Multilevel Analysis of Community Effects on Health Knowledge in Coastal Ghana: Evidence from the 2002 Ghana Population and Environment Survey

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Abstract: The spread of knowledge about the etiology of disease and prevention practices is key to lowering child mortality rates in the developing world. People acquire health knowledge through various means, including formal education, mass media, and personal social networks. In this paper, we use multi-level primary data from a 2002 survey of communities and households in coastal central Ghana to examine determinants of health knowledge at the individual, household, and community levels. Our findings indicate that there are indeed multiple pathways to the acquisition of health knowledge, and suggest that community social networks play a key role in the spread of health knowledge.

Introduction

Improving health remains a major challenge in Ghana, as it is in much of the developing world. Infant and child mortality are both relatively high in Ghana, and most infant and child deaths are due to infectious diseases such as malaria, respiratory infections, and diarrheal diseases. Lowering child mortality rates requires health policy interventions like immunizations, but to deal with environmentally-based diseases like malaria, educating parents about how to prevent disease becomes crucial. Of course, traditional health education and raising literacy are important, but social networks are also a key mechanism through which people learn about health etiology and prevention. As urbanization increases in Ghana, there are more opportunities for the diffusion of health knowledge through increasingly complex social networks in a process known as *social learning*. Even rural villages can benefit from health knowledge diffusion if they are part of the "right" social networks.

In this paper, we examine the effect of community context on parents' knowledge of etiology and prevention of child illnesses. Using primary data collected in coastal Central Ghana in 2002, we move beyond a simple rural-urban dichotomy by exploring the impact of community contextual factors on health knowledge. In other words, our analysis asks: how do communities themselves, net of individual and household characteristics, affect adults' knowledge about the etiology and prevention of childhood diseases? We find that community characteristics such as literacy prevalence and the presence of markets are significant predictors of health knowledge, which points to the merit of social networks as a key factor in the improvement of children's health in coastal Central Ghana and elsewhere. Our findings are relevant to theories of social learning and the diffusion of knowledge, and they also suggest new avenues for both research and policy to address the relationship between community and health.

Learning About Health and Illness

In addition to their own experience, there are a number of pathways through which people learn about various aspects of health: formal education, mass media, and social networks and diffusion. Types of health knowledge that may be acquired include the etiology of disease, contagion and germ theory, knowledge about the characteristics and symptoms of diseases, and preventive and treatment practices. Like most knowledge acquisition, it is likely that people learn about health through not just one, but through a variety of reinforcing (and sometimes contradictory) means. Although broad theories and literatures exist on learning through these various mechanisms, few authors have directly theorized or addressed learning about children's health, diseases, and prevention. Much of the demographic literature from the developing world also is related to the spread of knowledge about contraception and fertility change, not about knowledge of children's health or health knowledge generally. Nevertheless, the mechanisms for health knowledge acquisition are likely to be similar to mechanisms for acquiring knowledge about reproductive health and family planning.

Formal Education and Literacy

There is a vast amount of empirical research on the determinants of child survival. One central socioeconomic influence – which has long been deemed influential – is the role of maternal education. Across many diverse cultural contexts, rising levels of maternal education and literacy are strongly associated with improved child survival. Here we are primarily concerned with one intermediate causal mechanism through which education is thought to affect child health: "health knowledge". This concept appears to be less routinely explored in standard socio-demographic research than more easily measurable concepts such as years of schooling obtained or literacy. Moreover, the ongoing debate about the "true" role of education, particularly maternal education, in child survival, suggests there is a need for additional research on health knowledge and the links between education, knowledge, and health behaviors and outcomes in high mortality countries such as Ghana. Yet most existing quantitative data sources do not fully address these relationships.

Caldwell (1979; 1994) argued that there are three pathways, or causal mechanisms, through which maternal education can affect child survival: 1) education increases health knowledge, and as a consequence, fosters behavior change; 2) education promotes identification with modernity; and 3) education empowers women within the household. Oppong and Abu (1987) also stress the effects of education on literacy and thus increased access to information and increased social and economic status. Several other studies demonstrate the generally positive relationship between maternal schooling and child health outcomes (e.g., Tabutin and Akoto 1992, Raghupathy 1996). Other demographic researchers have also noted the importance of health knowledge in child survival (Garenne and van de Walle 1985, Oppong and Abu 1987, and Mosley and Chen 1984).

Yet this claim is disputed, most notably in recent cross-national analysis of Demographic and Health Survey (DHS) data by Desai and Alva (1998). Desai and Alva note that although there is a strong correlation between maternal education and child health, it does not necessarily indicate a causal relationship. Desai and Alva's work suggests that we remain cautious before assuming that education invariably translates into improved child health. Indeed the relationship between maternal education and child survival is weaker in sub-Saharan Africa than elsewhere in the developing world (Hobcraft et al. 1984, Mensch et al. 1985, and Hobcraft 1993).

Of course, most of the existing studies do not directly address an important intermediate variable—health knowledge. One notable exception to this apparent gap in the child health empirical research – to this dearth of information on knowledge of etiology – is the body of work in Guatemala by Pebley, Goldman and others (Pebley, Hurtado and Goldman 1999, Goldman, Pebley and Beckett 2001). Pebley et al. (1999) found that, in contrast to previous ethnographic work in Guatemala, biomedical models of ARI and child diarrhea appear to have gained ground over traditional models of illness causation, and that traditional and biomedical belief systems may coexist to a greater degree than in the past. In multivariate research on the diffusion of etiological beliefs about child diarrhea, Goldman et al. (2001) found that social contacts, particularly interpersonal social contacts, influence belief in hygiene (cleanliness) and contagion (pathogens) as causes of child diarrhea. Moreover, education and household economic status were strong predictors of biomedical views (2001:67).

Social Networks and Diffusion

Social networks are another key mechanism through which many people attain health knowledge. Although formal education and mass media campaigns are crucial in almost all settings, knowledge shared by friends and acquaintances through informal methods can in some cases carry greater weight or authenticity. People are embedded in social relationships with other individuals through whom they learn about new ideas (innovations). The spread of these ideas is known as *diffusion*. There is a large demographic literature about the diffusion of information and ideas about contraceptive use and fertility values via social networks (Casterline 2001; Reed et al. 1999), yet little research exists on social networks as mechanisms for the spread of knowledge about child health or health more broadly.

One small literature that is also relevant is the literature on social learning with regards to mortality decline (as it relates to changing fertility preferences). Montgomery (2000 and 1998) suggests that lower socioeconomic status individuals with heterogeneous social networks may be more likely to learn about mortality prevention and other health messages from their better-educated network partners. These "weak ties" (á la Granovetter 1973) to better-educated individuals can facilitate social learning about mortality risks, disease prevention measures, and other health information. Furthermore, social modeling of the hygiene practices or other health-related behaviors of better-educated women might also contribute to improved child health without the social learning component (Ewbank and Preston 1990; Lindenbaum 1990). This so-called social influence can be a powerful force of its own accord, or in combination with social learning, for behavioral and ideational change.

There are also lessons to be taken from the literature on diffusion and social networks and fertility change, however. Several studies have found that information about contraceptive use that is received through relatives, friends, and neighbors is more influential and (sometimes) considered more reliable than information obtained through health service providers or the mass media (Kohler 1997; Entwisle et al. 1996; Beckman 1983). The heterogeneity of social networks is, of course, a basic feature for the spread of new ideas. For this reason, migrants may play a significant role in bringing new ideas to a community. Lindstrom and Muñoz-Franco (2005) find that Guatemalan migrants to urban areas who maintain rural ties are likely to transmit information about new contraceptive methods to their rural families and contacts. One might suppose that migrants (or other community members who have diverse ties) could also be conduits for information about disease etiology and prevention, as well as general health knowledge. Kiros and White (2004) find that rural-rural migrant women in Ethiopia are less likely to immunize their children, however, which suggests that urban experience may be of vital importance for acquisition of health knowledge and behaviors.

A research project that has been collecting data in almost the same study area as we have has produced some interesting findings regarding social networks, diffusion, and fertility change. Montgomery et al. (2001) find evidence that suggests that the adoption of modern contraceptive methods among women in southern Ghana is strongly affected by the behaviors and interactions

with members of their social network. This suggests that perhaps general health knowledge and behavior is also subject to important social network influences in these communities.

Community Effects and Health Knowledge

There is substantial body of demographic research on the effects of community characteristics on human health in higher income settings (see Robert 1999; Leventhal and Brooks-Gunn 2000; Pickett and Pearl 2001; and Rajaratnam et al. in press, for thorough reviews of this literature). Yet relatively little has yet been done regarding community effects on children's health in developing countries (Montgomery and Hewett 2005; Parashar 2005; Sastry 1997, 1996; Steele, Diamond and Amin 1996), particularly in sub-Saharan Africa (DeRose and Kulkarni 2005; Fotso and Kuate-Defo 2005; Kiros and White 2004), although there is a burgeoning literature in this area. Additionally, neither of these literatures has explicitly examined how community context might influence people's knowledge about the etiology and prevention of childhood diseases, which is directly related to children's health outcomes.

Nevertheless, as improving health knowledge is a direct step to improving children's health, the literature on community effects on child health may give some insights into the importance of community context more generally. A few studies using multi-level models to examine community effects on child health have clearly found that community educational and/or literacy levels have strong effects on children's health outcomes (DeRose and Kulkarni 2005; Parashar 2005). Socioeconomic and development measures also appear to have positive effects on child health (Fotso and Kuate-Defo 2005; Montgomery and Hewett 2005; Parashar 2005; Sastry 1996). There is considerable heterogeneity across studies in terms of how community context is measured and which community-level covariates have significant effects on health outcomes.

Hypotheses

The literatures on education and diffusion and health knowledge, and community effects on health together suggest that the convergence of high levels of education and particular configurations of social networks within communities are important predictors of high levels of health knowledge. We thus expect to find that both individual characteristics related to education and social networks, as well as key measures of community context all will have an influence on health knowledge. Key individual characteristics of interest include: educational attainment, literacy, migrant status, and exposure to mass media. To operationalize education at the community-level, we use the proportion of literate adults living in the community. And to attempt to tap into community social network effects, we use the presence of a regular market in the community. Specifically, we hypothesize that:

H1: Better-educated individuals will have higher levels of health knowledge than less-educated individuals.
H2: Literate individuals will have higher levels of health knowledge than illiterate individuals.

H3: Migrants will have higher levels of health knowledge than non-migrants.
H4: Individuals with high levels of mass media exposure will have higher levels of health knowledge than individuals with lower levels of media exposure.
H5: Individuals living in communities with higher proportions of literate adults will have higher levels of health knowledge than individuals living in communities with lower proportions of literate adults.
H6: Individuals living in communities with regular markets will have higher levels of health knowledge than individuals living in communities without a regular market.

Data

This research incorporates primary data collected in 2002: a standard household-based survey of 2500 inhabitants of coastal Ghana. The 2002 Ghana Population & Environment Survey, as the project came to be called, is a representative survey of residents of the six coastal districts of Ghana's Central Region, one of ten administrative regions in Ghana. These six districts represent approximately four percent of Ghana's population of 19 million people (Ghana Statistical Service 2002:1, 17).

Study Site: Ghana's Central Region

The six Central Region districts in our study include: Komenda-Edina-Eguafo-Abirem (KEEA), Cape Coast, Abura-Asebu-Kwamankese, Mfantsiman, Gomoa, and Awutu-Efutu-Senya. Our study area is shown in **Figure 1**. This area of Ghana is primarily inhabited by the Fante ethnic group (an Akan sub-group linguistically related to the Asante), as well as other smaller groups (e.g., Ewe, Ga-Dangme, etc.). Nationally, the Fante comprise about 10 percent (about 1.7 million people) of Ghana's total population. While Ghana's major sources of foreign exchange are gold, timber and cocoa, economic activities in the study area include fishing, small-scale farming, salt production, and some tourism activities (concentrated around the former slave trading castles dotting the Central Region coastline which now operate as museums).

[Figure 1 here]

Sampling Design, Survey Instruments, and Fieldwork

The Population & Environment Survey included four components: a community questionnaire, a household questionnaire, a men's questionnaire, and a women's questionnaire. The community questionnaire, administered to a group of community leaders or other knowledgeable people (such as schoolteachers, etc.), contained questions on community resources and infrastructure, including such things are presence of a school, health clinic, paved road, electricity, etc. The household questionnaire contained questions on current household composition, basic characteristics of household members and economic characteristics of the household. The women's questionnaire had modules on the respondent's socio-demographic background, birth history, health knowledge, child health (of living children under six years of age), fertility preferences and family planning, environmental attitudes and awareness, and a life history calendar (by yearly intervals). The men's questionnaire was a reduced version of the

women's questionnaire, excluding the modules on birth history and child health. While the survey instruments were similar to the Demographic and Health Survey in form and content, the instruments incorporated several unique sections, particularly the section on knowledge of child illnesses, including knowledge of cause, prevention and treatment of malaria, diarrheal disease and respiratory infection.

The survey followed a two-stage stratified sampling design. We selected equal numbers of PSUs [in Ghana they are called "Enumeration Areas," or EAs] in each of our three residence strata (rural, semi-urban, and urban) and we compensate for this in our analyses through the use of weights. We chose this design in order to evenly spread the sample across the strata, ensuring that there is sufficient sample size in each strata type. The stratification was done for the six districts, which, when multiplied by the three stratum types, resulted in 18 total strata. Within each of the 18 strata, we selected three EAs using probability proportional to size (PPS) of the EA, totaling 54 PSUs. The Ghana Statistical Service (GSS) aided us in this process by providing the list of EAs and their population information.

After we generated our first-stage sample of EAs (clusters), survey listing teams listed all of the households in our 54 selected EAs. We then randomly selected 24 households from each EA. Survey interviewing teams then interviewed all women and men age 15 and above in each selected household. Field supervisors also conducted a community questionnaire with a group of opinion leaders in each of the 54 EAs. The sample size of the individual portion of the survey was 2506; 1093 men aged 15 and above, or 94 percent of identified eligible men, were interviewed. And 1413 women aged 15 and above, or 93 percent of identified eligible women, were interviewed.

Methods

We employ multilevel modeling methodologies to analyze the relationships between community-level contextual factors, household-level variables, maternal characteristics, and child health outcomes. The multilevel approach is especially well suited to our situation, in which we have multiple observations within communities and households and for which we are keenly interested in uncovering community-level effects. While avoiding the ecological and atomistic fallacies, this type of modeling can take advantage of the hierarchical structure of our data and efficiently estimate variation at each level of analysis, recognizing that residual errors are likely to be correlated within levels of communities and households.

We elect a random effects model, with parameters fitted for the household and for the community level. This seemed most appropriate at this stage of our analysis, and we chose the RE approach after examining alternative model specifications. (Our implementation is with the STATA9 package using the xtreg routine. STATA's random effects estimator is a weighted average of within and between effects.) Our dependent variables are all indices of health knowledge, as described in more detail below. Outcome values range from zero to three. Our use of RE extends ordinary least squares (OLS) to model the correlation across observations from the same household and community.

Our preliminary work included an established set of individual and household traits. We also examined a set of community level attributes, since the most appropriate community-level

regressors are not always so clear. Our focus was on literacy, since theory would suggest that literacy could indicate community level capacity, and moreover, could offer spillover benefits from the more to less informed within the community. In our models we also include a measure of market presence. Again this is a simple community-level indicator of integration into a wider society and a marker of potential sources of diffusion. We did examine an index of community development but this offered neither improved conceptual clarity nor improved statistical performance.

Thus, the models we estimate include explicit regressors to measure characteristics of the individual and the household, explicit regressors for (usually two) community characteristics (usually proportion of adults literate and a dummy for market presence) and random effects parameters to control for otherwise unmeasured common variance at the household and community level.

Measures

In this analysis of community-level effects on adults' health knowledge, our outcome variables are three separate indices of knowledge of etiology and prevention of child illnesses. Our survey asked all adults about their knowledge of causes, prevention and treatment of three major child illnesses in Ghana: malaria, diarrheal disease and respiratory infection. This approach is rather unique in developing country settings. While standard surveys such as the DHS are nationally representative, they tend to target only mothers of young children to provide proxy reports of child illnesses and mothers' treatment behaviors. Our survey, in contrast, asked etiology questions regardless of age (all adults age 15+), sex (both men and women), or parenthood status (whether or not the respondent had any young children), such that we have a rich dataset of all adults' knowledge of etiology, prevention, and treatment of child illness.

The first health knowledge outcome, knowledge of contagion, is simply the number of the three child illnesses – malaria, diarrheal disease, and respiratory infection – each respondent attributed to contagion factors (i.e., the mosquito or malaria parasite for malaria, germs or infectious agents for diarrheal disease, and germs or infectious agents for respiratory infection). For each respondent, this ordinal variable ranges from zero (no illnesses attributed to contagion) to three (all three illnesses attributed to contagion).

Our second measure of health knowledge is a less stringent index of knowledge of etiology, allowing for both contagion- and hygiene-related responses. This index is a sum of the number of the three child illnesses each respondent attributed to *either* contagion or hygiene factors. This ordinal variable also ranges from zero (no illnesses attributed to contagion or hygiene) to three (all three illnesses attributed to contagion or hygiene).

Our third measure of health knowledge is an index of knowledge of prevention. This index is simply the number of the three child illnesses each respondent believed could be prevented. Again, this measure ranges from zero (believes none of the illnesses are preventable in children) to three (believes all three illnesses are preventable).

Independent variables include basic socio-demographic characteristics (e.g., age, sex, education, literacy, etc.) as well as household-level socioeconomic status, measured by an index of household possessions, and rural or urban residence. We include two community-level measures in our analysis. Proportion of literate adults in the community was calculated by aggregating at the community (EA) level the information on literacy from the individual questionnaire (administered to all men and women aged 15 and above in each randomly sampled household). The presence of a regular market in the community was asked in the community questionnaire.

Descriptive Results

Table 1 presents basic characteristics of the 54 communities in our study. Due to the stratified nature of our sampling design, in which we sampled equal numbers of communities by type (rural/urban) and district, one-third (18) of our EAs are classified by the Ghana Statistical Service (GSS) as rural, one-third are semi-urban and one-third are urban. Yet these 54 communities differ substantially. Only 14 of the EAs, or just over one-quarter, have a regular market. Nearly all the communities, 82 percent, have electricity, yet only about one-third (35 percent) have telephone service. Most communities (89 percent) have either a health facility or some type of health worker, and most (91 percent) have some type of school.

Unlike the other community characteristics, which were obtained from a community questionnaire administered to a group of knowledgeable community members, literacy prevalence was measured by aggregating responses to the individual questionnaires. The proportion of literate adults (age 15 and above) in the communities was 23 percent. The proportion of literate women was also 23 percent.

[Table 1 here]

Table 2 presents social and demographic characteristics of the residents of this area of Ghana. Table 2 shows frequencies, weighted means, and for continuous variables, standard deviations. Of the 1,296 households sampled in our study design, we successfully interviewed 1,197 households, achieving a response rate of 92 percent.

[Table 2 here]

Household socioeconomic status (SES) was measured by an index of 11 household possessions: radio or cassette recorder; television; video deck (VCR); telephone or mobile phone; electric or gas stove; refrigerator or freezer; clock; sofa or chair with foam pads; bed with foam mattress; bicycle; and motorcycle or car (or other motor vehicle). The average number of the 11 household possessions was just under three (2.9), demonstrating the low SES of this population. However, more than half (58 percent) of the households have access to electricity, ten percent more than the 2003 national figure of 48 percent, according to the DHS (GSS, NMIMR and ORC Macro 2004:20). Nearly three-quarters have access to piped water for their drinking water supply, while the remaining households rely on well water, surface water, or other sources of drinking water. Households in our study area appear to have much better

sources of drinking water than the Ghanaian national average. The 2003 DHS found that, nationally, only about 39 percent of Ghanaian households have access to piped water, whether piped directly into the dwelling or compound, or available via a public tap (GSS, MNIMR and ORC Macro 2004:20). This is far fewer than the 73 percent of households in our study area in Central Region. Nationally, far more households rely on well water (39 percent) and surface water sources (18 percent) than in our study area (GSS, NMIMR & ORC Macro 2004:20). About three percent of Ghana's population relies on other drinking water sources, including rainwater, water from tanker trucks, and sachets (GSS, NMIMR & ORC Macro 2004:20).

Only 12 percent of households in our study area have access to a flush toilet, whether their own or a shared facility. Most households (56 percent) rely on a pit toilet or latrine. Almost one-third of the households (32 percent) have no toilet facility. Nationally, the 2003 DHS found that the same proportion (11 percent) of households have access to flush toilets, more (68 percent) rely on pit toilets, either KVIP or traditional, and fewer (22 percent) have no toilet facility (GSS, NMIMR & ORC Macro 2004:20). It is noteworthy that, while the residents of our study area appear to have better-than-average drinking water, they appear to have worse-than-average sanitation, in the sense that relatively more households in our study area have no toilet facility (32 percent versus 22 percent nationally).

Most (72 percent) residents of our study area are Fante, and an additional 8 percent are some other Akan ethnic group (such as Asante). Thus the great majority – 80 percent – of our study population is of Akan ethnicity. About 4 percent are Ewe, an ethnic group which traditionally hails from the Volta region. Five percent are Guan, just one percent are northerners, and the remaining 10 percent are members of assorted other ethnic groups. More than half of our sample (59 percent) are migrants, meaning that they were not born in their current place of residence.

Like Ghana in entirety, coastal Central Region is religiously diverse. The most common religion in our study area (as well as nationally) is Pentecostal, with 31 percent of our population, followed by Protestant (26 percent); Syncretic (15 percent), a religion which combines elements of both Christianity and traditional beliefs; Catholic (12 percent); Muslim (4 percent); and traditional religion (4 percent). About eight percent of our population reports no religious affiliation.

Educational attainment appears to be fairly high in this area relative to the rest of the country. Nearly one-third (29 percent) of our study population (adults age 15+) have no or only Arabic schooling, 15 percent have attended primary school, 37 percent have attended middle school (known in Ghana as Junior Secondary School, or JSS), and 18 percent have attended secondary school (Senior Secondary School, or SSS) or above. The 2000 census found that, nationally, fully 43 percent of Ghanaians age six and above have no schooling, 20 percent have completed only primary, 23 percent have completed middle school/JSS, and about 12 percent have completed secondary schooling or beyond (GSS 2002:8, 54). However, it is important to note that our measure asks about schooling attended and asks it of people age 15 and above, whereas the census reports schooling completed of people age 6 and above, so it is difficult to compare these two sources of data. Nevertheless, the gap between the number of people in our

study area and nationally who have no schooling (29 versus 43 percent, respectively) is insightful.

Almost half (44 percent) of the study population is illiterate, reporting that they can read a letter or newspaper in any language "not at all", while 21 percent read "with difficulty". Just over one-third (35 percent) reports that they can read "easily". These figures, particularly illiteracy, correspond with Ghana's national literacy rates. The 2000 census found that 46 percent of Ghanaian adults (age 15 and above) were illiterate, while 53 percent were literate in either English or a Ghanaian language (GSS 2002:7, 27).

The most prevalent form of media in this area of Ghana appears to be radio. Nearly three-quarters (72 percent) of the study population reports listening to the radio daily. Fifty-eight percent watches television weekly, while only 23 percent reads a newspaper weekly. Finally, just over one-third (34 percent) of the study population participates in some kind of community organization, such as an Asafo company[1] or women's group.

Lastly, given the relevance of personal and household hygiene behaviors on child health, we asked respondents about their hand washing practices. Only half (50 percent) of respondents reported washing their hands with soap after toileting, and only about one-quarter (26 percent) reported washing with soap before eating. (Note that traditionally, Ghanaians tend to eat with their hands.) Less than one-quarter (23 percent) reported washing their hands with soap both after toileting and before eating.

Health Knowledge

Table 3 presents descriptive characteristics of the health knowledge questions in the survey, the focus of this analysis. As mentioned above, we asked all respondents (adults age 15+) questions about knowledge of causes, prevention, and treatment of three serious child illnesses in Ghana: diarrheal disease, malaria, and respiratory infection. **Figure 2** illustrates the prevalence of the three child illnesses in our study area compared to the 1998 and 2003 national figures from the Ghana DHS.

[Figure 2 here]

[Table 3 here]

Table 3 shows weighted means for the knowledge of etiology, prevention and treatment questions, both for the total population (the first column) and by level of education. This table reveals that knowledge of contagion – infectious agents and microbes – is relatively low in this population, whereas knowledge of hygiene is higher. Moreover and as expected, level of education is significantly associated with every measure of health knowledge. Those with less schooling are less knowledgeable about etiology, prevention, and treatment of these three child illnesses than those with more schooling.

[1] Asafo companies are Fante social and political organizations that traditionally functioned as local militias. Each Fante town typically has at least one Asafo company, and today they tend to function as public service and community organizations.

Just over half – 53 percent – of our survey respondents cited the mosquito vector or malaria parasite as the main cause of malaria, consistent with knowledge of contagion.[2] Moreover, knowledge of the mosquito vector or malaria parasite increases dramatically with increasing education, from only 29 percent of those with no schooling to 89 percent of those with secondary or more schooling. Despite the low level of knowledge of the etiology of malaria, most people (80 percent) view malaria as preventable and nearly all (97 percent) feel that malaria can be treated.

For both diarrheal disease and respiratory infection, Table 3 shows the proportion of respondents in our survey who attribute the illnesses to *contagion* (i.e., germs or other infectious agents such as bacteria or viruses) as well as, a less stringent measure of health knowledge, the proportion who simply cite *hygiene* factors (i.e., anything associated with uncleanliness or dirt). (Table 3 does not make this contagion/hygiene distinction for malaria given the relatively straightforward relationship between the malaria parasite/mosquito vector and malaria.)

When queried about the etiology of diarrheal disease in children, knowledge of germ theory is very low in this population. Only nine percent of respondents cite contagion or germs as the main cause of diarrheal disease in children. However, more than half (60 percent) cite hygiene or dirt as the cause of diarrheal disease (e.g., dirty water, dirty food, dirty hands or utensils, etc.). As we saw with malaria, level of education is significantly associated with knowledge of contagion- and hygiene-related causes of diarrheal disease. Only 5 percent of those with no education cite contagion as the cause of diarrheal disease; this figure rises to 15 percent among the most educated. In contrast to knowledge of contagion, knowledge of hygiene is much more common across all educational levels. Forty-five percent of those with no education city hygiene causes of diarrhea, increasing to 74 percent among those with secondary or more schooling.

It is noteworthy that nearly a third of the population cites things *other* than contagion- or hygiene-factors (e.g., eating unripe mangoes, eating starchy foods, playing in the sun, etc.) as the cause of diarrheal disease, and these beliefs were echoed in follow-up qualitative work as well. About three-quarters (73 percent) feel that diarrheal disease can be prevented in children and almost all (97 percent) feel that child diarrhea can be treated. Again, level of education is significantly associated with knowledge of prevention and treatment of diarrhea. Finally, most respondents (84 percent), even the least educated, have heard of Oral Rehydration Solution (ORS) as a means to treat child diarrhea. Knowledge of ORS ranges from 67 percent of those with no schooling to 97 percent among those with secondary or more schooling.

Similar to biomedical knowledge of diarrheal disease, very few respondents – only six percent – identify contagion factors (e.g., germs or infectious agents) as the cause of respiratory infection in children. More respondents – 17 percent – identify hygiene or dirt (e.g., dust in the air, etc.) as the cause of respiratory infection. Once again, level of education is strongly associated with knowledge of the etiology of respiratory infection. Those with more education

[2] In Agyepong and Manderson's (1999) research on knowledge of etiology of malaria in two communities in the Greater Accra region, the region adjacent to our region, just ten percent of rural and 47 percent of urban respondents identified the mosquito as the main cause of malaria (1999:83).

are more likely to report contagion-related causes of respiratory infection, ranging from just two percent of those with no education to a still quite modest 13 percent of those with secondary or more schooling. Fourteen percent of those with no education report hygiene-related causes, but this increases to 28 percent of those with the most education. More than three-quarters of the population (77 percent) cites causes other than contagion- or hygiene-related causes, including, for example, exposure to cold weather (a common perception in Western countries as well), the rise of the new moon, and, as we saw with diarrheal disease, eating starchy foods such as yam and rice. Finally, the majority of respondents (65 percent) feel that respiratory infection in children can be prevented, and nearly all respondents (96 percent) feel that respiratory infection can be treated.

To summarize respondents' general knowledge of etiology, we created two indices of responses to the etiology questions. The first index, knowledge of contagion factors, is the number of the three child illnesses – malaria, diarrheal disease, and respiratory infection – each respondent attributed to contagion factors. The mean value of the contagion index, an ordinal variable from 0 to 3, is 0.68. Respondents, on average, attribute 0.68 of the three illnesses – slightly over half of an illness – to contagion, and knowledge of contagion increases with increasing education, ranging from 0.36 for those with no schooling to 1.17 for those with secondary or more schooling.

We also constructed a less stringent index measure of knowledge of etiology, allowing for both contagion- and hygiene-related responses. Knowledge of the role of hygiene in disease transmission is perhaps as important as knowledge of the specific etiological agent of disease. Indeed, Caldwell suggests that identification with "modern" notions of hygiene and cleanliness, may, in fact, be more important than specific knowledge of bacteriology in influencing parents' health-seeking behaviors (1986:205-6). Thus, our second index, knowledge of contagion *or* hygiene causes, is simply the number of the three child illnesses each respondent attributed to either contagion or hygiene factors. As shown in Table 3, the mean value of this index is 1.45. Respondents, on average, attribute 1.45, or almost one and one-half of the three illnesses, to contagion- or hygiene-related causes. As with the first index, level of education is significantly associated with knowledge of contagion or hygiene.

To summarize these descriptive findings, biomedical knowledge of the three child illnesses is very low in this population in Ghana. Very few people appear to subscribe to germ theory by identifying infectious agents – germs, microbes, and, in the case of malaria, the mosquito vector or malaria parasite – as the main cause of these infectious diseases. Just over half (53 percent) cite the mosquito as the cause of malaria, only nine percent cite contagion-related causes of diarrheal disease, and only six percent cite contagion-related causes of respiratory infection. Moreover, follow up qualitative work (Focus Group Discussions) across five communities in our study area verified this low level of knowledge of contagion; for example, in three of the ten FGDs, not a single respondent mentioned the mosquito as the cause of malaria.

However, more people cite hygiene-related causes of these illnesses – such as dirty water or dirty food – which can be viewed as biomedically appropriate when it comes to preventive measures. Sixty percent cite hygiene factors as the cause of diarrhea, and 17 percent cite hygiene

factors as the cause of respiratory infection. Ultimately, it may not matter so much that people know the various viral or bacterial agents that cause the various diarrheal infections, for example, but that they know that impure water or food can cause diarrhea in children, as opposed to etiological beliefs, revealed in our FGDs, such as witchcraft, eating too early in the morning or too late at night, a stomachache during the mother's pregnancy (later resulting in diarrhea in her child) or the mother's breast milk, to give but a few examples of etiological beliefs in this area of Ghana. What matters, when it comes to preventing infectious child illnesses, is ensuring that infants and children consume clean water and food, as well as other preventive measures such as hand washing with soap.

Moreover, as expected and as shown in Table 3, level of education is strongly associated with biomedical knowledge. Those with less schooling demonstrate significantly less health knowledge than those with more schooling. This holds across all measures of health knowledge – including knowledge of etiology of malaria, diarrheal disease, and respiratory infection, as well as whether the illness can be prevented and treated. Bivariate analysis does not tell the whole story, however. This paper is concerned with other influences – particularly the effect of one's community – which affect health knowledge.

Multivariate Results

To examine community- and household-level effects on health knowledge, we first fit an empty model, the simplest case of the hierarchical linear model. There are no explanatory variables in the empty model. With this three-level model, total variance can be partitioned into three variance components. Parameter estimates for three models—one for each of the three outcome indices—are given in **Table 4**. The total variance for the general knowledge of contagion index is 1.034 (the sum of the three variance components). The total variance for the general knowledge of contagion or hygiene index is 1.56, and for the general knowledge of prevention index is 1.793. All three components contribute to the variance, although the community level and household level effects are greatest for Models 2 and 3. Community and Household variation (both upper level effects) amount to the order of one-half the variation in these three outcomes. In turn, community level variation (villages and urban neighborhoods) accounts for about half the variation above the individual level. The results strongly suggest that being a member of a particular household and community in coastal Central Ghana may be important in determining one's knowledge of health etiology and prevention.

[Table 4 here]

Following the estimation of the empty model, we estimate a more extensive multilevel model, including individual-, household-, and community-level covariates.[3] **Table 5** presents

[3] We also ran several other multi-level models with different community-level covariates, including presence of a school, presence of a clinic or health care provider, distance to a paved road, presence of electricity, and presence of phone service. Although there were some slightly significant effects for some covariates in some models, the results were not consistent across models. Because of concerns about degrees of freedom (we have only 54 communities or EAs), we also tried a community-level development index combining all of these variables and presence of a market. Yet, the significant effects for presence of a market across all models washed out when included as part of an index. Ultimately, we decided that a model including only two community-level covariates: proportion of literate

these results for all three outcome variables (Model 1—knowledge of contagion index, Model 2—knowledge of contagion or hygiene index, and Model 3—knowledge of prevention index).

[Table 5 here]

Model 1 gives restricted maximum likelihood (REML) estimates for determinants of the knowledge of contagion index. A chi-square test for the log-restricted likelihood indicates that the model fits the data well. In terms of individual- and household-level effects, the respondent's education and literacy both have the expected significant and positive effects (at $p<0.001$) on knowledge of contagion. Media exposure also has a significant and positive effect ($p<0.01$), which indicates the probable diffusion of health knowledge through mass media. Those who are members of a community organization have significantly greater knowledge of contagion ($p<0.01$), which is a more local-level indicator of the diffusion of health knowledge through networks. Practitioners of traditional religions are significantly less knowledgeable about contagion ($p<0.05$). The household possession index is a positive and significant predictor of knowledge of contagion ($p<0.001$). It is worth recalling that all these individual and household effects are net of community level controls and random effects parameter estimation.

The community-level variables both show significant and positive effects on knowledge of contagion at the $p<0.01$ level. In other words, as the proportion of literate adults in the community increase, one's knowledge of contagion is also likely to be greater. In addition, people living in communities with regular markets have significantly higher levels of knowledge about contagion compared to those living in communities without markets. Thus, community context can affect health knowledge. In this model the community level component accounts for about 16 percent of the error variance, while the household component accounts for about 25 percent.

Results shown in Model 2, which has the same independent variables and the knowledge of contagion or hygiene index as the dependent variable, are similar to those from Model 1. Recall that this index is a less stringent measure of health knowledge than the knowledge of contagion index. Again, education, literacy, and mass media exposure all have significant and positive effects (at $p<0.001$) on the knowledge of contagion or hygiene. Although traditional religion is not significant in this model, those who are members of a community organization or a migrant have significantly greater knowledge of contagion or hygiene ($p<0.10$). This is suggestive of the importance of diverse social networks in the spread of health knowledge. Socioeconomic status, as measured by the household possession index, has a significant and positive effect ($p<0.01$) on health knowledge in this model also.

Community-level effects in Model 2 are also significant and positive. Again, the proportion of literate adults in the community has a positive relationship with health knowledge ($p<0.01$). And the presence of a regular market is highly significant and positive ($p<0.001$), which suggests the importance of markets, perhaps as indicators of economic development and thus higher levels of health knowledge, but probably more importantly as centers of social

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adults and presence of a market was the most appropriate model. In addition, we tested our findings using simple OLS regression models and found very similar results; this consistency of findings across different estimation models gives us confidence in the validity of the results.

learning which increase health knowledge. Household and community components of the error variance are in line with those observed in Model 1, accounting collectively for about 43 percent of the error variance.

In the final model, which has the knowledge of prevention index as the dependent variable, slightly different results emerge. Children ever born has a significant and positive effect on knowledge of prevention at $p<0.05$. The more children one has, the more experience in preventing (and treating) childhood illnesses one may have, thus knowledge of prevention may be higher for parents with more children. Again, education and literacy are strongly significant and positive predictors of knowledge of prevention ($p<0.001$). Media exposure is slightly less significant ($p<0.05$), but still has a significant and positive effect on knowledge of prevention. Migrants have significantly higher levels of prevention knowledge than non-migrants ($p<0.01$), which suggests that social networks are important and also that there is some selectivity among migrants in terms of knowledge. And socioeconomic status also has a significant and positive effect on knowledge of prevention ($p<0.01$).

Turning to the community-level effects, the proportion of literate adults in the community has a slightly less significant, yet still positive effect on knowledge of prevention ($p<0.05$). Again, however, the presence of a regular market has a highly significant ($p<0.001$) and positive effect on health knowledge. In this model the household level component of error variance is slightly larger than in the previous two models. This may be the case because the community literacy covariate is less powerful in Model 3, yet there still may be community-level variation working through another means. In all three of these models we observe appreciable error variance component contributions at the household and community level. It is noteworthy that in the presence of several controls the community level covariates (adult proportion literate and market presence) capture potential sources of influence at the village and neighborhood level.

Discussion and Conclusions

The two key results from this analysis indicate the important roles that: 1) education and literacy; and 2) social networks may play in raising levels of health knowledge and, consequently, improving children's health. First, both the bivariate and multivariate results suggest the central role that education plays in increasing health knowledge. Clearly educational attainment and literacy achievement matters for individuals. Ghanaians with higher educational attainment and who report literacy are more likely to have higher levels of health knowledge than those who are illiterate or have lower levels of education. Education and literacy, measured at the individual level, have significant and positive effects on all three health knowledge indices across all of our multi-level models. Formal educational opportunities may expose people to new ideas, improve literacy, lead to increased social status and diverse social ties, promote different kinds of socialization, and suggest new opportunities through social or spatial mobilization (migration). Through all of these pathways, health knowledge may be extended. Literacy facilitates access to health knowledge through printed word media, such as newspapers, pamphlets or billboards. In the models, mass media exposure also had a positive and significant effect on all three health knowledge outcomes, which reinforces the potential importance of health communication programs through both printed word media and other media, including

radio and television. The impact of diffusion effects on general and child health knowledge (rather than only reproductive health or family planning) through mass media programs are a potential area for additional future research and programs in Ghana and possibly other sub-Saharan African countries.

In addition to these individual-level effects, literacy at the community level also impacts individuals' levels of health knowledge. Our multivariate models found that the proportion of persons literate within the community has a significant and positive effect across all three outcomes indices of health knowledge. This community-level effect indicates that even if an individual herself is not literate, living in a community with high levels of literacy can still improve her knowledge of health. Literate individuals in the community may share their health information with others in their social networks who are not literate. Thus a diversity of literate and illiterate individuals in the community, while not ideal for overall development goals, may still indicate a great potential for health programs to communicate health knowledge through informal social networks. In addition, the findings that being a migrant or a member of a community organization has a significant and positive effect on health knowledge in some of the models suggest that health education programs could rely on particular members of the community as key players in the distribution of health knowledge. It also is suggestive of the potential role in social change that migrants, who are often motivated and aware of other settings, may play.

Second, the presence of a market has a highly significant and positive effect on all three measures of health knowledge in our multi-level models. While on the one hand, this may indicate a development effect, as towns with markets are centers of commerce and economic development. But again, we find an interesting interplay between community-level effects and effects at other levels, namely the household. Socioeconomic status, measured at the household level by a possession index, is also a significant and positive predictor of health knowledge across all three multivariate models. It is not surprising that individuals living in wealthier households would have higher levels of health knowledge, even controlling for educational attainment and literacy. Yet in combination with the findings about community-level effects of a market, this suggests that even individuals living in household with a relatively low socioeconomic status can benefit from the presence of a market in the community. Again, this suggests the importance of diffusion and social networks in the spread of health knowledge.

Market villages or neighborhoods (within urban areas) are centers not only of commerce, but also of networking. Individuals come to these areas on market day from the same village or neighborhood, surrounding areas, and often, as traders or even customers, from areas that are much farther away. Thus, social connections found in market areas, particularly on market day (which is usually weekly in Ghana) may be more diverse than the social networks found in non-market areas or even in the same area on a non-market day. Market towns or neighborhoods thus become key sites for social learning and the diffusion of health knowledge. Health education programs could leverage this information to better reach wider audiences. It also suggests the possibility that non-market towns might merit additional interventions, as they are not benefiting from the spillover effects that the market creates. In combination with our findings about the role of education and literacy, migrants, members of community organizations, and media exposure, these findings about the importance of markets suggest that social networks and the

diffusion of knowledge are quite complex. Nevertheless, they can clearly be effective as means of promoting health knowledge. Government health ministries, health promotion organizations, and international organizations like the World Health Organization should attempt to understand how to access these networks and utilize them in their health education programs.

Our findings suggest that formal education and increased literacy, mass media, and social networks and social learning all play important roles in the spread of health knowledge. We reiterate Desai and Alva's (1998) call for additional research on community context and its effect on child health. Although we acknowledge their emphasis on socioeconomic status as important, particularly in light of our evidence that economic development also has an impact on levels of health knowledge, we suggest that research must go further in also examining the role of social networks for advancing health knowledge and ultimately, children's health. Although our findings are generalizable only for a relatively small area of coastal Ghana, they suggest important research and policy directions for many other developing world regions. These results suggest, moreover, the potential for uncovering greater sources and impact of community-level variation as studies extend to an even more widespread and heterogeneous population. In fact, exploring the interplay between education, social networks, and development should be a major research agenda for health researchers and policy makers seeking to improve health conditions in the developing world.

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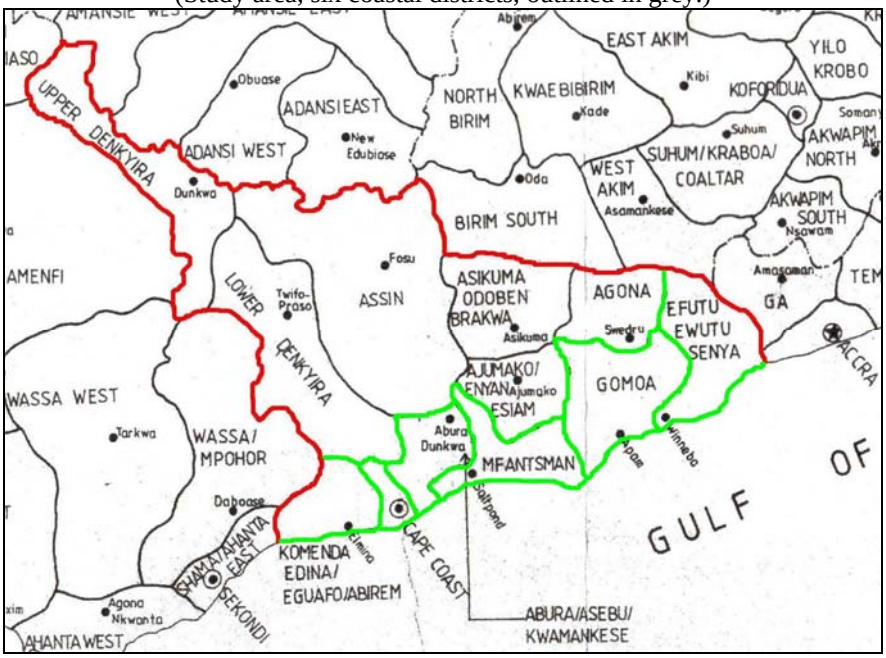
Figure 1: Ghana's Central Region

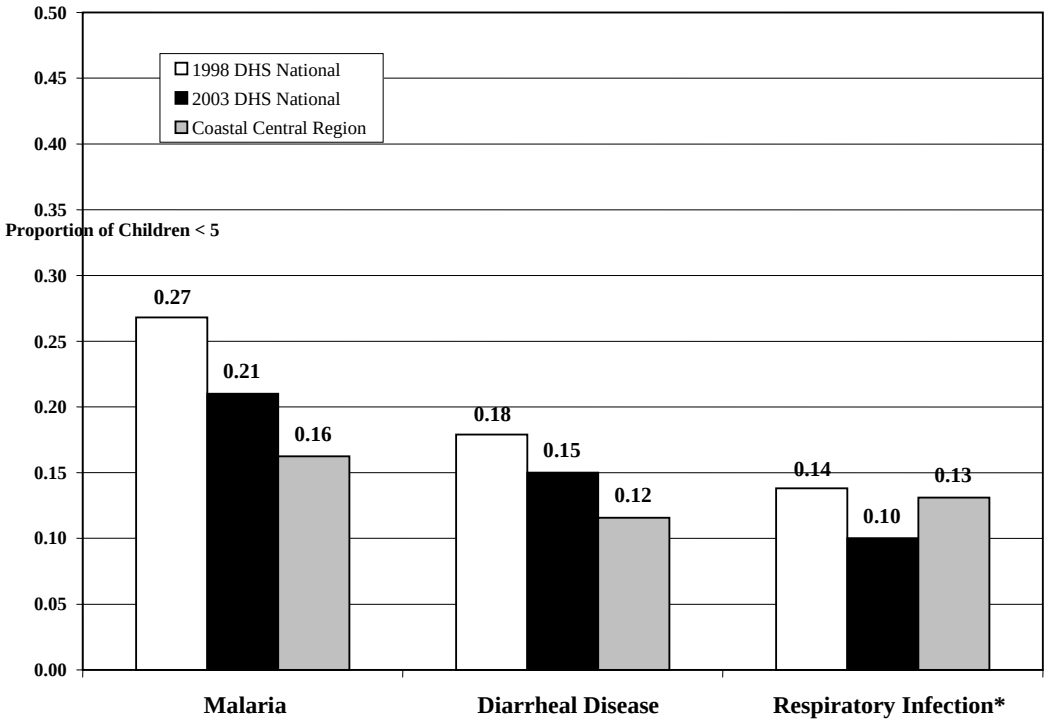
(Study area, six coastal districts, outlined in grey.)



Source: Ghana Statistical Service, 1990.

Figure 2: Prevalence of Child Illnesses

Ghana DHS (1998 and 2003) and Ghana-PCE Survey (2002)



* Ghana DHS asked about Acute Respiratory Infection (ARI).

Table 1: Descriptive Characteristics of Communities (N=54)

2002 Ghana Population & Environment Survey

Characteristic	Freq.	Mean (Std. Dev.)
Regular Market	14	**25.9**
Electricity	44	**81.5**
Telephone Service	19	**35.2**
Health Facility or Health Care Worker	48	**88.9**
Minutes to Paved Road		**13.7** (15.3)
School	49	**90.7**
Proportion of Literate Adults in Community		**0.23** (0.05)
Proportion of Literate Women in Community		**0.23** (0.02)

Table 2: Descriptive Characteristics of Households and Individuals

(Weighted value unless indicated.)
2002 Ghana Population & Environment Survey

Characteristic	Freq.	Mean (Std. Dev.)
Household Characteristics		
Number of Households[1]	**1197**	
SES Index[2]		**2.86** (2.47)
Electricity	699	**58.4**
Drinking Water Source		
Piped Water	870	**72.7**
Well Water	164	**13.7**
Surface Water	58	**4.9**
Other (sachets, rainwater, tanker water)	105	**8.7**
Toilet Facility		
Flush Toilet	141	**11.8**
Pit Toilet/Latrine	674	**56.3**
No Facility/Bush	382	**31.9**
Individual Characteristics		
Number of Respondents[1]	**2506**	
Male	1093	**43.6**
Female	1413	**56.4**
Ethnicity		
Fante	1800	**71.9**
Other Akan (including Asante)	199	**8.0**
Ewe	104	**4.2**
Guan	134	**5.3**
Other Northern	28	**1.1**
Other	239	**9.5**
Migrant	1470	**58.7**
Children Ever Born	1437	**3.4** (3.2)

Table 2: Descriptive Characteristics of Households and Individuals

(Weighted value unless indicated.)
2002 Ghana Population & Environment Survey

Characteristic	Freq.	Mean (Std. Dev.)
Religion		
None	192	**7.7**
Catholic	312	**12.4**
Protestant	645	**25.8**
Pentecostal	774	**30.9**
Syncretic	366	**14.6**
Muslim	97	**3.9**
Traditional	88	**3.5**
Other	30	**1.2**
Education (highest level attended)		
None/Koranic	734	**29.3**
Primary	385	**15.4**
Middle/JSS	929	**37.1**
Secondary+	458	**18.3**
Literacy (read and understand letter/newspaper)		
Not at All	1092	**43.6**
With Difficulty	519	**20.7**
Easily	886	**35.4**
Exposure to Media		
Reads Newspaper (weekly)	585	**23.4**
Listens to Radio (daily)	1811	**72.3**
Watches Television (weekly)	1441	**57.5**
Member of Community Organization	850	**33.9**

[1] Unweighted frequencies.
[2] Measured via a simple index of 11 household possessions.

Table 3: Knowledge of Child Illnesses, for All and by Education Level

(N≈2500, Weighted mean unless indicated.)
2002 Ghana Population & Environment Survey

Characteristic	All	*Highest Level of Schooling Attended*				
		None	Primary	Middle	Second.+	Sig.
	(Std. Dev.)	(Std. Dev.)	(Std. Dev.)	(Std. Dev.)	(Std. Dev.)	
Knowledge of Malaria						
Cause of Malaria						
Caused by mosquito/malaria parasite	**0.53**	**0.29**	**0.41**	**0.59**	**0.89**	***
Can be prevented	**0.80**	**0.65**	**0.75**	**0.87**	**0.98**	***
Can be treated	**0.97**	**0.95**	**0.99**	**0.98**	**0.99**	**
Knowledge of Diarrheal Disease						
Cause of Diarrhea						
Contagion/germs	**0.09**	**0.05**	**0.07**	**0.09**	**0.15**	***
Hygiene/dirt	**0.60**	**0.45**	**0.55**	**0.66**	**0.74**	***
Other causes	**0.32**	**0.50**	**0.38**	**0.25**	**0.11**	***
Can be prevented	**0.73**	**0.58**	**0.65**	**0.77**	**0.95**	***
Can be treated	**0.97**	**0.93**	**0.97**	**0.99**	**0.99**	**
Heard of ORS	**0.84**	**0.67**	**0.80**	**0.92**	**0.97**	***
Knowledge of Respiratory Infection						
Cause of Respiratory Infection						
Contagion/germs	**0.06**	**0.02**	**0.04**	**0.07**	**0.13**	***
Hygiene/dirt	**0.17**	**0.14**	**0.13**	**0.16**	**0.28**	***
Other causes	**0.77**	**0.84**	**0.83**	**0.77**	**0.59**	***
Can be prevented	**0.65**	**0.54**	**0.55**	**0.67**	**0.87**	***
Can be treated	**0.96**	**0.94**	**0.93**	**0.97**	**0.99**	**
Spiritual Causes of Child Illnesses	**0.48**	**0.56**	**0.56**	**0.46**	**0.34**	***
Knowledge of Causes Indices						
Contagion factors [0, 3][1]	**0.68**	**0.36**	**0.52**	**0.76**	**1.17**	***
	(0.67)	(0.52)	(0.61)	(0.67)	(0.62)	
Contagion or Hygiene factors [0, 3][2]	**1.45**	**0.95**	**1.20**	**1.57**	**2.19**	***
	(0.96)	(0.86)	(0.93)	(0.89)	(0.73)	
Knowledge of Prevention Index **[0, 3]**[3]	**2.18**	**1.76**	**1.96**	**2.30**	**2.79**	***
	(1.08)	(1.19)	(1.15)	(0.98)	(0.55)	

***** = p < 0.001, ** = p < 0.01, * = p < 0.05**

Significance tests are unweighted.

[1] Number of three illnesses -- malaria, diarrheal disease, and respiratory infection -- attributed to contagion.

[2] Number of three child illnesses attributed to contagion or hygiene.

[3] Number of three child illnesses considered to be preventable.

Table 4: Estimates for Empty Model (REML) Without Covariates

2002 Ghana Population & Environment Survey

	Model 1		Model 2		Model 3	
	General Knowledge of Contagion Index (0,3) N=2,505		General Knowledge of Contagion or Hygiene Index (0, 3) N=2,505		General Knowledge of Prevention Index (0, 3) N=2,505	
Fixed Effect	**Coefficient**	**Standard Error**	**Coefficient**	**Standard Error**	**Coefficient**	**Standard Error**
Intercept	0.557	0.036	1.276	0.056	2.169	0.060
Random Effect	**Variance Component**	**Standard Error**	**Variance Component**	**Standard Error**	**Variance Component**	**Standard Error**
Community level	0.247	0.028	0.381	0.043	0.401	0.047
Household level	0.273	0.018	0.431	0.026	0.578	0.028
Individual level	0.514	0.010	0.748	0.014	0.814	0.016
Total variance	1.034		1.560		1.793	
Log restricted-likelihood	-2,206.37		-3,183.81		-3,494.59	
Chi-square (2)	420.45		454.54		495.76	

Table 5: Multi-Level Model (REML) of Determinants of Health Knowledge

2002 Ghana Population & Environment Survey

Variable	Model 1: General Knowledge of Contagion Index (0, 3) N=2,505		Model 2: General Knowledge of Contagion or Hygiene Index (0, 3) N=2,505		Model 3: General Knowledge of Prevention Index (0, 3) N=2,505	
	Estimate	Standard Error	Estimate	Standard Error	Estimate	Standard Error
Intercept	0.035	0.065	0.378 ***	0.098	1.387 ***	0.122
Individual- or Household-level						
Age	0.001	0.001	0.001	0.002	-0.0001	0.002
Male	-0.027	0.023	-0.026	0.034	0.021	0.039
Children Ever Born	0.001	0.005	0.013	0.008	0.021 *	0.009
None or Koranic Schooling (ref.)	0.000		0.000		0.000	
Primary or Middle School Education	0.142 ***	0.031	0.273 ***	0.045	0.194 ***	0.053
Secondary School or Higher Education	0.313 ***	0.051	0.556 ***	0.075	0.396 ***	0.087
Literate	0.157 ***	0.032	0.225 ***	0.047	0.197 ***	0.054
Exposure to Media (0, 3)	0.050 **	0.015	0.091 ***	0.022	0.052 *	0.026
Member of Community Organization	0.068 **	0.246	0.062 #	0.036	0.022	0.420
Traditional Religion	-0.065 *	0.032	-0.033	0.047	-0.035	0.057
Migrant	-0.022	0.025	0.062 #	0.037	0.134 **	0.044
Non-Akan Ethnicity	0.043	0.040	-0.046	0.060	-0.055	0.075
SES Index (0, 11)	0.029 ***	0.006	0.031 **	0.010	0.037 **	0.012
Urban or Semi-Urban Residence	-0.008	0.053	-0.016	0.080	-0.071	0.104

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	Estimate	**Standard Error**	**Estimate**	**Standard Error**	**Estimate**	**Standard Error**
Community-level						
Proportion of Literate Adults in Community	0.389 **	0.147	0.658 **	0.221	0.593 *	0.286
Regular Market in Community	0.178 **	0.053	0.300 ***	0.080	0.383 ***	0.104
Random Effects						
Community level	0.139	0.020	0.210	0.030	0.275	0.039
Household level	0.209	0.019	0.350	0.026	0.552	0.028
Residual	0.502	0.009	0.723	0.013	0.793	0.015
Log restricted-likelihood	-2,079.33		-3,036.63		-3,433.58	
Chi-square (2)	125.72		155.86		300.60	

***** = p < 0.001, ** = p < 0.01, * = p < 0.05, # = p < 0.10**