.08)**	(11.27)**	(1.21)	(4.00)**
Model includes dummy variables for sub-region and constant term (not reported)				
Observations	38916	38828	29035	28984
Joint tests (p-values)				
Own wealth	0.13	0.20	0.04**	0.76
Cluster wealth		0.27		0.01**
Cluster variables (wealth and fever)		0.00**		0.00**

*Notes: Model includes dummy variables for region (not shown) and a dummy variable for husband's data available. Robust z-statistics in parentheses. * significant at 10%; ** significant at 5%. Source: Author's calculations from pooled and weighted DHS. T-statistics, adjusted for clustering are reported in parentheses.*

[10] Clusters are the lowest level from which a sample of households is drawn – i.e. these are typically the primary sampling unit in the data. There are typically about 20 households in a cluster. The word "cluster" is used interchangeably here with the word "community".

The results, reported in Table 8, again show a weak association between the reported incidence of fever and the household's wealth conditional on the control variables. In the models without cluster variables the relationship is small and negative, and the coefficients on the wealth variables are jointly significant at the 5 percent level in Eastern and Southern Africa. With cluster variables the association is negative in Western and Central Africa and positive in Eastern and Southern Africa, but in both regions the wealth variables are jointly insignificantly different from zero.[11] The wealth of other households in the cluster is significantly negatively associated with fever in Eastern and Southern Africa but insignificantly so in Western and Central Africa. The models consistently find a significant relationship between fever and the incidence of fever in other households in the cluster. While this may not appear to be surprising, recall that this is conditional on many other individual, household, cluster, and regional characteristics – suggesting a strong underlying geographic concentration of episodes of fever.

Male children have statistically significant higher reported incidence of fever in Western and Central Africa, but the differential is small with the average predicted probability going from 34 for girls to 36 for boys. In Eastern and Southern Africa the relationship is insignificant, although it is positive as well. Age has a statistically significant inverse-U shaped relationship with incidence in both regions, with the highest incidence occurring at 16 months. Mother's years of schooling is significantly negatively related to the reported incidence of any fever in Eastern and Southern Africa but the magnitude of the effect is not large. The average predicted probability of fever setting the education of all mothers to zero is 44 percent whereas it is 41 percent setting the education of all mothers to 6 years, i.e. only about a three percentage point differential for 6 years of schooling. The mother's husband's (or partner's) education is insignificantly related to the incidence of fever.

[11] An alternative specification that includes wealth as dummy variables for quintile produces results that are qualitatively similar.

Country by country results

It is possible that there are too many confounding factors that would be obscuring a significant relationship. In particular, country-to-country differences in the exposure to malaria, in the support of the health care system, or relative position in the wealth distribution might not be well captured in the pooled model above (despite the dummy variables for sub-regions). In addition, the pooled approach to estimating wealth might overemphasize differences between countries compared to smaller differences within countries. Therefore, these country-by-country regressions used a wealth index that was recalculated country by country. Table 9 reports the selected p-values of the joint tests of significance of the wealth and cluster-level wealth and fever variables in a model that also includes all the other control variables (see Table 8) and that allow all the coefficients to differ across countries.

Table 9: P-values of tests on wealth, average cluster wealth, and average cluster fever variables in country-by-country probit regressions of fever.

	Joint test on wealth and wealth squared	Joint test on cluster wealth and cluster wealth squared	Average cluster fever		Joint test on wealth and wealth squared	Joint test on cluster wealth and cluster wealth squared	Average cluster fever
Benin 1993	0.403	0.421	0.072**	Comoros 1996	0.567	0.848	0.097*
Burkina Faso 1999	0.701	0.677	0.000**	Kenya 1998	0.730	0.044**	0.001**
C.A.R. 1994-95	0.313	0.525	0.025*	Madagascar 1997	0.824	0.438	0.001**
Chad 1996	0.082*	0.307	0.000**	Mozambique 1997	0.978	0.450	0.900
Cote d'Ivoire 1994	0.195	0.133	0.245	Malawi 1996	0.948	0.996	0.067*
Cameroon 1998	0.069*	0.388	0.000**	Rwanda 1992	0.559	0.685	0.001**
Ghana 1998	0.431	0.137	0.172	Tanzania 1996	0.475	0.022**	0.054*
Mali 1995-96	0.773	0.160	0.000**	Uganda 1995	0.253	0.902	0.000**
Niger 1997	0.604	0.685	0.000**	Zambia 1996-97	0.175	0.276	0.000**
Nigeria 1999	0.529	0.055	0.000**	Zimbabwe 1999	0.869	0.583	0.125
Senegal 1992-93	0.423	0.166	0.000**				
Togo 1998	0.910	0.848	0.000**				

*Source: Authors' calculations from DHS data. Model includes individual, household and cluster variables as well as dummy variables for sub-regions (not reported, see Table 8 for list of variables). P-values are calculated adjusting for clustering. *(**) indicates underlying variables that are significantly different from zero at the 10(5) percent level*

Again, the results do not provide evidence for a strong relationship between reported fever and poverty. Wealth – both at the household and cluster levels – are typically not statistically significantly associated with fever. Chad and Cameroon are exceptions where household wealth is significant, and Kenya and Tanzania are exceptions where cluster wealth and fever are significantly related. On the other hand, the average level of fever in the cluster is significantly related to wealth (with the exception of Cote d'Ivoire, Ghana, Mozambique, and Zimbabwe).

3) Treatment seeking behavior and poverty

Seeking care for malaria

The focus on fever here is driven by its availability in the DHS data. Typically, however, episodes of fever are what prompt caregivers to seek treatment, and most often patients are treated presumptively (both by parents and medical personnel) for malaria. Based on their review of the literature, Brinkmann and Brinkmann (1991) conclude that between 8 and 25 percent of persons with malaria visit health services, with self-treatment being more common in urban than in rural areas (more than 60 percent versus between 2 and 25 percent). McCombie (1996) reviews the literature on treatment seeking for malaria and finds a substantial variation across countries. On average, close to 50 percent of cases rely exclusively on self-treatment – usually with antimalarials. Most episodes involve some form of self-treatment, which in general involves the purchase of drugs. The use the official health sector - hospitals, clinics, dispensaries, private practitioners, and village health workers – for treatment varied from 10 to 99 percent depending on the country and the type of study (with about half the studies finding more than 50 percent). Very few cases rely exclusively on traditional methods (or not even at all for uncomplicated malaria). The review also identified urban-rural differences as the most common source of variation across studies. McCombie (1996) also observes that the community prevalence of malaria reduced the probability of seeking care from a doctor. In general, "[…] experience with malaria affects treatment seeking behavior and leads to diffusion of information on how to treat it (op. cit. p. 941).

Other more recent household survey based studies conform to these results. In western Kenya 60 percent of fever episodes were treated at home with only 18 percent resulting in a visit to a health clinic or a hospital, with the remainder seeking no treatment (Ruebush and others 1995). In coastal Kenya 23 percent of mothers reporting that a child had malaria in the prior two weeks had taken the child to a health facility (Mwenesi and others, 1995). Fifty-four percent had given over the counter drugs to the sick child and 24 percent had given no treatment, or had given a home remedy. In southern Ghana fever is mostly treated at home with commonly available drugs and herbal remedies and a visit to a health center was the last resort after failure of home treatment (Ahorlu and others 1997). On the other hand, in Malawi a higher share of episodes, 52 percent, resulted in a visit to a clinic (Slutsker and others 1994). In that study higher socio-economic status was found to be positively correlated with clinic attendance.

DHS data on the treatment of fever

In a subset of the DHS questionnaires, mothers were asked to report what, if any, action was taken if they responded that their child had a fever in the past two weeks. Analyzing this data can be done for Burkina Faso 1992-93, Cameroon 1991, Cote d'Ivoire 1994, Ghana 1993, Niger 1992, Nigeria 1999, and Senegal 1992-93 in Western and Central Africa, and for Kenya 1998, Malawi 1996, Rwanda 1992, Madagascar 1992, Tanzania 1992, Zambia 1992 and Zimbabwe 1999 in Eastern and Southern Africa. Note that Niger, Madagascar, Tanzania and Zambia refer to a survey from a different year from that used in the incidence analysis.

Typically, the surveys will ask "did you seek advice or treatment for the fever" for a child who is reported to have had a fever in the past two weeks. In some cases, the question is asked whether the child is reported to have had a fever *or* a cough with rapid breathing in the past two weeks. In those cases where the child is reported to have had both a fever and a cough it is impossible to know whether the advice or treatment was sought for the fever and not for the cough. In this analysis we ignore the problem and look at the advice/treatment seeking behavior as long as the child is reported to have had at least a fever.

The types of modern sector facilities/persons that the mother can report having visited are grouped into: "higher level public" (i.e. government hospital); "lower level public" (e.g. government health center, government health post, mobile clinic, community health worker); "private medical" (e.g. private hospital/clinic, private doctor, private mobile clinic); "private commercial" (e.g. pharmacy, shop); and traditional healers. [12] In addition to these generic options, country specific options (for example a nurse's practice, public health post, and a pharmaceutical depot) have been mapped to the basic classification. Among the responses included in the "no modern sector" category are "no treatment or advice" and "advice from friends or family".

Table 10: Treatment/Advice sought as a result of a child under 3 having a fever in the past two weeks.

	No Treatment / Advice	Public, higher level	Public, lower level	Private, medical	Private, commercial	Traditional	Total
Western and Central Africa							
Burkina Faso 1992/3	76.6	1.7	16.5	1.7	0.0	3.5	100
Cote d'Ivoire 1994/5	15.0	26.8	32.1	17.5	5.4	3.3	100
Cameroon 1991	52.1	8.1	19.2	14.5	2.3	3.8	100
Ghana 1993	31.3	22.3	15.6	12.5	14.3	4.1	100
Niger 1992	74.4	0.1	10.7	8.7	3.8	2.4	100
Nigeria 1999	38.8	13.1	14.2	11.5	22.2	0.3	100
Senegal 1992/3	60.7	4.0	25.7	4.8	2.1	2.6	100
Total	43.0	12.2	15.7	10.9	17.0	1.2	100
Eastern and Southern Africa							
Kenya 1998	23.4	12.2	24.7	22.5	16.5	0.8	100
Madagascar 1992	49.4	13.1	18.5	13.7	2.6	2.7	100
Malawi 1996	31.1	3.1	16.0	17.2	31.1	1.5	100
Rwanda 1992	54.6	5.4	26.3	7.5	3.0	3.2	100
Tanzania 1991/2	35.7	10.7	40.2	9.1	2.6	1.7	100
Zambia 1992	22.1	9.4	40.9	19.1	6.2	2.3	100
Zimbabwe 1999	35.2	6.2	31.2	15.2	12.0	0.3	100
Total	33.2	9.5	29.2	15.6	10.9	1.6	100

Source: Author's calculations from pooled and weighted DHS data. The classification is: "higher level public" is government hospital, "lower level public" is government health center, government health post, mobile clinic, community health worker, "private medical" is private hospital/clinic, private doctor, private mobile clinic, and "private commercial" is pharmacy or shop. In some countries additional options have been mapped to this classification. The "no modern sector" category includes no treatment or "professional" advice and advice from friends or family.

Table 10 shows the basic results in on treatment seeking behavior in the study countries. There is about a ten percentage point difference between the two regions in the overall level of modern sector use. In Western and Central Africa about 56 percent of cases of fever resulted in a visit to the modern health sector, whereas in Eastern and Southern Africa about 65 percent of cases did.

[12] Private medical facilities may be "commercial" in nature. This terminology is used purely to distinguish the two types of private services here.

While the focus in this paper is on regional averages, the data do show wide variation across countries within each region. For example, 43 percent of cases of fever among children in Western and Central Africa did not result in any medical advice sought, but this ranges from 15 percent in Cote d'Ivoire to about 75 percent in Burkina Faso and Niger. The type of treatment sought clearly depends on country characteristics and policies. For example, 29 percent of cases of fever in children resulted in a visit to a lower-level public facility in Eastern and Southern Africa but this masks a range of 16 percent in Malawi to 41 percent in Zambia. The data are consistent in showing a very small degree of treatment or advice sought from traditional healers: on average 1.2 percent of cases in Western and Central Africa and 1.6 percent of cases in Eastern and Southern Africa.

Treatment of fever and household wealth.

Turn now to treatment seeking and poverty as shown in Figure 4 and Table 11.[13] The first striking result is that wealthier households are substantially more likely to seek treatment or advice in the modern sector in response to an episode of fever. In Western and Central Africa the percent who seek no modern sector care is 2.8 times as high in the richest than in the poorest quintile, 64 versus 23 percent, and in Eastern and Southern Africa it is 1.8 times as high, 41 versus 23 percent. There is quite a bit of differentiation across countries underlying these regional averages. In Western and Central Africa the smallest differential is in Senegal (1.4 times) and the largest is in Cote d'Ivoire (3.7 times). In Eastern and Southern Africa the ratio ranges from 1 in Zimbabwe to 2.6 in Zambia.

The second feature to emerge from Table 11 is the high degree of unequal usage of higher level public health facilities the rich and the poor. In Western and Central Africa, 25 percent of fever cases involving children from the richest quintile result in a trip to a government hospital, whereas among the poorest quintile the number is only 5.2 percent. In Eastern and Southern Africa the percentage among the rich is about 17 percent, but is 8.4 percent for the

[13] Since the datasets are different from the incidence analysis, the wealth index was recalculated on the pooled and re-weighted observations in the new set of countries/years. The principal components yields a very similar set of "weights" for the index. These are not reported here, but are available on request from the author.

poor. In both regions there is a substantial increase going from the fourth to the fifth (richest) quintile.

Figure 4: Type of treatment sought as a result of fever in the past two weeks

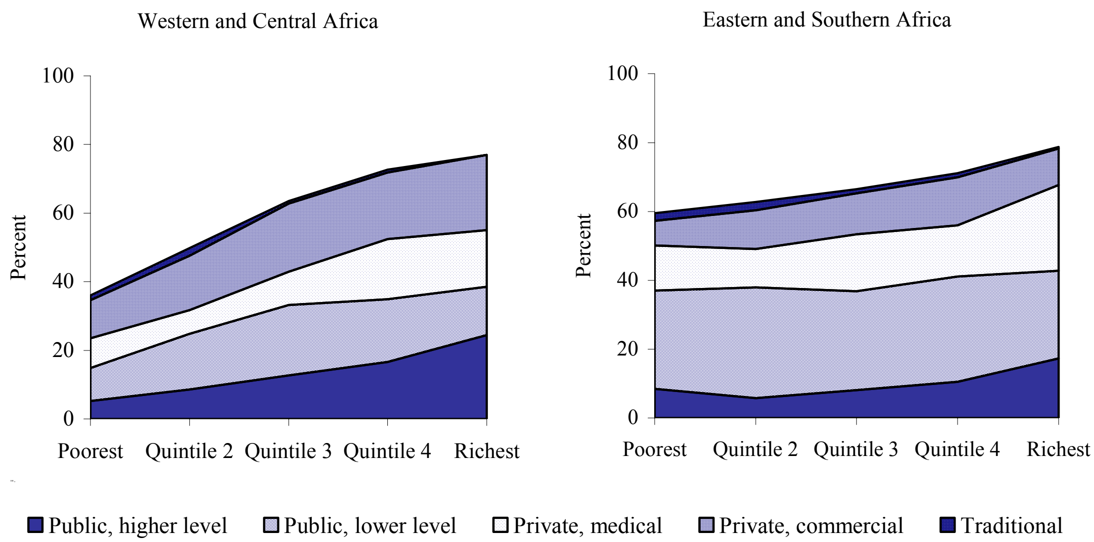


Table 11: Advice/Treatment sought as a result of a child having a fever in the past two weeks.

	No / Self treatment	Public, higher level	Public, lower level	Private, medical	Private, commercial	Traditional	Total
Western and Central Africa							
Quintile 1 (poorest)	64.2	5.2	9.7	8.6	11.1	1.4	100
Quintile 2	50.2	8.6	16.2	6.9	15.9	2.2	100
Quintile 3	36.5	12.7	20.5	9.7	19.9	0.7	100
Quintile 4	27.5	16.6	18.3	17.5	19.4	0.8	100
Quintile 5 (richest)	23.0	24.5	14.0	16.6	21.8	0.1	100
Total	43.0	12.2	15.7	10.9	17.0	1.2	100
Eastern and Southern Africa							
Quintile 1 (poorest)	40.5	8.4	28.6	13.1	7.2	2.2	100
Quintile 2	37.3	5.8	32.1	11.2	11.2	2.4	100
Quintile 3	34.4	8.1	28.7	16.5	11.9	1.3	100
Quintile 4	28.9	10.5	30.6	14.9	13.9	1.3	100
Quintile 5 (richest)	21.3	17.3	25.4	25.0	10.6	0.5	100
Total	33.2	9.5	29.2	15.6	10.9	1.6	100

Source: Author's calculations from pooled and weighted DHS data.

The use of lower level public facilities is greater than that of higher-level facilities, especially for the poorest groups in both regions. Perhaps surprisingly, however, in Western and

Central Africa there is a gradient whereby those from the middle quintiles lower level private facilities substantially more than the poorest – the differential is on the order of 4 percentage points (i.e. from 9.7 to 21 percent). This is not the pattern in Eastern and Southern Africa where the level of use of lower level public facilities is fairly constant at around 30 percent, falling slightly in the richest quintile.

Seeking treatment from private sources, either medical or commercial, is about 25 percent. In both regions the use of private facilities increases over most of the distribution, although it falls for commercial sources at the upper quintiles in Eastern and Southern Africa. This fall is (more than) made up for by an increase in the use of private medical facilities and government hospitals however. Overall in this region the use of all private facilities for treatment and advice increases from 17 percent in the poorest quintile to 28 percent in the richest. In Western and Central Africa the use of private facilities increases from 20 percent in the poorest quintile to 38 in the richest quintile.

Multivariate analysis.

Again, multivariate analysis can help sort out some of the confounding factors. The approach used here is to estimate a Multinomial Logit (MNL) model for the sample that reports having had fever in the past two weeks, i.e. an estimate of the correlates of treatment choice conditioned on the sample who were ill. The approach allows one to investigate the partial association between treatment choices and household wealth, after conditioning on the same set of variables as in the incidence analysis, i.e. observed individual, household characteristics, and cluster variables as well as controlling for the sub-region in which the individual lives (again through the inclusion of dummy variables).

Multinomial Logit estimates can be derived from what is known as the "random utility" model. For example, the utility from choice *j* for individual *i* am given as

$$U_{ij} = \beta_j \times Z_{ij} + v_{ij} \qquad (2)$$

where Z refers to all the regressors in the model (see equation 1). Under the assumption that the error terms (v) are identically distributed with a specific distribution, one can derive the expressions for the coefficients for each outcome, specifically:

$$\text{Prob}(Y_i = j) = \left(e^{\beta j \times Zij}\right) / \left(\sum_{j=1,J} e^{\beta j \times Zij}\right) \qquad (3)$$

The model is unidentified (i.e. there are many solutions yielding the same set of probabilities) and the usual way of estimating it is under the restriction that the coefficients for the "reference choice" are all equal to zero. The resulting coefficient estimates are therefore only interpretable relative to this base category. In this exercise the reference category has been set to those who sought no modern sector advice or treatment in response to an episode of fever.[14]

There are two major assumptions that are being made in this estimation. First, since the model is estimated conditional on the set of those reporting fever, the estimates will be biased if unobserved factor that determine fever (u s from equation 1) are correlated with unobserved factors determining treatment choice (v s from equation 2). In addition, the model assumes that the error terms from the different choices are uncorrelated (i.e. the v s from the different choices in equation 2), also known as the Independence of Irrelevant Alternatives (IIA) assumption. Therefore the Multinomial Logit model is estimated under the assumptions of no sample selectivity and independence of the errors in the choice model.

Tables 12 reports the results from the MNL estimation for the specification that excludes average cluster wealth and fever. The results confirm that the observationally large relationship of being in the richer quintiles in Western and Central Africa with the use of public care is significantly different from zero. In the MNL results, higher wealth is significantly associated with more public facility use – substantially more so for higher level services. In Eastern and Southern Africa, wealth is significantly positively associated with more public higher-level care, and private care from both medical and commercial sources. It is unrelated to public lower level care.

[14] Note that seeking care from traditional healers is grouped with no treatment in this part of the analysis. This is mostly because the multivariate choice analysis is difficult to identify when only few cases choose one particular choice.

Table 12: Multinomial logit estimates of treatment choice for children under 3 reporting fever in the past two weeks (no modern sector treatment is reference choice).

	Western and Central Africa				Eastern and Southern Africa			
	Public, higher level	Public, lower level	Private, medical	Private, commer-cial	Public, higher level	Public, lower level	Private, medical	Private, commer-cial
Wealth index	0.325	0.190	0.165	0.161	0.129	-0.016	0.121	0.146
	(2.58)**	(1.71)*	(1.24)	(1.29)	(1.75)*	(0.31)	(2.03)**	(1.83)*
Wealth index squared	0.040	-0.093	0.006	-0.087	-0.012	0.000	0.014	-0.038
	(0.61)	(1.60)	(0.08)	(1.21)	(0.59)	(0.02)	(0.79)	(1.59)
1 = Male	0.091	0.053	0.175	0.222	0.043	-0.004	0.023	-0.127
	(0.34)	(0.26)	(0.64)	(0.89)	(0.39)	(0.05)	(0.26)	(1.13)
Age (months)	0.047	0.034	-0.006	-0.064	0.048	0.054	0.068	0.011
	(0.71)	(0.78)	(0.10)	(1.17)	(1.91)*	(3.36)**	(3.44)**	(0.44)
Age squared (months)	-0.001	-0.000	0.000	0.002	-0.002	-0.002	-0.002	-0.000
	(0.33)	(0.38)	(0.06)	(1.52)	(2.52)**	(3.84)**	(3.51)**	(0.22)
Mother's schooling (yrs)	-0.017	0.055	0.113	-0.037	0.050	0.053	0.060	-0.003
	(0.37)	(1.49)	(2.69)**	(0.77)	(2.53)**	(4.08)**	(3.50)**	(0.15)
Husband's schooling (yrs)	0.025	0.033	0.100	0.065	0.035	0.033	0.024	0.016
	(0.72)	(1.05)	(2.68)**	(1.74)*	(1.89)*	(2.54)**	(1.46)	(0.82)
1= Drinking water covered	-0.516	0.235	0.101	-0.197	0.099	0.276	0.206	0.209
	(1.48)	(0.76)	(0.30)	(0.64)	(0.75)	(3.34)**	(1.88)*	(1.51)
1= Toilet flush or pit latrine	0.449	-0.056	0.001	0.235	0.362	0.139	0.272	0.229
	(1.21)	(0.20)	(0.00)	(0.73)	(2.29)**	(1.45)	(2.20)**	(1.52)
1 = Urban	1.624	0.294	0.018	0.804	1.164	-0.445	0.068	0.001
	(4.29)**	(0.98)	(0.05)	(2.30)**	(7.22)**	(3.01)**	(0.44)	(0.00)
Constant	-5.454	-1.840	-1.518	-2.049	-1.418	-0.163	-1.334	-1.811
	(4.27)**	(2.96)**	(1.93)*	(2.87)**	(4.41)**	(0.74)	(4.64)**	(4.82)**
Observations	6406	6406	6406	6406	8176	8176	8176	8176
Joint tests (p-values)								
Own wealth	0.018*	0.065*	0.410	0.223	0.168	0.939	0.004**	0.157

*Notes: Model includes dummy variables for region (not shown) and a dummy variable for husband's data available. T-statistics, adjusted for clustering are reported in parentheses. * significant at 10%; ** significant at 5%. Source: Author's calculations from pooled and weighted DHS.*

The magnitude of these conditional associations can be assessed from the predicted probabilities summarized in Table 13. The table shows the percentage probability of seeking each type of care conditional on having a fever, setting all observations to have the same wealth (chosen to be the means of each quintile) and averaged across all observations. Even controlling for other characteristics, the use of public higher level services goes from 9.2 percent for the average wealth of the poorest quintile to 19 percent for the average wealth of the richest quintile in Western and Central Africa, with the magnitude increasing substantially between the wealth level of those in the fourth quintile to those in the fifth. The use of public lower level care in Western and Central Africa increases fastest at lower levels of wealth, and then stabilizes at around 18 percent at the wealth level of those in the third and fourth quintiles, and then decreases slightly to 16 percent at the richest level of wealth evaluated. In Eastern and Southern Africa while the associations are significant, they are typically not as large. The percentage who use no modern care falls from 36 to 32 percent for the average wealth of the poorest to richest quintiles. It is only the use of private medical facilities that increases appreciably with wealth: from 14 percent for those with the wealth of the poorest quintile to 19 percent to those with the wealth of the richest quintile.

Table 13: Average predicted probabilities from Multinomial Logit Estimation of Advice/Treatment sought as a result of a child under 3 having a fever in the past two weeks.

	No / Self treatment	Public, higher level	Public, lower level	Private, medical	Private, commercial	Total
			Western and Central Africa			
Probabilities evaluated at:						
Mean wealth in the poorest quintile	53.4	9.2	12.0	10.7	14.7	100
Mean wealth in quintile 2	46.1	9.4	16.0	10.3	18.1	100
Mean wealth in quintile 3	41.0	10.7	18.2	10.5	19.6	100
Mean wealth in quintile 4	38.0	13.8	18.1	11.2	18.9	100
Mean wealth in the richest quintile	36.6	19.1	15.6	12.4	16.3	100
			Eastern and Southern Africa			
Probabilities evaluated at:						
Mean wealth in the poorest quintile	36.0	8.8	30.9	14.3	10.0	100
Mean wealth in quintile 2	35.9	8.8	30.8	14.4	10.1	100
Mean wealth in quintile 3	34.9	9.5	29.6	14.9	11.1	100
Mean wealth in quintile 4	34.1	10.0	28.6	15.6	11.7	100
Mean wealth in the richest quintile	32.0	11.0	26.0	19.1	11.8	100

Source: Author's calculations from pooled and weighted DHS data. See Table 10 for definition of categories. Predictions are the average probability averaging over all individuals with their observed characteristics but substituting all observations to have the average wealth of the specified quintile.

The MNL results conform to the expectation formed by the bivariate analysis in Table 11. A comparison between Table 11 (which doesn't control for background characteristics) and Table 12 (which does) implies that although a substantial amount of the rich-poor differential is explained by characteristics other than household wealth, wealth still plays a substantial role in determining weather to treat using modern methods versus home or no care, as well as treatment choice. Although the predicted differential is reduced after controlling for other characteristics it still exists. For example, the average predicted probability of seeking no modern sector care ranges from 53 percent for the poorest quintile to 37 the richest quintile in Western and Central Africa and from 36 to 32 percent in Eastern and Southern Africa. The unadjusted ranges are 64 to 23 percent and 41 to 21 percent in each region respectively. Clearly other factors (including sub-regional fixed attributes) go a long way in explaining wealth differentials.

None of the other variables included in the model have a clear impact on the choice of service. In Western and Central Africa mother's education is associated with an increase in the probability of private medical facilities. In Eastern and Southern Africa mother's years of schooling is statistically significantly positively associated with seeking advice or treatment from all sources except private commercial. Table 14 reports the average predicted probability of seeking care various types of care setting mother's education to 0 and then to 6 and averaging across all observations. Public lower level facility use is about 4 percentage points higher in both regions for children of mothers with 6 years, as opposed to zero years, of schooling. Similarly, the use of private medical facilities is only about 3 or 4 percentage points higher among the more educated mothers. While the relationship with education is statistically significant, it is not large.

Table 14: Average predicted probabilities from Multinomial Logit Estimation of Advice/Treatment sought as a result of a child under 3 having a fever in the past two weeks.

	No / Self treatment	Public, higher level	Public, lower level	Private, medical	Private, commercial	Total
Western and Central Africa						
Mother has 0 years of schooling	45.4	13.8	13.4	6.6	20.8	100
Mother has 6 years of schooling	42.5	11.9	17.2	11.9	16.5	100
Eastern and Southern Africa						
Mother has 0 years of schooling	39.0	8.6	26.4	13.3	12.6	100
Mother has 6 years of schooling	33.4	9.7	30.3	16.0	10.6	100

Source: Author's calculations from pooled and weighted DHS data. Predictions are the average probability averaging over all individuals with their observed characteristics but substituting all observations to have the years of schooling of the mother in question.

One surprising result is that having a flush toilet or a pit latrine is positively associated with an increase in the likelihood of seeking treatment or advice from many of the modern sector choices listed. One might expect that better sanitation is a proxy for the general health environment in the household and would therefore affect the probability of being reported as sick (which is not true according to Table 8), but it is surprising that it should affect the choice of care conditional on illness. It is possible that toilet facilities are picking up a component of wealth. Indeed, having a flush toilet or a pit latrine is very highly correlated with household quintile.

A second specification estimated for each region includes the average wealth among other households in the cluster (and its square) as well as the incidence of fever among children from other households in the cluster. This specification will allow a test of whether it is a household's own wealth that matters or whether it is the general wealth of the surrounding households that matters. Moreover, it will allow a test of McCombie's (1996) observation that experience with malaria affects treatment choices.

Including the cluster variables, as reported in Table 15, changes neither the significance nor the magnitude of the control variables. On the other hand, household wealth in this model is almost always insignificant – the exception being increased public lower level services among wealthier households in Western and Central Africa. By contrast, cluster wealth is a significantly related to many of the treatment choices analyzed: public higher-level facilities and private facilities in Western and Central Africa, and all types of services in Eastern and Southern Africa. Table 16 summarizes the magnitudes of the estimated effects. The table shows the predicted probability of choosing a given type of care, setting the cluster average wealth variable to the mean level of wealth in the poorest 20 quintile of *clusters*, the second quintile of clusters, and so on; and then averaging those predicted probabilities across all observations for each of these levels. In both regions the probability of using no modern care falls substantially with increased cluster wealth: from 56 to 36 percent seeking no modern care among the poorest and richest clusters in Western and Central Africa, and from 39 to 27 seeking no modern care in Eastern and Southern Africa.

In Western and Central Africa the results imply large and statistically significant differentials between richer and poorer clusters: public higher level care goes from 7.2 to 20 percent, private medical care goes from 7.5 to 17, and seeking care from a private commercial source increases and then decreases among the richest clusters (with the largest differential being between the poorest clusters at 5 percent and the clusters with the wealth of those in the fourth quintile at 27 percent). Likewise in Eastern and Southern Africa the results imply large differentials for all but private commercial sources: use of public higher level facilities increase from 7.9 to 11 percent, the use of public lower level facilities decreases from 31 to 21 percent, and the use of private medical facilities increases from 12 to 31 between the poorest and richest clusters.

Table 15: Multinomial logit estimates of treatment choice for children under 3 reporting fever in the past two weeks (no modern sector treatment is reference choice). Model including cluster wealth and fever.

	Western and Central Africa				Eastern and Southern Africa			
	Public, higher level	Public, lower level	Private, medical	Private, commer-cial	Public, higher level	Public, lower level	Private, medical	Private, commer-cial
Wealth index	0.195	0.211	0.044	0.057	0.067	-0.016	0.015	0.114
	(1.40)	(1.71)*	(0.29)	(0.42)	(0.77)	(0.30)	(0.24)	(1.38)
Wealth index squared	0.058	-0.086	0.031	-0.018	0.004	0.012	0.019	-0.021
	(0.87)	(1.42)	(0.45)	(0.24)	(0.17)	(0.64)	(1.09)	(0.84)
Cluster mean wealth index	0.596	-0.135	0.518	0.407	0.421	0.074	0.532	0.273
	(2.42)**	(0.59)	(1.99)**	(1.55)	(2.13)**	(0.81)	(4.92)**	(1.81)*
Cluster wealth index squared	-0.013	-0.106	0.036	-0.698	-0.137	-0.074	-0.057	-0.110
	(0.09)	(0.72)	(0.24)	(3.72)**	(1.79)*	(1.76)*	(1.20)	(1.76)*
Cluster prop. with fever	1.142	-0.684	-0.297	-0.096	-0.699	0.482	0.037	0.560
	(1.48)	(0.98)	(0.39)	(0.15)	(2.22)**	(2.19)**	(0.15)	(1.75)*
1 = Male	0.089	0.065	0.182	0.257	0.060	-0.008	0.029	-0.127
	(0.33)	(0.31)	(0.65)	(1.01)	(0.55)	(0.11)	(0.32)	(1.12)
Age (months)	0.048	0.030	0.004	-0.051	0.046	0.053	0.063	0.009
	(0.70)	(0.68)	(0.06)	(0.90)	(1.84)*	(3.34)**	(3.18)**	(0.38)
Age squared (months)	-0.001	-0.000	-0.000	0.002	-0.002	-0.002	-0.002	-0.000
	(0.33)	(0.25)	(0.02)	(1.23)	(2.43)**	(3.80)**	(3.22)**	(0.15)
Mother’s schooling (yrs)	-0.039	0.063	0.106	-0.028	0.046	0.052	0.055	-0.004
	(0.83)	(1.71)*	(2.42)**	(0.58)	(2.30)**	(4.04)**	(3.16)**	(0.21)
Husband’s schooling (yrs)	0.014	0.031	0.084	0.047	0.035	0.032	0.022	0.015
	(0.42)	(0.98)	(2.17)**	(1.25)	(1.86)*	(2.50)**	(1.30)	(0.76)
1= Drinking water covered	-0.564	0.202	-0.043	-0.132	0.041	0.260	0.136	0.170
	(1.65)*	(0.67)	(0.12)	(0.40)	(0.30)	(3.12)**	(1.23)	(1.22)
1= Toilet flush or pit latrine	0.324	-0.144	-0.242	-0.105	0.313	0.138	0.237	0.209
	(0.84)	(0.49)	(0.65)	(0.30)	(2.03)**	(1.44)	(1.90)*	(1.39)
1 = Urban	1.102	0.315	-0.522	0.430	0.871	-0.482	-0.409	-0.177
	(2.41)**	(0.89)	(1.16)	(1.10)	(3.91)**	(2.93)**	(2.37)**	(0.74)
Constant	-5.259	-1.420	-0.845	-0.365	-0.719	-0.353	-1.024	-1.898
	(3.64)**	(1.86)*	(0.82)	(0.42)	(1.71)*	(1.32)	(3.06)**	(4.26)**
Observations	6394	6394	6394	6394	8170	8170	8170	8170
Joint tests (p-values)								
Own wealth	0.260	0.083*	0.820	0.893	0.523	0.814	0.289	0.386
Cluster wealth	0.037**	0.698	0.134	0.000**	0.097*	0.209	0.000**	0.131
Cluster variables (wealth and fever)	0.040**	0.683	0.252	0.001**	0.044**	0.050*	0.000**	0.070*

*Notes: Model includes dummy variables for region (not shown) and a dummy variable for husband’s data available. T-statistics, adjusted for clustering are reported in parentheses. * significant at 10%; ** significant at 5%. Source: Author’s calculations from pooled and weighted DHS.*

Table 16: Average predicted probabilities from Multinomial Logit Estimation of Advice/Treatment sought as a result of a child under 3 having a fever in the past two weeks.

	No / Self treat-ment	Public, higher level	Public, lower level	Private medi-cal	Private com-mercial	Total
Western and Central Africa						
Probabilities evaluated at:						
Mean cluster wealth in the poorest quintile of clusters	56.2	7.2	23.6	7.5	5.4	100
Mean cluster wealth in second quintile of clusters	46.9	8.5	20.9	8.0	15.8	100
Mean cluster wealth in third quintile of clusters	39.0	9.8	17.0	8.6	25.6	100
Mean cluster wealth in fourth quintile of clusters	35.1	13.4	13.3	11.3	26.9	100
Mean cluster wealth in the richest quintile of clusters	36.2	19.8	10.9	17.1	16.0	100
Eastern and Southern Africa						
Probabilities evaluated at:						
Mean cluster wealth in the poorest quintile of clusters	38.7	7.9	31.4	11.8	10.2	100
Mean cluster wealth in second quintile of clusters	36.3	8.8	31.0	13.2	10.8	100
Mean cluster wealth in third quintile of clusters	33.7	9.9	30.2	15.0	11.3	100
Mean cluster wealth in fourth quintile of clusters	30.4	11.2	28.2	18.5	11.7	100
Mean cluster wealth in the richest quintile of clusters	27.0	11.3	21.0	30.8	10.0	100

Source: Author's calculations from pooled and weighted DHS data. See Table 10 for definition of categories. Predictions are the average probability averaging over all individuals with their observed characteristics but substituting all observations to have the average cluster wealth of the specified quintile of clusters.

Last, the results support the notion that experience with fever affects treatment choice, but only in Eastern and Southern Africa. The coefficient on the average incidence of fever in other households of the cluster is significantly negatively related to the use of public higher-level facilities; positively related to the use of lower level public facilities; and (weakly) positively related to seeking care from private commercial sources. In Western and Central Africa, however, the coefficient is always insignificantly different from zero.

Conclusions

There are serious caveats to using DHS data to analyze the relationship between malaria, its treatment, and poverty in Sub-Saharan Africa: there is not a one-to-one correspondence between fever and malaria, even in areas with stable malaria; fever is not always recognized in children, and it may be recognized in a selective way that potentially biases results; the DHS do not collect the data typically used for poverty analysis. Recognizing these caveats, this analysis explores the existing DHS data for patterns between fever and poverty.

The results show a positive, but weak, relationship between reported fever and poverty across geographic space. Some areas have both high levels of fever and poverty and the correlation between the two is positive. However, this correlation, while statistically significant, is small in magnitude. Moreover, it becomes insignificantly different from zero after controlling for the education of mothers in the area. The relationship between fever and wealth across households is also insignificant, although in Eastern and Southern Africa a higher level of wealth in the cluster in which a household lives is associated with a lower incidence of fever. Fever is highly geographically concentrated: even after controlling for a variety of individual, household, and cluster attributes (including wealth), the average level of fever in the cluster in which a child lives is a strong determinant of their own probability of reporting fever.

Treatment or advice from the modern sector is more likely in Eastern and Southern Africa than in Western and Central Africa. In both regions, the percent who seek care in the modern sector is substantially larger for the rich than for the poor, even after controlling for individual, household, and cluster attributes. While the type of treatment sought is related to the wealth of the household, the average level of wealth in the cluster in which the household lives supercedes this relationship. In Western and Central Africa children with fever in wealthier communities are substantially more likely to seek care from government hospitals and from private sources than those from poorer households. Care for children from wealthier *households*, regardless of the wealth in the cluster, is significantly more likely to be from public lower level sources in this region. In Eastern and Southern Africa care is significantly more likely to be sought from government hospitals and from private medical facilities in richer than in poorer communities, whereas in this region the use lower level public services falls in wealthier communities. Seeking care from private medical sources increases substantially in wealthier communities – although the use of private commercial sources is unrelated to wealth. The experience that a cluster has with malaria is significantly related to the type of treatment sough in Eastern and Southern Africa, but not in Western and Central Africa.

Unlike cross-national results which show a strong association between malaria and poverty, the results of this analysis of DHS data across these 22 countries in Sub-Saharan Africa do not support the notion that fever and poverty are closely related. There is some support for the idea that levels of wealth in the community might affect the incidence of fever in Eastern and Southern Africa. The results suggest that poverty affects the type of treatment sought as a result of an episode of fever, although the patterns differ between the two broad regions analyzed here. Moreover, the results suggest that it is levels of wealth in the community in which a household lives that influences treatment the most, rather that wealth of the household itself.

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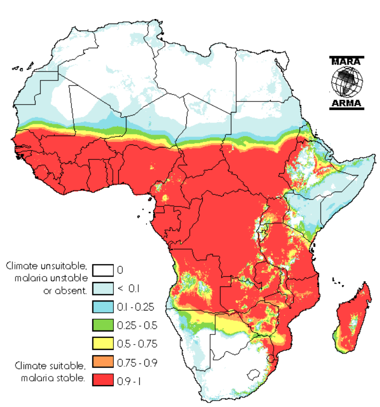
Annex 1:

Table A1: Classification table for management of childhood fever.

Signs	Classify as	Treatment
High malaria risk area		
-Any general danger sign -Stiff neck	Very severe febrile disease	-Give quinine for severe malaria (first dose) -Give fist dose of an appropriate antibiotic -Treat the child to prevent low blood sugar -Give one dose of paracetamol in clinic for high fever -refer urgently to hospital
-Fever (by history or feels hot or temperature ≥ 37.5°C)	Malaria	-If no cough with fast breathing treat with oral antimalarial or If cough with fast breathing, treat with cotrimoxazole for 5 days -Advise mother when to return immediately -Follow-up in 2 days if fever persists -If fever is present every day for more than 7 days, refer for reassessment
Low malaria risk area		
-Any general danger sign -Stiff neck	Very severe febrile disease	-Give quinine for severe malaria (first dose) unless no malaria risk -Give fist dose of an appropriate antibiotic -Treat the child to prevent low blood sugar -Give one dose of paracetamol in clinic for high fever -refer urgently to hospital
-No runny nose and no measles and no other cause of fever	Malaria	-If no cough with fast breathing treat with oral antimalarial or If cough with fast breathing, treat with cotrimoxazole for 5 days -Advise mother when to return immediately -Follow-up in 2 days if fever persists -If fever is present every day for more than 7 days, refer for reassessment
- Runny nose present or measles present or other cause of fever present	Fever – malaria unlikely	-Give one dose of paracetamol in clinic for high fever (38. 5°C or above) -Advise mother when to return immediately -Follow-up in 2 days in fever persists -If fever is present every day for more than 7 days, refer for reassessment

Source: Adapted from Gove (1999).

Figure A1: Climate suitability for stable malaria



Source: Reproduced from MARA (1998)

Annex 2 : Derivation of country level weights.

Assume, for example, that two countries A and B have the same population, NA=NB. In country A 1 percent of the population (SA people) were sampled and in country B 2 percent of the population was sampled (SB people). In order for the mean of the pooled sample to be a valid estimate of the mean of the pooled populations, one needs to weight the sample from country A by a factor of 2. The specific weight we use here is a relative weight such that the sum of the weighted samples within each region equals the actual regional sample size. In particular, the weight for each country is equal to

$$[SC / ST] / [PC / PT]$$

where SC is the sample size in the country, ST is the total regional sample size, PC is the country's population and PT is the population of the region as a whole.

Annex Table 2 reports the relative weights derived for each country in the two regions. In the Western and Central Africa region Nigeria gets a large weight (5.836) as the sample is a small percentage of the country's population yet the country constitutes a large part of the regions population. On the other hand, C.A.R. gets a small weight (0.211) as a large percentage of the population was sampled, but the country only contributes a small share of the region's population. In the Eastern and Southern Africa region Comoros gets a very low weight (0.077) whereas Kenya and Tanzania receive large weights (1.65).

Table A2.1: Derivation of country level weights for analysis of incidence.

	Population in DHS sample	Population in country (in thousands)	Percentage of population sampled	Relative weight
	(I)	(II)	(I) as a percentage of (II)	
Benin 1996	27,892	5,632	0.495	0.367
Burkina Faso 1998	32,181	10,996	0.293	0.621
C.A.R. 1994-95	28,050	3,254	0.862	0.211
Cameroon 1998	26,523	14,303	0.185	0.979
Chad 1996	37,213	6,937	0.536	0.339
Cote d'Ivoire 1994	38,783	13,132	0.295	0.615
Ghana 1998	22,625	18,460	0.123	1.482
Mali 1995-96	50,159	9,849	0.509	0.357
Niger 1997	36,722	9,799	0.375	0.485
Nigeria 1999	38,558	123,897	0.031	5.836
Senegal 1992-93	31,966	7,800	0.410	0.443
Togo 1998	44,157	4,345	1.016	0.179
Western and Central Africa	**414,829**	**228,404**	**0.182**	**1.000**
Comoros 1996	14,297	504	2.837	0.077
Kenya 1998	37,705	28,612	0.132	1.656
Madagascar 1997	35,059	14,148	0.248	0.881
Malawi 1996	12,597	8,986	0.140	1.557
Mozambique 1997	44,822	16,630	0.270	0.810
Rwanda 1992	31,881	7,350	0.434	0.503
Tanzania 1996	40,220	30,488	0.132	1.654
Uganda 1995	36,026	19,168	0.188	1.161
Zambia 1996-97	39,721	9,214	0.431	0.506
Zimbabwe 1999	28,523	11,904	0.240	0.911
Eastern and Southern Africa	**320,851**	**147,004**	**0.218**	**1.000**

Source: Population data from World Development Indicators (World Bank, 1999)

Table A2.2: Derivation of country level weights for analysis of treatment.

	Population in DHS sample	Population in country (in thousands)	Percentage of population sampled	Relative weight
	(I)	(II)	(I) as a percentage of (II)	
Burkina Faso 1992/3	34,222	9,198	0.372	0.312
Cameroon 1991	20,724	11,797	0.176	0.660
Cote d'Ivoire 1994	38,783	13,132	0.295	0.393
Ghana 1993	22,139	16,200	0.137	0.849
Niger 1992	34,297	8,261	0.415	0.279
Nigeria 1999	38,558	123,897	0.031	13.938
Senegal 1992/3	31,966	7,800	0.410	0.283
Western and Central Africa	**220,689**	**190,285**	**0.116**	**1.000**
Kenya 1998	37,705	29,295	0.129	1.661
Malawi 1996	12,597	8,987	0.140	1.525
Rwanda 1992	31,881	7,350	0.434	0.493
Madagascar 1992	31,423	12,202	0.258	0.830
Tanzania 1991/2	46,733	26,691	0.175	1.221
Zambia 1992	34,943	8,262	0.423	0.505
Zimbabwe 1999	28,523	11,904	0.240	0.892
Eastern and Southern Africa	**223,805**	**104,690**	**0.214**	**1.000**

Source: Population data from World Development Indicators (World Bank, 1999)