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Edward Geoffrey Jedediah Stevenson

Schooling and life chances:
Explaining the effects of mothers' schooling on child health
in Ethiopia

By

Edward Geoffrey Jedediah Stevenson
Doctor of Philosophy

Anthropology

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Craig Hadley, Ph.D.
Advisor

_____

Peter J. Brown, Ph.D.
Committee Member

_____

Robert A. LeVine, Ph.D.
Committee Member

_____

Bradd Shore, Ph.D.
Committee Member

_____

Carol M. Worthman, Ph.D.
Committee Member

Accepted:

_____

Lisa A. Tedesco, Ph.D.
Dean of the James T. Laney School of Graduate Studies

April 14, 2011

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By

Edward Geoffrey Jedediah Stevenson
B.A., University College London, 2000
M.A., Emory University, 2007
M.P.H., Emory University, 2011

Advisor: Craig Hadley, Ph.D.

An abstract of
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Schooling and life chances: Explaining the effects of mothers' schooling on child health in Ethiopia

Edward Geoffrey Jedediah Stevenson

**Abstract**

The expansion of women's schooling is often asserted to be one of the largest influences on the global fall in child mortality of the past century. While consensus exists that the benefits of maternal schooling for child survival are due to improved health behaviors on the part of mothers, the factors that connect girls' school experience to these behaviors in later life are unclear. This dissertation tested 4 hypothetical connections between schooling and child health in Ethiopia, namely (1) knowledge of treatments for diarrhea and malaria, (2) literacy skills, (3) aspirations that could motivate greater parental investment, and (4) greater wealth and access to medical services among mothers with more education. The research was carried out in the town of Jimma and neighboring rural areas, and included approximately 120 hours of observation in primary schools and an 18-month longitudinal survey of ~140 children, aged 0-33 months, with varying levels of parental schooling. Children's illnesses, physical growth, and psychomotor development status were used as measures of mortality risk.

Living in rural communities, where there was neither piped water nor easy access to medical services, had larger negative effects on children's health than lack of parents' schooling. Knowledge, literacy, and aspirations showed variable relationships to children's health outcomes: fathers' health literacy appeared to mediate the relationship between paternal schooling and children's weight gain in the urban setting, while mothers' schooling and aspirations for children's development were related to greater weight for age among children in the rural settings. Lower odds of diarrhea among children of mothers with schooling in the rural communities could not be explained by any of the hypothesized mechanisms. In sum, parents' schooling did not exhibit consistent relationships to child health outcomes or to the hypothesized mediators. Community-level factors such as access to clean water and medical services may overwhelm the potential benefits for children's health that might otherwise follow from mothers' schooling. Investments in education should therefore be matched by provision of amenities to underserved communities, and by efforts to reduce the barriers to accessing healthcare faced by marginalized parents and children.

# Schooling and life chances:
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This dissertation is dedicated to the parents and children of Jimma, Serbo, and Qarsa.

**Acknowledgments**

My curiosity about questions of human and social development crystallized during travels in Turkey the year after I finished college, when I saw people plowing with oxen, and living, it seemed, more or less as their ancestors had two or three thousand years earlier. I had studied Classics and archaeology as an undergraduate, and I recognized this way of life from ancient texts. I wondered how it had survived. I also felt compelled to understand how such people's lives could be improved. Medicine and economics seemed like the most relevant disciplines, but I didn't feel I was cut out for them. So by default I settled on the idea of looking at the potential of education as a force for social change.

I ended up pursuing the question not in Turkey but in Africa, and the question itself changed along the way, with issues of health and economics entering in again. This was partly because of my good fortune to go to graduate school at a place where I felt supported to branch out and study subjects that were entirely new to me. The way I have come to frame the question, and the kind of sense I have made of it, owes much to the people I've studied with at Emory, particularly my advisor, Craig Hadley, and my committee members, Peter Brown, Bradd Shore, and Carol Worthman. I have also been much influenced by the work of my external committee member, Bob LeVine, and by my informal mentors Mel Konner and Mahdi Ibrahim. Fellow students who shared ideas and enthusiasm with me included Ryan Brown, Brandon Kohrt, Dan Hruschka, Dan Mains, Jen Kuzara, Erin Finley, Svea Closser, Tricia Fogarty, James Broesch, and Kenny Maes; and at the Rollins School of Public Health, Michael Kramer and Anoopa Sharma.

The research on which this dissertation is based took place in 2007-2009, but it was in gestation since my first visit to Ethiopia in 2003. Don Donham first inspired me to work in Ethiopia, and Dan Mains introduced me to Jimma. During my visits to Ethiopia, Leah Niederstadt, Tim Carmichael, Alula Pankhurst, Abby Maxman, Marton Kocsev, and Bruck Fikru provided me with fellowship and counsel.

At Jimma University, my advisors in the Faculty of Public Health were Tefera Belachew, Fasil Tessema, and Abebe Gebre-Mariam; Meketie Wondefrash and Yohannes Dibaba also provided informal advice. David Lindstrom of Brown University supported my collaboration with the Jimma Longitudinal Study of Youth. My friendly neighbors included Mette Olsen, Pernille Kaestel, Gregers Stig Andersen, Niels ten Oever, Anna Milius, and *Obbo* Jira Mekonnen. Kenny Maes was a good companion in the field.

The research in Jimma was collaborative work, and during weekly team meetings and walks across town and through the countryside I learned a lot from the data collectors who worked with me on the project:

Mintayesh Mosissa

Amina Kedir

Meseret Haile

Wosene Megerssa

Ayelech Getachew

Emebet Tamam

Alewiya Abba-Jihad

Amida Abba-Gidi

Wibrest Daribe

The families of Ayelech (Naga, Haadhee, Abush, and Mitanu), and Mintayesh (Romil, Rahel, and Meeraf) were also important parts of the team.

The families and children in Jimma, Serbo, and Qarsa who were the subjects of the study tolerated our monthly visits to their homes with grace, and frequently invited us to drink coffee or to eat with them. Teachers and staff at Bareedina Primary School and at the Jimma Zone Education Bureau were supportive of the project. I am especially grateful to Teacher Weynshet and Director Badhaasaa.

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In addition to my committee members, the following provided criticism and advice on all or part of this dissertation: Kay Stevenson, Kenny Maes, Ana Schaller, Brandon Kohrt, and Dan Mains. The weaknesses that remain are my own.

I thank my parents for their love and support: Kay Stevenson and Clive Hart, Jan Stevenson and Judith White. My mother in particular has had a tremendous and positive influence on this work and on me. Thanks too to Selam and Asa, who gave it all new meaning.

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**Note on transcription and names**

There is no standard system of transcription for Amharic, which is written in the Ge'ez syllabary (Bender et al. 1976). In the text, when using the Roman alphabet to represent Amharic words, I generally follow the system used by Hoben (1973), which is intended to give an approximate sense of pronunciation without extensive use of diacritics. However, I use apostrophes to indicate the explosive consonants *t'*, *s'*, and *ch'* (as in Appleyard 1995), and for the explosive *k'*, I use *q*. For orthography in *afaan* Oromo, which is conventionally written in the Roman alphabet, I follow Mahdi Hamid Muudee (1995).

In Ethiopia, first names are given names and second names patronyms. Many people in the text, including Ethiopian authors, are therefore referred to by their first names. For example, the current Prime Minister of Ethiopia is Meles Zenawi; it is proper to refer to him as Prime Minister Meles (just as we talk of Chairman Mao rather than Chairman Zedong). For fuller explication see Bahru & Pausewang (2002: 6).

## Introduction

The global expansion of schooling is often asserted to be one of the most powerful forces behind the fall in child mortality that has occurred over the past fifty to a hundred years. A recent analysis of data from 175 countries showed that the average number of years of schooling for women in each country exerted an independent influence on child survival after gross domestic product and HIV prevalence were taken into account, and might be responsible for half of the child deaths averted worldwide between 1970 and 2009 – equivalent to 4.2 million lives saved (Gakidou et al. 2010). And yet if women's education is a "social vaccine" (Vandemoortele and Delamonica 2000), it may be said that we understand as much today about the mechanisms by which mothers' education affects children's health as Jenner understood about the mechanism of vaccines' action during his first experiments in inoculation. While it is clear that at least a year of schooling is required to reap benefits, and that the relevant forces must involve changes in maternal health behaviors, the mechanisms linking women's school experience to these behavioral changes has so far been left in a "black box" (Mosley & Chen 1984; LeVine et al. 2001). Understanding how maternal schooling achieves these effects on child health may help spread the benefits more widely.

Certain features of the demographic association between mothers' schooling and child survival are well established: the relationship conforms to a dose-response pattern; it is stronger for children aged 1 - 4 than for infants; it varies in strength across countries, and is weaker in sub-Saharan Africa than elsewhere (Cleland & van Ginneken 1988; Hobcraft 1993; Bicego & Ahmad 1996). Fathers' schooling, while

as important or more important than mothers' schooling for child survival in some countries, is less important or negligible in others (Mensch et al. 1985), which is generally explained by the more variable roles of fathers compared with mothers in child-rearing across cultures.

Evidence from the Demographic and Health Surveys, an international program of health surveillance, provides evidence that women with schooling more readily adopt a range of health behaviors that protect their children, including vaccination and consulting medical professionals in cases of child illness (Bicego & Boerma 1991; Ryland & Raggers 1998; Stallings 2004). What is unclear is why school experience leads women to adopt these health behaviors. Among the explanations that have been proposed are that schooling enables women to recognize child illness earlier, helps them to negotiate with clinical service providers more skillfully, and inclines them to bond more intensely with their children as members of a nuclear family and therefore to invest more in their children's health. The challenge for researchers is to link these capacities and dispositions to the actual experience of children in schools. What is it about attending school, for instance, that could make a woman better at negotiating with clinicians?

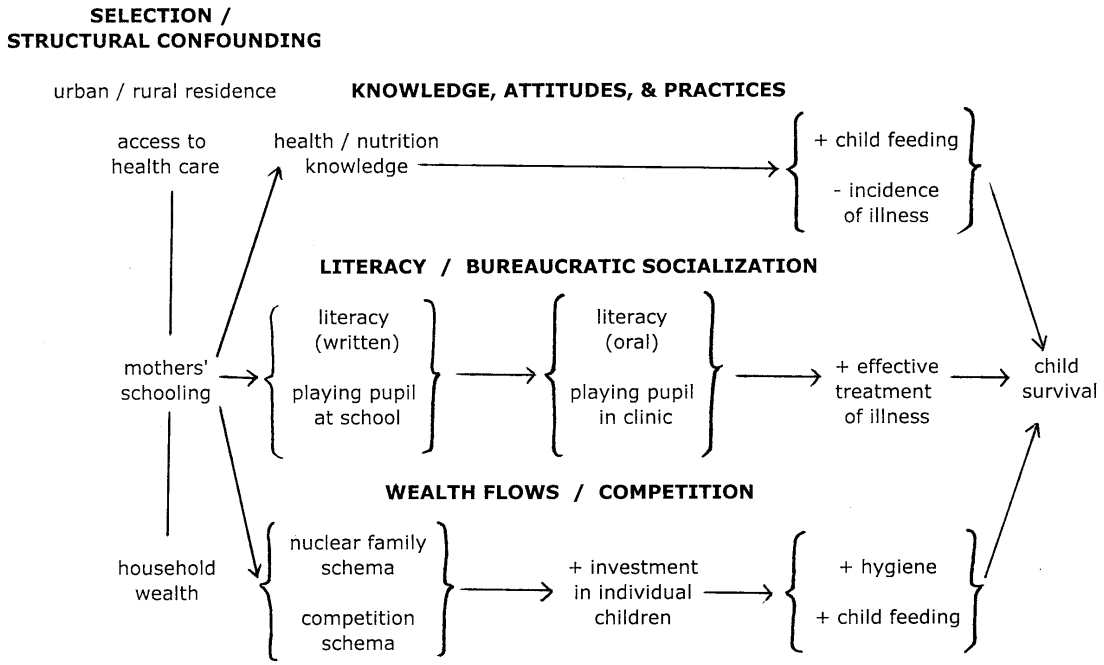
In the first chapter of this dissertation, I outline three bodies of theory that imply different answers to questions such as this one – namely the frameworks of Knowledge, Attitudes, and Practices (KAP), Marxism, and ideas derived from Weber and the study of socialization. The perspective associated with Marx proposes that the statistical association between women's schooling and child survival is an artifact of processes of selection by economic status and other unmeasured characteristics.

The dissertation focuses on the hypotheses that the most important elements of mothers' schooling for child survival are:

1. health knowledge acquired at school, which informs treatment of illness (the knowledge-practices hypothesis)
2. literacy, and the ability to decipher health-related materials, e.g. medicine packets and hospital forms (the literacy / bureaucratic socialization hypothesis)
3. a schema of the nuclear family (the wealth flows hypothesis) or a schema of competition for waged employment (the competition hypothesis), each of which intensifies parental investment
4. household wealth and access to medical care (the selection and structural confounding hypotheses)

The following model illustrates key links between mothers' schooling and child survival specified by these four hypotheses. The first 3 hypotheses in the above list are represented by horizontal pathways, and the selection / structural confounding hypothesis by the terms arrayed vertically on the left hand side of the figure.

**Figure 1: Hypotheses connecting mothers' schooling to child survival**




While the importance of hypotheses such as these has been acknowledged by demographers (e.g. Caldwell et al. 1987; Caldwell 1994), the methods required for testing them are uncommon in demography. Four components are key for testing these hypotheses:

1. observation in schools to identify health-relevant learning
2. assessment of women's knowledge and attitudes at the time of active motherhood
3. measurement of maternal health behaviors (i.e. behaviors that are clearly and directly connected to protecting a child from malnutrition, infection, or harm)
4. measurement of child health and survival outcomes associated with maternal schooling

Integrating these 4 components in research projects is a challenge. By employing measures of mortality risk, such as child growth status or incidence of illnesses, however, it is possible to gather information that is relevant to child survival, and to do so on a scale that permits closer attention to maternal knowledge, attitudes, and health behaviors than would be possible in a conventional demographic survey. Such is the approach of this dissertation project.

The research for this dissertation employed 3 measures of child health and mortality risk: illness, physical growth, and psychomotor development. Illness from infectious diseases is directly related to child mortality, since the majority of deaths among children 1 to 4 years old are attributable to diarrhea, acute respiratory infections, and malaria (Morris et al. 2003; Lopez et al. 2006). Physical growth impairment constitutes a sensitive indicator of mortality risk in children (Martorell & Ho 1984; Pelletier 1994a; Schroeder 2001). And psychomotor status reflects dimensions of wellbeing that, while affected by physical growth and illness, are not reducible to them alone – for example, linguistic and cognitive development (Grantham-McGregor et al. 2007).

The research reported in this dissertation also incorporated the 3 other components required for testing the hypotheses outlined above, i.e. (1) observation in schools to identify health-relevant learning in the classroom, (2) assessment of maternal knowledge regarding treatments for diarrhea and malaria, and maternal attitudes regarding children's future development, and (3) reports of maternal health behaviors (treatment of illnesses).

The fieldwork for the dissertation was carried out in Ethiopia, a country that is currently undergoing transition to mass schooling and decline in child mortality. Only within the past decade has the majority of youth in Ethiopia had access to schooling (Amdissa 2008; UNESCO 2008). Child mortality has been declining slowly since the 1970s, but between 1990 and 2010 the decline in under-five mortality in Ethiopia was among the greatest in the world, falling from approximately 200 to 100 deaths per thousand live births (UNICEF et al. 2010; Rajaratnam et al. 2010; You et al. 2010).

The research carried out for this dissertation included approximately 120 hours of observation in primary schools and an 18-month longitudinal survey of 142 children who ranged in age from newborns to 33 months old. The center of the study was the provincial town of Jimma in southwest Ethiopia, and research was also carried out in neighboring rural areas. Approximately a third of the mothers in the study, including the majority in the rural area, had no schooling, and the remainder had school experience ranging from 1 to 14 years.

While the question of how schooling affects child survival is at the core of the dissertation, a large part of it is devoted to description of competing influences on child health aside from mothers' schooling, including household wealth, variation in access to medical care between rural and urban areas, and the influence of biological characteristics such as children's ages. As I argue in Chapter 1, country-specific factors that are distinct from women's schooling exert a larger effect on overall levels of child mortality than does women's schooling alone. Accounting for other influences on child mortality is therefore essential for identifying the contributions of

mothers' schooling to child survival. No amount of mother's schooling will protect a child from malnutrition if a household is desperately poor; or if crucial medicines are unavailable, no amount of skill in negotiating in a clinic will help cure a child who is critically ill.

The key findings of the dissertation are that community effects exert a larger influence on child health than do individual or household-level factors, including parents' schooling and household wealth. Despite this, there are relationships in the expected direction between mothers' schooling and children's odds of diarrhea and growth status in rural communities, and between fathers' schooling and child weight gain in the urban community. Although there is weak evidence for mediation of these relationships by mothers' literacy in Amharic or developmental expectations for their children, fathers' health literacy appears to mediate the relationship between fathers' schooling and children's weight gain.

One interpretation of these mixed relationships is that schooling has contributed to the opening up of new *life chances* in Ethiopia – both in the sense of decreasing the risks of early death, and in the sense in which Dahrendorf (1979) used the term, i.e. a particular balance of options (possibilities to choose one's own life course) and ligatures (social bonds that give meaning to the life course). The spread of a new life chance involving schooling and waged employment has not been even, and it remains effectively closed to the majority of Ethiopians who make a living as smallholder farmers or pastoralists. For those who have gained access to schooling, an ethic of personal hygiene that is emphasized through physical examinations, and the learning of literacy skills that aid in negotiating with the medical system, may buffer children

from infection and help to ensure they receive appropriate treatment when they are ill. School experience may also change goals for childrearing, with the competitive environment of the school disposing parents to cultivate individual initiative on the part of the child – a characteristic that is adaptive in competition for waged employment. And yet when efficient medical services, sufficient food, or clean water are unavailable, lessons learned at school cannot protect children from illness or death.

**Structure of the dissertation**

The dissertation is divided into three parts. Part I provides theoretical background and local context, Part II assesses relationships between child health and factors including parents' schooling, and Part III tests hypotheses to explain these relationships. More specifically, Part I explains the theoretical framework (Chapter 1), and describes the study design and the study setting (Chapter 2), while data on the socio-economic backgrounds of participating families are presented in Chapter 3, and a report of observations in primary schools is given in Chapter 4. Part II contains analyses of the three child health measures – illness, physical growth, and psychomotor development – in relation to community and household factors including mothers' and fathers' schooling (Chapters 5-7). Part III focuses on the relationships between parents' schooling and child health demonstrated in Part II, and assesses the potential of health knowledge, literacy, and developmental expectations to explain these relationships (Chapters 8-10).

Chapters 2-10 often include portraits of individual children and families in the study, which serve as counterpoints to the quantitative data. The majority of the evidence

presented is, however, quantitative. Making sense of the relationships between schooling, child health, and intervening factors requires statistical techniques to assess mediation – a concept that is defined more fully in Chapter 1, alongside a more detailed account of the association between maternal schooling and child survival, and theories that may help to explain it.

Chapter 1

## Problem, concepts, and theories

> Every theory of education clearly requires a theory of society as a whole and of how social processes shape education. A theory of formal education also requires a theory of how learning and thinking skills develop in an individual member of society, and how educational processes contribute to the shaping of these skills. (Scribner & Cole 1973: 553)

The challenge of developing a theory of the effects of maternal schooling on child mortality is that it must combine a theory of education and a theory of demographic behavior, explaining the relationship between the varying experiences of girls as they grow up and their behavior as mothers, as well as the population-level patterns that emerge from these variations. The challenge is no smaller when the subject is education and mortality decline in a single country, such as Ethiopia, than when these subjects are considered on a global scale. The goals of this chapter are therefore (1) to summarize the broad outlines of the relationship between mothers' schooling and child survival in Ethiopia and the developing world, and (2) to recount three bodies of theory that might explain patterns in women's schooling and child survival, namely KAP, Marxism, and a body of theory centered on the anthropological concept of socialization, including insights from Weber. In the process, I will introduce a set of concepts that are useful for the theoretical task, i.e. the anthropological concepts of schema and socialization, and for the task of accounting for statistical relationships, i.e. the statistical concepts of confounding, selection, and mediation. Finally I will lay out a set of hypotheses that will be tested in this dissertation.

**Mothers' schooling and child mortality in Ethiopia and the developing world**

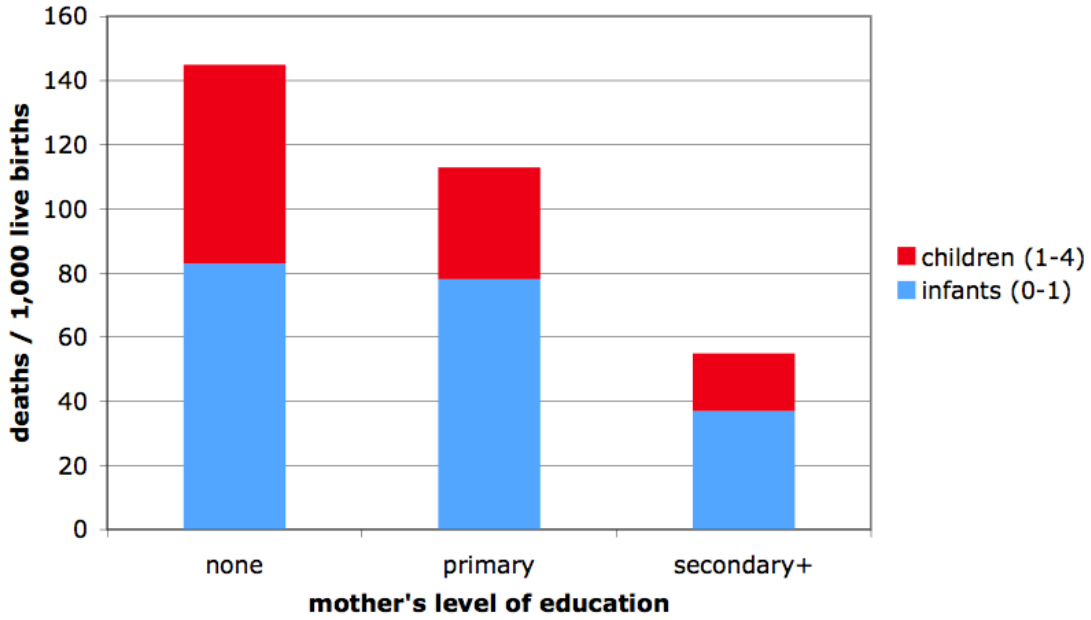
Since the late 1970s, international surveys – the World Fertility Survey, and more recently the Demographic and Health Surveys (DHS) – have provided data on the socioeconomic determinants of child mortality in dozens of developing countries (Cleland & Hobcraft 1984; ICF Macro 2011). The most important features of the statistical relationship between mothers' schooling and child mortality that emerge from these data are that it conforms to a dose-response pattern – an incremental decrease in under-five mortality for each year of mothers' schooling, with approximately half of this effect being statistically independent of household wealth (Cleland & van Ginneken 1988; Bicego & Boerma 1993). The dose-response characteristic – a decrease of between 2 and 9.5 % in under-five mortality for each year of mother's schooling (Cochrane et al. 1982; Caldwell & Caldwell 1991; Gakidou et al. 2010) – has important policy implications, since it implies that benefits of maternal education for child survival have no threshold (e.g. a course of a few years of primary schooling being sufficient to produce the total effect). In sub-Saharan Africa, however, there is a threshold in some countries: in 4 of 16 studies from the region reviewed by Jejeebhoy, risks of under-five mortality were similar for mothers with no schooling and for those with a few years of schooling, but dropped for those who had reached the higher years of schooling (a relationship referred to as "7-shaped" by Jejeebhoy, 1995: 103).

The effect of mothers' schooling on infant mortality is weaker in all regions of the world, and, especially in sub-Saharan Africa, it is rendered statistically insignificant when other socio-economic factors are accounted for (Hobcraft 1993; Bicego & Ahmad 1996: 40). An important analysis by Desai and Alva (1998), although it did

not include data from Ethiopia, provides information on factors that can confound the effects of mothers' schooling on infant mortality. Desai and Alva found that in urban areas with access to piped water and toilet facilities, among families in which fathers had attended secondary school, the effect of mothers' secondary schooling on infant mortality was statistically significant in only 13 of 21 countries they studied, including only 4 of the 8 countries in their sample from sub-Saharan Africa. When fixed effects models were used to control for influences at the community level (the villages or subdivisions of cities used as clusters for sampling in the Demographic and Health Surveys), the effect was attenuated further, with mothers' secondary schooling remaining a significant predictor of infant survival in only 7 of the 21 countries, and in only 1 of the 8 countries in Africa (Liberia).

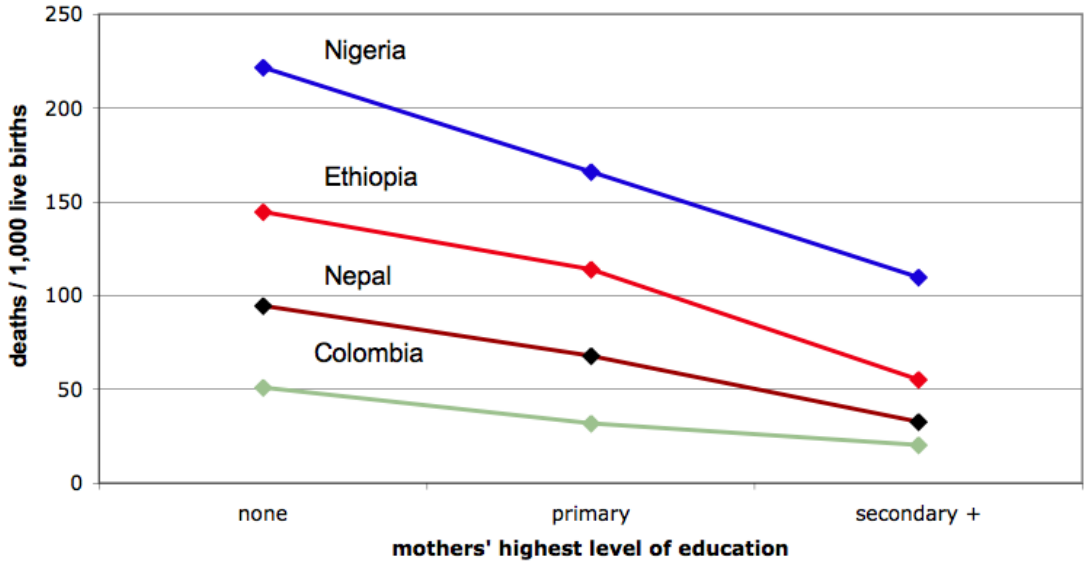
The relationship between mothers' schooling and child mortality in Ethiopia is broadly similar to that in other developing countries, with strong effects on child mortality but relatively weak effects on infant mortality (Mahy 2003: 27). For mothers with secondary schooling or higher in Ethiopia, both risks of infant (under 12 months) and child mortality (1-4 years) are reduced by more than half compared to those of mothers with no schooling. For mothers with primary schooling only, child mortality is substantially lower than for those with no schooling, but infant mortality is not significantly different (Figure 1.1).

**Figure 1.1: Infant and child mortality by mothers' level of education in Ethiopia**
(data from DHS 2005)




While the inverse relationship between mothers' schooling and under-five mortality (which includes both infant and child mortality) is stronger and more consistent across world regions than is that for infant mortality, there is still variation among countries in its strength. Figure 1.2 shows the relationship between mothers' education (classified as none, primary, and secondary or higher) and under-five mortality in Ethiopia and three other countries chosen for purposes of illustration.

**Figure 1.2: Under-five mortality rates by mothers' level of schooling in four countries** (data from DHS STATcompiler)




While in all four of these countries the difference between mortality among children under 5 years whose mothers have no schooling and those who have completed secondary school is 50 % or more, the differences in the baseline levels of child mortality for those with no schooling mean that women who have completed primary school in Nigeria have a higher risk of losing children than women with no education in Ethiopia; and those with secondary schooling in both countries are at still higher risk of losing children than those with no schooling in Colombia.

One hypothesis to explain this pattern is that there is a contextual effect of education, with higher average levels of schooling in some populations providing protection for the children of women with little or no schooling (Parashar 2005; Cleland 2010). Yet the fact that Nigeria, where the average level of women's schooling is higher than in Ethiopia (4.1 versus 1.0 years for women aged >24 [Gakidou et al. 2010]), has higher under-five mortality than Ethiopia at each level of women's schooling, suggests that

substantial variation in child mortality rates among countries is due to factors other than mothers' education.

Another hypothesis is that local disease ecologies affect mortality risks for all children in each country, with mothers' schooling only partially mitigating these risks. While the major proximal causes of child death in the developing world are diarrheal diseases, acute respiratory infections, and malnutrition (Black et al. 2003, 2010; Morris et al. 2003; Pelletier et al. 1993), there is substantial variation by region. Malaria, for instance, is a major threat in sub-Saharan Africa, where it accounts for 23 % of deaths between 1 week and 5 years, but is less prevalent in South Asia (including Nepal) and Latin America (including Colombia), where it accounts for <2 % of deaths at the same ages (Lopez et al. 2006: 144, 162; WHO 2009a). After local disease ecologies have been taken into account, much of the remaining difference between levels of under-five mortality across countries and regions is likely due to the availability of resources to combat malnutrition and disease, most importantly wealth and efficient medical systems (Hill et al. 2000; Kim et al. 2000).

*What accounts for the pattern of decreasing child mortality by mothers' schooling in these varying environments?* There is substantial consensus among researchers that the survival advantages conferred on children by mothers' schooling are due to differences in preventive health behaviors in the household (such as hygiene and appropriate feeding) and use of clinical services (e.g. Caldwell 1979, 1994; Cleland 1990, 2010). Although women with more schooling are more likely to use prenatal care (Bicego & Boerma 1991: 189) and to deliver in clinical settings (Stewart & Sommerfelt 1991; Bell et al. 2003: 30), the greater effects of mothers' schooling on

child survival at ages 1-4 than during infancy suggest that the advantages are due not just to reduced risks of dying during the most vulnerable period of the life course, soon after birth (e.g. from neonatal sepsis or tetanus) but also to childcare practices and illness management over the longer term. Demographic and Health Surveys show that, in general, mothers with more schooling are more likely to consult medical professionals for children's acute respiratory infections (Ryland & Raggers 1998; Stallings 2004), to use recommended treatments such as ORT (oral rehydration therapy) for diarrhea (Stallings 2004: 57), and to obtain a full set of child vaccinations (Desai & Alva 1998: 77). Improved management of children's illnesses and vaccination have great effects on reducing child mortality (Hill et al. 2001; Levine et al. 2004; WHO 2009b); it is therefore plausible that these health behaviors contribute to lowering child mortality among educated women.

There are, however, variations by region in the relationship between schooling and health behaviors, and in some countries the likelihood of mothers reporting to a medical professional when children have fevers or acute respiratory infections does not rise progressively by mothers' level of schooling. Most of the countries in which the relationship between mothers' schooling and use of clinical services for child illness is weak are in sub-Saharan Africa (Ryland and Raggers 1998: 24, 39); and Ethiopia is also an exceptional case in this respect. In urban settings in Ethiopia, the proportion of mothers seeking clinical treatment for children's acute respiratory infections or fevers is not significantly different between those with no schooling and those with primary schooling (45 % and 42 % respectively), nor in urban settings is the proportion who treat diarrhea with ORT significantly different between mothers

with primary schooling and those with secondary schooling (63 % and 61 % respectively) (Stallings 2004: 56, 109).

Two questions therefore emerge from these patterns: (1) *What is it about schooling that leads women to adopt recommended health behaviors in most countries?* and (2) *What explains the lack of association between women's schooling and health behaviors in some countries?* Various theories point to different aspects of school experience as crucial inputs for influencing maternal health behavior, including health awareness, family values, literacy, and achievement motivation. Compared to the large amount of evidence that has been compiled on the association between maternal schooling and child mortality, however, little research has been done to test the connections between schooling and health awareness, motivations, or even literacy. This is partly because of the challenge of integrating methods appropriate to measuring skills and attitudes in surveys with the large sample sizes required for demographic surveillance. Perhaps at least as important as this practical challenge, however, is a lack of clarity about the theoretical connections. Theories based on rational actor assumptions have so far dominated the literature on maternal schooling and child survival (e.g. Mosley & Chen 1984; cf. Carter 1998), and these theories have been unsuccessful in explaining the lack of dose-response relationships between women's schooling and child survival in the exceptional cases. Marxist theory and Weber's theory of bureaucracy offer potential insights into these questions. Among rational actor approaches, the case of KAP serves as an example of some of the analytical challenges, and serves to clarify the key concepts of confounding, selection, and mediation.

## Three theoretical frameworks for explaining the association between maternal schooling and health behaviors

### 1. KAP *and the knowledge-practice hypothesis*

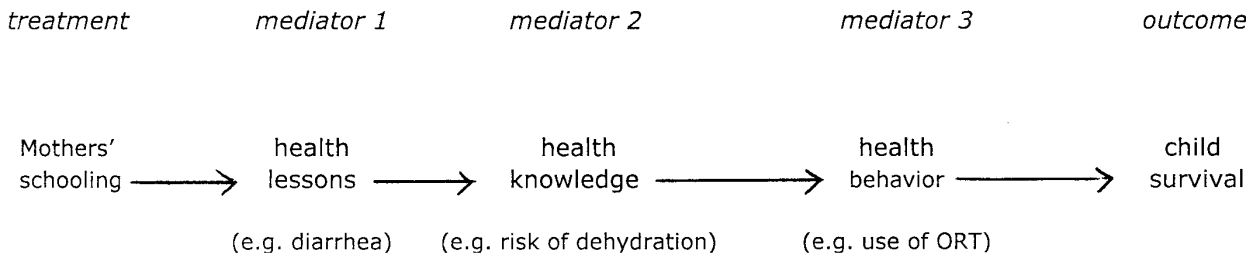
The most influential framework for explaining the relationship between women's schooling and child survival is Knowledge, Attitudes, and Practices (KAP).

KAP makes very general predictions about the aspects of school experience that might impact on maternal health behaviors, in terms of *knowledge* of medical treatments (e.g. vaccines, and oral rehydration therapy for diarrhea), *attitudes* such as gender equality and sense of agency (e.g. Bloom et al. 2001), and *practices* including hand-washing, exclusive breastfeeding, and growth monitoring (e.g. UNICEF 1989).

Although widely employed, KAP has no single source (in the sense that, for instance, Marxism does), and may be better characterized as a "meta-theory" (Pelto 1970: 18), i.e. a widely shared set of assumptions informing research within public health and allied disciplines (cf. Ewbank 1994); I will refer to it as a "framework" rather than a theory. Here I will concentrate on what is conceptually the simplest of the pathways between maternal schooling and child survival implied by KAP, i.e. the hypothesis that school-acquired health knowledge determines maternal health practices. In Figure 1.3(a), the relevant knowledge is the risk of death posed by dehydration when children have acute diarrhea, and the relevant behavior is use of oral rehydration therapy (ORT) to combat dehydration.[1]

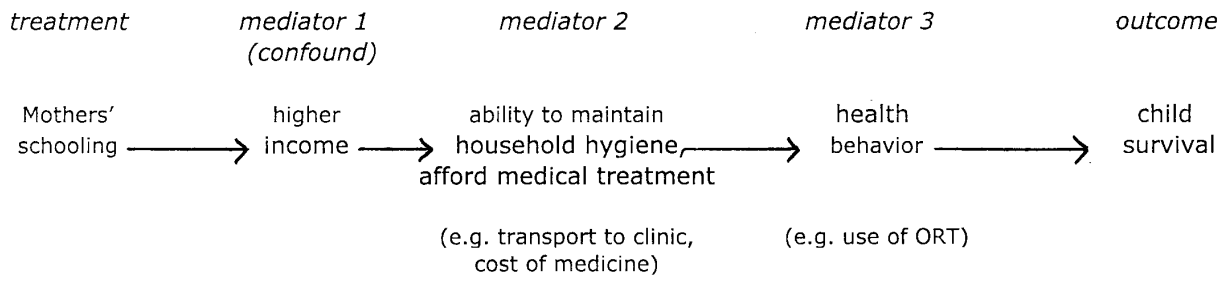
[1] I use the terms "health practice" and "health behavior" interchangeably. Maternal health behavior is defined here as any behavior on the part of a mother that is clearly and directly connected to protecting a child from malnutrition, infection, or harm. Cf. Mosley & Chen (1984).

**Figure 1.3(a): Model of the effects of mothers' schooling on child survival, mediated by health knowledge and health behavior**




This hypothetical set of relationships serves as an example of one *model* of school effects on child survival. (I will also use the word model in relation to statistical equations specifying such relationships, which can be built to test these hypotheses.) Such models assist in clarifying *mechanisms* that might connect maternal schooling to child health and survival. To speak of a mechanism is to invoke the metaphor of an experiment (such as a drug trial) in which mothers' schooling is the "treatment," child health or survival is the "outcome," and intervening factors are mediators (as indicated in Fig. 1.3(a)). If child survival advantages from a mother's schooling accrued largely through health lessons learned at school, which then influenced the care she provided to her child, then health lessons and knowledge could be said to *mediate* between the mother's schooling and her health behavior, where mediation is understood in the statistical sense of a relationship between two variables being accounted for wholly or in part through the effect of a third variable (Baron & Kenny 1986; Kenny 2009). A further example illustrates the danger of confounding in models such as these (Figure 1.3(b)).

**Figure 1.3(b): Model of effects of mothers' schooling on child survival, via health knowledge, confounded by mothers' income**




Income in model 3(b) constitutes a *confound* of the knowledge-practice hypothesis. A confound (from Latin, *confundere*: to mix together) is "a distortion in an association between a [treatment and outcome] brought about by the influence of extraneous factors" (Gerstmann 2003: 232). If income were not included in the model above, but an association between mothers' higher level of schooling and greater likelihood of using ORT was observed, we might erroneously interpret this association as evidence in support of the knowledge-practice hypothesis. (In this case we would say that the hypothesized relationship between schooling and child survival was confounded by income.) However, if both income and mothers' knowledge were measured and included in a model that combined the terms in model (a) *and* model (b), it might be possible – assuming appropriate sampling methods and sample size – to determine statistically the relative effects of wealth and knowledge on treatment of diarrhea and child survival.

While the knowledge-practice model is among the simplest models of maternal school effects on child survival, it is not trivial. Health knowledge (as assessed by questions about treating diarrhea, avoiding infection of wounds, and purifying water) has been

shown to be a partial mediator of the relationship between maternal schooling and child nutritional status (height for age) in Morocco (Glewwe 1998). But it remains an open question whether this is due to health lessons learned at school. In Morocco, there are reportedly no health education curricula in schools; this, together with the strong relationship between maternal literacy and child height-for-age in Morocco, led Glewwe to infer that school effects on health knowledge were mediated by literacy (which he showed was more strongly associated with mothers' health knowledge and child height-for-age than was mothers' schooling in years), and particularly by literate women gaining health knowledge from sources outside of school.

The potential of mothers' literacy to impact health behavior may be reduced in settings where sources of health information outside the school are lacking. This is suggested by the finding that in Brazil, mothers' literacy is not associated with height-for-age among children under 5 in rural areas, where access to media is lower, but is associated with children's height-for-age in urban settings, where reading newspapers, listening to the radio, or watching television appear to mediate the relationship (Thomas et al. 1990). In this case rural residence (and specifically, the absence of media and health information in rural areas) confounds the relationship between mothers' literacy and children's height-for-age. The possibility of confounding by place of residence was emphasized by Hugo Behm, the researcher who first demonstrated the linear relationship between maternal schooling and child mortality.

**2. Marxism** *and the selection and structural confounding hypotheses*

The first studies to demonstrate consistent and approximately linear decrease in child mortality by mothers' years of schooling were based on census data from 11 countries in Latin America (Behm et al. 1977-1979; Behm & Primante 1978). In interpreting this relationship, Behm noted that since women with lower levels of schooling tended to be poor, concentrated in rural areas, and deprived of access to medical care, the statistical relationship between women's schooling and child mortality could be an artifact: a result of differential wealth and access to medicine rather than a result of schooling per se (Behm & Vallin 1982: 32). The differential wealth and privilege of the educated, in other words, might confound the effect of schooling. Where access to schooling, medical care, and clean water are clustered among distinct subgroups of populations, it may be impossible to disentangle them in statistical analysis, even with the most sophisticated sampling methods and the largest samples. Oakes and Johnson (2006: 376) have called this *structural confounding*, a type of confounding that "can only be overcome by imagining a massive social revolution."

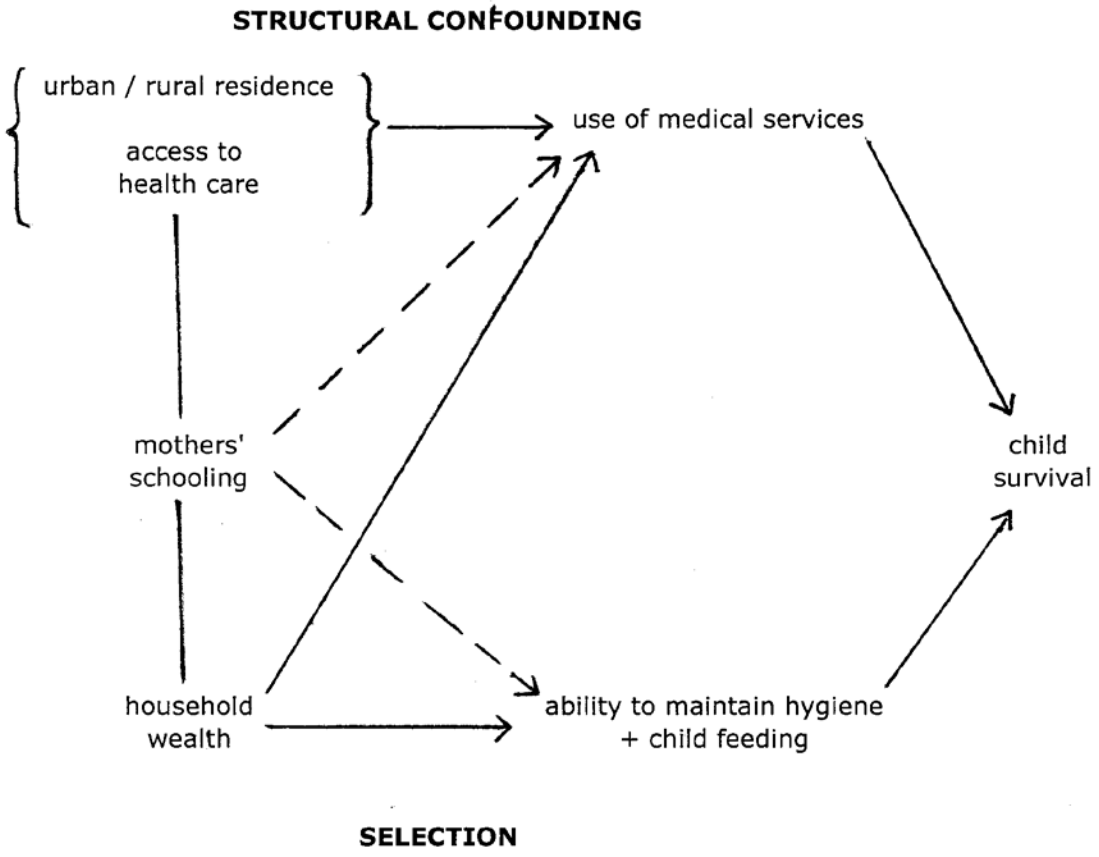
A related concern is *selection bias,* i.e. systematic bias in the constitution of the groups of the more and less educated based on unmeasured characteristics. Two women may live in the same neighborhood and have similar levels of income, but the fact that one went to school and the other did not could reflect other, unmeasured characteristics – related to schooling but not due to it – that determine the kind of care they provide for their children, and that in turn affect their children's chances of survival. For example, the fact that one woman went to school might be due to having had greater resources available to her as a child; this could influence her own

health in adulthood and hence her ability to protect her children's health, quite apart from her experience at school. In this case economic and health selection would be operating through schooling. Economic selection can influence school attendance through families' ability to cover the direct costs of school supplies or fees and the indirect costs of lost child labor (Filmer & Pritchett 1999; Pritchett 2004). Health selection can influence persistence and success in school, since diligence in school work and lack of interruption of attendance is predicated on adequate nutrition and health during childhood (Brown & Pollitt 1996; Martorell 1997; Stinson 1998). And we can also speak of cultural selection, which favors children from families whose home cultures are close to the culture of the school, e.g. families in which mothers and fathers regularly read and write; children from such families are likely to feel more at home with the language and tasks they encounter at school (Meyer 1977; Ogbu 1982; Bourdieu & Passeron 1990).

In the strong version of the Marxist theory of school effects on child survival, the combined effects of structural confounding and selection biases thwart attempts to analyze the discrete contributions of schooling to child survival in the developing world (e.g. Behm 1982: 271). While Marx himself did not theorize explicitly on this question, he emphasized the influence of macrosocial forces on child welfare (e.g. Marx 1946 [1889]): one tenet of a Marxist perspective, which is shared with some anthropological perspectives, is that trends in maternal schooling and child survival cannot be divorced from larger social processes (Lindenbaum 1990a; Millard et al. 1990). Marxist theory, in contrast to KAP, therefore has the advantage of offering linkages between micro- and macrosocial forces that influence both schooling and child survival (Harris & Ross 1987). In its strong form, Marxist theory is not

amenable to hypothesis testing (Popper 1953). But a weaker version of Marxist theory, which does lend itself to testing, holds that we must pay close attention to how schooling, wealth, and access to health services covary – where mothers and children live, whom they live with, and how wealthy they are, as well as their levels of education – before concluding that maternal schooling itself has a causal influence on child survival. A hypothetical model based on this weaker form of Marxist theory is as follows:

**Figure 1.4: The selection and structural confounding hypotheses of mothers' schooling and child survival (after Behm)**



While I label this perspective as Marxist, there is wide acceptance in sociology that selection effects operate on schooling (Blau & Duncan 1967; Woessman & Peterson 2007). An obstacle to testing the selection hypothesis is that it stipulates multi-generational effects, and would require following mothers and daughters over multiple generations, and examining the influence of wealth, education, and childcare practices in their natal households, on mothers' health behaviors towards their children. Such studies have yet to be carried out.

It has long been recognized, however, that school attainment and household wealth are correlated (e.g. Illich 1971), and Ethiopia is no exception in that "wealthier groups … become increasingly overrepresented as level of education rises" (World Bank 2005: 111). Parents in Ethiopia cite the need for child labor is the principal reason for holding children back from school (Rose & Tembon 1999; Cockburn 2002). The pervasive influence of household wealth and place of residence on child mortality is shown by survey data from 19 countries, where urban children whose fathers have "professional, technical, or clerical occupations" have on average half the risk of death of rural children whose fathers are farmers (a protective effect of similar magnitude to that of mothers' secondary schooling, and which is also stronger during 1-4 years than in infancy) (Bicego & Ahmad 1996: 47; see also Desai & Alva 1998). The selection and structural confounding hypotheses therefore predict that absence of dose-response relationships between mothers' schooling and child survival would be found in countries with predominantly poor and rural populations with scant access to medical services. Poverty and structural barriers could prevent mothers from realizing the potential benefits of schooling for their children's survival.

**3. Schemas and socialization**

Another set of theories that might help to explain the relationship between mothers' schooling and child survival posits connections between school experience and maternal health behaviors without the rational actor assumptions of the KAP framework. Although the theories that I group under this umbrella are diverse, each rests at least implicitly on the idea of *socialization* processes in school, involving the acquisition of *schemas* that may either motivate mothers to invest more intensively in children or serve as scripts for interactions in clinics or at home. The most influential of these theories, the wealth flows hypothesis, was proposed by the demographer John Caldwell, and in some ways resembles modernization theory; another approach to the problem derives from Weber's theory of bureaucracy, and has been developed by Robert LeVine.

*The wealth flows hypothesis*

Caldwell's seminal study in Nigeria (1979) was the first to demonstrate that effects of mothers' schooling on child survival were partly independent of wealth. Caldwell showed that in the city of Ibadan, maternal education was associated with lower child mortality in both higher and lower income households (households in which husbands held white-collar jobs and those in which husbands held non-white collar jobs) (Caldwell 1979: 407). The explanation he proposed for this finding was that educated mothers and fathers acted in accordance with "a new family system," investing more intensively in their children by, for example, feeding their children more animal-source foods, and being more likely to use modern health services when children were ill (Caldwell 1979: 409-10; Caldwell & McDonald 1982). Caldwell developed these ideas as the hypothesis of *wealth flows*, according to which schools, by promoting the

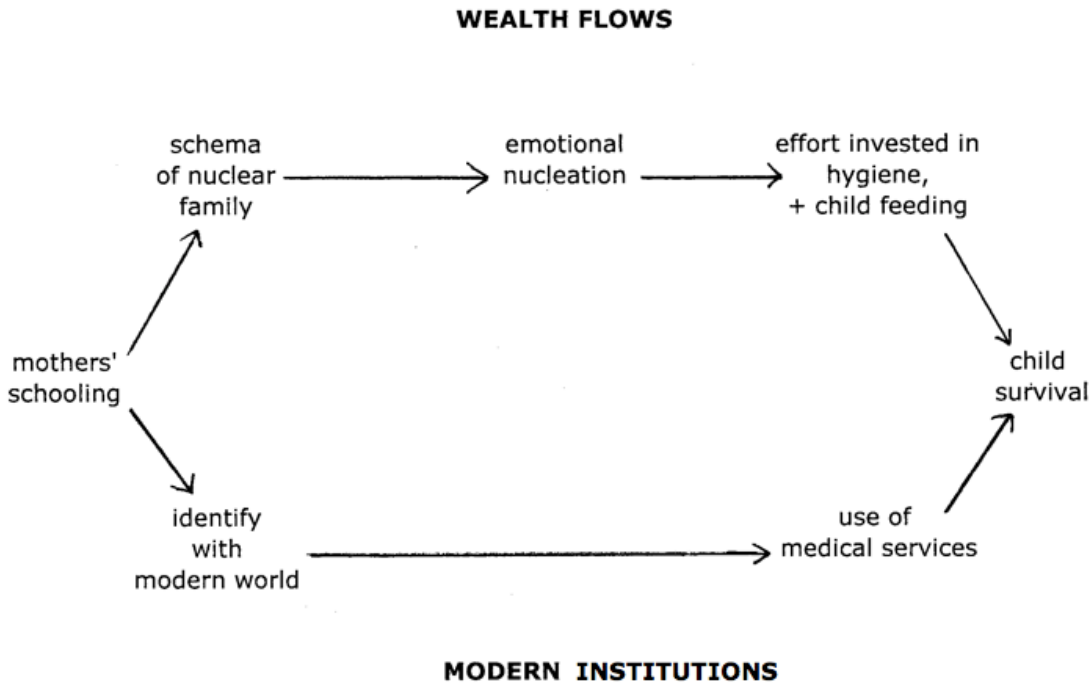
ethos of the Western nuclear family, led parents to abandon the traditional agrarian pattern whereby children were valued primarily for their contribution to the household economy, and inclined them to invest in children more resources and emotion than they could repay (Caldwell 1976, 1982).

The wealth flows hypothesis rests on the power of a cultural model or *schema*, i.e. "a distinct and strongly interconnected pattern of interpretive elements [that] can be activated by minimal inputs … [and that] can function as [a] goal" (D'Andrade 1992: 29) to affect a wide range of parental behaviors with population-level effects on mortality and fertility.[2] The anthropological theory of *socialization*, i.e. how culture is learned in the course of child development, helps to put Caldwell's hypothesis in context. In the language of cognitive anthropology, children acquire, through participation in particular settings (Whiting & Edwards 1988), schemas that aid in subsistence, reproduction, and communication, and which frame these modes of behavior in terms of a morality of interpersonal relations that prevails within a particular cultural group (LeVine 2003 [1990]). A distinct culture in its entirety – "a reality lit up by a morally enforceable conceptual scheme composed of values (desirable goals) and causal beliefs (including ideas about means-ends connections)" (Shweder 1996: 20; cp. Tylor 1881; Geertz 1973; Richerson & Boyd 2005: 5) – constitutes a unique configuration of such schemas (Shore 1996). In theory, these schemas are learned through mutually reinforcing channels including language socialization (Schieffelin & Ochs 1986; Shweder et al. 1998) and bodily practice (Bourdieu 1972; Goodnow et al. 1995).

[2] The terms schema and cultural model are often used interchangeably in this literature (e.g. Shore 1996; D'Andrade & Strauss 1992). To avoid confusion with "model" in the sense of a hypothetical model or a statistical model I will use "schema" to refer to cultural models.

A single schema would have to provide connections to many other schemas in order to motivate and inform parental behavior, and in Caldwell's view, the nuclear family was part of an overarching schema to which children were exposed in school, namely Western culture. The nuclear family served, then, as a "foundational schema" that organized other, related schemas (Shore 1996: 53). Caldwell also proposed that a mother who had been to school would be more likely to use modern medical services because her school experience had made her identify with such institutions as "part of her world," and to feel entitled to their use (Caldwell 1979: 410). Joshi has distinguished this from the wealth flows hypothesis and has called it the "[modern] identity acquisition hypothesis" (Joshi 1994: 3); since Caldwell proposed that schooling specifically altered women's relationships to modern institutions I will refer to it as the "modern institutions hypothesis" (Fig. 1.5).

**Figure 1.5: The wealth flows and modern institutions hypotheses of mothers' schooling and child survival (after Caldwell)**



Despite the fact that it could be measured through systematic observation in schools, Caldwell's assertion that the nuclear family schema is prominent in school discourse was based on speculation, and has not been investigated empirically. Measuring parental allocation of food and other resources to children is difficult, and therefore researchers often use indirect measures (cf. Haddad et al. 1997). Studies of household resource allocation provide mixed results in relation to the wealth flows hypothesis: Yoruba families in Nigeria traditionally ration meat to children on the grounds that their moral character would be spoiled by eating too much of it (Zeitlin 1997: 420); Caldwell & McDonald (1982) asserted that the schema of the nuclear family would lead women to abandon this belief, but they did not provide evidence to evaluate the claim. Other studies show that net resource flows in non-industrial societies are from parents to children (e.g. Kaplan 1994; Lee 2004; Lee & Kramer 2002; Stecklov 1997), challenging an underlying assumption of the wealth flows hypothesis that in agrarian societies children contribute more to their parents than they receive.

Since the modern institutions hypothesis is tied less specifically to a measurable aspect of school experience, it is more difficult to operationalize. A body of theory associated with Weber, however, provides more empirical purchase on women's relationships with modern institutions as a potential mediator of school experience and maternal health behavior.

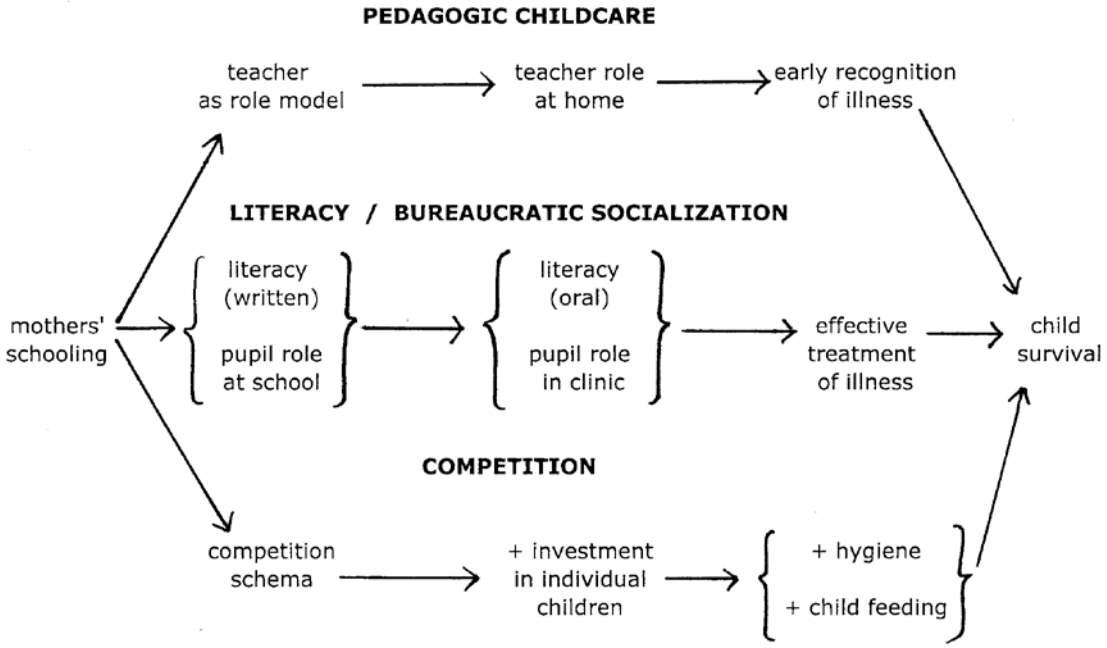
**Weber** *and the pedagogic, bureaucratic socialization, and competition hypotheses*

Weber classified the school as a species of bureaucratic organization, and his writings suggest several schemas potentially acquired in school that might influence childcare

and child survival. In Weber's view, the historical expansion of formal schooling was a product of the development of bureaucratic organizations. According to Weber's definition, bureaucracies are characterized by the fact that they employ personnel with (a) literacy skills necessary for managing files, (b) familiarity with an explicit and decontextualized form of language and instruction, (c) acceptance of strict division of labor and status hierarchy, (d) loyalty to impersonal and functional purposes as opposed to particular persons and their interests, and (e) recognition of explicit rules known to experts (Weber 1968: 956-1003). Schools qualify as bureaucracies by this definition, as do clinics and government offices (cf. Thomas, Meyer, et al. 1987).

Weber's theory of bureaucracy has been applied to the question of maternal schooling and child survival by LeVine and his colleagues in studies published over the past two decades (1994b; 2001; in press). The research program of LeVine's group has focused on the forms of communication used in schools and clinics, and the potential of these abilities in mothers to affect child survival. Schemas that LeVine and his colleagues suggest may be learned at school, and that carry over to other settings, include (1) the behavioral scripts associated with the roles of teacher and pupil, (2) a code of explicit, literal and decontextualized oral communication, and (3) competition among individuals for entitlement to privileged occupations and social status (the "academic-occupational" schema). Each of these propositions implies a distinct hypothesized pathway between mothers' schooling and child survival. While these pathways are not mutually exclusive, they may be distinguished heuristically (Figure 1.6)

**Figure 1.6: The pedagogic childcare, bureaucratic socialization, and competition hypotheses of mothers' schooling and child survival (after LeVine)**




*(i) The pedagogic childcare hypothesis: "Mothers as teachers in the home"*

Mothers who have been to school may play the role of teacher in relation to children at home, devoting full attention to them, talking with them before they are fully able to respond verbally, and, as they develop, correcting their speech and practice as would a teacher. This "pedagogic" style of childcare contrasts with a "pediatric" style characterized by low stimulation, constant body contact, and concentration of parental investment during infancy when risks of death are highest. These terms were coined to characterize differences between modal childcare styles in rural East Africa and urban North America (LeVine et al. 1994a; LeVine 2005), but they may also map onto childcare styles among women with more and less schooling *within populations* (LeVine et al. in press). The main implication of the pedagogic childcare style for health behavior is that, in theory, parents who act like teachers and seek feedback

from their children are likely to have a different idea of what a healthy baby looks like (a responsive, active baby, in contrast to a passive, demure baby) and could therefore be quicker to recognize signs of illness and quicker to seek help. Since this style of parenting would require more direct attention than the pediatric style, and since children used to high levels of stimulation might grow up to be more demanding, parents adopting the teacher role might also have fewer children, with subsidiary survival advantages accruing through the extra resources and time available for investment in each child (LeVine et al. 1994b).

Evidence relevant of distinctive features of teacher-student interaction comes from studies that point to routines such as the Initiation-Response-Evaluation (IRE) script, in which teachers initiate and interation, wait for a response, and then evaluate the response (Pellegrini & Blatchford 2000). These verbal routines, learned in the school, have been shown to be practiced by mothers in middle-class American families (Heath 1986). In Mexico, an observational study of mothers and infants showed that mothers with more schooling more often reciprocated infants' gazes and vocalizations (looking at and speaking to infants when they looked towards the mother or vocalized), and were less likely to respond to infants' activity by holding them (Richman et al. 1992). Another study in Mexico showed that children of mothers with more schooling had greater vocabularies at 31 months (LeVine et al. 1996). In Nepal, maternal literacy is significantly associated with reading abilities among children aged 4-9 years, independent of children's age, grade of schooling, and SES, and in this case maternal literacy appears to mediate the effect of mothers' schooling (LeVine et al. in press). Direct evidence on the association between these maternal behaviors and child survival, however, is lacking.

*(ii) The bureaucratic socialization hypothesis: "mothers as pupils in healthcare settings"*

In addition to routines such as IRE, students may learn a language in school that contrasts with the language of their home communities. The form of language used in bureaucracies, including schools and clinics, has been variously referred to as decontextualized (Cazden 1988; cf. LeVine et al. 1994c) or academic language (Snow 2010); ability to speak it has been called oral literacy (Tannen 1982). Reading and writing skills may serve as a prototype for this mode of communication, since in learning to read and write, language is rendered available for contemplation and criticism as a thing unto itself, hence "decontextualized" (Scribner & Cole 1981). Theoretically, a mother with a high level of literacy would provide a more concise report of her child's illness to a doctor, increasing the accuracy of diagnosis and the appropriateness of the prescription, and she would also better understand the doctor's advice, delivered in the same concise terms. Habits of deference and obedience learned at school in relation to teachers might also increase adherence to medical advice, since recognition of the health professional's elevated position in an official bureaucratic hierarchy could invest clinical recommendations with greater motive force.

Support for the proposition that decontextualized or academic language assists in doctor-patient interactions comes from studies in Mexico and Venezuela showing that mothers with higher literacy skills speak more clearly about their children's health problems, as judged by doctors (who do not know their level of schooling), than do those with less schooling (Dexter et al. 1998; Schnell-Anzola et al. 2005). In Nepal, mothers with higher literacy are also able to understand recorded health messages

better than those with lower literacy; and mothers' literacy appears to mediate the effect of mothers' schooling on comprehension of these recorded messages (LeVine et al. in press). Studies in the United States and Europe show that level of education, more than income, predicts the quality of patients' interactions with doctors, both when patients are seeking treatment for themselves and when parents are seeking treatment for children (Ross & Duff 1982; Waitzkin 1985; Cooper & Roter 2003). Evidence for how these communicative competencies affect adherence and child survival are as yet lacking.

*(iii) The competition hypothesis*

The final hypothesis I will present here draws on both Weber's theory of bureaucracy and on the theory of *life chances*, which connects social change to individual development via individuals' ability to pursue *options* (i.e. ways of exercizing agency) and to take advantage of, or be constrained by, various *ligatures* (social networks, relationships, and obligations) (Dahrendorf 1979: 30-31). Dahrendorf characterized pre-modern societies as prioritizing options at the expense of ligatures, and modern societies as prioritizing ligatures at the expense of options. Schooling constitutes a key institution in enabling individuals to move from one form of society to the other, from an agrarian life course, in which people's "reproductive and relational potentials" are privileged, to an "academic-occupational" life course in which greater emphasis is placed on "the development of skills in the individual" (LeVine & White 1986: 208). This theory thus connects the expansion of schooling to other socio-economic changes in developing countries including the growth of export-oriented agriculture and manufacturing and service industries, the expansion of formal labor markets, and increased flows of international labor migration and

remittances (Suarez-Orozco & Qin-Hilliard 2004; Ferguson 2006). These socio-economic changes have opened up new means of livelihood for some – with success in the competitive environment of the school as the principal route of access to them – at the same time as they have constrained the means of livelihood of others, e.g. through increased land scarcity caused by the encroachment of plantation agriculture and increasing dependence of farmers on export crops, the prices of which are subject to volatile fluctuation on local and international markets (e.g. coffee in Ethiopia), and they have diminished the influence of the family and the local community over individual lives. Parents who have been to school, even if they themselves have been unable to translate their education into improved livelihoods, may be more motivated to prepare their children to compete for modern economic opportunities. Preparation for competition in this new landscape could include greater investments in child feeding (i.e. quality or quantity of foods) and greater effort invested in seeking care for children when they are ill.

While the theory of life chances provides connections to a broad range of other social and economic phenomena without the historical determinism of Marxism or modernization theory, it can muster only indirect support from existing studies. For example, a competitive environment in schools is implied by the restricted access to higher grades of schools, especially to high school (Clignet & Foster 1966; Serpell 1993), and frequent repetition of grades (Johnson-Hanks 2006) that exists in many countries in Africa. Parents' and students' aspirations regarding schooling often center on employment: In a multi-sited study in Kenya in the 1970s, a majority of parents in 5 different culture groups reported hopes that their children would secure waged employment as the primary motive for sending children to school (Whiting &

Edwards 1988: 244; cf. Serpell 1993: 143). There is evidence that parents' beliefs can influence both children's psychomotor development (Miller 1988; Zeitlin 1997) and parents' feeding practices (Engle et al. 1997). However, evidence that schooling affects parents' developmental expectations for children and thereby leads to altered health behaviors and improved child survival is so far lacking.

**Recapitulation**

Like metaphors that highlight different aspects of a phenomenon, each of the theories considered above offers a potentially valuable perspective on the question of how mothers' schooling might affect their health behaviors on behalf of children. KAP, while it does not apply to phenomena above the individual level, is useful for thinking about the range of knowledge, attitudes, and health behaviors that might influence child survival. Marxism helps in considering social forces, over which individuals may have little or no control, that affect child mortality risks. Ideas derived from Weber provide a bridge between the individual and the macrosocial context, with schools, as institutions of bureaucratic socialization, investing individuals with new skills (e.g. literacy) and motives (e.g. the schema of the family, or the schema of competition) which affect parental investment or mothers' ability to negotiate for medical services.

The hypotheses on which this dissertation focuses are the propositions that the most important elements of mothers' schooling for child survival are:

1. knowledge acquired at school, which informs treatment of illness (the knowledge-practices hypothesis, derived from *KAP*)

2. literacy, and the ability to decipher health-related materials, e.g. medicine packets and hospital forms (the literacy / bureaucratic socialization hypothesis, derived from *Weber*)
3. a schema of the nuclear family (the wealth flows hypothesis, derived from *Caldwell*) or a schema of competition for waged employment (the competition hypothesis, derived from *LeVine* and *Dahrendorf*), each of which intensifies parental investment
4. household wealth and access to medical care (the selection / structural confounding hypothesis, derived from *Marx*)

Each of these hypotheses is investigated through observation in schools and through assessment of parents' health knowledge, literacy skills, and expectations of their children's development. The following chapter describes the setting in which the project was carried out, and the methods used in the research.

Chapter 2

## Research design and methods

The field research for this project was carried out in the town of Jimma (population circa 160,000: CSA 2006), located 350 km from the capital city of Addis Ababa, in southwest Ethiopia, and in rural communities neighboring it. The design of the project combined a longitudinal survey of child development with ethnographic components aimed to elucidate potential contributions of schooling to parents' health behaviors. The survey aimed to assess how parents' schooling affected child health and development, while the ethnography helped to generate hypotheses and aided in interpretation. The sample frame for the survey was provided by the Jimma Longitudinal Family Survey of Youth (JLFSY), a population-representative sample of Jimma town and three outlying rural *weredas* (districts), [3] with a total of 3,695 participating households (Brown University / Jimma University 2010).

The study population exhibits great variation in adult school attainment. In the areas outside Jimma covered by the JLFSY, 38 % of men and 63 % of women >24 have no schooling, and 13 % and 7 % have reached secondary school (grade >8), while in Jimma town only 10 % and 30 % have no schooling, and 40 % and 25% have reached secondary school. The contrasts are even greater if one excludes the small towns outside of Jimma: in rural communities, 53 % of men and 82 % of women have no schooling, and <4 % of men and <1 % of women have reached secondary school. Since Ethiopia's population is ~80 % rural, the national figures are close to those in

[3] The administrative units used in Ethiopia at the time of the study were, from the largest to the smallest: federal state (Ethiopia), regional state (e.g. Oromia), zone, *wereda* (district), *qebele* (locality), *got'* (village or group of households). Jimma town is the administrative center of Jimma zone, which is itself part of the regional state of Oromia.

the rural areas: In Ethiopia as a whole, ~40% of men and ~66% of women have no schooling (DHS 2005). On average, men aged >24 in the JLFSY have mean (SD) 5.8 (4.9) years of schooling, and women 3.7 (4.7) years of schooling, while the averages of 2.4 (3.2) and 0.8 (1.9) years in the rural sites are closer to the national averages of 2.3 and 1.0 years respectively (Gakidou 2010).

Estimates of infant and child mortality in the Jimma area come from research by epidemiologists at Jimma University. A one-year birth cohort study in 1993-1994 including Jimma and the neighboring administrative zones of Illubabor and Kefecho estimated infant mortality at 105 (urban 96, rural 112), and neonatal mortality (<30 days) at 32 (urban 26, rural 36) (Makonnen & Fasil 1997). In 2005 a longitudinal study in Qarsa (a *wereda* adjoining Jimma town) and two neighboring *weredas* estimated under-five mortality at 131 (per 1,000 live births), infant mortality at 76, and neonatal mortality at 38 (Amare et al. 2007). The 2005 figures are close to the national mortality rates of 77 for infants and 123 for under-fives (DHS 2005).

Mothers' schooling in Jimma is associated with reduced levels of infant mortality. The birth cohort study cited above estimated infant mortality rates of 78 for mothers with secondary schooling (17 % of the sample), compared with 93 for those with primary schooling (23 %), and 118 for those with no schooling (61 %) (Chi-square log rank test = 22.7, $p < .001$) (Makonnen et al. 2000). These figures, from 1993-1994, are higher than those reported in Figure 1.1 for Ethiopia as a whole. They suggest that the differential between infant mortality between mothers with primary schooling and those with no schooling may be wider in the Jimma area than in Ethiopia as a whole, but the differential between those with secondary schooling and

those with no schooling narrower: national rates of infant mortality in 2005 were 37 among mothers with secondary schooling, 78 for those with primary, and 83 for those with no schooling (DHS 2005). Data on differences in under-five mortality by mothers' schooling in the Jimma area were unavailable at the time of writing.

***Population context***

Jimma was incorporated in the Ethiopian state during the 1880s, having previously been an independent kingdom (Lewis 1965). In broad outline, Ethiopian history was marked by the kingdoms of the Christian north (the Abyssinians, also known as the people of Amhara and Tigray) extending their power over the Muslim and pagan south (Levine 1965; Donham 1986) (see Appendix 1: Table of events in history of Jimma and Ethiopia). The conquered peoples included the Oromo, the largest ethnic group in Ethiopia, who constitute the majority of the population around Jimma (Hassen 1994, 1998). The majority of the Oromo neighboring Jimma are Muslim, having converted to Islam after revivals in the Sudan during the 19$^{th}$ century (Trimingham 1965). Amhara who settled in Jimma during the 20$^{th}$ century are mainly Orthodox Christian. Jimma's makeup and the worldviews of its inhabitants therefore reflect a blend of Oromo, Amhara and Arab influences, as well as the influences of neighboring minority groups. Jimma is one of the wettest regions of Ethiopia, receiving approximately 1500 mm rainfall per year (Butzer 1971; Kloos 1993), and the surrounding countryside is green and fertile. Agriculture, the backbone of the economy, is predominantly rain-fed and based on the ox-drawn plow. The major

subsistence crops are maize and sorghum, and the major sources of cash income for farmers are coffee and qat [4] (Hadley et al. 2011).

***Sampling strategy***

The child development survey described here was based on a subset of the JLFSY sample, consisting of families in Jimma town and Qarsa *wereda* that had children aged <14 months. By enrolling children aged 0-14 months at baseline and following them over 18 months, we combined longitudinal assessment of child development with a synthetic cohort from birth to 3 years. The age range of the children in the study spanned two periods of heightened health risk: (1) the transition from breastmilk as the sole nutritional requirement to the period after 6 months of age when supplementary feeding is required for adequate growth; and (2) the transition from the first to the second year of life, after which other studies have demonstrated increasing disparities in mortality risks between children of mothers with and without schooling. The observation period also included critical periods of psychomotor development including the emergence of language and locomotion.

***Study sites***

The most distant rural households included in the study were two hours walk from the market town of Serbo, itself 20 km from Jimma, making them approximately 35 km from Jimma (see maps: Fig. 2.1). The rural sites of Serbo and Qarsa differ from Jimma in ethnicity, language, and religion: while the majority of residents of Jimma town are Amharic speakers, and roughly half of them are Orthodox Christians, Qarsa,

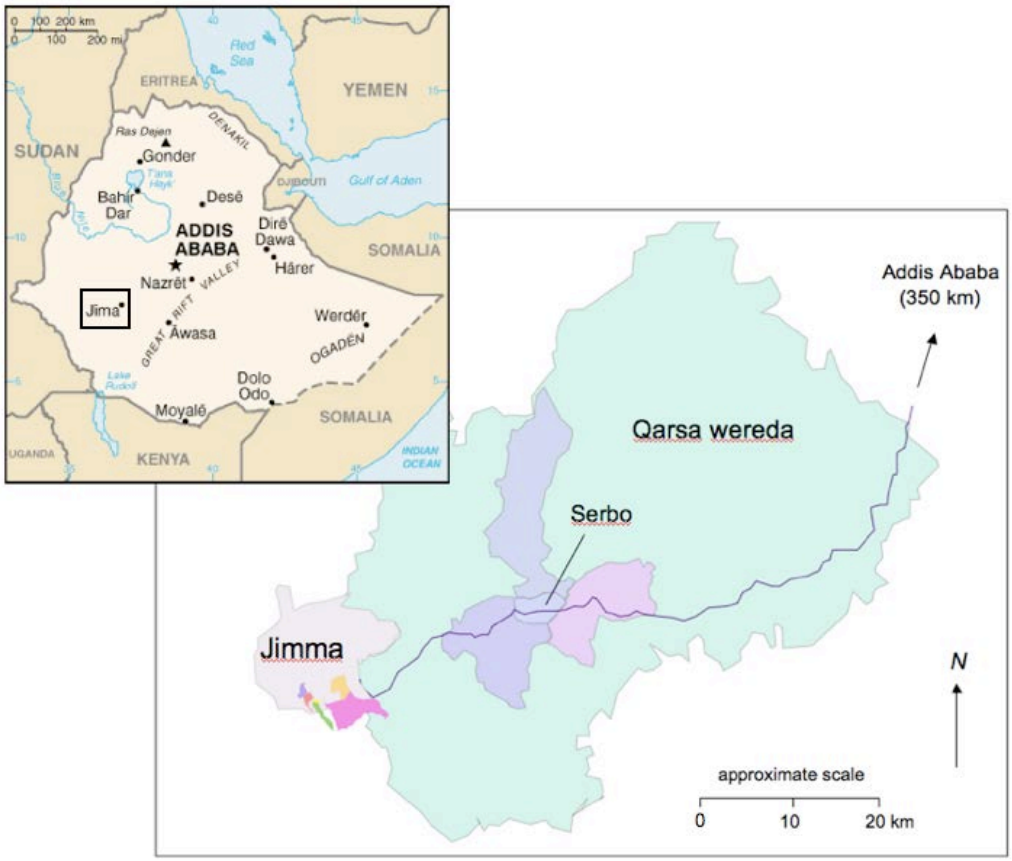
[4] Qat (*Catha edulis*, Amharic *ch'at*, *afaan* Oromo *Jimmaa*) is a stimulant leaf widely consumed both in the Horn of Africa and in Yemen (cf. Ezekiel 2004).

like other rural areas outside the city, is *afaan* Oromo speaking and predominantly Muslim.[5]

**Figure 2.1:**

**(a) Map of Ethiopia, with location of Jimma marked in box** (source: CIA)

**(b) Map of Jimma and the neighboring district (*wereda*) of Qarsa, centered on the market town of Serbo** (courtesy of JLFSY)




[5] *Afaan* Oromo means literally "the Oromo language." The term "Oromo" on its own refers to the people.

***Recruitment of sample***

The sampling method was to visit each of the households in Jimma, Serbo, and the 3 rural *qebeles* of Qarsa *wereda* (hereafter 'Qarsa') that were enrolled in the JLFSY, and to ask whether there were any children in the household aged one year or younger. Children recruited included two pairs of fraternal twins; all other children were singletons. Subsequent to enrollment, local event calendars were used to check children's dates of birth and verify reported ages. This revealed that 13 children whom we had recruited were over 13 months of age (on methods of age reckoning see Appendix 2). For the sake of comparability with other studies of infant development, the children over 13 months have been excluded from most analyses, as have the twins, bringing the effective sample size at baseline to 137 (141 including the twins). Apart from the twins and one pair of half-brothers with the same father, all other children were from different mothers and fathers.

After enrollment in April 2008, we visited families once per month for the following year, and then again 6 months later (i.e. 18 months from the start of the survey), yielding a maximum of 13 successive observations of each child. The age structure of the sample at baseline (R1) and at round 13 (R13) is shown in Table 2.1. Although the project was initially conceived as a two-site (urban-rural) study, substantial differences between the market town of Serbo and the rural communities outside it suggested that it might be more appropriate to stratify the sample into three sites. The following table indicates the distribution of the sample among the study sites of Jimma, Serbo, and Qarsa, the ages of the children at R1 and R13, and the extent of attrition in each site over the 18 months of follow-up.

**Table 2.1: Age distribution of children in the three study sites at rounds 1 and 13, and retention rates over the 18 months of the study**

| | Jimma | | Serbo | | Qarsa | | all sites | |
|---|---|---|---|---|---|---|---|---|
| | R1 | R13 | R1 | R13 | R1 | R13 | R1 | R13 |
| AGES (months) | | | | | | | | |
| mean | 7.6 | 27.6 | 8.5 | 25.1 | 6.1 | 23.5 | 7.2 | 25.6 |
| median | 8.4 | 28.8 | 9.5 | 25.7 | 6.7 | 24.1 | 7.8 | 26.3 |
| s.d. | 3.6 | 3.7 | 3.1 | 3.5 | 3.5 | 3.6 | 3.6 | 4.1 |
| range | 12.4 | 12.8 | 11.4 | 11.3 | 11.6 | 11.6 | 13.6 | 14.9 |
| minimum | 0.3 | 20.3 | 2.4 | 19.2 | 0.8 | 18.3 | 0.3 | 18.3 |
| maximum | 12.6 | 33.2 | 13.8 | 30.5 | 12.4 | 29.9 | 13.8 | 33.2 |
| <6 mo at baseline (%) | 26.9 | | 14.3 | | 45.3 | | 31.9 | |
| SAMPLE SIZE | 67 | 54 | 21 | 16 | 53 | 46 | 141 | 116 |
| retention rate (%) | | 80.6 | | 76.2 | | 86.8 | | 81.2 |

The constitution of the sample across the three sites departs slightly from representativeness on two counts: (a) discrepancies in the ages of children across the samples from the 3 sites, and (b) differences in customs of marital coresidence in the city and the countryside.

*Age structure:* Although only a few eligible families were unwilling to participate, these tended to be families with very young children, and they were concentrated in Jimma town. This biased the age distribution of the sample, such that the mean age of children in the Jimma sample at R1 was 7.6 months, while that of rural Qarsa was 6.1 months. Had no households refused we would have expected to see a more even distribution of ages across the first year of life, and a mean age closer to 6 months in

Jimma. The smaller sample in Serbo (21 children at round 1, falling to 16 at round 13) had a mean age of 8.5 months, with no neonates among them.

*Kinship and residence patterns:* Among rural Oromos, daughters traditionally move to the villages of their husbands' families after marriage. Since kinship is reckoned patrilineally, a daughter who has left the family by marriage may not be considered by parents to be kin any longer, and children produced by her would not be considered grandchildren. These features of the kinship system influenced the set of households that entered our sample in the countryside. When a man was asked whether there were any infants in his household, he might have pointed to a son's compound next door, but he was unlikely to nominate a daughter's children, who were in any case likely to be living further away. The rural sample therefore includes more families in which the fathers are sons of the JLFSY household heads, and the urban sample more mothers who are daughters of the JLFSY household heads.

***Follow-up and attrition***

During the first 12 months of follow-up, three of the children in the study died – two of malaria and one of dehydration secondary to diarrhea and congenital hydrocephaly. Two mothers also died between the time the study began and the 13$^{th}$ round, 18 months later. In both cases the mothers were in their 30s or early 40s and their deaths were sudden. In neither case did we ascertain a precise cause of death. One mother died of a gynecological condition for which she had sought treatment in Addis Ababa. The other came down with fever and died within a week, possibly of malaria. A further 18 families were lost to follow-up on account of moving away from the study area. 116 children were followed through 18 months, a retention rate of 81 per cent.

***Survey methods***

At each household visit, children's physical growth and psychomotor development were measured and a structured survey was used to gather information on children's illnesses and their treatment, plus vaccinations, and child feeding practices.[6] In addition to the standard questionnaire, separate survey components on parents' schooling, parents' language and reading abilities, and parents' developmental expectations were incorporated during the latter six months of follow-up (rounds 6-12). We asked parents their level of schooling towards the end of the study, in order to avoid possible bias on the part of the data collectors, who, if they had known parents' education status early on, might unconsciously have favored the more educated, for example in psychomotor assessment of children. All survey data were collected by 8 female research assistants with high school education who were native to the study communities (4 in Jimma and 4 in Serbo/Qarsa). Amharic was used as the language of interviews in most urban households, and *afaan* Oromo in most rural households.

Supervision and initial data entry were carried out during the first 6 months of the project by one male research assistant fluent in Amharic and English, and thereafter by myself. I visited each of the households in the longitudinal study sample at least once, and throughout the period of the survey the data collectors and I met weekly to discuss progress and troubleshoot problems. By the end of the fieldwork, I was able to carry out the standard household interview in Amharic by myself, but I did so only twice. Journal notes that I took during household visits constituted a quality control check for the survey – whenever I noticed something awry in the research assistants'

[6] Child feeding and vaccination data are not currently available for analysis, and will be reported elsewhere.

interviewing or measurements, or a discrepancy between responses I had heard and the responses recorded on our paper questionnaires, I would bring it up with them, to check the accuracy of the data. Journal notes also provided raw material for descriptions of families in the text that follows.

At each household visit, in addition to carrying out interviews and assessments of children's development, we took photographs of the children, and gave each family a small gift. These gifts consisted of either a kilo of sugar, a half-kilo of coffee, a bar of baby soap, or two bars of laundry soap (each gift worth about $1 US). Beginning at the second round of the study, we also gave the families prints of the photographs we had taken of their children the previous month; and at the eleventh round we gave them laminated growth charts showing their children's physical development over the course of the study. To the families of four severely malnourished children we provided monthly rations of 1 kg of baby food, namely a grain-based mixture fortified with vitamins and milk powder (brandname Cherry).

**Data collection methods**

The quantitative data collected for this project included anthropometrics, psychomotor development status, children's illness histories, parents' developmental expectations for their children, and parents' reading abilities. Qualitative data were collected through ethnographic observation in primary schools and opportunistic observations of childcare practices as witnessed during household visits.

*Anthropometric assessment*: In anthropometric assessment we followed the protocol of Frisancho (1990) for measuring children's length (recumbent) and weight.

Children were usually weighed in their mothers' arms with their weights calculated by the Tare function (on Seca Uniscale digital scales) after mothers were weighed alone, and occasionally weighed solo. Children's head circumference, mid-upper-arm circumference, and triceps skinfold thickness were also measured. At round 1 we measured parents' height (standing), and at every round we recorded mothers' weights. We also weighed fathers if they were present, although in practice we found fathers at home much less often than mothers. On three occasions over the course of the survey, standardization sessions were held to check the accuracy of research assistants' anthropometric measures; at these sessions problems with accuracy were identified and rectified.

*Psychomotor assessment:* The psychomotor assessment tool we used was an adaptation of the Denver II Developmental Test (Frankenburg & Dodds 1967) with the addition of motor milestone items from the WHO Multicenter Growth Reference Study (Wijnhoven et al. 2004). The source for the psychomotor test was a prior adaptation of the Denver II by Hadley et al. (2008). Several items were excluded from the Denver test on grounds of local irrelevance (e.g. walk up stairs, and brush teeth), and some props were substituted (e.g. grasp bead instead of grasp raisin, and photographs of animals instead of cartoon images used as verbal stimuli). The domains tapped by the tool included language, social-personal, and motor development. To ensure consistency in assessment across researchers, assistants independently rated a video recording of a child whom I had previously assessed (following the procedure of the WHO Multicenter Growth Reference Study Group 2006b). Inter-rater reliability was generally very high. When there were differences

of interpretation of particular psychomotor items, we reviewed the relevant tapes together to reach consensus on ratings.

*Child illness questionnaire:* Child illness questions were adapted from the Ethiopia Demographic and Health Survey (DHS 2005). After pretesting we added follow-up questions about domestic and non-biomedical treatments to help uncover home or traditional treatments that parents (who could associate us with biomedical health practitioners) might otherwise neglect to mention. The survey questionnaire was translated from English into Amharic and *afaan* Oromo, and back-translated into English from each language, whereupon discrepancies of translation were checked and revised. During the month before beginning the survey, we carried out pretest interviews with 11 families in the city and 4 families in the rural area, and thereafter refined the final version of the questionnaire.

*Literacy assessment:* Academic and health literacy skills were assessed through tools assembled in the field. The model for both tests was the Harvard Maternal Literacy Project (see LeVine et al. 2004, Appendix A). Texts for the academic reading tests in Amharic, *afaan* Oromo, and English were taken from Ethiopian primary school textbooks (grades 1-8). We also tested Arabic literacy using excerpts from the Qur'an, in which comprehension was tested simply by the ability to translate phrases from Arabic to Amharic or *afaan* Oromo. In each language, comprehension was assessed by presenting subjects with cards printed with numerals, words, sentences, and passages of text, and asking them to read these and, if they were able, to tell us the main ideas in each text. The number of points awarded for comprehension was then determined by the number of "idea units" that subjects nominated correctly.

In the health literacy test, parents were shown another set of cards printed with photographic reproductions of the packages of locally available medicines for diarrhea and malaria (ORT and Coartem) and other materials relevant to nutrition or healthcare (a tin of powdered milk, a picture of a pharmacy, a hospital registration form) and asked to identify them. In the case of the medicine packets, they were also asked to decipher the recommended dosage and instructions. We pretested the literacy instruments on neighbors and friends in the urban and rural sites with varying levels of education. These pretests helped identify problems with some of the test items and idea units we had initially specified, which were then corrected.

*Developmental expectations interview:* During fieldwork, I paid attention to the activities that children and adults around me were taking part in, and compiled a list of the most important of these activities and occupations (e.g. cleaning the house, fetching firewood and water, tending animals). I combined this list with a list of life milestones (e.g. beginning school, marrying, and having children) (after Brown et al. 2009), and developed graphical icons to represent each item. The interview procedure was to ask parents (1) whether they expected their children to engage in each of the activities, and (2) if so, at what age they expected them to begin the activity or attain the milestone. Parents were also asked what careers they expected their children to pursue. Parents were invited to reflect on the similarities or differences between the lives they envisioned for their children and the lives that they themselves had led. This component constituted an "ethnographic survey" (Schensul et al. 1999), that is, an attempt to measure on the level of individual mothers and fathers characteristics that appeared from an ethnographic perspective to have

potentially important consequences of schooling for child health, according to the wealth flows and competition hypotheses.

*Data from JLFSY:* Additional data from the JLFSY, including household wealth and mothers' ages, were taken from the JLFSY round 1 (2005). Household wealth was calculated according to the DHS wealth index, derived by principal components analysis from an inventory of household possessions (Rutstein and Johnson 2004; cf. Gwatkin et al. 2007). Regarding the challenges of linking the JLFSY dataset to the current sample and problems of incompleteness in these data, see Appendix 3.

*School ethnography:* I observed classes at Bareedina Primary School in Jimma, [7] which in 2008 had approximately 3,200 students (1,800 boys and 1,400 girls) in grades 1 through 8. I spent approximately 120 hours at the school – the equivalent of about half a semester for a full-time student – spread over the course of a year. I concentrated mainly on grades 1 to 6, and about half of my observation time was spent in a first-grade class during the first semester of the school year. The class I focused on was an Amharic-medium class, since my Amharic language ability was better than my *afaan* Oromo. I focused on aspects of school experience that could have both proximal effects on health behaviors (e.g. health content in lessons, hygiene inspections) and aspects that could have more distal effects on health behaviors (e.g. literacy skills, cultural schemas of competition and family values). Most of my observations were recorded in notes written on the spot, but towards the end of the period of observation, I also video-recorded three days of activities at the school, and created a short film of a day in the life of the school (after Tobin et al. 1989).

[7] The name I use for the school is a pseudonym, meaning "beauty" in *afaan* Oromo.

*Ethical review:* The design and research methods of this study were reviewed and approved by the Institutional Review Boards at Emory University and Jimma University. Participants in the longitudinal survey of child development provided oral consent, and some parents also gave permission for photographs of themselves and their children to be used in publication. Permission to carry out observation in local primary schools was granted by the Jimma Zone Education Bureau, by the director and teachers of Bareedina Primary School, and by parents of children in the first grade class on which I focused. In order to preserve confidentiality, the names of teachers, parents, and children used in the following text are pseudonyms.

Chapter 3

## Socio-economic and demographic background

Country-specific circumstances including disease ecology and access to medical services exert a larger influence on rates of child mortality than do levels of women's education. As noted in Chapter 1, children of women in Ethiopia without any schooling experience lower child mortality than do children of women with primary schooling in Nigeria, and those with secondary schooling in both countries experience higher child mortality than do those with no schooling in Colombia. To identify the contributions of women's schooling to child survival we must therefore first account for other environmental influences. Where people live, whom they live with, and how wealthy they are influence children's chances of survival, and are reflected in their growth, vulnerability to infection, and psychomotor development. The purposes of this chapter are (1) to assess how place of residence, family background, and household wealth vary with mothers' education; and (2) to give a sense of how families in Jimma and neighboring communities live. In doing so we will lay the groundwork for assessing the possibility that these background factors, rather than mothers' schooling itself, may be to credit for associations between maternal schooling and child health outcomes (the selection and structural confounding hypotheses).

The demographic data I draw on for these purposes are from the JLFSY and the household surveys conducted for this dissertation project. These quantitative data are supplemented by material from interviews with mothers and fathers about their reasons for dropping out of school, and by fieldnotes from visits to households and

clinics in the study communities. Following are snapshots of 3 families, in rural Qarsa, Serbo, and Jimma.

Haadhaa-Imran was born and raised in Qarsa, in a village across the valley from her husband Abba-Biyyaa's house. Like the one she grew up in, Abbaa-Biyyaa's compound is ringed with hedgerows of euphorbia, and surrounded by fields of maize and sorghum. Woodsmoke rises through the thatched roof of the *gojo-bet* [a hut with a conical roof], the walls of which are plastered with mud and cowdung. Inside, it is dim, but as one's eyes adjust, Haadhaa-Imran is visible by the hearth at the back of the house, where she is cooking with her three-month-old child, Mohammed, asleep in a sling on her back. An adolescent girl, the eldest of Abbaa-Biyyaa's children, is sitting on a mat by the back door, sorting grain. Haadhaa-Imran greets us and bids us sit while a younger child is sent to call Abbaa-Biyyaa. We take seats on a mat in the area of the house where visitors are received and where the family sleeps at night. Soon Abbaa-Biyyaa arrives from the field where he was plowing, and he bends over to kiss our hands, and sits down beside us. Haadhaa-Imran brings out a plate of *qiixaa* [a gray bread made from corn, sorghum, and teff] and *raafuu* [spinach], and before we eat, her 7-year-old daughter Kalida washes our hands, pouring water from a large teapot over our hands and into an enamel pan. As we are eating, Mohammed wakes up, and as he begins to move around, Haadhaa-Imran puts him to her breast.

From Abbaa-Biiyaa's house, the terrain rolls down to the Qarsa valley, and on the horizon, the mobile phone tower and the tin roofs of the market town of Serbo are just visible, two hours walk away.

* * *

Elina moved to Serbo from her parents' village in Qarsa at 18, when she and Tamrat had their first child. She had begun attending school three years

earlier, but dropped out to take care of the baby. The house in which she, Tamrat, and their three children now live is beside the road from Jimma to Addis Ababa, one of a long line of shacks that skirt the road. The house is mud-walled and mud-floored; an internal partition separates it into two rooms, and behind the partition the family keeps a goat. On the morning that we visit, Tamrat and the two elder children lie sleeping in the main room. Elina's third child, Amir, who is nine months old, she holds in her arms as he breastfeeds. In the corner is a pile of avocados that Elina bought from a farmer, and which she will try to sell at the market tomorrow. Against a wall is propped a mattress made of sacking material and stuffed with grass; Elina's husband makes and sells these for a living. The family, however, do not sleep on mattresses: between them and mud floor there is only a tarpaulin and a sheet. The tin roof is rusty, and there are tarpaulins rigged up overhead to catch water when it rains. The air is cold. Baby Amir is wearing only a T-shirt, and mucus drips from his nose: he has had a cold and fever for some days, Elina says.

Minibuses whiz past Elina's door shuttling workers and traders between Serbo and Jimma every day from dawn to dusk. Jimma is a half-hour's drive from here.

* * *

Alemnesh was born in Jimma, and her father, who had attended primary school, supported her education. As a high school student during the literacy campaigns of the 1980s she taught her mother to read and went on to study at an evangelical college in Addis Ababa. She lives in her parents' compound, off a cobbled street in Jimma's Mercato district. The house is solidly built, with brick walls, a tin roof, and a cement floor covered with linoleum. On the doorstep a *serategna* [housemaid] is roasting coffee on a charcoal brazier when we arrive, and Alemnesh is inside. On weekdays and Sundays she works at a Protestant church where she is a preacher; she has made arrangements to be at home for our visit. As we enter the house she stands to greet us, and her daughter Innat, who is two years old, flees to the bedroom crying. She is a shy girl, uncomfortable with strangers, and since her father

> does not live with her, she is especially shy around men. Alemnesh coaxes Innat back from the other room, and tries to quiet her by pulling out a toy laptop computer that plays music when the keyboard is pressed. When that fails to interest her, she calls the *serategna* to prepare a bottle of formula milk, which Innat accepts, and as she feeds she looks us over with curious eyes.

These snapshots of families represent important aspects of the communities in which they live – Qarsa, Serbo, and Jimma – as environments for children's development. The differences among these communities include levels of wealth and access to government services including water and electricity, medical care, and schools.

***Wealth and economic opportunities***

The rural area of Qarsa is home to farmers of greater and lesser means, with Abba-Biyyaa and his family being among the best-off. Serbo's residents range from relatively wealthy merchants, medical professionals and government employees to petty traders like Elina and her husband, whose livelihoods depend entirely on the influx of customers at the weekly market. Of the three sites, Jimma has the most diverse economy, the steepest gradient of wealth and the widest distribution of schooling, with Alemnesh being among the most highly educated and most economically secure.

The wealth of families in the study sample was measured by a household asset index consisting of 11 items: owning (rather than renting) a house, the house floor being of cement or tile rather than dirt, having a latrine or flush toilet for the household, getting drinking water from a tap or protected well or spring versus an unprotected source, having access to electricity, and ownership of a clock, bicycle, motorcyle, and functioning radio or television. This index of possessions was converted into a single

variable by principal components analysis with internal validity measured by Cronbach's alpha at 0.536 . In the JLFSY, this variable predicts a larger range of possessions and moves in the expected direction in relation to income.

The major constraint in using this wealth index in the current project is the inconsistent overlap between the study sample and the JLFSY households. For the 121 households for which we have reliable data (data quality categorized as good or fair as per the criteria in Appendix 3), average wealth was highest in Jimma town, followed by Serbo and Qarsa. The range of wealth in Jimma town (from -1.34 to 2.39), however, covers the same range as in the whole sample, attesting to the fact that some residents of the city are as poor as any of the households in the rural area. For the most part the poorest families live in neighborhoods on the outskirts of Jimma, where there are no municipal water or electricity services. In the center of Jimma, many residents enjoy both piped water and electricity. In Serbo, there is electricity service but no piped water, with most families relying on well-water. And in rural Qarsa there is neither electricity nor piped water, and most families obtain water from springs or wells, carrying it home from the source in jerry-cans.

***Access to health care and education:***

Jimma is the site of the major reference and teaching hospital in western Ethiopia, with approximately 500 beds and 65 doctors serving a catchment population of several millions. The caseload from this population puts great pressure on the hospital, which overflows with the severely ill, injured, and malnourished. In the malnutrition ward, I noted on my first visit, "children with distended bellies lie in the corridors, with plastic from nasal feeding tubes stuck to their faces. Outside in the

compound, clothes are laid out to dry on the grass – washed by parents who have come to visit their children or, as in many cases, are living with them in the hospital until they are discharged."

Other government medical facilities in Jimma include two major clinics, called health stations (*t'ena t'abya*). Since the change of government and economic liberalization in 1991 a private health care sector has developed in Ethiopia (Kloos 1998), and more than a dozen private clinics and many private pharmacies have opened in Jimma. The city is also served by a hospital run by Catholic nuns, the Missionaries of Charity, that provides free care for the indigent on the principle of triage, and which also houses an orphanage.

The range of biomedical services in rural areas outside Jimma is much narrower. In Qarsa wereda, with a population of 177,000, the only clinic, located in Serbo, at the time of this study had 5 nurses, 1 pharmacist, and 1 laboratory technician, but no full-time doctor. According to clinic records for 2006-2007, 75 % of the caseload was malaria. On a slow day, the clinic saw a few cases of malaria, and on a busy day it was overwhelmed. On market day each Tuesday the clinic was thronged with patients, most of whom had walked into town from a long distance, and who sought treatment or medical advice at the same time as buying or selling wares at the market, or begging for alms. Two private clinics and 3 private pharmacies in Serbo also offered medicines or services for fees. Outside the market town, biomedical services are limited to the health posts (*t'ena qela*) in each *qebele*, manned by Health Extension Workers, the lowest level of clinical professionals in the government system, who were high school graduates who had undergone short courses of

specialized training, and who were authorized to provide perinatal care and treatment for malaria in addition to vaccinations and health education (Wakabi 2008).

The terrain and a scarcity of transport infrastructure in the rural areas exacerbates problems of access to both medical care and education for rural communities. Outside of Jimma town, the only asphalt road is a two-lane road that leads from Jimma to Addis Ababa, passing through Serbo en route. The route between Jimma and Serbo is plied by private minibuses (charging 3-5 Birr) and a less frequent government bus (1 Birr); for shorter journeys along the road, there are 3-wheeled motorized rickshaws (*Bajaj*) and horse-drawn buggies.[8] The rural *qebeles* of Qarsa are traversed by dirt paths, few of which are passable by car, and cross-cut with seasonally rising streams, through which people must wade with caution during the rainy season for fear of being swept away. The time and energy required to walk to town constitute a major constraint on access to medical care and education alike.

Ease of access to schools across the three study sites roughly corresponded to access to medical care. Jimma town is the major center of education in southwest Ethiopia, with a university, an agricultural college, a Teacher Training Institute, several secondary schools and primary schools, and dozens of private kindergartens operating in the city. Serbo has a high school and two primary schools. In rural Qarsa, each qebele has one primary school, none of which offers education beyond the 8$^{th}$ grade.

Figure 3.1 shows the distribution of schooling among mothers and fathers in all three sites combined, and Table 3.1 shows the proportions of mothers in each site who had

[8] The exchange rate at the time of this study in 2008 was approx. 11 Birr : $1 US.

completed each level of schooling. The table also indicates how wealth varied among households by mothers' level of schooling within each site. The classification of school levels used here corresponds to the administrative categories in the Ethiopian school system: grades 1-4 constitute the first cycle of primary, 5-8 the second cycle, 9-10 secondary, and 11-12 college preparation or vocational training (Ethiopia MOE 2002).

**Figure 3.1: Mothers' and fathers' highest grades of schooling, all sites**

(mothers = 138, fathers = 127)

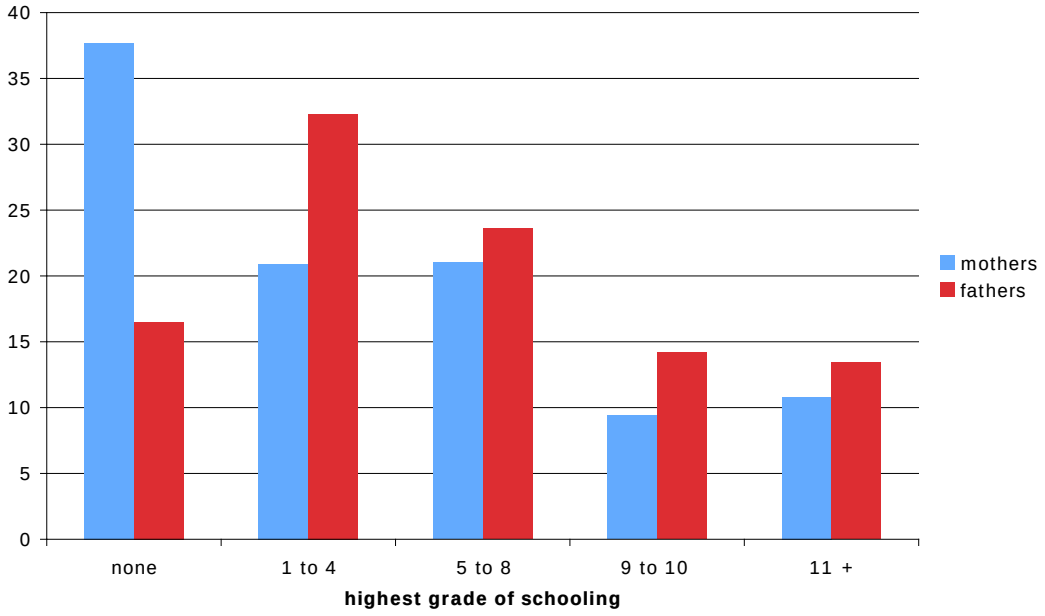


**Table 3.1: Mothers' schooling and household wealth by education category, in 3 study sites**

| Education (years) | Jimma<br>school %<br>wealth m (sd) | n | Serbo<br>school %<br>wealth m (sd) | n | Qarsa<br>school %<br>wealth m (sd) | n |
|---|---|---|---|---|---|---|
| none | 14.5% | 9 | 36.4% | 8 | 64.8% | 35 |
| | -0.38 (.75) | 6 | -0.17 (.54) | 7 | -0.94 (.26) | 34 |
| 1 to 4 | 14.5% | 9 | 9.0% | 2 | 33.5% | 18 |
| | -0.28 (.78) | 7 | 0.05 (.01) | 2 | -1.07 (.20) | 17 |
| 5 to 8 | 38.8% | 24 | 18.1% | 4 | 1.9% | 1 |
| | -0.01 (.43) | 17 | -.08 (0.01) | 4 | -0.94 ( - ) | 1 |
| 9 to 10 | 19.4% | 12 | 4.5% | 1 | | 0 |
| | 0.47 (.70) | 9 | -0.60 ( - ) | 1 | | |
| 11 plus | 12.8% | 8 | 31.8% | 7 | | 0 |
| | 0.55 (1.04) | 5 | -0.16 (.22) | 6 | | |
| n (schooling) | | 62 | | 22 | | 54 |
| n (wealth) | | 44 | | 20 | | 52 |

There are great contrasts in both women's and men's schooling between the urban and rural communities. In the rural area of Qarsa more than half of women had no schooling at all. The average mother in the city had more experience of schooling (mean 6.4 years [SD 2.9]) than did rural fathers (2.5 [SD 1.9]). Notably, the mean years of schooling of fathers and mothers in rural Qarsa matched the national averages very closely, at 2.5 and 0.9 years respectively (national averages: 2.3 and 1.0 years).

While access to schooling remains limited, it has expanded substantially since the grandparents' generation. In the grandparents' generation, there were three forms that education could take: (1) formal government schooling, (2) nonformal literacy training (known as *meserete timhirt*, "basic education", i.e. training provided during

government literacy campaigns of the 1970s and 1980s) (Gudeta et al. 1983; Sjöström & Sjöström 1983; Alem 1996), and (3) religious schooling (Quranic or Biblical) (Haile-Gabriel n.d., 1971). Because of the relative rarity of religious schooling – only 7 grandfathers had received religious schooling – and its differences in content from secular schooling, I focus here on government schooling and nonformal literacy training. In calculating the average years of schooling of grandparents, I counted any experience of nonformal literacy training as equivalent to one year of formal government schooling, but since this training could range in duration from a few weekend classes to a few years of instruction, the estimates of years of grandparents' schooling in the table should be considered liberal. Even by this liberal system of reckoning, *only one grandmother* in rural Qarsa, and approximately half of the grandmothers in the Jimma town had any schooling, compared to 43 % and 86 % among women in their children's generation (rural and urban respectively). Among men of the grandparents' generation, approximately half had schooling across both rural and urban sites, compared to 79 % and 90 % among fathers of children in the study. These figures give a sense of the dramatic rise in access to schooling, especially for women, that has occurred in the course of the past decades in Jimma, as in Ethiopia as a whole (cf. Amdissa 2008; UNESCO 2008).

Table 3.2 contains basic information on the demographics of the three sites and the study sample as a whole. Data on the years of schooling of mothers, fathers, and grandparents, and on mother's weights and heights, were collected for this project in 2008. All other data in the table are from the JLFSY in 2005-2006. Mothers' and fathers' ages have been adjusted upwards by 2 years to reflect the age of the

participants at the time the project began. Variation in sample sizes reflects imperfect matching of JLFSY to JCDP datasets and attrition (see Appendix 3).

**Table 3.2: Socio-economic and demographic characteristics of families in Jimma and neighboring sites**

| | Jimma (city, n = 62) | Serbo (town, n = 22) | Qarsa (rural, n = 54) | *all sites* (n = 138) |
|---|---|---|---|---|
| Mother's age | | | | |
| mean (s.d.) | 28.3 (5.7) | 29.4 (5.3) | 30.1 (7.0) | 29.3 (6.5) |
| range | 19 - 42 | 18 - 37 | 17 - 47 | 17 - 47 |
| n | 30 | 14 | 44 | 88 |
| Father's age | | | | |
| mean (s.d.) | 42.5 (11.8) | 39.4 (5.9) | 38.3 (9.8) | 39.7 (10.0) |
| range | 27 - 72 | 31 - 52 | 22 - 70 | 22 - 72 |
| n | 23 | 12 | 44 | 79 |
| Mother's schooling (years) | | | | |
| mean (s.d.) | 6.4 (3.9) | 5.6 (5.3) | 0.9 (1.4) | 4.1 (4.4) |
| Range | 0 - 15 | 0 - 13 | 0 - 6 | 0 - 15 |
| N | 62 | 22 | 54 | 138 |
| Father's schooling (years) | | | | |
| mean (s.d.) | 8.3 (4.4) | 6.5 (4.5) | 2.5 (1.8) | 5.5 (4.5) |
| range | 0 - 17 | 0 - 15 | 0 - 5 | 0 - 17 |
| n | 52 | 20 | 55 | 127 |
| Grandmother's schooling[9] | | | | |
| mean (s.d.) | 2.2 (3.0) | 0.8 (1.1) | 0.1 (0.3) | 1.1 (2.2) |
| range | 0 - 12 | 0 - 4 | 0 - 1 | 0 - 12 |
| n | 48 | 22 | 51 | 121 |
| Grandfather's schooling | | | | |
| mean (s.d.) | 4.2 (4.6) | 3.9 (4.7) | 0.7 (1.9) | 2.6 (4.1) |
| range | 0 - 12 | 0 - 14 | 0 - 12 | 0 - 14 |
| n | 45 | 21 | 51 | 117 |
| Mother's living children | | | | |
| mean (s.d.) | 2.4 (1.9) | 3.1 (1.8) | 4.3 (1.9) | 3.2 (2.1) |
| range | 1 - 6 | 1 - 6 | 1 - 8 | 1 - 8 |
| n | 48 | 18 | 43 | 109 |
| Mother's BMI | | | | |
| mean (s.d.) | 21.4 (2.9) | 19.7 (2.2) | 19.4 (1.8) | 20.4 (2.6) |
| range | 15.9 - 30.3 | 15.7 - 19.7 | 15.7 – 23.4 | 15.7 – 30.3 |
| n | 60 | 25 | 51 | 136 |
| Mother's weight (kg) | | | | |
| mean (s.d.) | 52.9 (8.9) | 48.6 (7.8) | 48.1 (4.9) | 50.4 (7.8) |
| range | 40.5 - 83.5 | 37.5 - 70.0 | 35.4 - 57.3 | 35.4 - 83.5 |
| n | 64 | 21 | 53 | 138 |
| Household wealth score[10] | | | | |
| mean (s.d.) | 0.19 (0.71) | -0.11 (0.39) | -0.97 (0.26) | -0.37 (0.71) |
| range | -1.34 - 2.39 | -1.15 - 0.51 | -1.34 - -0.50 | -1.34 – 2.39 |
| n | 47 | 23 | 53 | 123 |

[9] "Grandmothers" and "grandfathers" refer to the preceding generation on the mother's side – the *mother's mother* and *mother's father*.

[10] Wealth scores reported are only for households with link quality 1 or 2 (see Appendix 3).

Variation in mothers' and fathers' years of schooling, grandparents' schooling, household wealth, and mothers' nutritional status across the study sites suggest the potential for structural confounding and selection bias in the distribution of schooling. The correlations between mothers' years of schooling and potential markers of confounding or selection across the three study sites are shown in the following table.

**Table 3.3: Socio-demographic correlates of mother's years of schooling**

| | Jimma | | Serbo | | Qarsa | | *all sites* | |
|---|---|---|---|---|---|---|---|---|
| | r | p | r | p | r | p | r | p |
| Household wealth (asset index) | 0.168 | .14 | 0.277 | .12 | -0.201 | .08 | 0.543 | <.01 |
| Grandfather's schooling (years) | 0.512 | <.01 | 0.483 | .02 | -0.032 | .41 | 0.559 | <.01 |
| Grandmother's schooling (years) | 0.313 | .02 | 0.260 | .12 | -0.060 | .33 | 0.428 | <.01 |
| Mother's age (years) | -0.195 | .08 | -0.344 | .08 | -0.020 | .45 | -0.278 | <.01 |
| Mother's height (cm) | -0.107 | .23 | -0.097 | .33 | 0.384 | <.01 | -0.107 | .12 |
| Mother's weight (kg) | 0.092 | .24 | 0.070 | .34 | -0.159 | .13 | 0.218 | <.01 |
| Mother's offspring (number living children) | -0.391 | <.01 | 0.477 | 0.01 | 0.045 | 0.39 | -0.391 | <.01 |

Note: r = correlation coefficient, p = significance (1-sided)

In Jimma, grandparents' schooling and mothers' number of children were the factors most closely correlated with mothers' schooling, with those whose own parents had attended school and who themselves had fewer children being more likely to have continued to higher grades. In Serbo, by contrast, the relationship between mother's schooling and number of children was positive and in Qarsa absent.

Clustering of wealthier households in Jimma and Serbo, where there are also more women with schooling, led to a high correlation between wealth and schooling when the data from the three sites were pooled, although in none of the individual sites was the correlation significant at $p < .05$. In Qarsa, however, taller women were more likely to have completed more years of schooling (mothers' height: $r = .38$ $p < .01$), which may reflect mothers with schooling being from families that provided a healthier environment of upbringing (e.g. better hygiene, or more balanced diets) during the critical period for growth in stature during thei youth.

This initial analysis provides potential evidence of structural confounding of mothers' schooling by place of residence and selection effects that might operate through grandparents' schooling, and suggests that including women from all three sites in the same analysis may produce misleading results.

In order to investigate further the relative influences of urban and rural environments, as well as individual and household-level factors, on mothers' schooling, I conducted a multivariate regression with mother's years of schooling as the dependent variable. In this regression analysis and subsequent ones, I define the significance of relations between the dependent variable and the predictors *a priori*, in terms of "substantive significance" rather than conventional statistical significance (Achen 1982). In this case, I define influences that are substantively significant as those that are associated with at least one year of extra mothers' schooling when other factors are held equal, i.e. a regression beta coefficient of >1.0. The influences on mothers' schooling that met this standard of substantive significance were place of residence and

grandmother's schooling (Table 3.4). Since wealth, as described below, was not consistently related to mothers' schooling, it is not included in this model.

**Table 3.4: Predictors of mother's schooling: OLS regression**

Dependent variable: mother's years of schooling
n = 103, df = 5, F = 29.6

| | Beta | Std. Error | p |
|---|---|---|---|
| (Constant) | 2.09 | 0.81 | 0.012 |
| Serbo (versus Jimma)[11] | -1.25 | 0.83 | 0.134 |
| Qarsa (versus Jimma) | -2.31 | 0.77 | 0.004 |
| Grandfather's years of schooling | 0.22 | 0.08 | 0.011 |
| Grandmother's schooling (any/none) | 2.26 | 0.67 | 0.001 |
| Husband's years of schooling | 0.29 | 0.08 | 0.001 |

Adjusted R^2 = .58

Standard error of regression: 2.742

Living in Jimma as opposed to the rural area of Qarsa, controlling for other factors, was associated with an advantage of 2.3 years of schooling on average (beta coefficient for the Qarsa dummy variable = -2.31; significance: p = .004), while the equivalent advantage of women in Jimma over those in Serbo was 1.3 years of schooling (Serbo versus Jimma: beta -1.25, p = .134). Having a mother who attended school was associated with an advantage of 2.2 more years of schooling for women in this sample (beta = 2.26, p < .001). This variable ("grandmother's schooling") proved most significant when dichotomized. A year of grandfather's schooling, by comparison, was associated with 0.21 years more schooling for women, and husband's schooling with 0.29 years of wives' schooling; unlike grandmothers'

[11] The reference category for both the Serbo and Qarsa site dummy variables is Jimma town.

schooling, when dichotomized these two variables rose only modestly in strength of effect, and decreased in statistical significance.

Household wealth had a variable relationship with mother's schooling, remaining a substantive predictor of women's schooling when grandparents' schooling was controlled for, but when either place of residence (Serbo or Qarsa as opposed to Jimma) or husband's schooling (in years) was added to the model, the wealth coefficient fell (to 0.25, $p = 0.70$ when place of residence was added; to 0.49, $p = 0.40$, when husband's schooling was added). Mother's age was not significant when other factors were controlled.

**Discussion**

Mothers with more schooling proved to be distinctive in several ways in addition to their school experience. Mothers with more schooling were more likely to be urban, to have parents who themselves went to school, and, for those who were married, to have husbands with higher levels of schooling.

*Community effects (structural confounding):*

Advantages in average levels of women's schooling in Jimma were substantial compared to Serbo and Qarsa, equivalent to 1.3 years and 2.3 more years of schooling respectively. These differences in women's school attainment overlapped with differential access to healthcare, electricity, and piped water, which were compounded by challenges of terrain and lack of transport and communication infrastructure in rural areas. In some respects, Serbo was equally disadvantaged as rural Qarsa, e.g. in having no piped water service. In other respects, Qarsa stood out from Serbo and

Jimma, e.g. for most villages in the *wereda*, in having no nurse of doctor within an hour's walk. In subsequent analyses, I will sometimes group Serbo and Qarsa together as rural in contrast to urban Jimma, and sometimes treat each of the three sites separately, depending on context. In relation to risks of illnesses from diarrheal diseases, for instance, which can be transmitted through contaminated water, it will make sense to compare Jimma, where there is piped water, to the rural sites. When examining parents' knowledge of pharmaceuticals and their treatment of illnesses, on the other hand, it will make sense to compare Jimma both with Serbo, which has a clinic and pharmacies, and with Qarsa, which has neither.

While the differences among the three study sites are substantial, in other respects there are shared risks for child health across all sites that contrast with those in other parts of the world, e.g. the lack of efficient sewerage systems, which means that parents must be assiduous in caring for children to avoid contact with diarrheal pathogens. On these grounds it is warranted to analyze the data for all 3 sites together. When I do so, I will refer to the data from the 3 sites together as "the combined sample."

*Wealth effects (selection):*

Although household wealth was positively correlated with mothers' years of schooling in Jimma and Serbo, it was not a robust predictor of women's schooling in multivariate models. This finding conflicts with other studies in Ethiopia (e.g. Bigsten et al. 2002: 95; World Bank 2005). The contrary result could be due to defects of the asset index used as a measure of household wealth, which does not account for cash income, landholdings, or livestock ownership. It might also be

related to missing data problems (Appendix 3). There is reason to believe that many families in this study were under great economic strain at the time of the research in 2008, when rising food prices were affecting family budgets. JLFSY data from the same year suggest that 22% of urban households, 17% in intermediate sites such as Serbo, and 8% in the rural *qebeles* were resorting to extra income-generating activities in response to inflation in the price of food (Hadley et al. 2011). While in these circumstances, education might improve chances of gaining waged employment, Jimma, like Ethiopia in general, also suffers very high rates of urban unemployment among high school graduates (Mains 2007; cf. Serneels 2007), which would reduce the potential economic pay-off from schooling.

The influence of grandparents' schooling on women's school attainment, and the correlation between mothers' height and grade of schooling attained in rural areas, suggests the possibility of selection effects operating through conditions in mothers' natal households, i.e. the possibility that variation in mothers' schooling may reflect prior advantages (including wealth and social support) that could themselves affect children's chances of survival. The role of economic selection in determining women's access to and persistence in school is also suggested by the reasons women gave for dropping out of school, which included lack of family support, failure in exams, and pregnancy or marriage. "I was living with my sister, and she encouraged me to take a job [as a domestic worker] at another person's house," one mother said. "For that reason I dropped out." Mothers often glossed family problems and academic problems (e.g. failing the "Ministry", a federal exam at 8$^{th}$ grade) together by the phrase *Be-chegger mekenyat* ("Because of problems"). "There were problems

at home, and I got married," one woman said, suggesting that the transition from girlhood and school attendance to the status of wife and mother had been abrupt.

As we proceed to look at the relationships between schooling and child health in the following chapters, we must bear in mind the ways that families with varying levels of mothers' schooling differ, including their family backgrounds, access to medical services, and place of residence. These differences do not, however, rule out the possibility that what mothers learn in school has consequences for their children's health. To get a clearer idea of the kinds of learning in schools that could influence mothers' health behaviors, we turn now to look at a primary school in Jimma.

Chapter 4

**Learning health behaviors in the school**

Various theories proposed to explain the connection between mothers' schooling and child survival place emphasis on different kinds of learning in school. The KAP framework is very general in its implications, pointing to (a) health lessons that may be taught directly, (b) skills such as literacy that offer the prospect of vicarious learning about health topics from sources outside the school, and (c) attitudes such as gender equality and female autonomy that could influence women's sense of agency and their inclination to act independently to protect their children's health. The wealth flows hypothesis, by contrast, points specifically to the schema of the nuclear family encountered in school, and postulates that it leads mothers and fathers to "emotional nucleation" and to more intensive and generous investment in their children. The pedagogic childcare hypothesis proposes that particular forms of communication and relationships between teachers and pupils influence childcare styles in later life. The bureaucratic socialization hypothesis proposes that competence in a linguistic register patterned on writing leads to efficiency in dealings with clinicians. And the competition hypothesis proposes that experience of the competitive environment of school and awareness of the privileged positions that schooling entitles children to, motivates mothers to invest more intensely in their children's health and development.

Few of the claims made by the theories above about the features of school learning that are important to maternal health behavior have been grounded in systematic observation in classrooms; instead they are based largely on speculation. In this

chapter I draw on approximately 120 hours of observation of classes in primary schools, the majority at a single school, Bareedina Primary School in Jimma. My observations of school activities were recorded in notes written on the spot and through video-recordings, and in this case I use them to assess the kinds of learning occurring in schools that could influence health behaviors (i.e. behaviors on the part of a parent that could protect children from infection, malnutrition, or injury). For heuristic purposes I divide the relevant practices into two categories:

1. *Learning that could have a direct or proximal effect on health behavior*, including health content encountered in the course of formal instruction (as per the KAP framework)

2. *Learning that could have a more indirect or distal effect on health behavior*, including literacy skills and routines of communication that resemble those of the clinic (the bureaucratic socialization hypothesis); schemas of family relationships (the wealth flows hypothesis); and schemas of achievement and academic-occupational success that could motivate mothers to invest differently in their children (the competition hypothesis).

By way of introduction, the following passage summarizes a day in the life of a first grade class at a primary school in Jimma.

> Students begin to wander in to the school grounds before 8 AM, and by 8:15 they have gathered in the assembly area. Most wear uniforms – green pants and a shirt or jacket of the same fabric – some store-bought and others stitched together by hand. The students line up in files by grade order, and when the

principal gives the signal they begin to sing the national anthems as first the flag of Oromia and then the Ethiopian flag is raised.

After the ceremony, students regroup in their classrooms. In the first-grade class there are 31 students, 15 girls and 16 boys, ranging from 7 to 17 years old. They sit two or three to a bench, each of which is arranged either side of a desk, so that they are both in close contact with their benchmates and within arm's reach of others across the desks. The teacher, a woman in her mid-forties, takes attendance, calling out numbers assigned to each child by the school, to which each responds, "*Abet!*" And then the lessons begin: English, mathematics, Amharic or *afaan* Oromo, social studies, and arts or sport. In each lesson students copy words or problems from the blackboard or from textbooks into their exercise books. They are expected to work silently, and must raise their hands and gain permission before they speak. When the teacher asks questions, students clamor to be chosen to answer, calling "*Teacher! Teacher!*" or "*Me, teacher!*" In English class the teacher leads the students in a song of "Head, Shoulders, Knees and Toes," and has them point out parts of the body on a wall chart, using their English names.

At 10 o'clock there is a half hour's recess, during which students use the toilet, and play in the yard. In Amharic class, after break, the students chant the alphabet to themselves, each bent over a textbook, moving fingers over the page to trace the symbols as they read them. The social studies teacher arrives as the students are copying their Amharic homework from the board, and he leads them through a topic in their textbook on the importance of conserving the natural environment. In the final period, the teacher marches the class out to the playing field in single file, and coaches them in a ball game. When lessons are over, students leave school at 12:15 PM – to be replaced by others who will study during the second shift, in the afternoon.

## 1. Proximal influences on health behavior

### *Health themes in textbooks*

Official textbooks in languages and social science include many passages with themes of health and hygiene, such as the transmission of malaria, the stigma of leprosy, or the care of HIV/AIDS patients. As well as exhorting children to keep clean and warning them about diseases, textbooks extol the virtues of hard work and thrift. These themes are combined in some texts, such as the following.

> Darartuu is a 9-year-old girl. She studies in second grade. She keeps her teeth and body very clean. Her teeth are as white as milk. Darartuu is a strong student. She asks questions when things are not clear. She explains what she knows. In the classroom and outside she studies with her friends.
> (*Afaan* Oromo, Grade 2 textbook, circa 2007. Chapter 10, Exercise 1.)

Health content remained present in higher-level language texts (e.g. grades 8-10), albeit couched in more technical terms, such as descriptions of the nature of viruses and bacteria.

### *Hygiene drill*

Another kind of school learning that is proximally related to health behavior is physical examination by teachers. Teachers regularly survey students' cleanliness and grooming, and challenge them when they fail to meet their standards. Examinations of students' hands and hair occurred approximately once per week in the first grade classes I observed. These examinations took the following forms:

- Fingernail / hand examination: Teacher ordered students to lay their hands on the top of their desks, palms down. She walked around the classroom and looked at children's hands, paying particular attention to whether their nails had been cut and whether there was dirt underneath their nails.

- Hair examination: Teacher walked around the class pointing out students who needed a haircut. She pointed to children whose hair was cut short or arranged in neat braids. "This is good – easy to clean," she said.

Children who failed hygiene or grooming exams were interrogated about their habits, as in the following exchange.

> TEACHER: You haven't combed your hair?
> STUDENT: [*inaudible*]
> TEACHER: Do they force you not to comb your hair? This is a problem. You have to take the initiative. You're not taking the initiative. [*Atenqesaqeshim.*] Don't you have any time? Isn't there a [place] or anything [for you to comb your hair]?
> STUDENT: [*inaudible*]
> TEACHER: I'm really sorry. If that's true, I'm really sorry.

In other instances physical punishment was used to reinforce lessons related to personal hygiene; for example, when examining fingernails, a teacher struck children on the backs of their hands with a stick if they proved dirty.

**2. Distal influences on health behaviors**

Aspects of school learning that may have indirect effects on health behavior include literacy skills that open up avenues for learning about health and disease through sources outside the school (e.g. mass media, libraries); specific routines and forms of communication that mimic those encountered in clinics; schemas of family

relationships; and a schema of competition that might affect parents' aspirations and investment in their children.

*Literacy practices*: Reading and writing in Amharic and English were practiced every day in school. Symbol-recognition was initially taught by copying and chanting of the alphabets, but within the first year students were expected to copy full sentences. Some of the writing exercises, for example writing the day's date at the beginning of every exercise, and completing filling-in-the-blanks exercises, mimicked the conventions of official forms that might be encountered in clinics. Students were required to bring with them to school every day a full set of five exercise books (to be purchased by the students themselves) as well as textbooks (provided by the government) at risk of being dismissed, a practice that might instill the importance attached to maintaining and presenting on demand documents such as child vaccination cards, patient IDs, and prescriptions.

*School routines resembling those of the clinic:* Habitual behavior at school often resembles what is expected at a hospital or clinic, for example:

- Lining up every morning for the flag ceremony, and before games periods, is comparable to queueing in hospital waiting rooms. (The Amharic word *silf*, used for the daily ceremony, is the same word used for queue.)

- Remembering an ID number issued by the school when the register is called is comparable to the issuing of numbers to indicate priority in a queue and to code numbers indexing official correspondence.

*Communicative routines of schools and clinics:* Students were obliged to wait until being called upon before addressing the teacher, as might be expected with doctors and other health professionals. The criteria teachers used to judge students' responses to questions included not only the correctness of the information given but also the style of speech (clarity, audibility, and respectfulness). Signs of respectful behavior towards the teacher included standing whenever the teacher entered the classroom, and, when greeting the teacher individually, bowing slightly, looking down, and shaking hands, with the left hand clasping the wrist of the right hand (Figure 4.1).


**Figure 4.1: How to greet a fellow student and a teacher. Illustrations from an Ethiopian school textbook in Amharic.** [12]

[12] Captions in Amharic read (left) 'A good greeting between students'; (right) 'The respectful greeting that a student gives to his teacher.' Source: Ministry of Education, Ethiopia. Amharic Civics textbook, circa 2007.

Behavior interpreted as implying disrespect towards the teacher or the school (e.g. tardiness in arriving in class, failing to remember one's ID number in roll call, or speaking out of turn) were responded to with injunctions from the teacher ("Is this the time to arrive?" "Tomorrow, don't forget.") and punished by twists of the ear or pinching of the thighs.

*Schema of the family*: Family relations were a theme in textbooks and of class discussions in primary school. For example:

> *Obbo* Qanaa and his wife love their children. In their free time they collect their children together to advise them. They tell them that work improves a man, and that they should demonstrate this in their own conduct. The children listen well to their mother's and father's advice. They water the plants. They tend the chickens. They buy clothes and exercise books with the income they have earned. They know their role in work. Because of these things they are loved by their mother and father.
> (*Afaan* Oromo, Grade 2 textbook, circa 2007. Chapter 9, Exercise 1.)

As the grade-level of textbooks rises, themes of family values, which are very common in the early primary-level texts, tend to be replaced or supplemented with explicitly political themes, particularly concerning the federal system of Ethiopia and its principles. Family themes were, however, reinforced in question-and-answer between teachers and students in class. The following exchange, for example, occurred in a first-grade Social Science class taught in Amharic.

> TEACHER: What were we talking about last time? Who remembers?
> STUDENT: The family [*beteseb*].
> TEACHER: The family. What does "family" mean?

> STUDENTS: Teacher! Teacher! [*Many students call out at once, and raise their hands.*]
> TEACHER: Mohammed?
> MOHAMMED (A STUDENT): Family means people who live together: mother and father, brothers and sisters.
> TEACHER: Very good. A family is people who live together in one house. Mother and father and children.

The schema of parents as teachers also occurs in school textbooks, as in the following passage:

> Zeynaba has had many teachers. But the teacher she likes most is her father. Her father does not teach in a school, but he has taught her many things. He teaches her to use tools on their farm. He is always patient, and he explains things very carefully. He teaches her how to milk cattle, raise goats, and care for sick animals. When she grows up, Zeynaba wants to be a veterinarian so that she can heal sick animals.
> (English, Grade 6 textbook, circa 2007.)

Of the several teachers I asked to compare the roles of teacher and parent, all agreed that a good teacher should act like a parent towards his or her students. Teachers also appeared to pay attention to the family circumstances of the children in their classes. One of the first questions teachers would ask new students at the beginning of the school year was where they lived and with whom. "A good teacher knows his student, his family background," one teacher told me. Conscious of the varying support networks that different students had, the same teacher appeared to calibrate her criticism or praise of students' work depending on their family circumstances, as in the following example. Here the teacher was checking a homework assignment in first grade – to write out the letters of the Roman alphabet.

> TEACHER: [*Looking at the student's homework.*] Who wrote this for you?
> STUDENT: [*Inaudible.*]
> TEACHER: They wrote it well. But you must try this by yourself. They're making an effort for you, but you're not making an effort yourself [*t'eret ataregim*]. You have a good family, but you're not making an effort. It's just the ABC: small letters here, capital letters here. It's nothing. I will beat you [for this]. [*Egerefeshalehu.*] It's your family that is making the effort. [*Beteseb eyemokere new.*]

As well as demonstrating the teacher's awareness of the student's family circumstances, also emphasizes the concept of individual effort (*t'eret*), which is enshrined in school rules that mandate individual work and discourage collaboration. As in the dialog between the teacher and the student who was criticized for her grooming (recounted above under 'Hygiene drill') emphasis is placed on personal initiative. The two cases contrast, however, in that in the exchange about grooming, the teacher criticized the student for not taking the initiative to do something (combing her hair) that her household did not support, while in this case the teacher criticized the student for allowing her family to do her homework for her. In both cases, students failed to display a quality that the teacher emphasized as important: initiative or effort. Failing to demonstrate this quality was cause for punishment ("You're not making an effort…. I will beat you.").

Students' calling "Teacher! Teacher!" in addition to raising their hands to gain attention was another way in which individual effort and competition among peers was manifested in the schoolroom. This particular routine was something that some teachers objected to ("Don't say, 'Teacher!'"), but that most tolerated or even encouraged by choosing answers from students who had made themselves most conspicuous, and complimenting them when they answered correctly.

The themes of thrift and industry in textbooks (noted above as occurring alongside health content) and material on careers to which educated people might aspire (e.g. to be a veterinarian) corresponded to this emphasis on initiative and personal effort, serving as examples of the prizes, in terms of wealth, respect, and fulfillment, that might follow for those who succeeded in the competition for good grades.

*Gender:* The environment of the school is also distinctive from the community outside the school in terms of the official authority wielded by women (as teachers). School texts included female role models (e.g. Darartuu, celebrated for her clean teeth and her forthrightness in asking questions). In the classes I observed, girls and boys were approximately equally represented in the classroom, and were sitting in close proximity with each other and attending to the same tasks irrespective of gender.

**Summary: Health-relevant learning in the school**

Observations in primary schools suggest various ways in which schools might influence health behavior: proximally through health content encountered in textbooks and inculcation of hygiene practices through physical examinations; and distally through several routes: literacy skills that potentially open up horizons of learning about health and disease from sources outside the school, familiarity with forms of communication (e.g. directness of speech and deference to bureaucratic authority), practices (arriving on time, queueing, form-filling, waiting) that recur in clinics, and schemas of the nuclear family and of competition. Lessons were reinforced variously by repetition, praise, shaming, and physical punishment. Some lessons, such as literacy practices, communicative routines, and competition with

peers, were encountered every day in school. Hygiene lessons, although they occurred less frequently, were both positively reinforced (e.g. through praise of children wearing their hair cut short) and negatively reinforced by shaming (as in the case of the child who was not well groomed) or by physical punishment (raps on the hands to punish students for coming to school with dirty fingernails).

**Discussion**

The observations summarized here provide support for a range of theories that connect maternal schooling to health behaviors. In the case of KAP, the inclusion of health content in textbooks for languages and social science provides support for the proposition that schooling could directly boost health knowledge. Researchers in demography and public health have remarked that information concerning health risks or child feeding could not be learned in school because of the absence of relevant curricula (Glewwe 1998; Webb et al. 2009: 304). But going into schools and observing the content of lessons and texts can reveal relevant information that is communicated even when health is not officially on the curriculum. An ethnography of a high school in Tanzania, for example, reports that home economics classes included lessons on "baby's daily routine" and scheduling clinic appointments (Stambach 2000: 55). In the Ethiopian case, historical sources that show that health education was prominent in the literacy campaigns of the 1970s and 1980s (Alem 1996); and since the 1990s, schools in Ethiopia have convened anti-HIV/AIDS clubs to spread awareness of HIV risks in particular (Discovery Consultants/MOE 2003).

The strong reinforcement of lessons of hygiene through praise, shaming, and physical punishment suggest that hygiene habits might well be internalized in the course of a

year or two of exposure, and that increasing years of attendance could ratchet up the effect. The multiple pathways through which health-relevant information is transmitted (texts, physical exams) and reinforced (praise, shaming, punishment) suggests that school knowledge relevant to health could persist into adulthood (contra Basu 1997: 314). Some of this knowledge might be internalized at a subconscious level, in the form of attitudes, habits, and dispositions (cf. Dewey 1997 [1938]: 48), which would make it difficult to elicit in conventional survey interviews. Similar practices at schools in Bangladesh, including "daily inspection[s] for scabies or other skin disorders," contribute, Lindenbaum has argued, to a particular kind of middle class identity associated not only with hygiene but with religious purity (Lindenbaum 1990b: 434; cp. Briggs 2004).

Some aspects of school experience more distally related to health behavior – e.g. literacy and forms of communication between teachers and pupils that mimic those of clinics – are encountered every day in school, and are thus "redundantly represented" as models for learning (Lave & Wenger 1991). These practices may assist with interaction in clinics, as suggested by LeVine and colleagues (in press), who showed that women's literacy is associated with improved communication of health complaints as rated by doctors in Mexico, and with improved comprehension of recorded health messages on the radio in Nepal. In Ethiopia, an ethnography of a high school in Addis Ababa by Poluha (2004) provides rich descriptions of the hierarchy and authority relations of the school; the commonalities between Poluha's observations in Addis Ababa and those reported here from Jimma suggest that routines of respect formalized in teachers' and students' interactions are widespread features of the Ethiopian education system.

Caldwell suggested that promotion of the nuclear family in schools happened through school texts, but even more so through "the inbuilt assumptions of the [school] system and its teachers" (Caldwell 1976: 354) and that this schema of the family would affect parental investment in later life. I observed that family themes were indeed present in textbooks and classroom discourse, where "family" was defined as the nuclear family. The attention teachers paid to students' family backgrounds might also be considered as reflecting an assumption of teachers regarding the nuclear family. Another interpretation, however, is that the teacher's emphasis on students' personal efforts, as opposed to the efforts of their families, represents a certain kind of independence from the family.

The concepts of effort (*t'eret*) and initiative (literally, movement: *enqesqase*, from *manqesaqes*, to move) may have been familiar to students before they attended school, but especially for rural children, these words would likely take on new meaning in the school context, where the ends to which effort and initiative were directed were different (e.g. copying out the alphabet) or based upon a different set of standards (e.g. of cleanliness or grooming) than those familiar from home. Whiting and Edwards (1988: 240) have pointed to the "new motives involving the acceptance of remote goals" as one of the distinctive features of schools from the point of view of cultures without mass schooling. These remote goals, they noted, include both material wealth (e.g. a radio, a car) and the economic security and prestige of waged employment. Similarly, a group of researchers who studied students in Liberia observed that desire for "money, power, and Western luxuries" was among the most important motivations for study (Cole et al. 1971: 54). The fact that the compliance

with the standards of the school not only leads students to be spared chastisement by the teacher but is also accompanied by the prospect of wealth and prestige in future lends the school a peculiar power for shaping habits.

In Dahrendorf's terms, the school promotes a different life chance from those that are possible in rural communities, i.e. a particular balance of options and ligatures that, in its emphasis on work for oneself and one's career (options) as opposed to work for one's family or kin group (ligatures) may be a novelty for many children. If this schema were internalized it might affect health behaviors towards children:

the greater potential gains to be reaped from children's success in school and subsequently through their careers could motivate women to invest more intensely in their children's health and development. And under conditions where economic self-sufficiency through traditional means, such as subsistence farming, is precarious, the new life chance offered by the school might look particularly attractive, or even necessary for survival. Assessing the extent to which this schema is internalized in fact, and the degree to which it affects health behaviors at the time of motherhood must rest, like the claims of other theories, on triangulation with evidence of parents' childcare practices and their children's health.

**PART II:**

## CHILD ILLNESS, GROWTH, AND PSYCHOMOTOR DEVELOPMENT

Does women's schooling affect child survival in Jimma and neighboring areas? Epidemiological studies in the Jimma area suggest that infant mortality is significantly lower among women with primary and secondary schooling than among those with no schooling (Mekonnen et al. 2000, cited in Chapter 2). Although information on survival differentials among children under 5 is not available for Jimma, data collected for this dissertation may allow us to infer how survival chances differ by mothers' schooling. Frequency of children's illnesses, nutritional and growth status, and psychomotor development can serve as sensitive indicators of children's risks of mortality (in the case of illness and growth) and as reflections of the quality of interactions with caregivers (in the case of psychomotor development). In the next three chapters, I describe children in the longitudinal study in terms of each of these three dimensions of development, and search for explanations for the emerging patterns not only in mothers' schooling but also in relation to children's age and gender, place of residence, and household wealth. Attention to place of residence is important for addressing the structural confounding hypothesis; attention to household wealth is important for addressing economic selection effects that may operate on child health through mothers' schooling. I also consider effects on children's health operating through fathers' schooling. In each case I consider the implications of these relationships for the question of how parental schooling affects children's survival.

Chapter 5

## Child illness and infection

Every theory that connects mothers' school experience to child survival must account for variation in vulnerability to the infectious diseases that are the largest killers of children in the developing world (Snow et al. 1999; Morris et al. 2003). Ethiopia's epidemiological profile in terms of under-five deaths is consistent with the pattern elsewhere in the developing world in that the majority of child deaths are caused by diarrheal diseases, acute respiratory infections, and malaria (Shewatatek & Gebreselassie 1993). In Qarsa and two neighboring *weredas* in 2005, the leading causes of death among children aged 1-4 years were estimated by verbal autopsy in an age-matched case-control study as acute or persistent diarrhea (45 % of deaths), acute respiratory infections (35 %), and malaria (29 %). Among children <12 months, a larger share of deaths were attributed to acute respiratory infections (48 %) and malaria (41 %), while diarrhea was a less common cause of death (26 %) (Amare et al. 2007).

In the current study, the most commonly reported illness was diarrhea (229 cases), followed by respiratory infections (191) and, depending on the site, either fevers (104) or malaria (55). After these, the most frequently reported ailments were skin infections (22), vomiting (10) and trauma, i.e. injuries and burns (8). Children experienced between 4 and 5 episodes of illness on average over the 10 to 11 months of the study, although there was considerable variation, with some children experiencing none and others experiencing up to 13 bouts (SD 2.77). Table 5.1

summarizes the distribution of the most commonly reported child illnesses across the 3 sites in this study.

**Table 5.1: Reported illnesses of children during follow-up (2008-2009)** [13]

| Site: | Jimma (n = 62) | Serbo (n = 23) | Qarsa (n = 53) | all sites (n = 138) |
|---|---|---|---|---|
| All illnesses (bouts) | | | | |
| mean | 4.98 | 4.48 | 3.81 | 4.45 |
| range | 0 - 13 | 0 - 9 | 0 - 9 | 0 - 13 |
| s.d. | 2.95 | 2.76 | 2.45 | 2.77 |
| Diarrhea | | | | |
| mean | 1.81 | 0.96 | 1.57 | 1.57 |
| range | 0 - 5 | 0 - 5 | 0 - 6 | 0 - 6 |
| s.d. | 1.39 | 1.21 | 1.46 | 1.42 |
| Respiratory infections | | | | |
| mean | 1.42 | 1.22 | 1.23 | 1.31 |
| range | 0 - 6 | 0 - 5 | 0 - 4 | 0 - 6 |
| s.d. | 1.68 | 1.45 | 1.15 | 1.45 |
| Fever | | | | |
| mean | 0.94 | 0.70 | 0.40 | 0.69 |
| range | 0 - 5 | 0 - 2 | 0 - 2 | 0 - 5 |
| s.d. | 1.13 | 0.77 | 0.66 | 0.94 |
| Malaria | | | | |
| mean | 0.24 | 1.04 | 0.30 | 0.40 |
| range | 0 - 3 | 0 - 4 | 0 - 3 | 0 - 4 |
| s.d. | 0.53 | 1.15 | 0.63 | 0.76 |
| Skin infections [14] | | | | |
| mean | 0.26 | 0.26 | | 0.16 |
| range | 0 - 4 | 0 - 6 | none | 0 - 6 |
| s.d. | 0.65 | 1.25 | | 0.67 |

Comorbidity occurred among a large proportion of children: 47 % had two illnesses at once on at least one occasion, and 21 % were reported to have two illnesses at once on at least two occasions during the period of follow-up.

[13] The sample used here is all children for whom we have at least 6 rounds of data (n=138).
[14] Skin infections include fungal and bacterial infections and rashes (Amharic, *shefeta*).

***Differentials in child illnesses by urban and rural sites, and household wealth***

Illnesses were more frequently reported among children in Jimma town than in the rural sites; for instance, of the 15 children in the top decile of illness frequency (>8 bouts), 9 were in Jimma town. Diarrhea, respiratory infections, and fevers were all more frequent in the city than in the rural areas, and together they made up approximately 80 % of child illnesses in Jimma town, compared to approximately 60 % outside the town. The exception to this pattern was malaria, which struck more children in the rural sites, especially in Serbo, where 60 % (14 of 23) of children had malaria at least once during the study, compared to 21 % in Jimma and 23 % in rural Qarsa. The two children who died of malaria during this study, however, lived in Jimma and Qarsa.

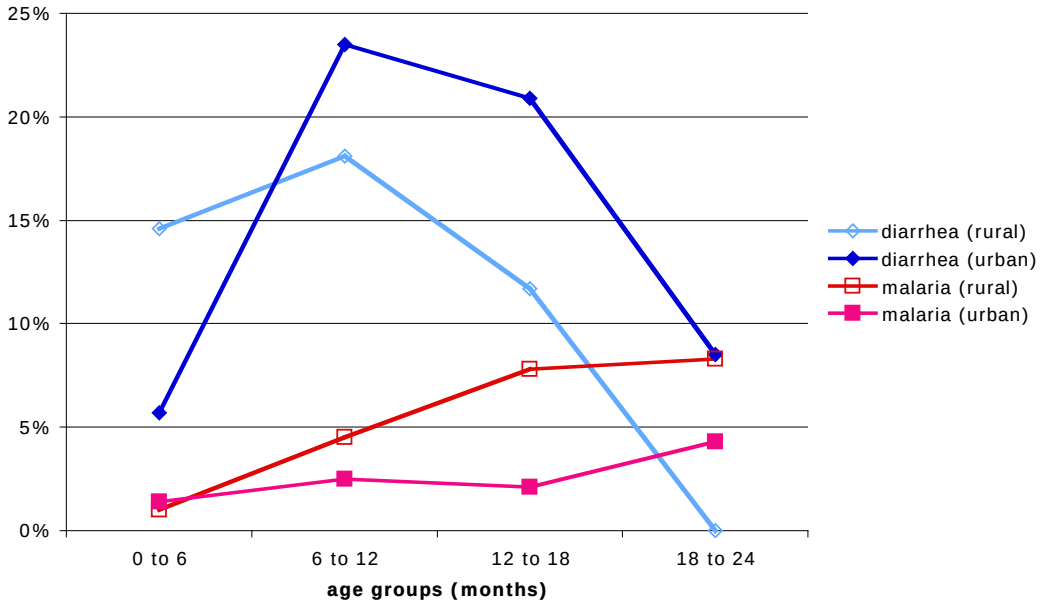
Cross-tabulation of illness frequencies by wealth quintiles did not reveal a clear pattern of illness frequency by wealth, although the mean wealth index score of those with at least >8 (the top decile) during the year was 16 (SD .35), compared with .34 (SD .88) for those with <8 bouts. In rural Qarsa those with at least 9 illnesses were not substantially less wealthy than the rest, with wealth score of -.81 (SD .21) compared with -.96 (SD .25).[15] Cross-tabulations suggested that in none of the three sites, and for none of the individual illnesses, was there any clear gradient of illness frequency by wealth quintiles.

[15] The sample sizes in these comparisons are (children with >8 illnesses : children with <9 illnesses) for Jimma 5 : 24, and for Qarsa 4 : 39. Samples are constrained by the exclusion of children with fewer than 6 months' data and inclusion of only households with good connections to the JLFSY dataset (Appendix 3).

***Differentials in child illnesses by age***

In Jimma town and the rural sites, malaria prevalence rose more or less linearly over the first two years of life, while diarrhea prevalence peaked during the period 6-12 months and declined thereafter. These patterns were more pronounced in the countryside for malaria and in the city for diarrhea (Figure 5.1). As noted in Chapter 2, the children in the sample from Jimma town were slightly older than those in the rural sites, and therefore more vulnerable to infection. These patterns also appear to be consistent with the different disease ecologies of town and country (for both diarrhea and malaria) and with the transition from breastfeeding to (potentially contaminated) foods around 6-12 months.

**Figure 5.1: Age-specific prevalence of diarrhea and malaria among children in Jimma town and rural sites (Serbo & Qarsa)**
(n = 138, observations = 611) [16]




[16] In this and the following graphs, the points on the graph that are plotted with solid squares or diamonds represent the urban sub-sample, and those with unfilled squares or diamonds represent the rural sub-sample.

Fevers (excluding those identified by parents as due to malaria) showed a similar pattern to diarrhea in the rural sites, with a rise from 1.9 to 6.2 % reporting fevers over the first year of life, and a decrease thereafter, whereas in the urban site fevers varied less across age groups. While in rural areas respiratory infections declined with age from a high at 0-6 months, in the urban area of Jimma they increased as children grew older.

***Mothers' schooling and child illness***

Correlations between mothers' years of schooling and total number of episodes of illness reported over the course of the study showed a positive correlation (0.115, 1-sided p = .09), suggesting that children of women with more schooling in general had more illnesses. The strength of correlations differed, however, across sites and among the most common illnesses (Table 5.2).

**Table 5.2: Correlations between mothers' years of schooling and child bouts of illness over 10 / 11 months of follow-up**
(Pearson's r, one-sided significance)

| | Jimma (n=62) | Serbo (n=22) | Qarsa (n=54) | all sites (n=138) |
|---|---|---|---|---|
| diarrhea | -0.183 | -0.521 | -0.146 | -0.136 |
| | 0.07 | 0.01 | 0.15 | 0.06 |
| respiratory infections | 0.075 | 0.248 | -0.135 | 0.119 |
| | 0.28 | 0.13 | 0.17 | 0.08 |
| fevers | 0.236 | 0.132 | -0.015 | 0.277 |
| | 0.03 | 0.28 | 0.46 | <.001 |
| malaria | -0.168 | 0.307 | 0.050 | 0.083 |
| | 0.10 | 0.08 | 0.36 | 0.17 |
| skin infections | -0.081 | 0.017 | none | 0.084 |
| | 0.27 | 0.47 | | 0.17 |
| other illnesses | -0.132 | 0.109 | 0.171 | 0.133 |
| | 0.15 | 0.32 | 0.11 | 0.06 |
| sum of all illnesses | -0.021 | -0.014 | 0.088 | 0.115 |
| | 0.44 | 0.48 | 0.26 | 0.09 |

Of the 6 most common child illnesses, only diarrhea consistently showed the expected inverse correlation with mothers' schooling. When all illnesses were combined, the correlations with women's schooling were negative in Jimma and Serbo, but remained positive in Qarsa; however, none of these correlations was statistically significant. When all three sites were combined, the dominant pattern was of positive correlations between schooling and frequency of children's illnesses. The strongest and most significant correlation in the combined data was the positive correlation between mother's schooling and children's fevers. Respiratory infections and the residual category of other illnesses were also positively correlated with mother's schooling ($r > .10$, $p < .10$). The correlations within the individual sites were various:

in Jimma, diarrhea and malaria were inversely correlated with mothers' schooling while fever and respiratory infections were positively correlated with mothers' schooling; in Serbo only diarrhea was inversely correlated with mothers' schooling; and in Qarsa no statistically significant correlation – either positive or inverse – was observed.

**Mothers' schooling and incidence of children's diarrhea**

Because children's diarrhea was inversely correlated with mothers' schooling consistently across the three sites, this relationship was examined in further depth. I first looked at frequencies of children ever having diarrhea by mothers' level of education (primary or secondary versus none). Having diarrhea during the period of the study was less common among children of mothers with secondary schooling or higher (61 %) than among those with no schooling (76 %); somewhat surprisingly, however, it was most common among those with primary schooling (81 %). This might reflect the fact that in Jimma town, where diarrhea prevalence was highest, the majority of women had at least some primary schooling, whereas in the rural areas, with lower diarrhea prevalence, most women had no schooling. When Jimma town was considered on its own, reports of children ever having diarrhea decreased in frequency in a stepwise fashion from children of mothers with no schooling (89 %), to those with primary schooling (85 %), to those with secondary or above (57 %).

To investigate the influences of other factors including wealth and fathers' schooling on the relationship between mothers' schooling and child diarrhea, I next fit logistic regression models of diarrhea ever reported during the 10 months of follow up (Menard 2002). Covariates included mothers' and fathers' schooling measured in

three ways: as years of schooling (continuous), as any versus none (binary), and as none / primary / secondary+ (ordinal). Since children's age had demonstrated effects on diarrhea incidence with a curvilinear pattern over the first two years of life, I included child age (in months) and age-squared in all models. To assess whether children in wealthier families had lower odds of suffering diarrhea, independent of mothers' schooling, I also included the household wealth index. To account for variation in the effects of local environments, I ran models both on the combined sample (with the addition of a dummy variable for urban versus rural residence) and separately for Jimma town (n = 56) and the Serbo and Qarsa sites together (n = 67). In interpreting results I set the substantive significance of the predictors as equivalent to an odds ratio 0.8 or less, i.e. a one-fifth reduction in odds of ever having diarrhea.

In bivariate analyses with the combined sample, both household wealth and urban residence were positively related to diarrhea, yielding log odds of children ever having diarrhea ranging between 1.8 and 4.3 (>.01 p < .20). When both wealth and urban residence were included in models together, however, the size of the effects of each declined, suggesting that wealth and urban residence were each indexing the same set of influences on likelihood of diarrhea, most likely the clustering of wealthier families in the urban environment with dense population and higher risk of pathogen exposure. Children's age and age-squared had very small effects in all models, while parents' schooling had more variable effects. In the combined sample, mothers' years of schooling, but not fathers', was consistently negatively associated with odds of children ever having diarrhea. Mothers' years of schooling yielded odds ratios in the region of 0.8 or 0.9 (i.e. borderline substantive significance) (p <.10), i.e. marginally lower odds of children ever having diarrhea. The effect of household

wealth, however, reduced the statistical significance of mothers' years of schooling, as in the model below (Table 5.3). In this model the urban/rural dummy variable is removed, and the wealth index is used in its place.

**Table 5.3: Logistic regression of child diarrhea, combined sample**

Dependent variable: child ever experienced diarrhea during 10 or 11 mo. follow-up

(coded 0 = never experienced diarrhea, 1 = experienced diarrhea once or more)

N= 100

Chi-square 8.69 (p <.122)

| | Beta | S.E. | O.R. | p |
|---|---|---|---|---|
| Intercept | 3.13 | 1.15 | 22.85 | 0.006 |
| child age (months) | -0.24 | 0.32 | 0.79 | 0.462 |
| child age squared | 0.02 | 0.03 | 1.02 | 0.411 |
| mother's schooling (years) | -0.14 | 0.09 | 0.87 | 0.158 |
| father's schooling (years) | -0.09 | 0.10 | 0.92 | 0.380 |
| wealth index | 1.19 | 0.57 | 3.28 | 0.036 |

-2 log likelihood = 99.17

Substituting binary and categorical codings of mothers' schooling, instead of years of schooling, showed that the protective effect of mothers' schooling for child diarrhea declined when mothers with any schooling were compared to those with none, and that the protective effect was accounted for largely by mothers' secondary schooling, which consistently predicted log odds of diarrhea <0.30 ($p < .05$) regardless of controls for wealth or place of residence.

Dummy variables for the three sites showed that odds of diarrhea were much higher in Jimma town than in either Serbo or Qarsa, so the contrast between urban and rural

categorization of the study sites appeared to be justified. To assess effects of local environment, I stratified the sample by urban and rural residence and ran regressions separately on each group. In the urban sample the coefficient for mothers' years of schooling was similar to that in the combined sample, while primary schooling remained negligible in its effects on odds of diarrhea (OR .09, p = .90) and the statistical significance of mothers' secondary schooling declined (OR <0.40, p = .40). In the rural areas, however, the effect of mothers' years of schooling was stronger than in the urban area, and was less influenced by household wealth (Table 5.4).

**Table 5.4: Logistic regression of child diarrhea, rural sites only**

Dependent variable: child ever experienced diarrhea during 10 or 11 mo. follow-up

(coded 0 = never experienced diarrhea, 1 = experienced diarrhea once or more)

N= 64

Chi-square 5.59 (p <.347)

| | Beta | S.E. | O.R. | p |
|---|---|---|---|---|
| Intercept | 0.92 | 1.40 | 2.52 | 0.511 |
| child age (months) | 0.32 | 0.41 | 1.38 | 0.434 |
| child age squared | -0.02 | 0.03 | 0.98 | 0.458 |
| mother's schooling (years) | -0.24 | 0.12 | 0.79 | 0.057 |
| father's schooling (years) | 0.02 | 0.13 | 1.02 | 0.874 |
| wealth index | 0.51 | 0.78 | 1.67 | 0.508 |

-2 log likelihood = 71.10

In this model, while mothers' schooling was only borderline statistically significant (p = .057) it was the strongest negative predictor of child diarrhea, and met the criteria of substantive significance (OR < 0.80). In further analysis of the rural sample, I experimented with excluding the 4 women with secondary schooling (all of whom

lived in Serbo), to assess the degree to which they influenced the relationship in the rural sample as a whole. When women with secondary schooling were excluded, the OR for mothers' years of schooling moved marginally towards 1.0 and statistical significance declined (OR = 0.84, p = .28). This suggested that, contrary to the hypothesis that odds of child diarrhea would show a significant incremental reduction for every year additional year of mothers' schooling, the majority of the effect of women's schooling on childhood diarrhea in the rural sample was due to the few mothers with secondary schooling.

**Summary**

Patterns of child illness in Jimma and neighboring sites were strongly influenced by children's age and place of residence, with most illnesses being more common in urban than rural settings, and less common among infants than in the second year of life. Diarrhea incidence peaked between 6 and 12 months and fell over the second year of life, while frequency of malaria increased over the first two years. Especially high frequencies of diarrhea were seen in Jimma town, and of malaria in Serbo.

Contrary to expectation, mothers' years of schooling were positively correlated with number of bouts of child illnesses in the combined sample, and particularly with fevers in Jimma and Serbo. Frequency of diarrhea was, however, inversely correlated with mothers' schooling across all 3 sites, and logistic regression analysis showed that this effect was not accounted for by fathers' schooling, or, at least in the rural communities (Serbo and Qarsa), by household wealth. A small number of mothers with secondary schooling in the rural sites exerted considerable influence over this relationship, however, and removing them from the sample caused the effect to

decline to statistical insignificance and borderline substantive significance, contrary to the hypothesis of significant dose-response effects of mothers' schooling on children's risk of diarrhea.

**Discussion**

The trends in bouts of illness by age group that emerge from this analysis are similar to those elsewhere in Ethiopia and the developing world in that susceptibility to infection is strongly influenced by age, reflecting stage of immune system development (McDade 2005). In particular, the "inverted U" pattern of diarrhea incidence across the first two years of life, with a peak at 6-12 months, matches closely the period of transition from breast milk to complementary foods as nutritional requirements, and is widely reported in developing countries (e.g. Stallings 2004).

National-level data from Ethiopia suggest that for most illnesses, including diarrhea, prevalence rates are generally higher in rural than urban areas (ibid.). The higher rates of infections in Jimma town than in the rural sites reported here are therefore surprising, especially given the availability of piped water in Jimma town, which we would expect to reduce risks of diarrheal disease. The pattern of higher illness in the city may be the result of greater population density, with diarrheal pathogens in particular being difficult to avoid in crowded environments without efficient sewerage systems, even when there is piped water available. While the cause of the very high rate of malaria among children in Serbo is unclear, it may be due to proximity to the reservoir of the Gilgel Gibe hydroelectric power plant, the environs of which constitute a breeding ground for mosquitoes, combined with the population density of

the town compared to surrounding rural areas – implying a greater availability of potential hosts for the malaria parasite than in the rural *qebeles* near the Gilgel Gibe reservoir. This suggests that higher risks of infection due to population density in the urban and semi-urban settings of Jimma and Serbo, where average years of schooling are higher, may weaken underlying positive effects of mothers' schooling in protecting children from diarrhea and malaria.

The lower odds of diarrhea among children of women with schooling is consistent with national-level data (Stallings 2004: 73). In the current study, the relationship between women's schooling and lower odds of child diarrhea in the rural setting appeared to be strongly influenced by the few women with secondary schooling. This contrasts with findings from a longitudinal study in the Philippines where incidence of infant diarrhea fell, and likelihood of maternal preventive health behaviors (e.g. hygienic disposal of excreta) increased, with each year of women's schooling (Cebu Study Team 1991). Households in Serbo (but not those in rural Qarsa wereda) had latrines, and it is possible that if the latrines were well maintained, they might have helped protect children from diarrhea. Use of safer sources of drinking water, such as protected wells or springs, by mothers with schooling could also have a protective effect against child diarrhea (Sugita 2004). Other possibilities are that mothers with schooling washed their hands more frequently – a practice that, as we saw, was emphasized in primary school – or adhered to exclusive breastfeeding during the first 6 months, each of which would reduce children's contact with diarrheal pathogens. A limitation of these analyses is that the outcome variable, "ever had diarrhea," failed to distinguish between children who had diarrhea only once and those who had diarrhea

on multiple occasions. Future analyses should investigate factors associated with repeated bouts of children's diarrhea.

The absence of inverse correlation between mothers' years of schooling and frequency of other child illnesses is consistent with studies showing that the prevalence of acute respiratory infections (ARIs) and fevers does not vary substantially by mothers' schooling in Ethiopia (Stallings 2004). In the case of ARIs in urban sites, two-week prevalence is actually significantly higher among children of women with secondary schooling than among those with no schooling (Stallings 2004: 21). This may be due to reporting bias, with mothers who have more schooling more commonly noticing and reporting signs such as fever than those with less schooling – in other words, it may reflect greater attention to children's health among educated women, rather than genuinely higher disease burden. Problems of reporting bias have been acknowledged as a hazard in all research on the relationship between mothers' schooling and child illness that is based on maternal report (Cleland 1990).

It is also possible that while susceptibility to infection, as captured by number of bouts of illness, is determined largely by local environment and children's ages, mothers' *responses* to infection – mitigation of the duration or intensity of disease bouts – may be influenced by schooling.

A limitation of the analyses reported here is that they do not account for comorbidity, which may have a substantial impact on mortality risk. In future, focusing on the 47 % of the children in Jimma and neighboring sites who reported comorbidity or the 21 % who had repeated comorbidity might provide more accurate estimates of

mortality risk, and could reveal different patterns of child illness in relation to mothers' schooling.

One dimension of comorbidity that is connected to the duration and intensity of bouts of illness is malnutrition. In a longitudinal study in Bangladesh, for example, while diarrhea incidence was not associated with children's growth status as assessed by weight for length, duration of diarrhea bouts was significantly associated with weight for length (Black et al. 1984). Children's physical growth status may therefore provide an indirect way of assessing the burden of illness, as opposed to its incidence (Tomkins & Watkins 1989). At the same time, child growth also provides information on mortality risk due to undernutrition. It is to the topic of child growth that we now turn.

Chapter 6

**Child growth**

In the course of the first year of life, a healthy child will more than double in weight and increase by at least one half in length (Bogin 1999). If diet is inadequate, growth will be impaired. Many studies have shown that child growth also slows or ceases during bouts of illness (e.g. Martorell et al. 1980) as energy is diverted to fight infection or nutrient absorption is disrupted by parasites. Children's growth status can therefore be used as a proxy for malnutrition and disease burden, and since both are linked to mortality by clear physiological mechanisms (Shankar 2000) growth can also be used as a proxy for mortality risk.

Suboptimal growth can be assessed in many ways (Gibson 2005), but most commonly it is done by comparing the achieved height of a child of a given age and sex to a child of the same age and sex who has grown up in an affluent setting and whose height is therefore likely to reflect genetic potential. Similar comparisons can be made for weight for age and current weight to achieved height. Each of these indicators provides distinctive information about children's growth and wellbeing. Height reflects long-term nutrition and health, whereas weight is an indicator of shorter-term nutrition and health, being sensitive to transient variation in food intake and insults. Degrees of growth deficit are commonly reported in terms of standard deviations (z-scores) below the median height or weight expected for the age group in an affluent population, with more than 2 standard deviations below the reference median classified as stunted (in height for age), underweight (in weight for age), and wasted (in weight for height) (FANTA 2003). In relation to children of the same age

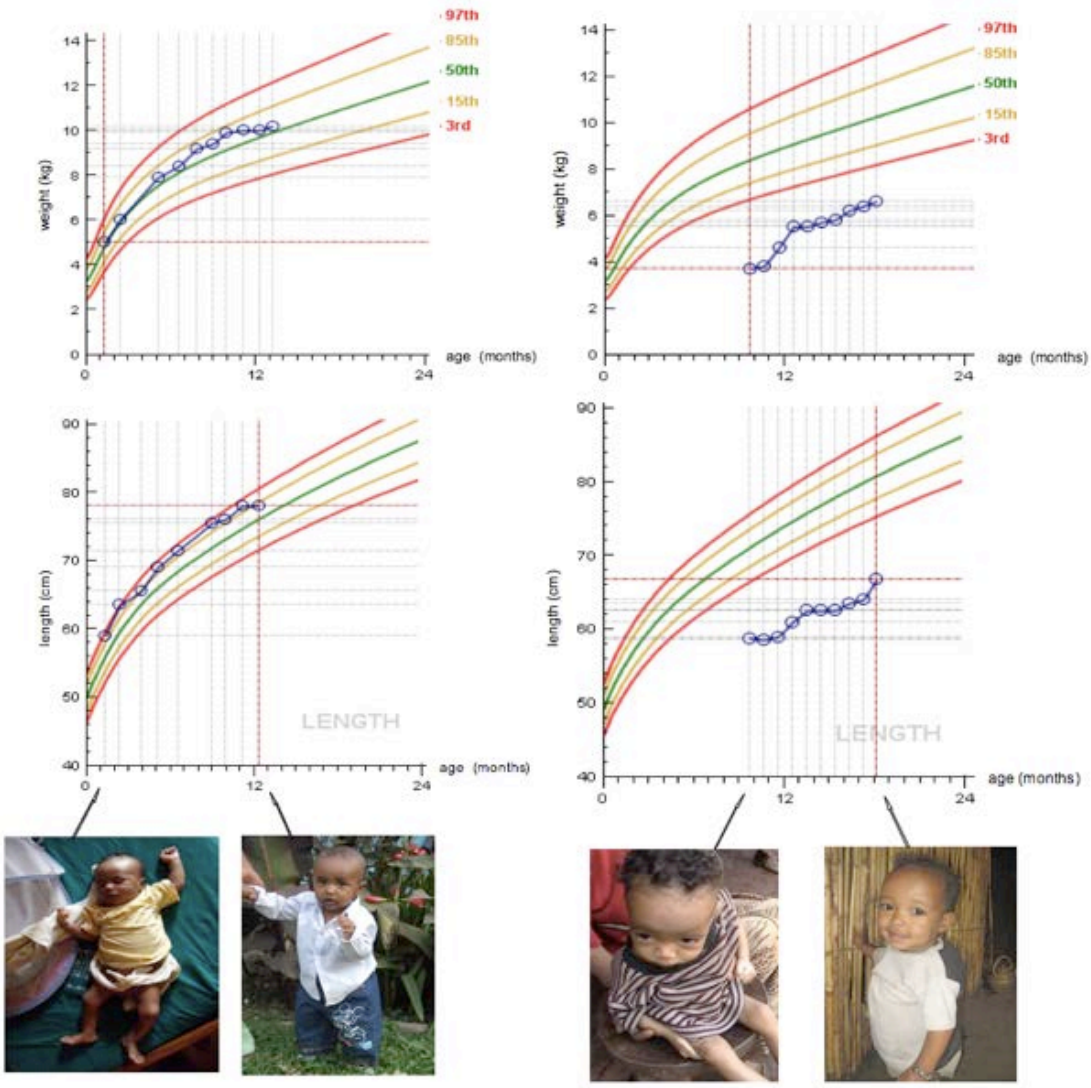
in the United States (the NHANES reference) almost half (47%) of children in Ethiopia under age 5 are stunted, and 38 per cent underweight – among the highest rates in the world on both counts (Macro International 2007: 45, 47).

Z-scores can also be used as continuous variables, with each child identified by position on a continuum of variation relative to the reference distribution (decimal z-scores) or in terms of percentiles (Johnston 1998). The theoretical value of using z-scores is that they provide rich information about potential threats to health, activity levels, and cognitive abilities. As the seminal work of Pelletier and others has shown, z-scores also provide information about mortality risk. In a meta-analysis, Pelletier (1994b) combined data from several longitudinal studies to show that as child weight for age (WAZ) declined, risk of death increased. Child growth status may therefore be considered as a proxy for risk of death, not only in extreme cases of growth impairment, but on a continuum ranging through mild and moderate malnutrition.

In the following analyses we use the WHO growth standards as our reference (de Onis et al. 2006), and compare the growth performance of children in Jimma and neighboring sites by children's age, household wealth, child sex, illnesses, and parents' schooling.

To give a sense of the variation in growth trajectories in the study area, Figure 6.1 shows the growth performance of two children, one from Jimma town (Abush, left panel) and one from rural Qarsa (Fatuma, right panel), plotted against the WHO standards, which are shown as smooth curves representing the $50^{th}$ percentile (the median) and the top and bottom $15^{th}$ and $3^{rd}$ percentiles for weight and length.

**Figure 6.1: Weight and length trajectories of Abush (0-12 months) and Fatuma (9-18 months), relative to international growth standards**




Abush's growth trajectory during his first year of life tells a happy story. He was a healthy weight at birth, more than 3 kg, and remained at or above international standards for both length and weight throughout his first year. The child of a single mother who had taken the job of a secretary after finishing high school, Abush was well cared for. Although his mother's work required her to be away from him during weekdays, she shared responsibility for him with her own mother, a brother and two

sisters, with whom she lived in a small, tin-roofed house near Jimma University. At his first birthday, when the second photograph above was taken, the house was decked out with balloons, a crowd of friends and neighbors gathered to celebrate, and the family served up *injera*, cake and *t'ella* (homemade beer).

Fatuma, who lived about 30 km away in Qarsa, was less fortunate. Severely stunted and underweight when we first met her at 9 months old, she experienced catch-up growth at around 12 months, but remained seriously undernourished at 18 months. She had been born to a family, who lived in a thatched hut in a village an hour's walk from Serbo, and her father spent much of the family's little money on *qat*. Although she had been cared for by her mother for the first months of her life, she was abandoned soon before our study began, when her mother had a dispute with her husband and left for her natal village. Since Fatuma's father was rarely present, her main caregiver was her paternal grandmother, a woman in her 70s who struggled to keep the house in order. On one occasion, walking through the village where her family lived, I saw Fatuma sitting on the path outside her house with a group of older children, aged between 2 and 7 years old. When I returned an hour or so later, the other children had left but Fatuma was still there, sitting alone in the dirt. This was the only time in more than 2 years in Jimma that I ever saw an infant left completely alone.

The contrasting growth trajectories and life circumstances of Abush and Fatuma suggest the range of variation among children in Jimma and environs. While Abush's mother had a high level of schooling relative to most women in the population, and Fatuma's mother had none, the contrasts between them in growth cannot be attributed

to maternal schooling alone, but were undoubtedly influenced by other factors including their places of birth, their parents' livelihoods, and their networks of social support. For Fatuma, while the lack of milk and appropriate foods was a proximate cause of her malnutrition, other, more fundamental causes included her family's poverty, her father's *qat* habit, and her lack of any dedicated or capable caregiver.

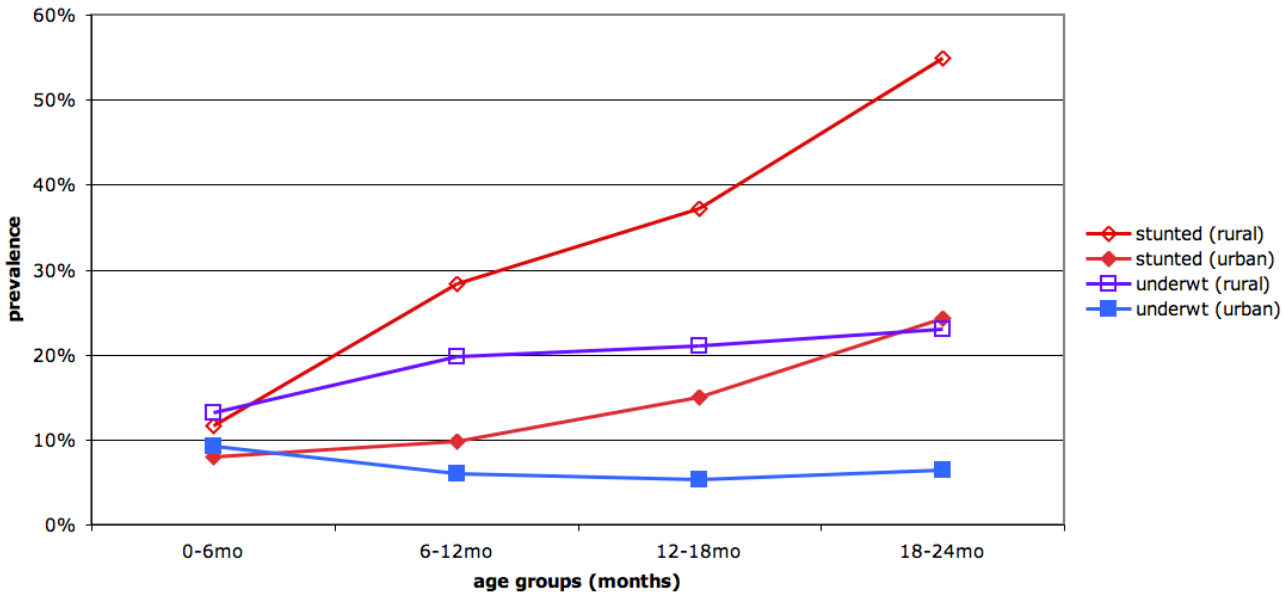
In this chapter we will assess how sub-groups within the study sample differ in growth status – the children of the rural, the wealthy, and the educated. It is worth emphasizing, however, that when the whole sample of children – and indeed the Ethiopian population in general – is compared with international standards, the entire distribution is shifted approximately 1 standard deviation below the reference median. Compared to international standards, the majority of the population is therefore poorly nourished.

***Age and sex as influences on child growth in urban and rural sites***

First we examine patterns of growth by age groups in urban and rural settings (Figure 6.2). As in previous graphs, filled squares and diamonds represent urban children and unfilled shapes represent rural children.

**Figure 6.2: Child stunting and underweight: prevalence by age groups in urban and rural**

(n= 144, observations = 1500 [stunting], 1559 [underweight])




Although at 0-6 months of age there was little difference between urban and rural communities in prevalence of child stunting or underweight, the disparities between children in urban and rural communities increased progressively as children grew older. Prevalence of wasting (not depicted in Fig. 6.3) declined steadily over the course of the first two years of life in both rural (from 14% to 4%), and urban (from 7% to 4.5%) sites, although there was a rise after 18 months in the urban site (to 8%).

Boys were more likely than girls ever to be stunted, wasted, or underweight, as Table 6.1 shows.

**Table 6.1: Children ever stunted, underweight, and wasted, by sex during 12 months follow-up** (n=143)

| | ever stunted | | ever underweight | | ever wasted | |
|---|---|---|---|---|---|---|
| female | 23 / 59 | 39.0% | 15 / 42 | 36.0% | 14 / 37 | 37.8% |
| male | 36 / 59 | 61.0% | 27 / 42 | 64.0% | 22 / 37 | 59.4% |
| both sexes | 59 / 143 | 41.3% | 42 / 143 | 29.4% | 37 / 143 | 25.8% |

The proportion of children ever wasted, 25.8 %, was much higher than the prevalence of wasting among the most-at-risk demographic group, comprising those aged 0-6 months in the rural sites, where it was 14.6 %. This indicates that many children fell into the wasted category transiently over the course of the 18 months of follow-up, and the same conclusion can be drawn for the other indicators by comparing proportions of ever stunted and underweight with the age and rural/urban profiles. This may reflect the fact that there are critical moments in children's development (not captured by 6-month windows alone) when children's wellbeing falters.

***Wealth and children's growth***

While rural children were more likely to be stunted, underweight, and wasted over the course of the study, in neither the urban nor the rural sites were stunting, underweight, or wasting (defined as <-2 z-scores) distinctly less common among those who were wealthier as assessed by the DHS asset index. Severe growth deficits (<-3 z-scores), however, were more common among the rural poor. All but one of the 5 children in

the rural communities who were ever *severely* underweight, 3 of the 5 who were ever severely wasted, and all 3 in whom these two conditions co-occurred were from poorer households (<60$^{th}$ percentile of the DHS asset index). In Jimma town, 3 children were severely wasted or underweight, but their households did not stand out in terms of wealth or poverty. In Jimma town, these cases of severe underweight or wasting were transient, occurring for less than a month, but in the rural sites there were 2 children who were persistently severely underweight for more than 6 months. These 2 rural children – Fatuma and one other – had no more illnesses than average over the course of the year (2 and 3 respectively), suggesting that inadequate diet, rather than repeated or chronic infection, was the primary cause. In both cases their mothers had no schooling, but in this they were no different from many children in their communities whose growth was better.

***Mothers' schooling as an influence on child growth***

The higher prevalence of underweight and stunting in the rural sites did not appear to be driven by differences in illnesses, which (as noted in Chapter 5) were more frequent in the urban setting. It is possible, however, that the higher levels of mothers' schooling in urban Jimma might explain the contrasting patterns of growth. Prevalence of children's stunting, underweight, and wasting was substantially lower for children of mothers with any schooling in the rural areas, but in Jimma town, the proportions of stunting showed little difference among the schooled and unschooled (approximately 33 % ever stunted in both groups). When data from all sites were combined, there were strong bivariate correlations ($p < .001$) between mothers' schooling and child growth indicators, in the hypothesized direction, with the strongest correlation being between schooling and WAZ. In general, the correlation

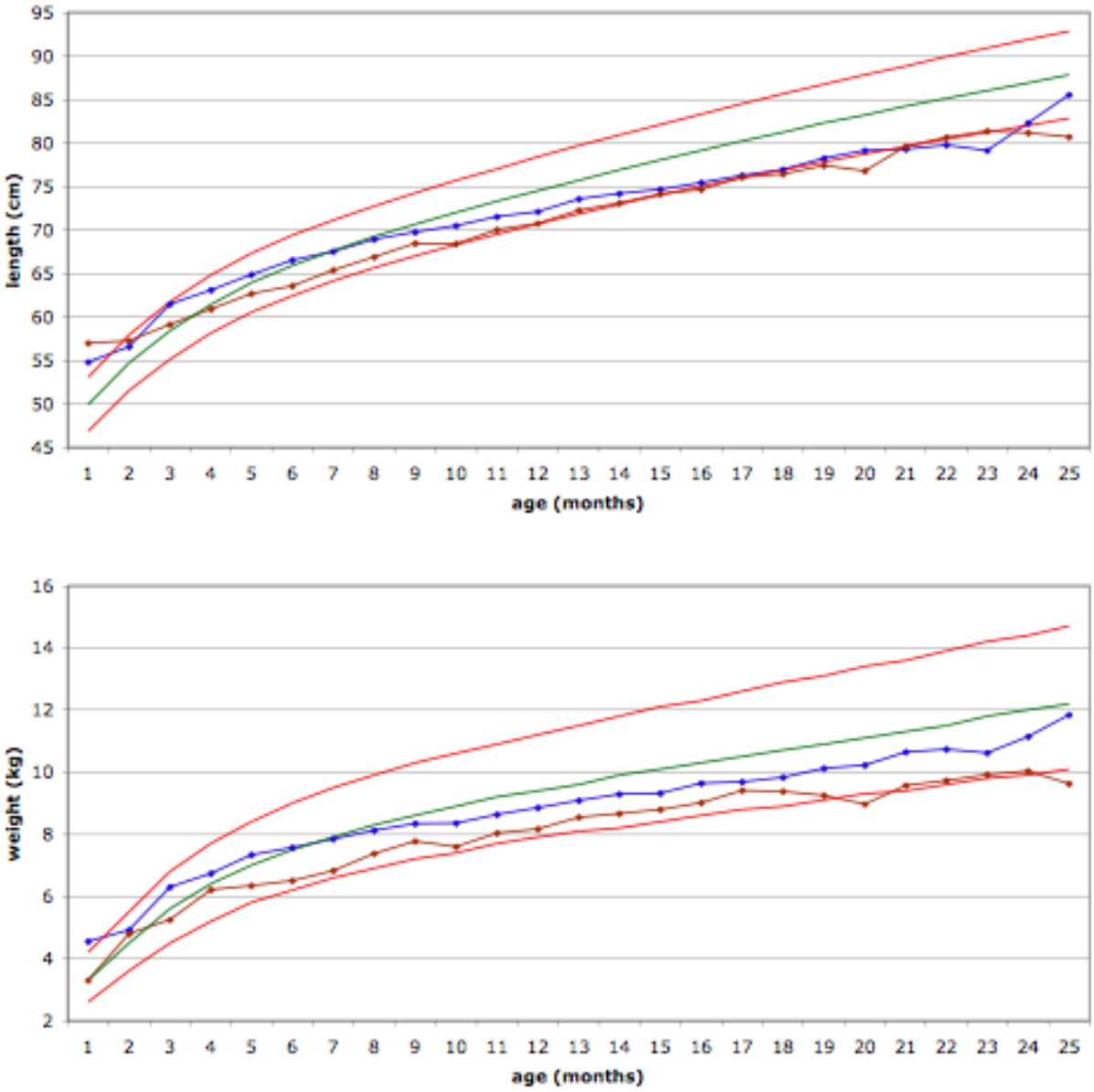
coefficients were stronger and more significant in the rural sites than in Jimma town (Table 6.2).

**Table 6.2: Correlations between mothers' schooling (in years) and child growth indices (HAZ, WAZ, and WHZ) in Jimma and neighboring sites**

| | Jimma | | Serbo | | Qarsa | | all sites | |
|---|---|---|---|---|---|---|---|---|
| **HAZ** | -0.021 | 0.32 | 0.148 | 0.02 | 0.180 | <.001 | 0.190 | <.001 |
| **WAZ** | 0.073 | 0.04 | 0.298 | <.001 | 0.215 | <.001 | 0.323 | <.001 |
| **WHZ** | 0.087 | 0.02 | 0.294 | <.001 | 0.143 | <.001 | 0.271 | <.001 |

To investigate how mothers' schooling might affect children's growth trajectories over time, I plotted growth trajectories of the combined sample (Jimma, Serbo and Qarsa together) stratified by mothers' schooling. In the following graphs, children's length and weight trajectories are plotted according to mothers' education, classified as any schooling versus none. Lines in blue (the upper line in both graphs) represent children of mothers with any schooling, and lines in brown those of mothers with no schooling. Smooth curves indicate the median and the $5^{th}$ and $95^{th}$ percentiles of the WHO reference. In these graphs the length and weight of all children of a given age-group (by month) are averaged to produce synthetic cohort means. These data are for rounds 1 through 12; the graphs therefore represent mean values generated by pooling 12 months of data on 141 children, from the rural and urban sites combined (89 whose mothers had schooling, and 52 whose mothers had no schooling).

**Figure 6.3: Children's length and weight by mothers' schooling (any versus none): synthetic cohort trajectories, 0-24 months** (n = 141)




Although on average, children began life at or above the reference medians, children of mothers with any schooling soon grew larger for age than those of mothers with no schooling, with means of weight and length between the two groups diverging by 3 months of age. The advantage appeared to persist throughout the first 24 months of

life in the case of weight and for the first 14 months in the case of length, after which there was a convergence between the two groups.

The timing of growth faltering becomes clearer when length and weight are converted to age-specific z-scores, as in the following graphs. Here, the central line in the previous graphs (the curve which represented the $50^{th}$ percentile of the WHO reference in growth for age) is converted into a horizontal line, centered on zero standard devations (HAZ or WAZ = 0) while the upper and lower horizontal bars at approximately +/- 1.5 on the y-axis represent the $5^{th}$ and $95^{th}$ percentiles of the WHO reference.

**Figure 6.4: Children's length-for-age and weight-for-age z-scores: synthetic cohort trajectories, 0-24 months** (n = 141)

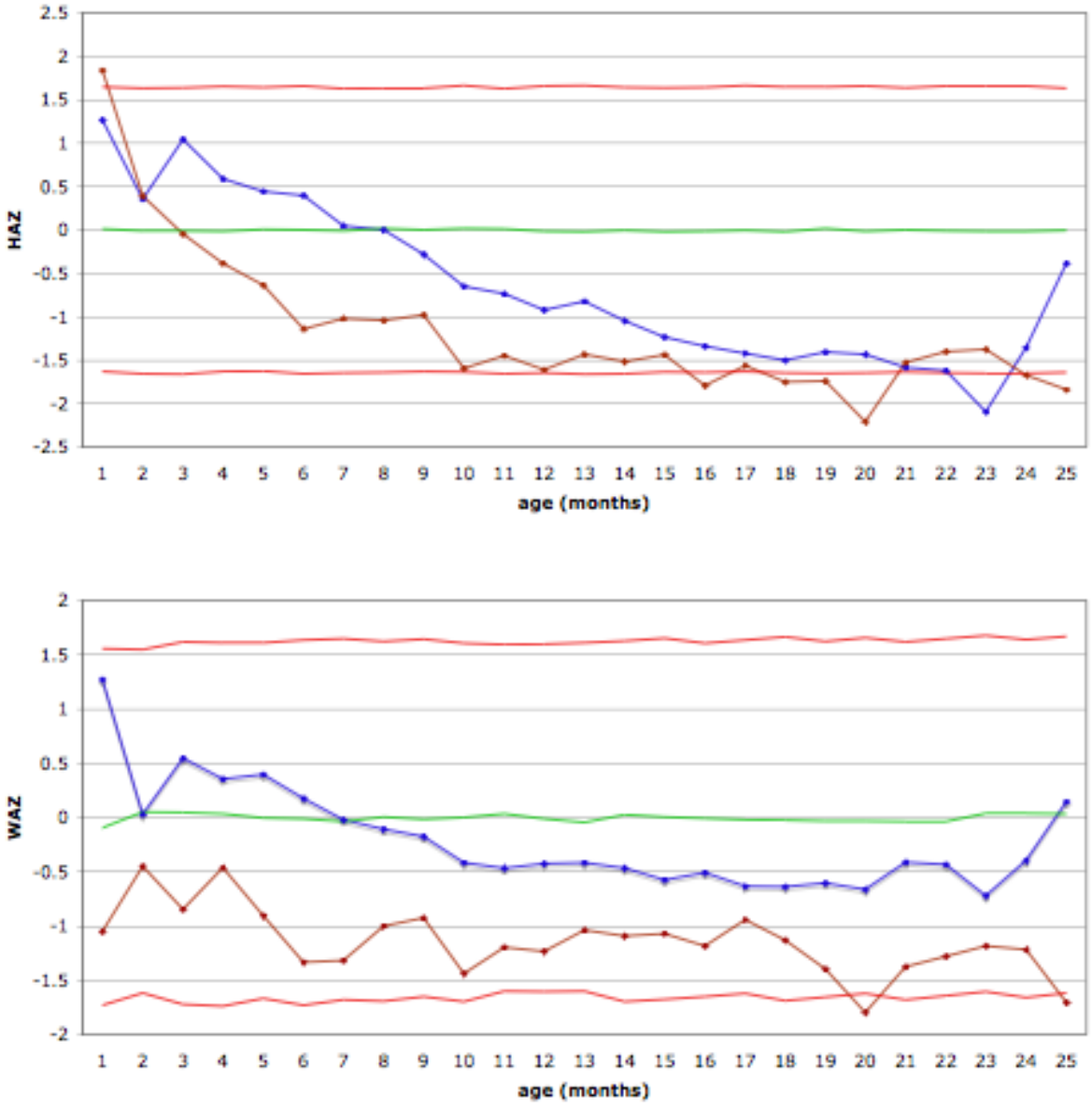
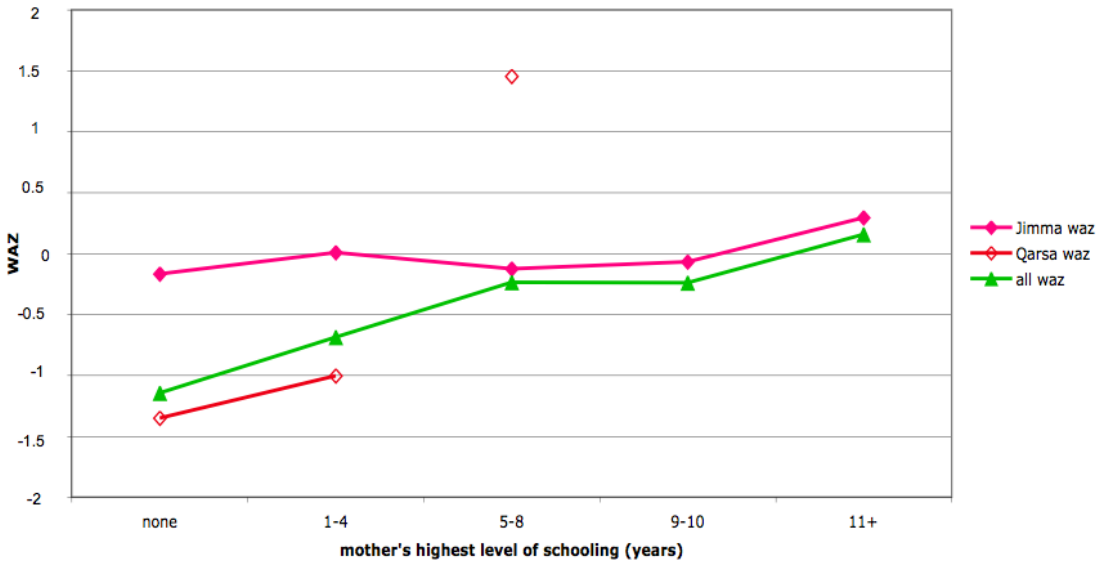



Figure 6.4 shows more clearly that the difference in HAZ (height or length for age z-scores) between children of mothers with any or no schooling is substantial during the first year but slight or nonexistent thereafter. (Among children born to mothers with schooling, the upswings after 24 months in the lines for HAZ and WAZ are artifacts, due to the small, unrepresentative sample size at these ages.) The overall downward trends in both lines remind us that HAZ is low among both groups. In this

challenging environment, effects of mother's schooling on HAZ may be either absent or not discernable. In WAZ (weight for age z-scores), by contrast, an advantage of half a standard deviation on average among children of women with any schooling appeared to persist through 24 months of age.

Although they are informative, the patterns in the combined sample, with schooling dichotomized into any versus none, obscure variation across urban and rural sites. We get a more accurate picture of the relationship between schooling and child growth in the study communities by looking at mean anthropometric z-scores by mother's level of schooling, and breaking down the sample by place of residence. In Figure 6.5, the mean weight for age z-scores for the children in Jimma and Qarsa (excluding Serbo) are plotted separately by mothers' highest level of schooling; the means of WAZ by mothers' level of schooling across all sites is also shown. As in the previous graphs, the distribution is here centered on zero (the reference median) but the x-axis now represents mothers' level of schooling, as opposed to children's age. Unfilled diamonds represent rural Qarsa, filled diamonds Jimma town, and triangles the combined sample.

**Figure 6.5: Children's mean WAZ by mother's level of schooling in Jimma, Qarsa, and all sites**




In Figure 6.5 the unfilled diamond in the central upper segment of the graph represents an outlier: the son of the one woman in the rural Qarsa sample who had more than 4 years of schooling. The remainder of the families in these rural *qebeles* were evenly divided (17: 16) between those in which mothers had no schooling and those in which mothers had between 1 and 4 years of schooling (the short, slanted line in the lower left quadrant). In other words, comparison by levels of mothers' schooling in Qarsa provides the same information as the contrast between mothers with any schooling versus no schooling; only in Jimma and Serbo were there women with higher levels of schooling. While in rural Qarsa children of mothers with 1-4 years of schooling had higher WAZ on average than their neighbors whose mothers had no schooling, *both groups* had much lower mean WAZ than did the children of women *without schooling* who lived in the city. Since women with little or no schooling were rare in the city, but common in the countryside, the numerical weight of the rural families in the "none" and "1-4" categories of schooling serves to pull

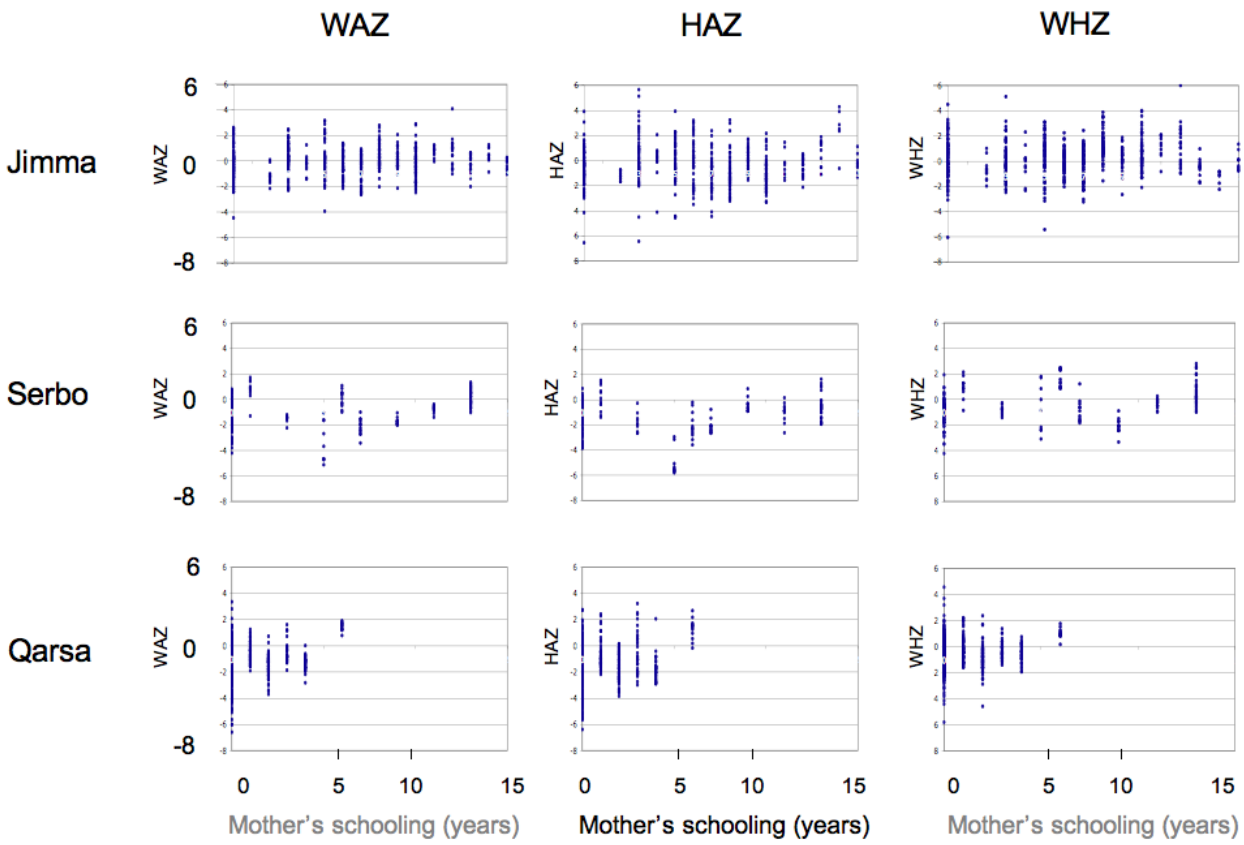
down the mean WAZ for children of women in these categories across the whole sample, creating the appearance of a dose-response relationship in the pooled data from all sites ("all waz": the line marked by triangles in Fig 6.5).

Because of small sample size, comparisons by mothers' level of schooling are less informative for families in Serbo. When HAZ and WHZ were examined by mothers' level of schooling in Jimma and Qarsa (not depicted here), however, they exhibited similar patterns of poorer growth status among rural children than urban children, regardless of mothers' level of schooling. Graphing these data provides a sense of the variation in children's nutritional/growth status across sites and levels of mothers' schooling. However, multivariate analyses are needed to discern whether the relationships between mothers' schooling and child growth within these communities can be attributed to schooling itself, or whether other factors are responsible for these relationships.

**Multivariate analyses of child growth**

As a first step towards multivariate analysis of the relationship between rural versus urban locations, mothers' schooling, and children's growth status, I plotted the growth z-scores (WAZ, HAZ, and WHZ) for each child over the 13 rounds of measurements by mothers' years of schooling, for each of the three study communities. These revealed variable relationships between mothers' schooling and child growth across the three sites (Figure 6.6).

**Figure 6.6: Child growth indices by mothers' years of schooling in Jimma, Serbo, and Qarsa**




Associations between mothers's years of schooling and children's growth status appeared clearest in Qarsa, least clear in Jimma, and intermediate in Serbo. To assess the relative influence of mothers' schooling versus biological and socio-economic factors on children's growth in these three communities, I fitted multivariate models for each of these three growth indicators plus change in weight over time, for each of the three sites. In these analyses I used mixed regression models to incorporate repeated observations across the 13 time points of the survey. Mixed models allow the assessment of individual-level patterns in longitudinal data, which in conventional regression would be treated as error variance (Cairns & Cairns 2002; Fitzmaurice et al. 2004). The following models were fit using *proc mixed* in the SAS software

package v.9.2. The analytical approach was to build up from biodemographic variables that are proximally related to growth status such as age, sex, and maternal weight or height, to more distal socio-economic influences on child nutrition, including place of residence, household wealth, and schooling. I first present the results of the models in which HAZ, WAZ, and WHZ were dependent variables, and then present the results of those in which change in weight was the dependent variable.

**(1)** ***Regressions of HAZ, WAZ, and WHZ***

In the case of growth z-scores, I defined substantive significance for dichotomous predictors such as child sex or place of residence as a beta coefficient of >1.0, i.e. an increase of one standard deviation (roughly equivalent to the difference between the median of the study population and the WHO growth reference median). For continuous predictors such as mother's years of schooling and mother's age that vary across a range of 1-10+, I defined substantive significance as a coefficient of >0.10.

To find a best fit for age trends across the growth indicators, I used the Akaiki Information Criterion (AIC), a statistic that reflects the balance between covariance and parsimony in terms of the number of predictors included in the model (Fitzmaurice et al. 2004: 176). I experimented with adding age-squared and age-cubed to the models, and noted changes in AIC. In the case of WHZ, adding age-squared gave lower AIC statistics than other combinations of age terms; in the case of HAZ and WAZ, adding age-cubed gave the lower AIC, indicating a better fit to the data.

In the combined sample, mothers' weight (kg) was consistently positively related to children's growth (beta ~ 0.30, p <.05) and mothers' age was consistently inversely related to children's growth (beta ~ -.04, p <.05) on all 3 indicators (HAZ, WAZ, and WHZ), suggesting that younger mothers, and those who themselves weighed more, had better nourished children. Mothers' height was not significantly related to any indicator. As expected, girls were consistently larger for their age and heavier for their length than boys (male sex: >-0.27 beta < -0.40, >.25 p <.06), and urban residence (beta ~0.70, p <.05) and household wealth (beta ~0.30, p. <.05) also consistently predicted better growth for all 3 indicators. While household wealth and urban residence are closely related in this sample, the relationship between urban residence and the child growth indicators was generally stronger than that of household wealth.

Mothers' schooling (in years) was positively related to child growth status on all 3 indicators, with generally stronger coefficients for each successive level of schooling (when entered as an ordinal variable), but the strength and significance of the relationships declined when other factors were controlled. Of the three growth indicators, mothers' schooling showed the most substantial relationship with WAZ, with the strength of the relationship rising roughly with level of schooling (Table 6.3).

**Table 6.3: Regression of child WAZ, combined sample**

Dependent variable: child weight for age z-scores (WAZ) relative to WHO standards

subjects=106, observations=1160

AIC = 2621.2

| | Beta | SE | df | p |
|---|---|---|---|---|
| Intercept | -1.449 | 0.887 | 98 | 0.106 |
| child age (months) | -0.131 | 0.061 | 1051 | 0.033 |
| child age squared | 0.007 | 0.004 | 1051 | 0.074 |
| child age cubed | 0.000 | 0.000 | 1051 | 0.091 |
| child sex (male = 1) | -0.362 | 0.213 | 98 | 0.092 |
| mothers' weight (kg) | 0.027 | 0.015 | 98 | 0.076 |
| household wealth | 0.219 | 0.180 | 98 | 0.227 |
| mothers' schooling (1-4) | 0.487 | 0.226 | 98 | 0.033 |
| mothers' schooling (5-8) | 0.745 | 0.349 | 98 | 0.035 |
| mothers' schooling (9-10) | 0.667 | 0.390 | 98 | 0.090 |
| mothers' schooling (11+) | 0.790 | 0.408 | 98 | 0.056 |

In this model, mothers' schooling showed generally increasing effects on children's WAZ with rising level of school attainment, and these effects were robust to biodemographic controls (children's sex and age, age squared, and age cubed) and borderline statistically significant, but not substantively significant (beta > 1.0). When mothers' schooling was coded as a continuous variable (in years), however, it was only weakly related to WAZ when household wealth (beta 0.07, $p < .05$) or place of residence (urban: beta 0.05, $p = .05$) was controlled. When fathers' schooling was controlled, moreover, mothers' schooling became insignificant as a predictor of child WAZ. As for HAZ and WHZ, control for wealth, site and fathers' schooling rendered relationships with mothers' schooling insigificant in the combined sample. Fathers' schooling tended to be more weakly related to child growth indicators than mothers' schooling in the primary grades, but to have an equivalent relationship when fathers

had reached grades >8. As with mothers' schooling, the effects of fathers' schooling were attenuated by control for urban residence.

Since place of residence was the most significant predictor of child growth and appeared to overwhelm the effect of mothers' schooling in the combined sample, in subsequent analyses I examined patterns separately in each study site for each of the 3 growth indicators. Across the 3 sites, some patterns recurred for all 3 indicators. The effect of one year of mother's schooling on child growth, controlling for biodemographic factors, increased in its influence as one went from Jimma to Serbo to rural Qarsa, i.e. from the environments with the most to the least availability of schooling. The effects of one year of father's schooling, on the other hand, showed an opposite trend, decreasing in influence as one went from Jimma to Serbo to Qarsa (Table 6.4).

**Table 6.4: Regression coefficients for one year of mother's and father's schooling in relation to child WAZ, HAZ, and WHZ, controlling for biodemographic covariates, across three study sites**

**Mothers' schooling:**

| | | Jimma | Serbo | Qarsa | all sites |
|---|---|---|---|---|---|
| **WAZ** | beta | 0.03 | 0.08 | 0.16 | 0.09 |
| | p | 0.028 | 0.077 | 0.113 | <0.001 |
| **HAZ** | beta | -0.01 | 0.05 | 0.15 | 0.06 |
| | p | 0.897 | 0.223 | 0.225 | 0.008 |
| **WHZ** | beta | 0.04 | 0.08 | 0.09 | 0.08 |
| | p | 0.231 | 0.128 | 0.206 | 0.001 |

**Fathers' schooling:**

| | | Jimma | Serbo | Qarsa | all sites |
|---|---|---|---|---|---|
| **WAZ** | beta | 0.06 | -0.01 | -0.03 | 0.08 |
| | p | 0.089 | 0.907 | 0.755 | 0.002 |
| **HAZ** | beta | 0.05 | 0.01 | -0.03 | 0.08 |
| | p | 0.141 | 0.838 | 0.759 | 0.002 |
| **WHZ** | beta | 0.05 | -0.01 | -0.02 | 0.05 |
| | p | 0.206 | 0.815 | 0.767 | 0.034 |

Note: Covariates = child age, age^2, child sex, mother's weight, mother's height.
WAZ and WHZ models also include age^3.

Mothers' schooling was substantively associated with child growth z-scores only in Serbo, and there only at secondary level (WAZ: beta 1.07, p <.05). When household wealth was controlled, however, the effect of mothers' secondary schooling on WAZ

in Serbo was reduced almost by half (beta 0.62, p <.15). In Qarsa the substantively significant effect of single years of mothers' schooling on WAZ was robust to control for household wealth, but did not meet conventional standards of statistical significance (beta 0.15, p = .12) (Table 6.5).

**Table 6.5: Regression of child WAZ, Qarsa sample**

Dependent variable: child weight for age z-scores (WAZ) relative to WHO standards

subjects=50, observations=570

AIC = 1260.4

| | Beta | SE | df | p |
|---|---|---|---|---|
| Intercept | -3.002 | 1.622 | 44 | 0.071 |
| child age (months) | -0.239 | 0.080 | 517 | 0.003 |
| child age squared | 0.016 | 0.006 | 517 | 0.006 |
| child age cubed | 0.000 | 0.000 | 517 | 0.009 |
| child sex (male = 1) | 0.036 | 0.308 | 44 | 0.909 |
| mothers' weight (kg) | 0.049 | 0.030 | 44 | 0.118 |
| household wealth | -0.377 | 0.476 | 44 | 0.433 |
| mothers' schooling (years) | 0.150 | 0.095 | 44 | 0.123 |
| fathers' schooling (years) | 0.014 | 0.086 | 44 | 0.874 |

WHZ showed somewhat different patterns across the 3 sites, with mothers' secondary schooling coming close to substantive significance as a predictor of increased WHZ in both Jimma and Serbo (beta ~0.90, p <.15). In Serbo, however, household wealth had a very large effect on WHZ (beta 2.3, p <.001) and much reduced the effect of mother's secondary schooling (to beta 0.2, p = .60), while in Jimma, irregularity of estimates in the reduced sample (the 61 % of the sample on which wealth data were available) precluded accurate assessment of the influence of wealth.

For none of the growth z-scores, and in none of the individual sites did fathers' schooling meet standards of substantive or statistical significance, and effects of maternal grandparents' schooling on these growth indicators were slighter than those of fathers' schooling.

**(2) *Children's gain in weight over time***

Change in weight from one month to the next provides a measure of growth tempo, and can reflect bursts of growth over time. Unlike z-scores, change in weight is not derived from comparison with a reference population but instead directly represents individual trajectories of gain or loss of weight in kilograms between time *t* and *t* +1. It can therefore potentially provide information about children's catch-up growth after periods of illness, which could be due either to appropriate feeding or to effective medical treatment. We should therefore expect to see patterns of greater weight gain among children of mothers and fathers with schooling.

Among children in this study, change in weight ranged from -2.7 to +2.6 kg during the period of monthly observations (rounds 1 to 12) and from -2.1 to +7.8 kg during the six months between round 12 and round 13. In the analyses that follow I combined data from all 13 rounds. The coefficients therefore cannot be interpreted strictly as change in kilograms per month, but they nonetheless represent change in children's weight over time, in kilograms. Since in most cases changes in weight between rounds was slight, substantive significance in the case of this outcome was set at >0.030 kg for dichotomous and >0.010 kg for continuous predictors.

On the basis of comparison of models with various combinations of age terms, I used age in months and age-squared to represent children's age in these models, a combination which provided the lowest AIC. I used the same biodemographic covariates as in the models of growth z-scores. In order to account for potential weight loss or cessation of weight gain caused by illness, I included a term representing any illness recorded at the previous round ("lagged illness").

In analyses of change of weight, wealth and urban residence had smaller effects than when the dependent variables were growth z-scores, as did biodemographic covariates. Any illness at the previous round was associated with a substantial but statistically insignificant deficit of -0.05 kg ($p = .22$). Children in Serbo appeared to gain less weight than those in Jimma over the course of the study, while children in Qarsa were not significantly different from those in Jimma in this respect. Compared to place of residence, the influence of household wealth on children's change in weight was small. Mothers' age, weight, and height showed weak and insignificant relationships to children's change in weight.

In the combined sample, father's schooling (in years) was associated with greater weight gain among children than was mother's schooling (in years). Entering mothers' and fathers' schooling in the same model, the effect of fathers' schooling on change in child weight remained strong while the effect of mothers' schooling was attenuated (Table 6.6).

**Table 6.6: Regression of children's change in weight, combined sample**

Dependent variable: children's change in weight (kg) between observations, over max 13 rounds

subjects = 116, observations=1166

AIC = 2781.5

| | Beta | SE | df | p |
|---|---|---|---|---|
| Intercept | 1.022 | 0.101 | 109 | <.0001 |
| child age (months) | -0.137 | 0.017 | 1049 | <.0001 |
| child age squared | 0.005 | 0.001 | 1049 | <.0001 |
| child sex (male = 1) | 0.014 | 0.030 | 109 | 0.649 |
| Serbo vs. Jimma | -0.078 | 0.031 | 109 | 0.015 |
| Qarsa vs. Jimma | 0.035 | 0.038 | 109 | 0.365 |
| mother's schooling (years) | -0.002 | 0.006 | 109 | 0.763 |
| father's schooling (years) | 0.012 | 0.005 | 109 | 0.014 |

These results did not support the hypothesis that mothers' schooling should lead to greater child weight gain, but suggested that fathers' schooling was associated with greater child weight gain. When analyses were run separately on the urban and rural samples, the influence of fathers' schooling on children's weight gain remained significant in Jimma town, but not in the rural communities. Within Jimma town, the greatest effects of fathers' schooling were among those with secondary schooling, which was associated with a mean gain in weight of 0.2 kg between observations ($p < .05$). Household wealth was only weakly and insignificantly related to child weight gain, and when fathers' schooling was controlled for, the relationship was attenuated.

**Summary**

In Jimma and neighboring sites, children began life on average at or above the median in weight and length in relation to international standards, but growth faltering thereafter was common. Growth deficits were larger in rural sites outside Jimma than

in Jimma town, and across all communities girls were larger on average for their age than were boys.

Children whose mothers had any schooling experienced growth faltering later than those whose mothers had none, with average trajectories of weight and length between these two groups diverging by 3 months of age, which may represent more prolonged or severe bouts of illness or earlier introduction of liquids other than breastmilk among children of mothers without schooling. Relationships between mothers' schooling and children's growth status varied considerably across urban and rural settings, however. In rural Qarsa, for instance, children of mothers with 0-4 years of schooling were shorter and lighter for their age on average than those of mothers with no schooling in Jimma town.

Multivariate analyses showed that, despite the apparent advantage in child growth associated with mothers' education in the city, when household wealth and biodemographic covariates were controlled, the effects of mothers' schooling (in years) on children's growth z-scores were proportionally smaller in the city than in the rural sites, with coefficients increasing in strength as one went from the urban to the rural settings. The borderline substantively significant associations between mothers' schooling and child growth (secondary schooling versus no schooling in Jimma and Serbo, associated with ~0.9 standard deviation increase in child WAZ) was rendered insignificant in Serbo by controlling for wealth, and was not amenable to control for wealth in Jimma due to the limited number of households for which wealth data were available. In rural Qarsa, however, mothers' schooling (in years) was associated with child WAZ independent of household wealth, meeting the

criterion of substantive significance, although not conventional statistical significance. Fathers' schooling was not substantively or significantly related to any of the 3 child growth z-scores in any of the study sites, but when children's change in weight in kilograms was used as an outcome variable, fathers' schooling emerged as more influential than mothers' schooling in predicting children's growth.

**Discussion**

The trends in child growth by age and urban versus rural sites demonstrated here are consistent with other studies, with children in general being more vulnerable to stunting and wasting after 6 months, when breastmilk ceases to meet nutritional needs, and urban children being larger and heavier for their age than rural children, which likely reflects a narrower range of complementary foods available among rural families relying largely on subsistence farming. When complementary foods are inadequate to meet nutritional requirements, growth is likely to falter and vulnerability to infection to rise (Gibson et al. 1998; de Onis 2001). Zewditu et al. (2001) have documented deficiencies in the nutrient content of complementary foods in Ethiopia, which are mostly cereal-based and low in micronutrients and minerals. Chronic inadequacy of children's diets contributes to the pattern of deteriorating growth status for age over the course of the first 5 years of life, which is common in developing countries (Sommerfelt 1991).

The fact that mothers' schooling was associated in this study with divergence in child growth trajectories as early as 3 months, together with the absence of strong evidence for illness frequency as a determinant of growth deficits, suggests that early feeding practices may lie behind the different patterns of growth between these groups.

Although breastfeeding was almost universal in the study sample, early introduction of liquids other than breast milk is also common in the Jimma area (Makonnen et al. 1998), and infants who receive liquids other than breast milk may be at risk for growth faltering (WHO 2003). This practice might be related to higher workloads of rural women, who are often obliged to return to farm work before children are weaned. Further investigation is needed to determine the proximate causes of these differences.

While data from urban and rural sites combined appeared to show a strong dose-response relationship between mothers' level of schooling and child growth status, controlling for urban versus rural residence and household wealth rendered the relationship insignificant in the combined sample. Despite this, small differences in children's growth by mothers' level of schooling remained in rural Qarsa. Although this relationship was not statistically significant by conventional standards, it is noteworthy because (a) these rural communities are the ones with the highest levels of child undernutrition; (b) the duration of schooling (<6 years) in these rural communities is low; (c) fathers' schooling, which is more common and of longer duration on average, had negligible effects on children's growth z-scores in these communities; and (d) schooling has only become available to women in these communities within the last generation, and therefore these effects may be considered independent of selection processes operating through grandmother's schooling (although we cannot rule out selection operating through other channels, e.g. the wealth and health of women's natal homes).

The association between fathers' schooling and change in children's weight, which was strongest in Jimma town, suggests that educated fathers in the city may be more involved in their children's nutrition and health than are those in the rural area. Since change in weight represents bursts of weight gain such as may occur in catch-up growth after illness, one possible explanation for this association is that fathers with more schooling are helping their children to overcome illness through more appropriate medical treatment or improved feeding during illness episodes. As the majority of this effect was due to fathers' secondary schooling (absent in rural Qarsa), the question of whether the same levels of fathers' schooling in rural areas would lead to equivalent benefits for children's nutrition/growth status remains open. Studies of the effects of fathers' schooling on child health in general are much less common than those of mothers' schooling; this finding suggests they should be a focus of further research.

The patterns of child growth that appeared to be independently associated with parents' schooling are largely specific to particular sites, namely the associations between mothers' schooling and WAZ in Qarsa, and fathers' schooling and change in weight in Jimma. Part III of this dissertation will attempt to explain these site-specific associations in terms of mothers' treatment of children's illnesses, parents' language and literacy abilities, and expectations of children's development.

Chapter 7

# Psychomotor development

Researchers increasingly advocate including psychomotor measures alongside measures of physical growth to provide a more nuanced picture of children's health and functional development (e.g. Richter 2004; Hadley et al. 2008; Hobcraft & Kiernan 2010; Worthman 2010). Children who are undernourished have been shown to be delayed in psychomotor development: growth status, micronutrient intake, and diet quality are all predictive of earlier independent walking, for example (Cheung et al. 2001; Kuklina et al. 2004, 2006; Kariger et al. 2005; Siegel et al. 2005). Given the associations between mothers' schooling and reduced likelihood of diarrhea (Chapter 5) and improved child growth (Chapter 6), we might expect motor milestones to be attained earlier among children of mothers with more schooling – at least for children who do not suffer from congenital conditions that delay psychomotor development.

We might also expect to see precocity in language among children of educated mothers due to factors independent of nutritional status. The pedagogic childcare hypothesis, for example, predicts more verbal stimulation of infants by mothers with schooling. Consistent with this hypothesis, LeVine et al. (1996) showed that in Mexico, schooling affected mothers' estimates of the age at which children could hear speech, and this in turn affected verbal behavior towards infants, with significant effects on children's vocabulary at 31 months. The more intensive parenting predicted by the wealth flows and competition hypotheses might also lead to motor precocity, since motor development is sensitive to physical practice and behavioral scaffolding (Thelen & Smith 1994; Adolph et al. 2010).

In this chapter we will focus on two aspects of children's psychomotor development, namely gross motor and language (walking and talking). We will examine the relationship between these outcomes – the timing of first walking alone, and development of language abilities – and child age, urban and rural residence, household wealth, physical growth, illness, and parents' schooling.

**Background and methods**

The 18 months of follow-up (birth-33 months) in the longitudinal study included the most dramatic period of motor development and language acquisition in the lives of the children in this study. When data collection began, the youngest children in the study were unable to sit unassisted and were preverbal; when data collection ended, the eldest were able not only to walk but to run, and had greater vocabularies than we were able to record.

We assessed children's psychomotor development using a modified version of the Denver Developmental Test II (after Hadley et al. 2008) plus gross motor milestone assessment (after Wijnhoven et al. 2004; WHO MCGRS 2006), with observations monthly from rounds 1 to round 12 (R1-R12) plus a follow-up round 6 months later (round 13). The Denver II assesses 4 psychomotor domains: language, social-personal, fine motor, and gross motor (the last of which overlaps with but is not identical to the domain as assessed by the WHO MCGRS protocol). Of these domains, data on age at walking alone are currently available for all 13 rounds, while data on language are available for R1 and R13 only (*t* and *t* +18 months).

The ontogeny of child walking is conventionally assessed in terms of two milestones, walking with support and walking alone. Walking alone is defined here as taking at least 5 steps consecutively without holding onto any person or object. It was tested by placing the child in a standing position away from objects that could be used for support, and encouraging the child to walk towards the tester or the child's mother (after Wijnhoven et al. 2004).

Language abilities were tested by asking the caregivers whether their children imitated sounds or spoke any words; by tests of receptive vocabulary, showing children pictures of animals, to which they were encouraged to point when the animals' names were called; by asking children to point to body parts when their names were called; and, when children were more fully verbal, by simply recording words or phrases produced by the child during the household visit.

For both the motor and language development tests, the scoring procedure was to award a point for each item passed (e.g. walks with support, walks alone; speaks a word, points to a picture of an animal when its name is called). The maximum possible score for gross motor development was 12. For language, by contrast, there was no predetermined upper limit, with the highest scores representing the largest vocabularies. Language scores of up to 30 were recorded, reflecting the sum of abilities from simple vocalization to speaking full sentences.

The following description of a psychomotor test on a child in Serbo suggests how these test items were administered, and also indicates how family members would sometimes spontaneously participate in the testing procedure.

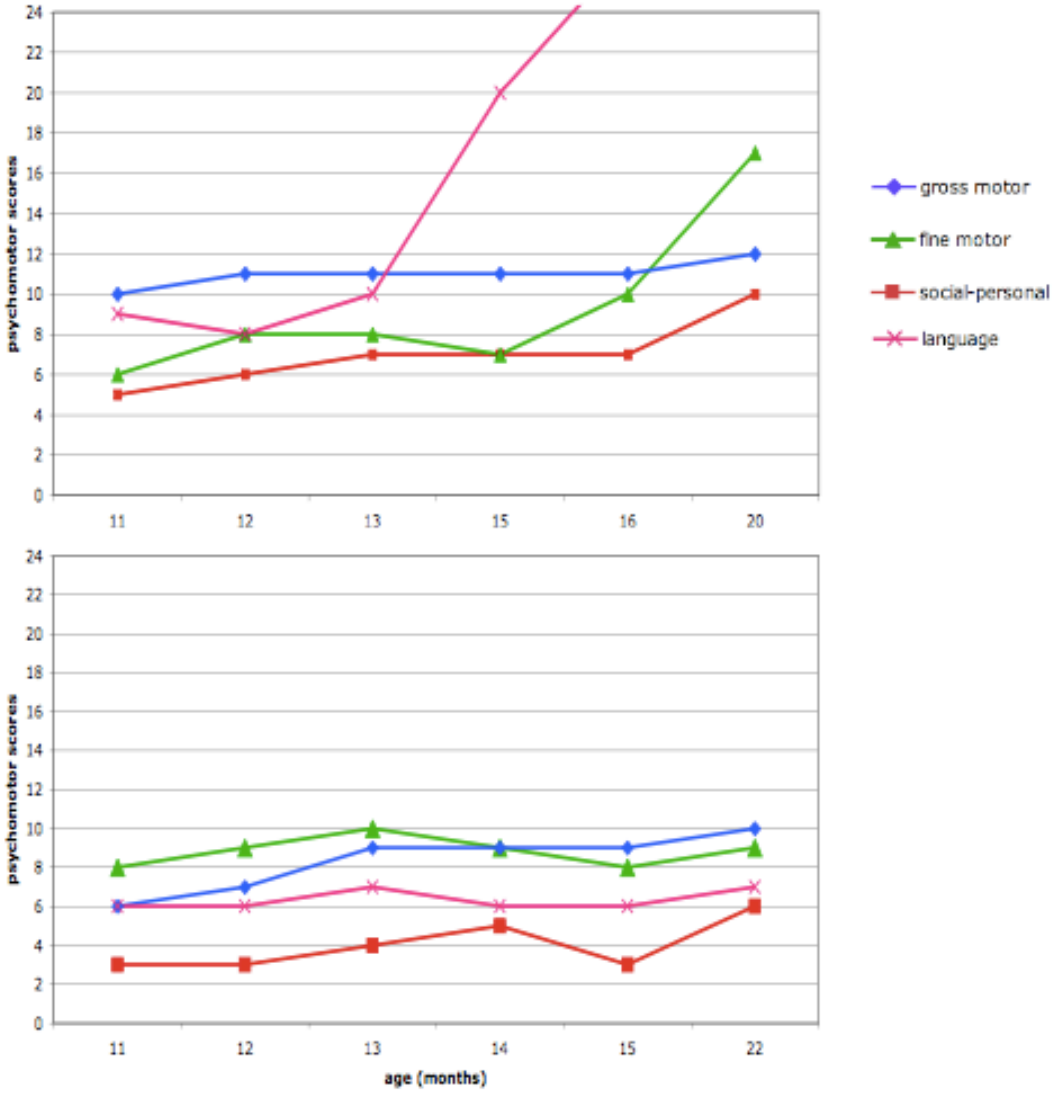
> Baby Sitina is sitting in a band of sunlight falling through the doorway of the house, and vocalizing to herself. Inside, Biqiltu, a teenage girl who lives next door, greets us, and we take seats on a bench. Aziza [a data collector] does the psychomotor test with Sitina where she sits. Aziza is patient and gentle in doing the tests, e.g. during block play [part of the fine motor test] making little noises of encouragement, to which Sitina sometimes responds with vocalization. To test her walking ability, Aziza places her beside the bench, and she takes inching little steps along it to reach a rattle. She gets the rattle and then drops it on the floor accidentally, and expends great effort getting herself down from standing to sitting on the floor to get it again. Biqiltu coaxes Sitina over to her, and then picks up a piece of sponge that is lying on the floor and offers it to Sitina. Sitina reaches up for it and grabs onto it, but Biqiltu doesn't let go, so they have a sort of tug-of-war, in the course of which Sitina rises to her feet, and tugs on the sponge above her head, which provides her with enough balance to stay upright.
>
> Sitina stands between Biqiltu's legs, holding onto one of them, and the two of them "talk" to each other.
>
> "Ag-ka, oo-aa – ka-da! Gaga – kaga – gaga," says Sitina.
>
> "*Izzi-ga, izza-ga*," ["Over here, over there"] Biqiltu replies, interpreting Sitina's vocalizations, saying the words and smiling at us.

Interactions like these between Sitina and Biqiltu, which occur between children and their parents, siblings, or, as in this case, neighbors, are positive influences on children's psychomotor development, providing scaffolding for emerging abilities.

The following case studies of one child who suffered from an undiagnosed developmental delay and another who was precocious in language give a sense of the

range of variation in psychomotor development among children in Jimma, and how caregivers perceived their children's development. For these two cases, a full series of observations of each of the four psychomotor domains were entered, and the scores for each of these domains are plotted for the period 11-22 months (Figure 7.1). The upper graph represents Binyam, who was precocious, and the lower one Timotios, who was developmentally delayed.

**Figure 7.1: Psychomotor development trajectories of two children, Binyam and Timotios**



*Case 1: Binyam*

At 11 months, when we first met him, Binyam was walking with help, and would fetch papers or his mother's purse when asked to. At that age he spoke a few words already, including *nyanya* (babytalk for food) and *dadé* (a walking game he played with his parents). By the time of our next visit at 12 months he was able to walk alone, and while his speaking abilities developed gradually over the next 4 weeks, by 14 months of age he had undergone a huge spurt of language learning, his vocabulary increasing from 10 to more than 20 words. By 18 months he was remarkably competent in speaking, as suggested by notes from my visit to the household:

> During our visit Binyam asks his parents for food, saying "*Qolo amt'a*," (Give me *qolo* [roasted grains]), and when we're silent says "*Tech'awat*," ('Say something' [literally, 'Play': a conversational gambit conventionally used by hosts]). Lydia and Teodros, his mother and father, pay attention to his speech and correct him, repeating his words with proper pronunciation, and adding or correcting consonants when he drops or mistakes them.
>
> On top of Amharic and *afaan* Oromo (the latter of which he is picking up from the housemaid) Teodros is teaching Binyam basic English that he learned at school: he calls out the names of body parts in English and Binyam points to them on his own body.

Naming body parts was also a routine I observed in English classes at a primary school. Binyam's parents, who had both attended high school, likely encountered the practice there; in reenacting it with him they were teaching him English and at the same time introducing him to routines he would in turn encounter at school.

*Case 2: Timotios*

> Timotios was slightly delayed in gross motor development, beginning to sit unassisted at 10 months, to crawl at 12 months, and to stand and walk with help at 13 months. Although at 9 months he was babbling and imitating sounds, between then and 22 months he did not produce any other words except *mama*, which he used in reference to his grandmother, who was his primary caregiver. Before he was 9 months old his grandmother sought advice at Jimma Hospital, recognizing that there was something wrong. Physically he was growing well [He was tracking the median of the WHO growth reference for weight and length.], but his slowness in beginning to move around, speak, and play worried her. Doctors could not diagnose any specific problem.
>
> After we had gotten to know her, Timotios' grandmother confided in us that his problems may have stemmed from his mother attempting to abort her pregnancy by taking herbal medicines. In many cases these medicines are said to be effective in aborting a fetus without harming the mother, but in this case they apparently did not work. Timotios' grandmother didn't divulge any more details about the episode, except that at the time her daughter had been in a relationship with a man of whom the family disapproved. After Timotios was born, his mother went to Dubai on a work contract, and left the child in the grandmother's care. "I don't know what would happen to him if he didn't have me," Timotios' grandmother said, reflecting on his situation. "They [his parents] don't have great love for him."

As with Abush and Fatuma, the contrast between Binyam and Timotios' development does not reflect differences in parents' schooling alone, and in the case of Timotios' developmental delay, the social support he received after birth is likely unrelated to his developmental problems. The cases of Binyam and Timotios nonetheless illustrate that parents in Jimma pay close attention to their children's psychomotor

development, scaffolding and encouraging it on the one hand, and being deeply concerned if it fails to unfold on the expected schedule.

## Walking and language development

### *Walking alone*

Children in this study were first observed walking alone at ages ranging from 7.9 to 18.5 months. With the exception of Timotios, who was not walking at 20 months, children in the study had either already begun walking at R1 (7.8% of the sample, among whom the mean age was 12.3 [SD 2.5] months) or began during the period of subsequent monthly observations between R2 and R12 (91.3%, mean age at walking 13.2 [2.1] months).

On average, children in Jimma started walking approximately half a month later than those in Qarsa (13.23 [SD 2.2] vs. 12.8 [SD 1.9] months), with those in Serbo being intermediate (13.0 [SD 2.1]). Children who were stunted or underweight were later in walking alone, by approximately 2 months on average for the stunted (14.8 [SD 2.3] months) and 1.5 months for the underweight (14.4 [SD 2.1]). Differences in the timing of walking by mothers' schooling were smaller: Children of women with no schooling in Jimma were later by 0.7 months in walking than those with any schooling, and in the rural sites were later by 0.5 months. However, this pattern did not hold up when mothers' schooling was disaggregated into multiple levels: children of women with the lowest level of primary schooling first walked at 11.9 months compared to 12.9 months on average for those with >10 years of schooling, and children of women with intermediate levels of schooling walked somewhat later

(~13.5 months). The hypothesized relationship between mothers' education and age at walking therefore appeared to be absent in this sample.

***Language development***

The strong influence of children's age on stage of language development means that we are constrained in the scope of analyses that we were able perform with data from only rounds 1 and 13 of the study, when children were 0-13 and 18-33 months on average. At R1 of the survey, children in Jimma were approximately 1 month older on average than those in the rural sites (Serbo and Qarsa combined) (7.6 months [SD 3.6], versus 6.8 [SD 3.6]), and scored a little less than one point higher on the language scale of the psychomotor test (4.87 [SD 1.9] versus 4.08 [SD 1.8]). The approximately 10 % of children who were underweight or wasted at R1 (approximately 10 % of the sample) scored lower on average than other children in language abilities (4.15 [SD 1.9] versus 4.55 [SD 1.8] in both cases), while those who were stunted scored no lower than the rest.

To assess variation in child language development in more detail, I fit linear regression models with child language scores at R1 and R13 as dependent variables, including as predictors age in months, age-squared, male sex, and urban versus rural residence. In subsequent analyses I added other predictors including HAZ, summed illnesses, and mothers' and fathers' years of schooling.

Unsurprisingly, age was the strongest predictor of children's language ability at R1, and although it retained a strong coefficient at R13 (ages 18-33 months) it declined in statistical significance (R1: beta 0.48, $p < .001$; R13: beta 1.17, $p = .34$). While girls

were more verbal than boys at R1, this was no longer the case at R13. The influence of urban residence, by contrast, increased between the two rounds: while at both time points it was a statistically significant predictor of children's language abilities, the size of its coefficient rose considerably between R1 and R13 (R1: beta 0.56, $p < .05$; R13: beta 1.64, $p < .05$). Children's height for age (HAZ) remained relatively stable as a predictor of children's language abilities at both time points (R1: beta = 0.19, $p < .05$; R13: beta = 0.46, $p < .05$).

Mothers' years of schooling, but not fathers', significantly predicted children's language scores at both R1 and R13, more strongly at R13 than R1. The relationship between mothers' schooling and child language ability was also robust to the influence of HAZ. At both R1 and R13, entering mothers' years of schooling into the model containing the intercept and terms for age, age-squared, male sex, and urban residence caused the strength of the coefficient for urban residence (the single strongest predictor of child language abilities at R13) to decline by ~50 %. This suggested that part of the effect of urban residence on children's language development might be mediated by mothers' schooling. Despite this, urban residence remained the strongest predictor of children's language abilities at R13 (Table 7.1).

**Table 7.1: OLS regression of child language scores at ages 18-33 months**

Dependent variable = Child language score at R13

N = 95

Adj. R^2 = 0.38

Standard error of the estimate = 3.74

| | Beta | SE | p |
|---|---|---|---|
| Intercept | -8.317 | 17.884 | 0.643 |
| child age (months) | 1.513 | 1.467 | 0.305 |
| age-squared | -0.020 | 0.029 | 0.504 |
| child sex (male=1) | 0.107 | 0.820 | 0.896 |
| urban / rural (urban=1) | 1.676 | 1.136 | 0.144 |
| child height for age (HAZ) | 0.448 | 0.269 | 0.100 |
| mothers' schooling (years) | 0.235 | 0.129 | 0.072 |
| fathers' schooling (years) | -0.112 | 0.129 | 0.386 |

The fact that mothers' schooling was a more significant predictor of children's language abilities at ages 18-33 months than 0-13 months suggests that the effects of mothers' schooling on children's verbal development may grow stronger as children's linguistic competence increases. However, because each round included children of widely varying ages, the difference between the relationships between schooling and children's language scores between rounds cannot be attributed definitively to children's ages.

**Summary**

Children who were stunted or underweight began walking later than better nourished children, and children in Jimma slightly later than those in Qarsa. Household wealth and mothers' education did not appear to affect age at first walking.

Children in Jimma town scored higher in language abilities than those in the rural areas at both R1 and R13 (0-13 months and 18-33 months). Language development was also apparently influenced by children's nutrition/growth status, with children who were taller for their age scoring higher on the language scale, even when age was controlled in multivariate analysis. Mothers' schooling (in years) was positively related to children's language abilities both at R1 and R13, with stronger effects at R13.

Case studies of children's interaction with caregivers suggested some ways in which language and motor development could be scaffolded by caregivers: (a) by pretend conversation with protoverbal children (e.g. Biqiltu and Sitina), (b) by repeating children's utterances or correcting mistakes, and (c) later, by reenacting games learned at school, such as pointing to body parts (as with Binyam and his parents). Similar scaffolding also occurred for child walking (e.g. the game of *dadé*).

**Discussion**

While the availability of language data from only two rounds of the study limited the scope of the analysis, these analyses give a sense of the value of assessing psychomotor development in addition to physical growth and illness. Language development is a positive measure of child wellbeing, since, unlike physical growth, it has no upper boundary. The influence of child HAZ on language scores in this sample may reflect not only children's maturation, in terms of increasing age, but could also be due to parents speaking more to children who were taller, i.e. who appeared to be older. Language and growth status together, therefore, may provide complementary information about children's social position as well as their health.

Future analysis should focus on fine motor and social personal domains, which may be more sensitive to environmental variation than gross motor development.

A study in Jimma by Drewett and colleagues (2002) using the Bayley scales of infant development reported significantly higher cognitive but not motor development scores at 24 months among children of mothers with more than 3 years of schooling. In Zohay, Ethiopia, children (16-42 months) of mothers with any schooling scored significantly higher in terms of motor but not verbal development than those of mothers without schooling (Aboud & Tadesse 1995). Both of these studies concur with this one that mothers' schooling may be associated with psychomotor precocity, albeit with variation across settings in whether motor, cognitive, or language abilities are affected.

The finding that children in Jimma began walking alone slightly later than those in rural Qarsa is consistent with Super's (1976) comparative study of motor development among urban and rural Kenyan children, which showed that urban children were later in walking than those in rural areas (whose parents were less likely to have been to school). In the cases documented by Super, urban parents more commonly left infants lying down, while rural parents more commonly practiced exercises intended to accelerate infant walking. These differences in scaffolding of motor development suggest that in some contexts parental schooling may be inversely correlated with children's age at walking.

In both urban Jimma and neighboring rural sites, I observed the game of *dadé* being played by parents and siblings, in which children who were not yet able to walk

independently were supported upright by their wrists or hands between the legs of a caregiver, and encouraged to take steps while the caregiver walked forwards along with them. This practice appeared to be very widespread, and did not appear to be clearly any more common in rural than urban settings, or among parents with more or less schooling. While my observations of *dadé* were not systematic, future research could assess whether there are significant differences in the commonness of practices such as this one among urban and rural families, and among parents with more and less schooling, and whether they predict earlier psychomotor competence.

The relationship between mothers' schooling and children's language development shown here, though not statistically significant, is consistent with the findings of LeVine and colleagues (in press) who show that children in Mexico aged 2.5 years whose mothers had more schooling had larger vocabularies (as assessed by tasks including pointing to body parts), and that this outcome was also associated with greater verbal responsiveness by educated mothers at 15 months.

The reationship between mothers' schooling and verbal stimulation of children may also have implications for children's survival in that mothers who interact with children more intensively are more likely to consider children's inactivity a sign of child illness, and therefore more likely to seek medical assistance promptly when illnesses have made children lethargic. Testing this hypothesis would require detailed assessment of the timing of illness recognition and management of children's illnesses.

To approach the question of how associations between parents' schooling and patterns of children's illness, growth, and psychomotor status might be explained, we turn now to consider how parents in Jimma and neighboring sites treat the most serious childhood illnesses, namely diarrhea and malaria. This, along with the relationships of parents' literacy and developmental expectations to children's health, will be the focus of Part III.

# PART III

## MEDIATION OF SCHOOLING AND CHILD HEALTH OUTCOMES

In Part II we established relationships between (1) mothers' schooling and (a) lower likelihood of children having diarrhea and (b) greater child weight for age in rural communities, and (c) higher scores on language development scales, and (2) fathers' schooling and children's change in weight over time. We may now go on to ask what it is about schooling that might explain these relationships.

In the following chapters I assess the potential of health knowledge, literacy, and developmental expectations as mediators of the relationships between parents' schooling and these child health outcomes. The procedure in each case will be to review the hypotheses implicating each mediator, to describe how the potential mediator was measured and its distribution in the sample, and then to assess mediation using Baron & Kenny's (1986) approach.

This approach to assessing mediation is a four-step process that assesses relationships separately between (1) the treatment and outcome variables, (2) the treatment and potential mediator, (3) the potential mediator and outcome, and finally (4) the treatment and potential mediator together, in a combined model, as predictors of the outcome variable.

In the case of mothers' schooling and child health outcomes, the four steps can be represented as follows:

1. mother's schooling → health outcome
2. mothers' schooling → mediator
3. mediator → health outcome
4. mother's schooling + mediator → health outcome

This method is also referred to as hierarchical regression (Spicer 2005).

Since the first step of this approach – assessing the relationship between schooling and health outcomes – has been completed, the steps that remain are steps 2-4. The specific mediators and health outcomes to be considered on in each chapter are:

- mothers' knowledge of ORT and Coartem medicines, and use of these medicines to treat diarrhea and malaria (Chapter 8)

- mothers' and fathers' literacy and children's diarrhea, WAZ, change in weight, and language development (Chapter 9)

- mothers' developmental expectations and children's WAZ and language development (Chapter 10).

Chapter 8

# Health knowledge and treatment of illness

In previous chapters we established that mother' schooling – particularly secondary schooling in Jimma town but also any schooling in the rural sites outside Jimma – was associated with lower odds of children having diarrhea (Chapter 5), but not with lower frequency of other child illnesses. It is possible, however, that mothers with more schooling might manage illnesses differently, consequently reducing the severity or duration of illness bouts when they occur. Since information about diseases is included in Ethiopian primary school textbooks (Chapter 4), they might learn about recommended treatments through school lessons or, outside the school, through literacy skills or through social networks (as predicted by KAP). The structural confounding hypothesis would predict that regardless of mothers' knowledge, access to medical services and ability to afford treatment would exert the greatest effects on use of recommended treatments.

In this chapter I assess the evidence for pathways leading (1) from mothers' schooling to knowledge of recommended therapies for diarrhea and malaria and (2) from mothers' knowledge of these recommended treatments to their use in actual episodes of children's diarrhea and malaria. The majority of under-5 deaths in the Jimma area are attributed to diarrhea and malaria (Amare et al. 2007), and many of these children's lives could be saved by appropriate administration of the treatments we will consider here, namely ORS and Coartem.

**Background and methods**

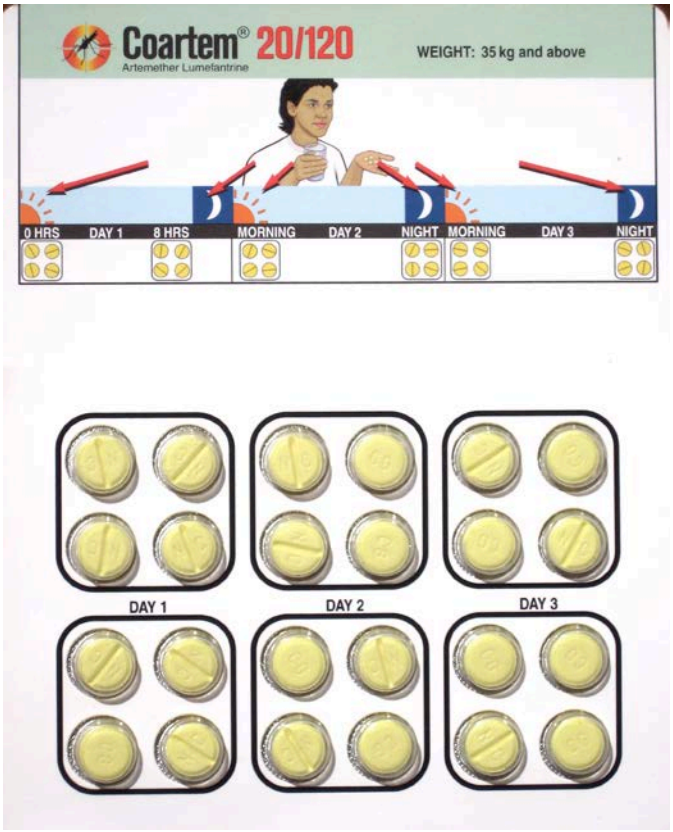
ORT (oral rehydration therapy) is the recommended treatment for acute childhood diarrhea (WHO 1999; cf. Werner & Sanders 1997). ORT can include commercially produced mixtures (ORS, or oral rehydration salts) and homemade drinks (RHF, or recommended home fluids). In Ethiopia ORS is available in through clinics and pharmacies under the brand name Lemlem (Amharic, 'lush') and in generic form, marked in English as ORS (oral rehydration salts) and in Amharic as *heywet aden net'ere medhanit* ("life-saving medicine"). At the time of this research it was impossible to find ORS in Jimma with packaging marked in *afaan* Oromo.

Coartem is the brandname of a malaria drug in the class of artemisinin-based combination therapies (ACTs). In Ethiopia at the time of this study, Coartem was distributed through government clinics exclusively for treatment of falciparum malaria (the most aggressive form of malaria) that had been verified by blood test; it was also sold illicitly by private pharmacies in Jimma. The other available treatments, quinine and chloroquine, are less effective against falciparum malaria, although chloroquine can be effective against vivax malaria, a less aggressive form that is also prevalent in Ethiopia (Snow & Omumbo 2006).

*Knowledge of ORS and Coartem*

We assessed mothers' knowledge of ORS by asking "Do you know what ORS or Lemlem is?" and "Do you know what it is used for?" In the case of Coartem, we assessed mothers' knowledge by showing them an image of a Coartem packet, printed in English, and asking them to identify it (Figure 8.1). Coartem packets in Amharic or *afaan* Oromo were not available in Ethiopia at the time of the study.

**Figure 8.1: Image of a medicine packet used in testing knowledge of Coartem**




*Use of ORS and Coartem*

For those mothers who reported that their children ever had diarrhea (n= 104, 74 % of children) or malaria (n = 34, 25 %) during the period of the longitudinal study, we can also assess whether they used ORS or Coartem as treatments for diarrhea and malaria respectively, versus other treatments or no treatment.

The following accounts from my fieldnotes illustrate how women without schooling may expend great effort in getting treatment for sick children, and sometimes fail despite their best efforts.

> India lays out three medicine bottles and an empty ORS packet on the floor as she describes her child Yimam's bout of diarrhea. The bottles contain medicinal syrups – Cadiprim (cotrimoxazole), Cadimol (paracetamol) and Wormexpel (a deworming drug). It was on the third day Yimam had diarrhea that India began treating it, first giving him *qoricha aadii* [afaan Oromo, "the white medicine," the root of a medicinal plant] and when that didn't produce results, taking him to Serbo health center, an hour's walk away. The staff there recommended the three syrups and ORS, but except for Cadiprim she couldn't find any of them in Serbo that day. The following days she went back to town, and eventually found them all.

India had no formal education, and nor did her parents. Yimam was healthy during most of the 18 months of the study, and India was very protective of him, having lost her first child in infancy.

In another case, a mother lost her child to malaria despite reporting to the clinic and obtaining Coartem:

> Abi developed a high fever, and his mother Amina carried him to Serbo for treatment, walking for a half hour to get to the health center. There he tested positive for falciparum malaria. A nurse prescribed Coartem and gave Amina a packet of pills. Since she thought Abi was too young to take pills, Amina bought chloroquine syrup from a pharmacy, and gave him the syrup instead. Abi's condition deteriorated, and he died during the night.

Abi died not because his mother was slow to seek help for his malaria, but because she did not recognize that she needed to grind up the pills to give them to him. While knowledge of therapies is potentially important, these case studies suggest that other considerations – whether the recommended treatments are available, and understanding of how to administer them – are also important.

**Treatment of diarrhea and malaria**

In the majority of cases of diarrhea, mothers reported giving no treatment (47 %). Factory-produced ORS obtained from clinics or pharmacies was the most common treatment for diarrhea (26 %), followed by other treatments including antibiotic syrups and traditional medicines (21 %). In very few cases were children given home-prepared salt-and-sugar solution (7 cases: 3.4 %) or other homemade liquids such as rice soup (3 cases: 1.2 %).

The majority of malaria cases, by contrast, were treated with Coartem (65 %), and in only one case did a mother report giving no treatment for malaria. After Coartem the next most common treatment was chloroquine syrup (24 %). Quinine, cotrimoxazole, and traditional medicines (i.e. *qoda guracha*: *afaan* Oromo, literally 'black wood') were each recorded in one case as the sole treatment for a bout of malaria. Often, more than one drug at a time was used to treat malaria, with paracetamol (8 cases, 24 %) or cotrimoxazole (4 cases, 12 %) frequently used along with Coartem. In several cases malaria recurred for individual children during the period of observation, with an interval of >1 month in between reports (7 cases, 20 %) and in 3 such cases Coartem was used to treat one bout but not another.

As noted in Chapter 5, malaria was more common in the rural sites (a ratio of 26: 8 cases in Serbo and Qarsa compared to Jimma). While in all but one of the cases of children's malaria in the rural sites, children were taken to the government clinic in Serbo, in Jimma town the majority of cases (5 of 8) were treated at private clinics or pharmacies.

***Is mothers' schooling associated with knowledge of ORS?***

In the combined sample, 63 % of mothers had heard of ORS or Lemlem and knew that it was used for treating diarrhea. However, while in Jimma and Serbo 80 % had heard of ORS or Lemlem, in Qarsa only 34 % of mothers had heard of them. Logistic regression with knowledge of ORS as a dependent variable and the two rural sites as dummy variables suggested that women in Qarsa had (log) odds of having heard of ORS of 0.2 compared to women in Jimma town ($p < .01$). In the combined sample, women in wealthier households had odds of having heard of ORS between 2 and 3 times as high as those in poorer households according to the wealth index – a contrast that overlaps with the urban-rural divide.

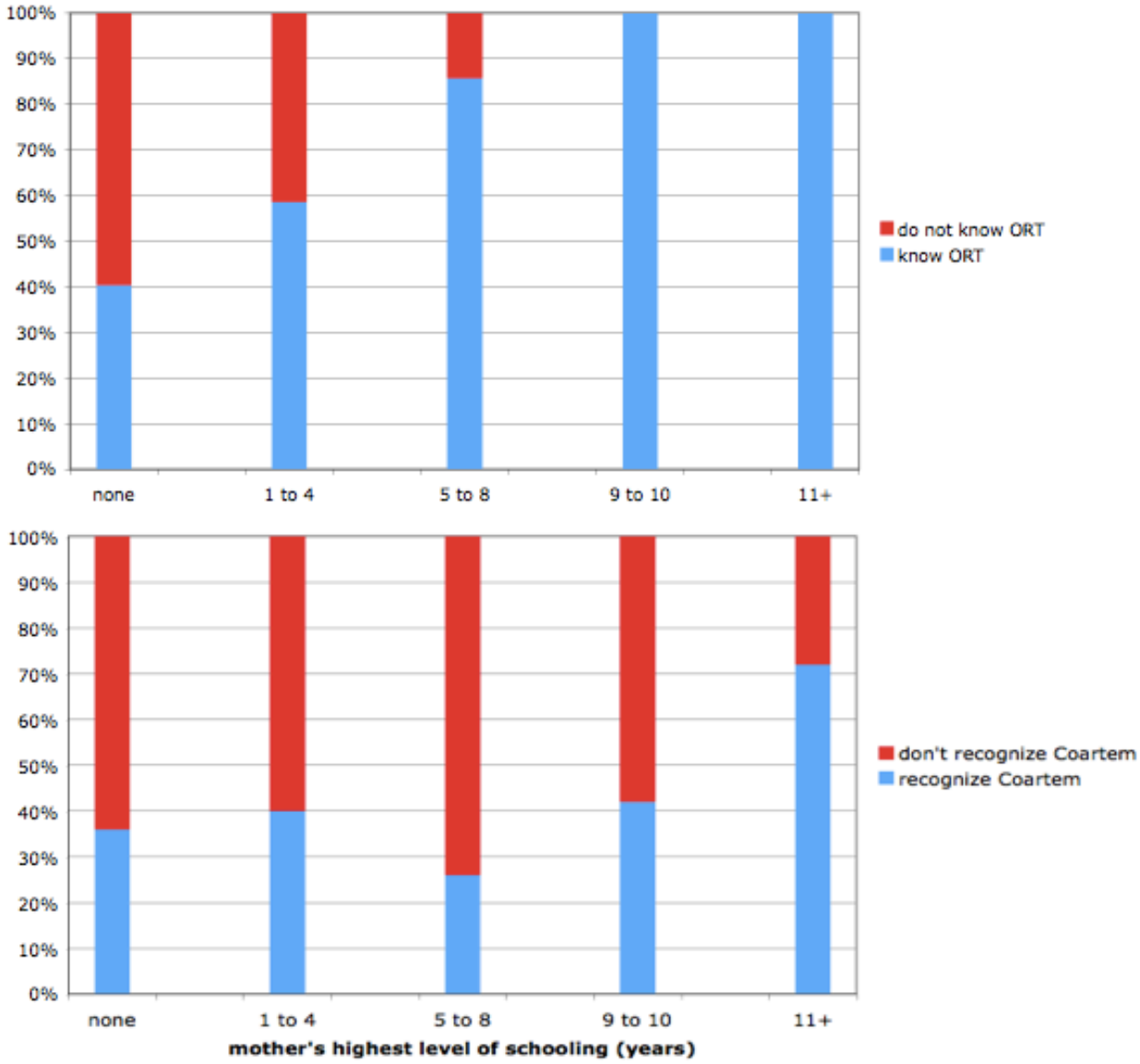
The proportion of women who had heard of ORS rose in a stepwise fashion with women's level of schooling (Figure 8.2). Adding mothers' years of schooling to the logistic regression model alongside dummies for Serbo and Qarsa suggested that schooling predicted better odds of having heard of ORS (OR = 1.3, $p < .05$) even after controlling for place of residence; and the association remained stable in strength and significance when household wealth was controlled.

***Is mothers' schooling associated with use of ORS to treat diarrhea?***

To assess whether knowledge of ORS made women more likely to use ORS in treating bouts of children's diarrhea, I restricted my focus to those families in which caregivers had reported children having diarrhea during the period of the survey (n = 98). Unexpectedly, among these families, those in Serbo were less likely ever to use ORS to treat diarrhea than were those not only in Jimma town but also in rural Qarsa, with only 2 out of the 12 recorded bouts of diarrhea in Serbo having been treated with ORS, compared to approximately 50 % each in Jimma and Qarsa. Across all sites, mothers with primary schooling were more likely to use ORS than those with no schooling (OR = 1.6, p = .49), but this contrast was not statistically significant, and mothers with secondary schooling or higher were no more likely to use ORS than those with no schooling. Neither household wealth nor having heard of ORS was a significant predictor of using it to treat diarrhea.

When the dependent variable was coded not as *ever* using ORS but as "*always* using ORS" (i.e. reporting use of ORS to treat every recorded case of child diarrhea) a different pattern emerged. Mothers in Jimma town were substantially more likely (OR = 3.7, p < .05) to use ORS to treat every recorded bout of diarrhea than were those in either Serbo or Qarsa, and this factor – urban residence – exerted a much greater influence on this outcome than did mothers' schooling.

**Figure 8.2: Proportion of mothers who knew of recommended therapies for treating diarrhea (ORS) and malaria (Coartem), by level of schooling** (n = 149)




***Is mothers' schooling associated with knowledge and use of Coartem to treat malaria?***

Across a range of strata – urban or rural, any school or none – approximately 80 % of women in each category were able to recognize Coartem when shown an image of the packet, either identifying it by name ('Coartem') or by its use ('malaria medicine'). However, 100 % of those who had used Coartem to treat a child's malaria (17

women) successfully identified the Coartem packet. Similarly, both mothers with no education and those with a high level of education were equally likely to procure Coartem for children when they had malaria.

**Summary**

We investigated whether knowledge of ORS and Coartem was associated with schooling, and whether it predicted greater use of ORS or Coartem. Mothers' schooling was significantly associated with knowledge of ORS, but not with knowledge of Coartem. Contrary to expectation, there was little variation in knowledge of Coartem between urban and rural, or among mothers with different levels of schooling, or in its use to treat malaria; it was the most commonly used medicine to treat malaria across the board. Although knowledge of ORS was higher among more educated mothers, mothers' schooling was not a clear predictor of use of ORS in recorded bouts of child diarrhea. Use of ORS to treat diarrhea was less common in Serbo than other sites, but differed little between Jimma and Qarsa, the communities with most and least access to pharmacies and clinics. Use of ORS to treat every recorded case of diarrhea was, however, more common in Jimma town than the other sites.

**Discussion**

In contrast to the KAP framework, which might predict that schooling would improve knowledge of the most common health threats *and* their treatment (whether through health content learned in school, or through literacy skills), we found different relationships between schooling and mothers' health knowledge between the therapies for diarrhea and malaria, and no clear relationship between mothers' schooling and use of these therapies in recorded cases of diarrhea and malaria. The finding that years of schooling were related to knowledge of ORS in a dose-response fashion, but not with use of ORS (Boerma et al. 1991). The fact that mothers' schooling predicted nither knowledge nor use of Coartem is likely explained by the fact that (a) risk of malaria is lower among the urban, more educated population than the rural, less educated population, and (b) recognition of the medicine packet presupposed either English reading ability or prior experience of using the medicine itself.

As the stories of individual cases of diarrhea and malaria treatment presented in this chapter suggest, knowledge or name-recognition of a particular therapy may be less important than the availability of the medicine (as in the case of India, who had to return to Serbo multiple times to find ORS) or understanding of how to administer it (as in the case of Amina, whose son died despite the fact that she had obtained Coartem from the clinic for him). Further analyses might focus on comprehension of how to administer ORS and Coartem. Further research should also focus on how miscommunications like the one between Amina and the nurse who prescribed her Coartem happen, and how they can be avoided.

The prediction of the structural confounding hypothesis, that use of the most effective medicines would be lowest in the communities with least access to medical care, was not supported by the data on ORS, in that ORS use to treat diarrhea was lower in Serbo (where there was a clinic and pharmacies) than in rural Qarsa (with fewer facilities). Nor was the hypothesis borne out by patterns of Coartem use, which were high across all sites in treatment of children's malaria. The structural confounding hypothesis was partially supported, however, by the finding that use of ORS to treat every bout of diarrhea ("always use ORS") was higher in Jimma, where access to medicines was greatest. Although the association between place of residence and always using ORS was stronger than that for mothers' schooling, it is notable that behavior such as this – strict adherence to use of recommended treatments in every episode of diarrhea – is consistent with several hypotheses of school effects on maternal health behavior, including the knowledge-practices hypothesis, which would explain this as a preventative approach to healthcare, and bureaucratic socialization, which would explain this as a result of obedience to medical authority.

Limitations of the approach to assessing use of ORS and Coartem used in this study include our failure to distinguish between more and less acute bouts of diarrhea, or between falciparum and vivax malaria. These different kinds of diarrhea and malaria call for different management, with Coartem, for example, not being medically recommended for vivax malaria, and ORS more urgent to treat longer or more severe bouts of diarrhea.

While the lack of association between mothers' schooling and use of diarrhea and malaria medicines might be due to failure to distinguish these factors, it is also

possible that treatment of illness is less important for child survival than preventive health behaviors in the home, such as hygiene and feeding practices. Among the New Delhi families studied by Basu (1992), for example, children of women with schooling had an advantage in survival, but there was no discernable difference in either knowledge or reported curative treatment behavior among mothers with more or less schooling (1992: 163).

Chapter 9

# Literacy

According to the KAP framework, literacy may impact child health through increased access to health or nutrition information through the media, or through the ability to decipher medicine packets and hospital forms. The bureaucratic socialization hypothesis suggests that mothers' literacy skills may also be valuable in healthcare settings because literacy serves as a prototype for a register of spoken language that assists in communication with health professionals. We saw in Chapter 4 that reading and writing are practiced every day in schools, in English and either *afaan* Oromo or Amharic depending on the stream. Additionally some of the writing exercises practiced in the school resembled those that might be used in clinics, e.g. filling in blanks on a form. In this chapter we will assess whether literacy helps to explain the association between parents' schooling and four measures of child health documented in previous chapters, i.e.:

(1) Mothers' schooling leading to
    a. lower odds of child diarrhea in Qarsa (Chapter 5)
    b. greater child weight for age (WAZ) in Qarsa (Chapter 6)
    c. higher scores on the child language scale in the combined sample (Chapter 7)

(2) Fathers' schooling leading to improved weight gain among children in the combined sample (Chapter 6).

Appraising literacy as a mediator requires testing 3 hypotheses: that (1) years of schooling predict literacy abilities, (2) literacy abilities predict child health, and that

(3) both schooling and literacy together impact on child health, with meaningful change in the coefficients for schooling when both predictors are added to a regression model.

We begin with the first of these 3 steps, assessing the relationship between schooling and literacy.

## Background and methods

### *Languages and literacies in Ethiopia and Jimma*

Jimma is a diverse language environment, with four major languages written in three different scripts: Amharic (Semitic family) in the Geez syllabary, Arabic (Semitic) in the Arabic alphabet, and *afaan* Oromo (Cushitic) and English in the Roman alphabet (Bender et al. 1976; Ethnologue 2005). The most widely used language of literacy (e.g. for vaccination cards, signs, and news media) is Amharic, which has been also used in Ethiopian schools since the Second World War. English is used in schools, on the packaging of many pharmaceuticals, and as a professional language among doctors and pharmacists. *Afaan* Oromo has been used in schools, and as a language of mass literacy (e.g. in media and local government), only since 1991 (Mekuria 1994; Mahdi 1995). Arabic is read and recited by Muslims in devotional contexts, and is spoken by those in Jimma who have lived or worked in Arab countries.

We assessed literacy and language abilities by self-report, by tests of reading ability in Amharic, *afaan* Oromo, English, and Arabic, and by comprehension of health-related materials such as medicine packets and hospital forms. This allows us to

compare self-reported literacy with objectively assessed reading ability both in terms of the conventional definition (ability to read a sentence [UNESCO 1958, cited in UNESCO 2005: 18]) and as a continuous variable. Treating literacy as a continuous variable is increasingly advocated, based on the fact that literacy skills vary across a wide spectrum (Guadalupe et al. 2009; LeVine in press). The criteria used for defining levels of literacy in this study (using the categories of Wagner 1990: 122) are provided in Table 9.1.

**Table 9.1: Literacy classifications used in this study**

| | Category | Definition |
|---|---|---|
| 1 | non-literate | unable to recognize numerals or words |
| 2 | low-literate | able to recognize only isolated numerals or words |
| 3 | basic-literate | able to read a sentence competently |
| 4 | moderate- literate | able to read and explain the content of a short paragraph from a textbook for grades 3 to 5 |
| 5 | high-literate | able to read and explain the content of a paragraph from textbooks of grade levels 6 – 10 |

The choice of passages from school textbooks for the Amharic, *afaan* Oromo, and English reading tests was made with the help of colleagues who were highly literate in each language. In the case of Arabic, we used a series of sentences of increasing length from the Qur'an (from Zeino 2006) allowing us to assess Arabic reading ability up to the level of moderate-literacy. Points were awarded for single words, numerals, and sentences and, as a measure of comprehension, "idea units" correctly nominated in descriptions of paragraphs of text of increasing complexity up to the level of grade 10 textbooks (after Chall 1996; LeVine et al. 2001). For Arabic, points were awarded

for words and numerals, and for correct translation of Arabic phrases into Amharic or *afaan* Oromo.

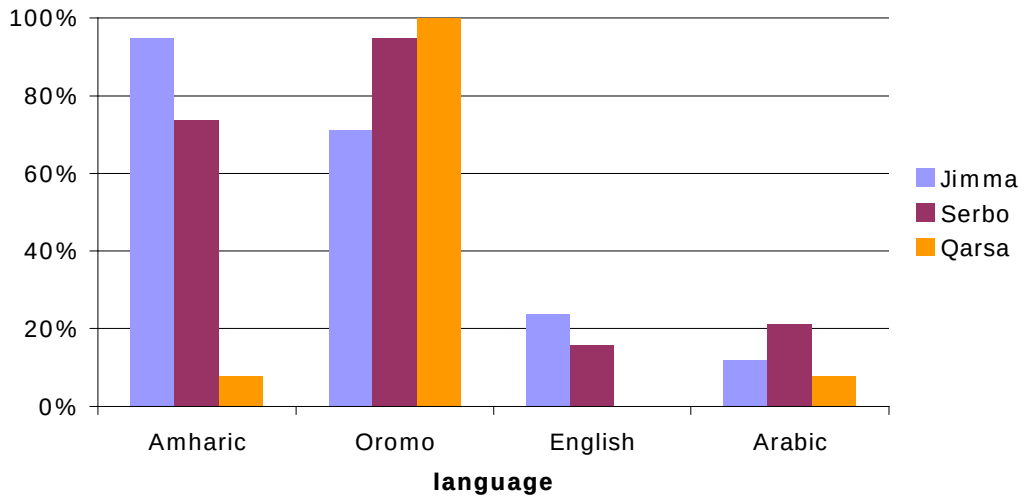
We also assessed health literacy, to gauge how academic reading abilities related to literacy skills that might be used in healthcare settings. Health literacy tests were scored by awarding points for correct identification of images including pictures of a pharmacy, medicine packets, and a hospital registration form. Points were awarded equally either for giving the name or the specific use of the medicine (e.g. 'Coartem' and 'malaria medicine' both scored as correct). The ORS section also included a test of interpreting a sequence of instructions printed on the packet about how to prepare the solution and feed it to a child. Data on individual components of the health literacy test will be reported separately elsewhere; here we combine all the components of the health literacy test into a summed score.

Both mothers' and fathers' reading abilities and health literacy were tested during rounds 10 and 11 of the longitudinal study. Academic literacy tests were carried out with 102 women, and health literacy with 100. Because of the difficulty of finding fathers at home, the number of records of fathers' literacy is lower (academic literacy, n = 48, health literacy, n = 43).

**Results**

Figure 9.1 shows the proportions of mothers in each site who reported that they spoke each of the four most common languages in the area.

**Figure 9.1: Languages spoken by mothers in Jimma and neighboring sites**
(n = 129)




*Afaan* Oromo was the most commonly spoken language across the 3 sites, although Amharic was spoken more than *afaan* Oromo in Jimma town. English and Arabic were spoken and read by minorities in each site.

Mothers' and fathers' scores in the language tests and the health literacy test are summarized in Table 9.2. Variation among the maximum scores for each language is due to variable numbers of idea units discernable in the higher-level reading comprehension texts.

**Table 9.2: Mothers' and fathers' reading scores in Amharic, *afaan* Oromo, and English and scores on health literacy test**

(n [languages, health literacy]: mothers = 110, 107, fathers = 50, 44)

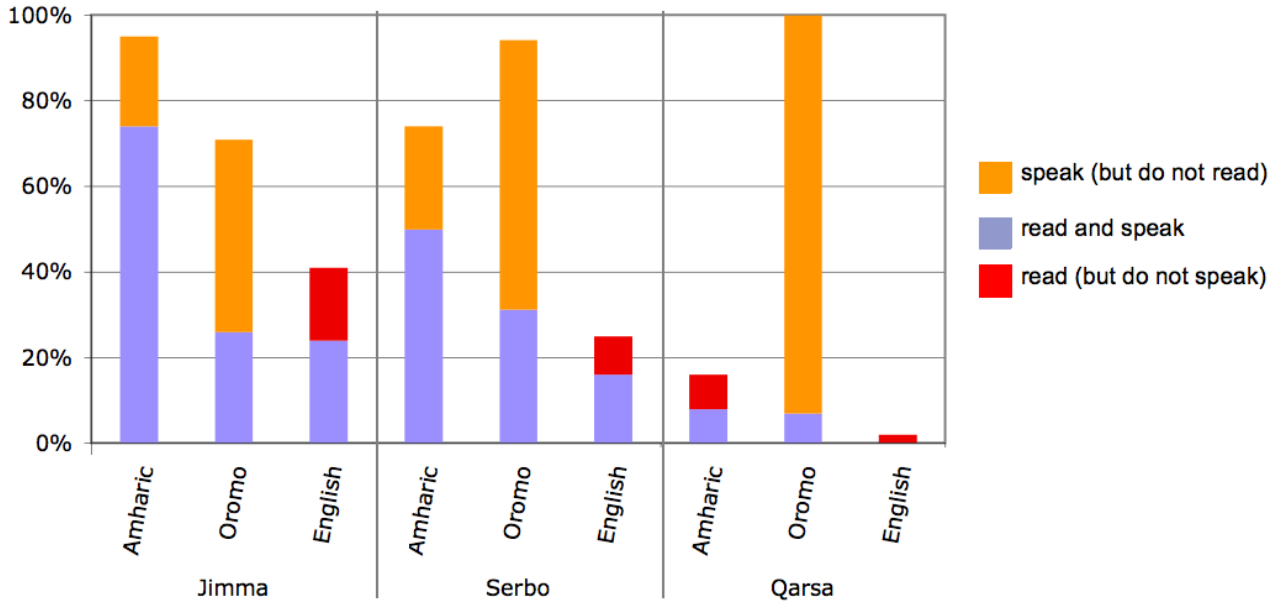
| | mothers | | fathers | |
|---|---|---|---|---|
| | mean (SD) | max | mean (SD) | max |
| Amharic | 7.9 (6.6) | 21 | 10.8 (7.1) | 21 |
| *Afaan* Oromo | 3.8 (4.9) | 23 | 9.4 (7.2) | 30 |
| English | 3.6 (7.1) | 38 | 8.5 (12.2) | 46 |
| Arabic | 0.5 (2.4) | 16 | 0.9 (1.4) | 18 |
| health literacy | 11.4 (5.5) | 22 | 13.9 (5.1) | 22 |

Both mothers and fathers scored higher in reading of Amharic than in other languages. While fathers scored higher on average than mothers in all languages, the difference between mothers and fathers was narrower for Amharic and health literacy than for English, *afaan* Oromo, or Arabic. The lowest levels of literacy were for Arabic, in which only 4 women (3.7 %) were able to read a sentence, compared to 13 men (26 %). Because of its relative rarity among women, Arabic was excluded from further analyses. Reading scores for the other languages were dichotomized into literate vs. non-literate on the basis of ability to read a sentence (equivalent to a score of >7 points for each language).

Slightly over half of women (51 %) were able to read a sentence in at least one language, compared to two thirds of the study sample (67 %) who ever went to school. There were, however, considerable variations in basic literacy by language and by site. Figure 9.2 shows the commonness of basic literacy in Amharic, *afaan* Oromo, and English for mothers across the 3 study sites. The figure also

demonstrates the relationship between speaking and reading ability in each language: the full height of the bars in general represents the percentage of women who reported that they spoke each language, and the height of the lower segment of the bars (in blue) represents the percentage who were also able to read at least a sentence in that language according to our tests. Darker segments (in red) at the tops of bars represent the percentage who tested as being able to read a language but who claimed not to be able to speak it.

**Figure 9.2: Reading and speaking abilities of mothers in Jimma and neighboring sites** (n = 107)




*Afaan* Oromo, while the most commonly spoken language across the 3 sites, was less commonly read by women than was Amharic. Amharic, spoken more than *afaan* Oromo in Jimma town, was the most common language of literacy in all 3 sites, with English read by minorities in each community. A larger proportion of women scored as basic literate in English in each site than claimed to be able to speak English.

In Qarsa this pattern also held for Amharic, with twice as many women being able to read a sentence of Amharic as reported being able to speak the language. The most striking pattern to emerge here, however, is the low level of literacy in rural communities, with only 19 % of women able to read a sentence of Amharic, compared to 74 % in the city.

***Is reading proficiency linearly correlated with years of schooling?***

The relationship between schooling and literacy varied according to the language of literacy. Table 9.3 shows correlations between both mothers' and fathers' schooling (in years) and literacy scores in the three major languages plus health literacy.

**Table 9.3: Correlations between mothers' and fathers' years of schooling and reading scores in languages and health literacy**

| | Mothers (n=102) | Fathers (n=48) |
|---|---|---|
| Amharic | 0.78 | 0.49 |
| | <.001 | <.001 |
| *afaan* Oromo | 0.59 | 0.58 |
| | <.001 | <.001 |
| English | 0.74 | 0.85 |
| | <.001 | <.001 |
| health literacy | 0.76 | 0.66 |
| | <.001 | <.001 |

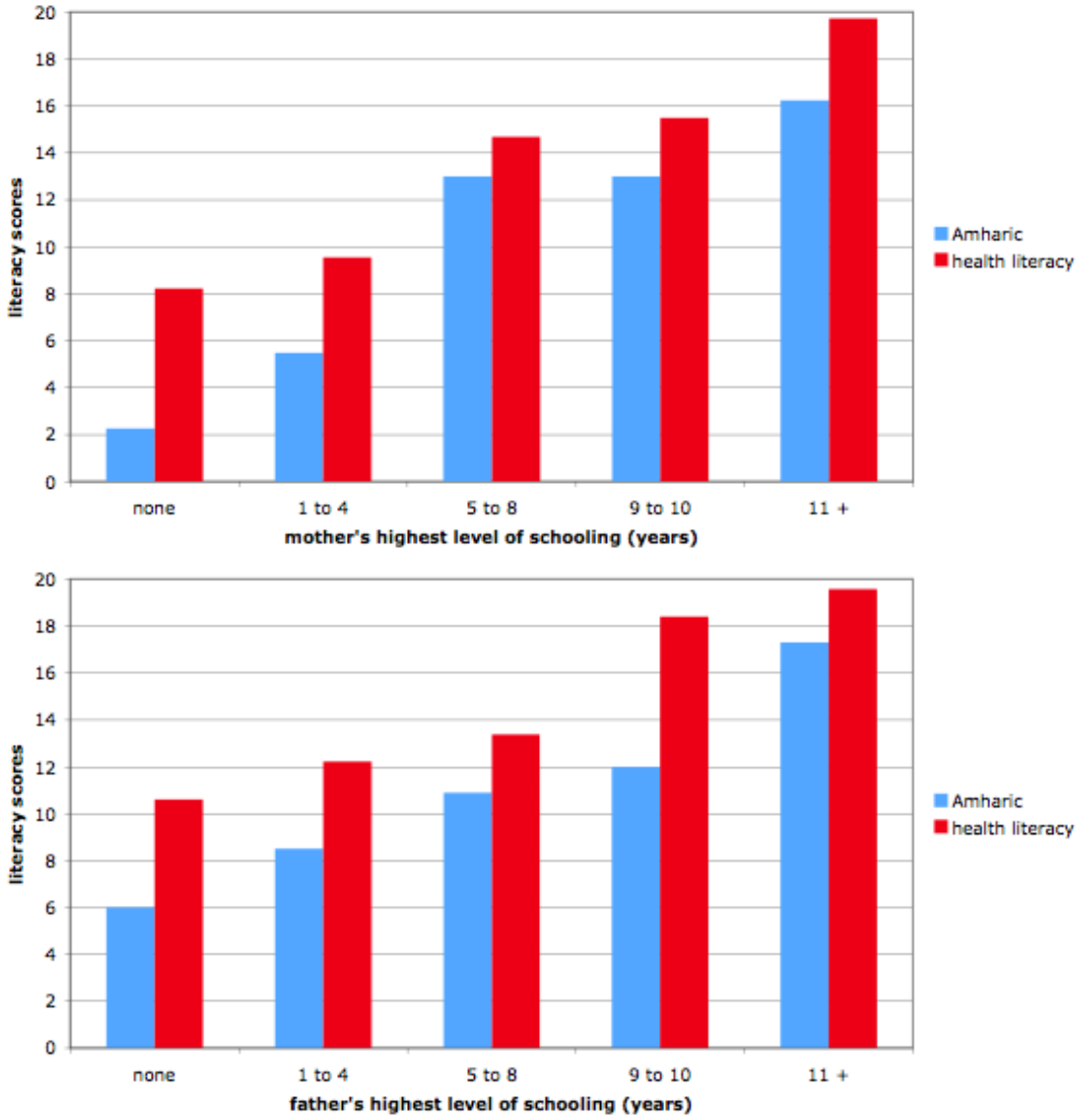
Note: significance is 2-sided.

For each language of literacy, and for health literacy, the correlations with schooling were substantial and highly significant for both mothers and fathers ($r > 0.45$, $p < .001$). There was a contrast between mothers' and fathers' schooling in their correlation with Amharic literacy (mothers: $r = 0.78$; fathers: $r = 0.49$), but for

fathers' schooling the correlation with English literacy was higher than for mothers (mothers: r = 0.74; fathers: r = 0.85). One feature not represented in the correlations is that English reading abilities were very low in the sample as a whole, even among women with primary schooling. Although English is taught as a subject in all Ethiopian schools, only a third of those who had been to school scored as basic-literate or above in English. Despite this, there was a clear tendency that women with more years of schooling gained greater English reading skills, with a clearer linear trend in the median years of schooling across levels of reading ability for English than for any other language (data not depicted here). Among mothers who tested as non-literate in all languages (26 %), however, only three had any schooling (1-3 years). There was therefore a fairly strong concordance between school experience and literacy in general.

Since Amharic is the most common language used in the media and on hospital forms, we should expect it to be closely related to health literacy. Indeed, both correlations between mothers' Amharic literacy and health literacy ($r = .79$, $p < .001$ [2-sided]) and fathers' Amharic literacy and health literacy ($r = .68$, $p < .001$) were strong. Amharic and health literacy also increased incrementally with parents' levels of schooling (Figure 9.3: mothers in the upper panel, fathers in the lower panel).

**Figure 9.3: Mean reading scores in Amharic and health literacy, by mothers' and fathers' highest levels of schooling** (mothers: n = 100, fathers: n = 43)




Fathers with no schooling scored higher on average in both Amharic reading and health literacy than did mothers with no schooling – almost 3 times as high in the case of Amharic, and >25% higher in the case of health literacy. Men with low levels of schooling (1-4 years) also scored higher in both tests than women, although those women who had reached grade 4 or higher scored as high as or higher than men on average at each successive level of education.

Having established that Amharic reading scores and health literacy are correlated with schooling among mothers and fathers, we may proceed to assess whether parents' literacy is also associated with child health outcomes. We will therefore examine in turn the relationships between parents' literacy and likelihood of child diarrhea, WAZ, weight gain, and language development.

**(1)** ***Is mothers' literacy associated with lower likelihood of children's diarrhea?***

In Chapter 5 we saw that mothers' schooling was associated with reduced odds of children ever having diarrhea, and that in the rural sites this relationship was largely independent of household wealth. To investigate whether mothers' literacy contributed to this effect, I experimented with adding literacy (coded either as a binary or as a continuous variable) to logistic regression models as a predictor of children ever having diarrhea during the period of the study, with the sample limited to rural sites only (Serbo and Qarsa). Mothers' ability to read a sentence in any language (i.e. a binary variable, literate versus non-literate) was associated with substantially reduced odds of child diarrhea, but was not statistically significant (OR = 0.68, p = .55). Ability to read a sentence in Amharic, the most common language of literacy in the rural sites, was associated with a smaller decrease in odds of diarrhea, and was less statistically significant (OR = 0.82, p = .77). When Amharic literacy was treated as a continuous variable (i.e. scores in the Amharic reading test), its level of statistical significance increased (OR = 0.93, p < .20), although it remained both substantively insigificant and statistically insignificant by conventional standards.

In the final step of the mediation analysis, adding mothers' Amharic literacy scores to a model containing mothers' schooling and biodemographic covariates caused little change in the coefficient of mothers' schooling (from beta 0.85 to $p < .05$ to beta 0.89, $p = .32$), while Amharic literacy scores fell further in significance (OR = 0.99, $p = .94$). These results suggest that Amharic literacy is not a mediator of the effects of maternal schooling in reducing odds of children's diarrhea, and that other aspects of maternal schooling may be involved in this relationship.

**(2)** ***Is mothers' literacy associated with children's growth?***

Since the patterns of variation in child growth z-scores by mothers' schooling were more complex than were those for children's diarrhea, they permit a broader investigation of relationships with mothers' literacy. As a first step in assessing the relationships between literacy and children's growth, I ran correlations between mothers' scores on the reading tests, plus health literacy, and children's HAZ, WAZ, and WHZ.

**Table 9.3: Correlations between children's growth z-scores and mothers' literacy and schooling** (all sites combined, n = 102)

| | HAZ | WAZ | WHZ |
|---|---|---|---|
| Amharic | 0.21 | 0.29 | 0.21 |
| | <.001 | <.001 | <.001 |
| *afaan* Oromo | 0.22 | 0.22 | 0.12 |
| | <.001 | <.001 | <.001 |
| English | 0.23 | 0.27 | 0.19 |
| | <.001 | <.001 | <.001 |
| health literacy | 0.11 | 0.23 | 0.22 |
| | <.001 | <.001 | <.001 |
| schooling (years) | 0.19 | 0.32 | 0.27 |
| | <.001 | <.001 | <.001 |

Note: significance is 2-sided.

The correlations between mothers' literacy and growth z-scores were consistently positive and significant, and were strongest between Amharic and WAZ (r = 0.29) and weakest between health literacy and HAZ (r = 0.11). The strength and significance of the correlations between child growth indicators and literacy were of a similar level of magnitude to those between the child growth indicators and mothers' schooling.

Since the only substantively significant association between mothers' schooling and child growth documented in previous analyses was for child WAZ, I concentrated on assessing the potential of literacy as a mediator of the association between mothers' schooling and WAZ. My analytic approach was to assess relationships between WAZ

and literacy scores in Amharic, *afaan* Oromo, English, and health literacy first as continuous variables and then as categorical variables (dummies for low, basic, moderate, and high literacy). Initially I fitted models including the intercept and children's age, age-squared, and age cubed; when beta coefficients for the literacy dummy variables exhibited patterns consistent with the hypothesis of increasing WAZ for each increment of mothers' literacy, I went on to control for biodemographic factors (mothers' weight and height, and child sex). Because relationships between WAZ and schooling had been shown to differ by community, I fitted models separately for each of the 3 study sites.

In Jimma town, coefficients of the relationship between mothers' reading abilities (either in Amharic or health literacy) and child WAZ were consistently either negative or zero. In rural Qarsa, however, mothers' Amharic literacy (but not health literacy) was a statistically significant predictor of WAZ. This relationship between mothers' schooling and child WAZ held when household wealth and biodemographic factors were controlled (beta 0.014, $p < .05$). However, when fathers' schooling was controlled, the effect of mothers' Amharic literacy became statistically insignificant (beta 0.014, $p = .73$). When Amharic literacy was treated as a categorical variable, basic literacy showed a weak and insigificant relationship to WAZ (beta 0.23, p. = .49), while moderate and high literacy were associated with more than one standard deviation increase in WAZ (moderate literacy: beta 1.02, $p = .22$, high literacy: beta 1.84, $p < .001$). There were, however, very few women represented in these categories: only two women who read Amharic at the level of moderate literacy, and *only one woman* who read at a level of high literacy, reflecting the low levels of literacy in the rural communities.

In the final step of the test of mediation, entering mothers' Amharic literacy scores in a model including mothers' and fathers' schooling plus biodemographic covariates and household wealth caused a slight decline in the relationship between mothers' schooling and WAZ, and a decrease in significance (from beta 0.15, p = .12 to beta 0.11, p = .35). Mothers' Amharic literacy meanwhile retained a stable but weak relationship to child WAZ (beta 0.013, p = .74). This suggested that Amharic literacy contributed slightly to the effects of mothers' schooling on child WAZ in Qarsa, but did not constitute strong evidence of mediation.

**(3)** ***Is fathers' literacy associated with children's weight gain?***

As described in Chapter 6, fathers' schooling, but not mothers' schooling, was positively associated with children's weight over the 18 months of the study. Fitting regression models with mothers' and fathers' Amharic and health literacy as predictors of change in weight showed that fathers' health literacy (but not Amharic literacy, or mothers' Amharic or health literacy) was significantly related to children's change in weight (0.015, p <.05). The relationship between fathers' health literacy and change in weight remained when place of residence and biodemographic factors were controlled (Table 9.4).

**Table 9.4: Regression of children's change in weight, with fathers' health literacy as a predictor**

Dependent variable: children's change in weight (kg) between observations, max 13 rounds
subjects = 38, observations=386
AIC = 1091.9

| | Beta | SE | df | p |
|---|---|---|---|---|
| Intercept | 0.715 | 0.219 | 32 | 0.003 |
| child age (months) | -0.098 | 0.039 | 346 | 0.013 |
| child age squared | 0.004 | 0.002 | 346 | 0.023 |
| child sex (male = 1) | -0.109 | 0.111 | 32 | 0.334 |
| Serbo vs. Jimma | -0.188 | 0.064 | 32 | 0.006 |
| Qarsa vs. Jimma | 0.009 | 0.056 | 32 | 0.877 |
| fathers' health literacy | 0.014 | 0.007 | 32 | 0.058 |
| mothers' health literacy | 0.005 | 0.008 | 32 | 0.571 |

Consistent with the earlier finding that the effect of fathers' schooling on child weight gain was stronger in Jimma town than in the rural sites, the effect of fathers' health literacy was stronger when analyses were run on the Jimma town sample alone (beta 0.042, p <.05 compared to beta 0.011, p <.15 in Serbo and Qarsa together).

In the final step of the mediation test, adding fathers' health literacy scores to the model including fathers' schooling and the covariates in Table 9.4 (except for mothers' and fathers' health literacy) reduced the coefficient for fathers' schooling by >50% and also greatly reduced its significance (from beta 0.0098, p = .01 to beta 0.0035, p = .69), while the coefficient for fathers' health literacy declined slightly, and was reduced in significance to a lesser extent (from beta 0.014, p = .06 to beta 0.012, p = .12). When the mediation test was replicated in the Jimma town sample,

adding fathers' health literacy scores to a model including children's age, age squared, mothers' and fathers' years of schooling, and household wealth reduced the coefficient for fathers' schooling by almost 50 % (from beta 0.015, p = .02 to beta 0.008, p = .74), and the the coefficient for fathers' health literacy declined by approximately 25 % (from beta 0.045, p = .07 to beta 0.032, p = .54). This implies that the effects of fathers' schooling on children's weight gain may be partially mediated by fathers' health literacy. The very small number of fathers on whom literacy data were available in the urban site (n = 18), however, means that the results from the urban setting should be interpreted cautiously.

**(4)** ***Is mothers' literacy associated with children's language development?***

As demonstrated in Chapter 7, mothers' years of schooling but not fathers' years of schooling significantly predicted children's language scores at round 1 (when children were 0-13 months old) and at round 13 (when children were 18-33 months old). When mothers' Amharic literacy scores were substituted for mothers' schooling in regression models with children's language abilities at R1 and R13 as dependent variables, they showed a positive and statistically significant relationship at R1 (beta 0.04, p <.05; model containing intercept, age and age squared, and child sex), but a negligible relationship at R13 (beta -0.01, p =.87, equivalent model). In models containing the same biodemographic covariates listed above, controlling for mothers' Amharic literacy had an attenuating effect on the influence of household wealth on children's language abilities at R1, which decreased in strength and significance (beta 0.42, p < .05) when Amharic literacy scores were entered (beta 0.24, p = .21), and urban residence, which declined (from beta 0.53, p < .05 to beta 0.18, p = .52),

suggesting that part of the effect of wealth and urban residence on children's language abilities might be due to mothers' Amharic literacy.

**Table 9.5: OLS regression of child language score at R1, including mothers' Amharic literacy as a predictor**

Dependent variable = Child language score at R1

N = 89

Adj. R^2 = 0.61

Standard error of the estimate = 1.20

| | Beta | SE | p |
|---|---|---|---|
| Intercept | 0.722 | 0.482 | 0.138 |
| child age (months) | 0.561 | 0.155 | <0.001 |
| age-squared | -0.009 | 0.011 | 0.434 |
| child HAZ | 0.193 | 0.086 | 0.027 |
| mothers' Amharic literacy | 0.044 | 0.019 | 0.026 |

However, when mothers' years of schooling were added to the model in Table 9.6, the coefficient for Amharic literacy declined by >75% and fell in significance (beta 0.009, p =.78) while the coefficient for mothers' schooling remained largely unchanged (beta 0.065, p <.05). This suggested that Amharic literacy did not mediate the effect of mothers' schooling on child language abilities, but that there were other aspects of mothers' schooling that contribute to children's language development.

**Summary**

Approximately half of the women in this study were able to read at least a sentence, with the majority language of literacy being Amharic. There was great variation in languages spoken across the 3 sites, with Amharic spoken by more than 90 % of

women in Jimma town but by less than 10 % of women in rural Qarsa. In the combined sample, women's literacy in all languages rose with years of schooling, with the strongest correlation between schooling and literacy for Amharic. Mothers' reading scores in Amharic did not appear to mediate the relationship between mothers' schooling and odds of children's diarrhea in Qarsa, nor did they appear to mediate school effects on children's language development. There was weak evidence of mediation of the effects of mothers' schooling on child WAZ by Amharic literacy in Qarsa. Fathers' health literacy, however, was shown to mediate the relationship between fathers' schooling and children's change in weight over time.

**Discussion**

The weak or nonexistent relationships between mothers' literacy and child health outcomes described here are surprising and run counter to evidence from other studies. In Nepal, for example, mothers' literacy has been shown to mediate mothers' schooling and reported health behaviors (Rowe et al. 2005). In Morocco, Arabic literacy mediated the effect of mothers' schooling on children's HAZ (<5 years) (Glewwe 1998). Studies in rural Guatemala show mixed results for different outcomes; children (<4 years) of mothers with higher literacy suffered fewer respiratory infections (Khandke et al. 1999), but the effect of literacy did not mediate the relationship between mothers' schooling and recommended infant feeding practices (Webb et al. 2009: 302).

The finding that fathers' health literacy, but not Amharic literacy, partially mediated the association between fathers' schooling and children's change in weight was also unexpected. The greater influence of health literacy than Amharic literacy among

fathers suggests that fathers' ability to deal with medical texts and forms in particular may be more important for children's nutrition or illness management than fathers' academic reading abilities. Another study in rural Ethiopia reported that 40 % of child malaria cases were taken to a clinic by fathers as opposed to mothers (Yeneneh et al. 1993). Although we do not have quantitative data on the frequency of fathers' involvement in health seeking for children, I often saw fathers who had come to Serbo health center to seek treatment for their children. Having a father who is familiar with the reading and writing practices of clinics and pharmacies would likely assure faster, more appropriate treatment, and consequently faster catch-up growth among children after illness.

Two important limitations of these analyses are that (1) fathers' literacy data were available on a small number of households (49 in total, and only 18 in Jimma town), and (2) levels of mothers' literacy in the rural sites, where there was evidence of associations between schooling and child health outcomes, were very low, with only 19 % of the sample (8 women) being able to read a sentence of Amharic of whom 2 scored as moderate literate and only one as high literate.

The small number of fathers whose literacy we were able to test was due to the difficulty of finding fathers at home, even on multiple visits to the households over a period of several months. Fathers were especially difficult to find in Jimma town, where the strongest associations between fathers' schooling and children's change in weight were documented. One possible explanation for the association between fathers' health literacy and children's weight gain observed here is that the sample of fathers on whom we have literacy data may be biased in favor of those who were both

more literate and more invested in their children's welfare – interested enough in the research we were doing with their children to meet with us on more than one occasion. This would not explain the greater effects of health literacy than Amharic literacy on children's weight gain, however.

The small number of mothers who were able to read in Qarsa, on the other hand, constrained the statistical power of the analyses in which maternal literacy was a predictor of children's weight for age and odds of diarrhea. It is possible that analyses on a larger sample of rural women might demonstrate stronger relationships between women's literacy and child health outcomes than were apparent in this study. Another factor that could explain the absence of a relationship between mothers' literacy and child health outcomes in this study, however, is the low level of mass media penetration of rural communities. The Ethiopian Ministry of Health has long promoted health education through radio broadcasts in major cities (Kifle 1988), but at the time of this research there was neither FM radio nor television service available in rural Qarsa, which would reduce the potential of literacy to enable women to learn about health or nutrition issues through the media. The fact that less than 10 % of women in Qarsa spoke Amharic meant that they were also disadvantaged in learning to read the language that is most commonly used for medical forms and (after English) for the packaging of medicines used in clinics and pharmacies. For women in these *afaan* Oromo-speaking communities, Amharic (the majority language of literacy in Ethiopia) is essentially a foreign language.

Despite the mixed findings reported here, the potential for mothers' and fathers' literacy to contribute to children's survival remains strong. Although we have

focused on direct applications of literacy to dealings with clinics and learning about health issues, other purposes that might be served by literacy include dealings with water companies and banks. To maintain a household's access to piped water, which may protect children against exposure to diarrheal pathogens, requires a relationship with a bureaucratic institution (the water company, or in the Ethiopian context, the government), which involves management of written contracts. And among families with relatives abroad, which are increasingly common in Jimma, the ability to deal with official forms is also required to secure receipt of remittances through the wire services operated by banks.

The absence of strong mediation effects of mothers' literacy on the relationship between mothers' schooling and child health outcomes raises questions about other aspects of schooling that might explain these associations. In the final chapter we will assess how mothers' schooling might affect their aspirations for their children, as an indicator of the degree to which mothers are invested in their children's development.

Chapter 10

**Developmental expectations**

According to Caldwell's wealth flows hypothesis, the schema of the nuclear family acquired at school alters relationships among parents and children and disposes parents to invest more intensively in children and to expect lesser contributions from children to the household economy, with implications both for family size and for children's survival. We saw in Chapter 4 that the schema of the nuclear family is current in Ethiopian school textbooks and classroom discussions. A next step in testing this hypothesis is to investigate whether mothers with more schooling expect their children to take part in less household work.

A second hypothesis relating school experience to intensity of parental investment rests on the schema of competition and awareness of the economic and status advantages to be gained from success in school (the academic-occupational schema) (LeVine & White 1986). In Chapter 4, I discussed the themes of effort and initiative, and thrift and industry, represented in textbooks and class discussions. These I suggested are congruent with a schema of competition and achievement that is promoted by the school, and which, together with awareness of a changing economic landscape, might lead mothers to invest more intensively in their children's health and development, in expectation of a new set of challenges to attaining economic self-sufficiency in adulthood. A next step in testing the competition hypothesis is to see whether women with more schooling envision their children's life courses in terms of preparation for waged employment.

We will concentrate first on assessing the range of variation in developmental expectations among mothers in the study across urban and rural sites, by children's gender, and among mothers with and without schooling. Subsequently we will assess whether differences in mothers' expectations for their children's development are associated with children's growth and language abilities.

**Background and methods**

Inspiration for assessing mothers' ideas about children's development came in part from the work of other scholars who have investigated schemas of the life course as influences on demography and health (Brown et al. 2009; Super & Harkness 1997; Weisner 2002). Further inspiration came from observing the elder brothers and sisters of children in the longitudinal study. In Jimma town, practically all children above 7 years old were attending school and many of younger children were enrolled in Kindergarten; in the countryside fewer attended school, and there were no Kindergartens. Many rural children seemed to take on impressive practical responsibilities in their households. An entry from my fieldnotes describes some of the activities that formed part of the round of daily life in rural communities: "girls carrying jerrycans on their way to fetch water, other girls carrying produce to market, boys herding cattle together…." In the city too, many children were contributing to household work, e.g. taking care of younger siblings, or helping their mothers with cooking; others were out on the streets selling peanuts or shining shoes. This degree of involvement of children in productive activities is typical of many developing country settings (Weisner & Gallimore 1979; Nieuwenhuys 1994) but, as Caldwell observed, it is less common in populations with higher levels of participation in mass schooling.

Asking mothers about the activities they expected their children to engage in in the short term, as well as their aspirations for children's long-term development, seemed to offer a way of assessing whether a distinctive schema of the life course had been acquired in the course of women's schooling, which might affect their health behaviors; at the same time it offered the possibility of testing a component of the wealth flows hypothesis.

The approach to assessing mothers' expectations for their children's development that we adopted resembled the Developmental Expectations Questionnaire (DEQ) (Hess et al. 1980, 1981; Edwards et al. 1994), but was organized around a different set of domains. The procedure for the interview was to walk mothers through their children's life course (birth - ~20 years), and ask them about a series of 41 activities or milestones, divided into 7 blocks: early developmental milestones (e.g. walking and talking), household activities (e.g. cleaning the house), activities outside the home (e.g. plowing, taking goods to market), religious rituals and ceremonies (e.g. christening and circumcision), formal education, adult occupations, and reproduction. In each case mothers were asked whether they expected their children to perform each activity, and if so, at what age. Figure 10.1 shows two of the icons developed to represent these activities.

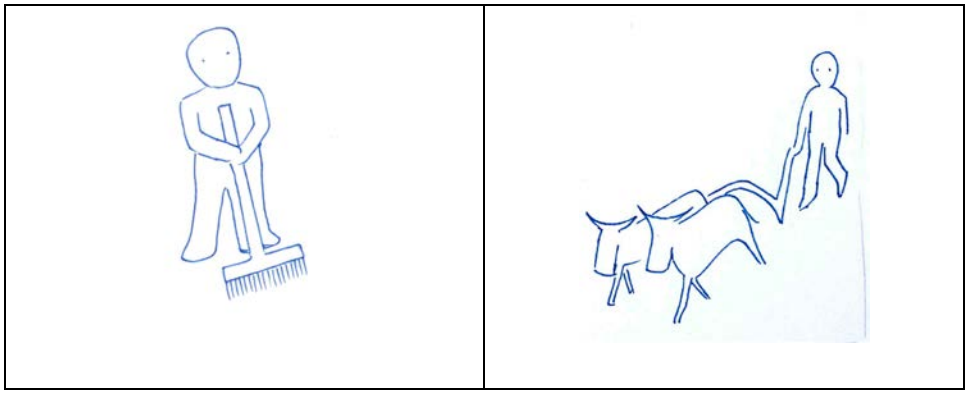


**Figure 10.1: Examples of activity icons used in the developmental expectations interview: cleaning the house (left) and plowing (right)**

Icons were printed on cards of approximately 11 x 9 cm, and as we proceeded through the interview each card was placed on a time line corresponding to the child's life from birth to approximately 20 years of age. This helped to sequence the activity items in relation to one another. Figure 10.2 shows a time line with icons arranged on it according to the responses of one mother in our study.

**Figure 10.2: Time-line showing a sequence of activities and life events, representing the expectations of a mother in Jimma for her child**

On the timeline in Fig. 10.2, the mother placed cleaning the house at 5 years old, beginning school and practicing *salat* (daily prayers) at 7, and caring for a baby when adults were not present at 8. Respondents appeared to have no difficulty estimating the ages at which children might begin performing different activities, and seemed to find the icons recognizable.

***Mothers' expectations of children in urban and rural sites, and for girls and boys***

Rural mothers expected children to get involved in household tasks earlier than did those in the city, e.g. children being sent on errands and carrying messages from house to house beginning before 6 years old on average (mean 5.8 [SD 2.5]), compared with over 8 years old in Jimma town (8.5 [SD 4.4]). The exceptions were typically urban activities: shining shoes and selling goods on the street.

Girls were generally expected to begin working earlier than boys (e.g. cleaning the house from 4.6 years old on average, compared to 5.6 years old for boys). A subset of activities were exclusively gendered, e.g. pounding with a mortar (girls only) and plowing (boys only). Marrying and having children were both estimated at younger ages for girls than for boys, which fits the facts of wives usually being younger than husbands. (Fathers in this study were 10 years older than mothers on average.)

***Is mothers' schooling associated with developmental expectations for children?***

A summary of mothers' responses to a selection of the activity items in the interview, disagreggated by mothers' schooling ("educated" vs. "uneducated": any schooling vs. no schooling), is shown in Table 10.1. The columns headed "endorsement"

represents the proportion of mothers who predicted that their children would take part in a particular activity. "Estimated age of performance" represents mothers' expectations of the age at which children would begin each activity, and "correlations with years of schooling" indicates the degree to which earlier versus later estimates of ages at beginning these activities were related to the length of mothers' school experience.

**Table 10.1: Predictions of children's activities and developmental milestones, by mothers' schooling**

| Activity / milestone | Endorsement | | Estimated age of performance (years) | | | | Correlation with years of schooling | |
|---|---|---|---|---|---|---|---|---|
| | Educated | Not educated | Educated | | Not educated | | | |
| | proportion | proportion | mean | s.d. | mean | s.d. | Pearson r (1-sided) | Signif. |
| care for baby | 0.88 | 0.95 | 7.1 | 3.1 | 7.1 | 2.2 | -0.08 | n.s. |
| cook food | 0.79 | 0.67 | 10.1 | 3.1 | 10.1 | 2.5 | -0.01 | n.s. |
| wash clothes | 0.96 | 0.98 | 11.5 | 3.5 | 11.3 | 2.9 | 0.08 | n.s. |
| clean house | 0.89 | 0.79 | 4.7 | 2.8 | 5.8 | 3.2 | -0.25 | ** |
| pound mortar | 0.59 | 0.56 | 12.4 | 3.4 | 11.7 | 2.9 | 0.22 | * |
| shine shoes | 0.39 | 0.33 | 12.2 | 4.5 | 15.0 | 4.1 | -0.32 | * |
| start school | 1.00 | 1.00 | 7.1 | 1.9 | 7.9 | 3.0 | -0.30 | ** |
| school grade attained | 1.00 | 1.00 | 11.1 | 1.4 | 10.9 | 1.5 | 0.09 | n.s. |
| marry (female) | 1.00 | 1.00 | 24.8 | 4.9 | 20.2 | 3.7 | 0.32 | * |
| marry (male) | 1.00 | 1.00 | 27.6 | 6.5 | 26.8 | 7.7 | 0.09 | n.s. |
| have child (female) | 1.00 | 1.00 | 27.6 | 4.6 | 24.1 | 4.5 | 0.23 | * |
| have child (male) | 1.00 | 1.00 | 30.0 | 7.1 | 29.0 | 7.0 | 0.05 | n.s. |

Key: * significant at p <.05, ** significant at p <.01. "Educated" = any schooling.

Among mothers' predictions of household work activities there was little difference between those with any schooling and those with none: cooking food, caring for a baby when adults were not present, and washing clothes were endorsed by similar numbers of women in each group, and their estimated ages at starting these activities were not significantly different. Women with any schooling were actually more likely to endorse children cleaning the house (89 % versus 79 % endorsing) and predicted that their children would begin a year younger on average than did women without schooling (4.7 [SD 2.8] years vs. 5.8 [SD 3.2]).

Mothers with and without schooling expected their children to study for a similar number of years (up to $10^{th}$ or $12^{th}$ grade), but mothers who had themselves been to school expected their children to start school younger (at 7.1 [SD 1.9] as opposed to 7.9 [SD 3.0] years old) on average. Differences in predictions of later life events, including marrying and having children, were substantial only for female children (mean 24.1 [SD 4.5] vs. 27.6 [SD 4.6] years). While mothers with and without schooling predicted roughly similar ages at marriage and fatherhood for boys, mothers without schooling expected their female children to marry and have children younger than did mothers with schooling.

Among careers, doctor was by far the most common response among mothers with and without schooling alike. There was, however, a wider range of occupations nominated by mothers with schooling (including engineer, nurse, office worker, banker, and psychology teacher) than by those without schooling, for whom three occupations (doctor, teacher, and government worker) almost exhausted the range of answers.

The prediction of the wealth flows hypothesis, that mothers with schooling should expect lesser contributions to domestic work from their children, was not supported by these data, which did not show substantial differences between mothers with and without schooling either in the number of chores endorsed or in expected ages at beginning domestic work. The competition hypothesis, on the other hand, was partially supported in that women with more schooling nominated a wider range of waged occupations that children might pursue and estimated earlier ages at which their children should start school – consistent with a life plan that prioritizes education and the careers to which it offers access. Although almost half of mothers overall (48% of those with any schooling, and 41% of those with none) predicted that their children would start school at age 7 (the legal minimum age), the predictions ranged from 2 to 20 years overall, and from mean 8.3 (SD 2.6) years among mothers with at the lowest level of primary education (grades 1-4) to 6.2 (SD 1.0) years among mothers with >10 years of schooling.

In the following section we consider the age at which mothers expected children to start school as a potential marker of the schema of competition acquired at school, and investigate its relationships to children's physical growth and language development. The hypothesis is that expectations of earlier ages at starting school will be associated with greater weight for age and more precocious language development, as a result of mothers who expect their children to start school earlier investing more effort in supporting their children's development.

***Are mothers' developmental expectations associated with children's growth status?***

In assessing the relationship between mothers' expectations of children's ages at starting school and children's WAZ, I followed a similar procedure as for the tests of literacy effects on child growth: first adding the predictor of interest to models including only the intercept and age terms, and then adding biodemographic covariates if the relationship proved to demonstrate the hypothesized qualities, i.e. an inverse relationship with growth (earlier expected ages at starting school predicting higher growth z-scores). In models with WAZ as the dependent variable, expected age at starting school passed these tests, demonstrating a substantively significant relationship (-0.14, $p < .05$). Next I investigated patterns across the study sites. In Jimma the hypothesized relationship was not borne out, with the ages at which mothers expected children to start school being positively rather than inversely related to child WAZ (beta 0.10, $p < .10$). In Qarsa, however, the predictor was inversely related to WAZ (beta -0.13, $p = .09$), controlling for biodemographic covariates (Table 10.2).

**Table 10.2: Regression of child WAZ, with age at which mothers expect children to start school as a predictor, in rural Qarsa sample**

Dependent variable: child weight for age z-scores (WAZ) relative to WHO standards

subjects = 41, observations=472

AIC = 1069.3

| | Beta | SE | p |
|---|---|---|---|
| Intercept | -7.911 | 4.566 | 0.092 |
| child age (months) | -0.215 | 0.095 | 0.025 |
| age-squared | 0.015 | 0.007 | 0.033 |
| age-cubed | 0.000 | 0.000 | 0.039 |
| child sex (male = 1) | -0.283 | 0.336 | 0.405 |
| mother's weight (kg) | 0.019 | 0.032 | 0.555 |
| mother's height (cm) | 0.051 | 0.030 | 0.096 |
| expected age start school | -0.131 | 0.075 | 0.091 |

Entering expected ages at starting school into a model with mothers' schooling (in years) caused the coefficient for mothers' schooling to fall by >50% and also to fall in significance (from beta 0.15, p = .11 to beta 0.05, p = .62), while the coefficients and significance of the predictor of interest remained little changed (beta -0.12, p = .13). This suggested that mothers' developmental expectations for their children might partially mediate the effects of schooling on children's growth status in the rural context of Qarsa.

**(2)** ***Do mothers' developmental expectations predict children's language development?***

In Chapter 7 we saw that mothers' schooling was associated with higher language development scores among children at rounds 1 and 13 of the survey (0-13 months and 18-33 months). To assess whether mothers' expectations of their children's

development mediated this relationship, I added children's expected ages at starting school to OLS regression models with language scores at R1 and R13 as dependent variables. Expected ages at starting school proved to be inversely associated with child language scores at R13 (Table 10.3), although not at R1.

**Table 10.3: OLS regression of child language scores at 18-33 months, with age at which mothers expect children to start school as a predictor, combined sample**

Dependent variable = Child language score at R13

N = 99

Adj. R^2 = 0.41

Standard error of the estimate = 3.71

| | Beta | SE | p |
|---|---|---|---|
| Intercept | -4.998 | 15.99 | 0.755 |
| child age (months) | 1.329 | 1.296 | 0.308 |
| age-squared | -0.012 | 0.026 | 0.635 |
| child HAZ | 0.347 | 0.231 | 0.135 |
| expected age at starting school | -0.373 | 0.156 | 0.019 |

The effect of expected ages at starting school on child language development was robust to control for household wealth, but was attenuated by control for urban residence. Adding mothers' years of schooling to the model in Table 10.3 caused the coefficient for expected ages at starting school to decline slightly in strength but it remained borderline statistically significant (beta -0.32, p = .051), while the coefficient for mothers years of schooling fell by 25% (to beta 0.15, p = .12) and also decreased in significance compared to a model containing child age, age squared, and HAZ (beta 0.19, p <.05). This constitutes weak evidence of mediation effects of mothers' expectations of children's ages at starting school on the relationship between

mothers' schooling and children's language abilities between 18 and 33 months of age.

***Note:*** Further analyses of expected age at starting school as a predictor of children's change in weight and likelihood of diarrhea over the course of the study produced null results.

**Summary**

Evidence from observation in primary schools suggested that schemas of the nuclear family and of competition were encountered in schools in Jimma. As a next step in testing the hypothesis that these schemas might affect mothers' expectations for their children's development, with implications for the intensity of maternal investment, we examined relationships between mothers' schooling and expectations of children's future activities. The finding that mothers' schooling was not associated with a decrease in the number of domestic work tasks expected of children or an increase in the ages at which children were expected to take responsibility for these tasks, conflicts with the prediction of the wealth flows hypothesis that schooling should lead to lesser emphasis on children's involvement in household labor. The alternative hypothesis suggested here, that school leads to the internalization of a schema of competition and expectations of children's involvement in waged employment, found partial support in the wider range of waged occupations nominated by women with schooling and the earlier ages at which they expected to enroll their children in school. When age at which mothers expected children to start school was used as a predictor in regression models, this revealed relationships in the hypothesized directions to child WAZ in Qarsa and to child language development at R13 in the

combined sample. In the case of child WAZ, expected age at starting school potentially mediated the effect of mothers' schooling on child growth. In the case of language scores, expected aged at starting school did not appear to mediate the effect of mothers' schooling on language development. Nor did expected ages at starting school not show relationships in the hypothesized direction in Jimma town in relation to WAZ, or in relation to change in weight or likelihood of children's diarrhea.

**Discussion**

This chapter demonstrated one approach to assessing mothers' attitudes that might be acquired at school and operationalizing them so as to compare them against other factors, such as wealth, explicit knowledge, or literacy skills, as influences on maternal health behaviors and child health. A problem that other researchers have encountered in studying parents' aspirations for their children is that stated expectations may not correspond to practice. Goodnow et al. (1984), for example, found that Lebanese-Australians valued early schooling, but were unlikely to send their children to Kindergartens. In Ethiopia too, parents tend to espouse positive attitudes towards schooling whether or not they have been to school (Daniel Bekele 2004: 106), and even if they do not send their children to school (Weir 2000).
By asking mothers about a broad range of activities that children might take part in between infancy and adulthood, we attempted to capture developmental expectations more generally, rather than just educational aspirations in particular.

The fact that mothers in both urban and rural sites, and with variable levels of schooling, appeared to have no difficulty estimating the ages at which children might begin performing the activities included in the developmental expectations interview

– and that they could provide estimates for the 41 activity items within a short period without needing to contemplate each item at length – suggests that the interview may have tapped an existing schema (or network of schemas) about the life course, rather than each activity being considered in isolation.

By selecting a single item from this list, i.e. the age at which mothers expected children to start school, and examining its relationship to mothers' schooling, to children's physical growth and language development scores, I demonstrated some of the potential applications of data such as these. Future research using similar methods could help to evaluate the contributions of attitudes acquired at school to maternal health behavior.

A limitation of age at starting school as a marker of the schema of competition is that it is likely strongly constrained by the availability of Kindergartens, which are present in Jimma town but not in rural Qarsa, and therefore contains built-in urban bias. This is also the case, however, with many other correlates of schooling – including Amharic literacy.

Despite this limitation, there does seem to be a case for considering age at starting school as a marker of a distinctive schema of the life course. The first grade class that I observed in Jimma included children ranging from 7 to 17, with the eldest students usually having begun late and repeated some years. For children of 7 years old, the transition to first grade and the adaptation to the environment of the school may be smoother than for older children, and it provides them with extra time in which to learn the culture of the school, to equip themselves for an academic-occupational life

course, and – for girls – to progress in studies before they are at risk of being married off by their parents, or becoming pregnant (cf. Entwhistle et al. 2004). As described in Chapter 3, some mothers in this study had themselves dropped out of school on account of marriage or pregnancy.

The fact that expected age at starting school showed evidence of partially mediating the relationship between mothers' years of schooling and children's WAZ in Qarsa suggests that, like literacy, the schema that it indexes could affect parenting behaviors including child feeding or preventive or curative health behaviors. The absence of the hypothesized relationships in the case of other health outcomes (language development, diarrhea incidence, and change in weight) weakens the case for expected age at starting school as being a key element in developmental expectations that might motivate more intensive parental investment. Future research might use similar methods to assess how other attitudes acquired at school are related to parents' health behaviors and children's health outcomes.

## Conclusion

> A large number of studies have shown, almost as convincingly as anything can in the social sciences, that a mother's education has an independent, strong and positive impact on the survival of her children. Nevertheless, unless the mechanisms whereby maternal education is converted to low child mortality can be worked out, some researchers will continue to doubt the finding. (Caldwell 1994: 224)

This project attempted to explain the effects of mothers' schooling on children's survival in Ethiopia. The theories that guided the research included the framework of Knowledge, Attitudes, and Practices, and theories of Marx and Weber that offered the potential of placing women's schooling and parental health behaviors in macrosocial context. By combining longitudinal study of children's development with observation of activities in primary schools, and descriptions of childcare in selected families, the dissertation attempted to test hypotheses derived from these theories and to place women's schooling and child survival in the socio-economic context of contemporary Ethiopia.

The principal findings of the longitudinal survey were that community-level factors were more powerful influences on children's health than mothers' or fathers' schooling. These community-level factors included wide disparities in access to medical services and piped water between urban and rural communities, and probably also reflected differences in diets, with a constrained range of foods available in rural communities. Patterns of child illness and growth differed markedly between urban and rural communities, with higher prevalence of most illnesses in the city, but higher rates of growth impairment among children in the rural sites. Relationships between mothers' schooling and child health outcomes also varied in strength and significance

between the urban and rural settings, as did the factors that appeared to mediate them. Table 11.1 lists the principal findings of the project, with the hypotheses for which most support could be mustered at the top of the list.

**Table 11.1: Summary of findings**

| Predictor | Health outcome (dependent variable) | Hypothesis confirmed? | Sites | Mediator |
|---|---|---|---|---|
| Fathers' schooling | + change in weight | yes | all sites | health lit |
| Mothers' schooling | + weight for age (WAZ) | yes | rural | dev exp? Amh lit? |
| | + language development score | yes | all sites | dev exp? |
| | - child ever has diarrhea | yes | rural | ? |
| | always use ORS to treat diarrhea | yes | urban | ? |
| | + know ORT | yes | all sites | ? |
| | + use ORT | no | all sites | |
| | + know Coartem | no | all sites | |
| | + use Coartem | no | all sites | |
| | + height for age (HAZ) | no | all sites | |
| | + weight for height (WHZ) | no | all sites | |
| | + change in weight | no | all sites | |
| | - frequency of all illnesses | no | all sites | |
| | - frequency of diarrhea | no | all sites | |
| | - age at independent walking | no | all sites | |

*Key*:

"Mothers' schooling" / "fathers' schooling" = years of schooling

Mediators:
"health lit" = fathers' health literacy score;
"dev exp" = developmental expectations (age at which child is expected to start school)
"Amh lit" = mothers' Amharic literacy score

"urban" = Jimma town; "rural" = Qarsa wereda; "all sites" = both urban and rural

The label “hypotheses confirmed” in the table of findings should be considered tentative. In reporting the relationships between parents’ schooling and child health I used liberal criteria in defining statistical relationships, and in some cases I ignored conventional standards of statistical significance and based my interpretations on beta values alone, on grounds of substantive significance (Achen 1982). According to these criteria, the hypothesized connections between mothers’ schooling and children’s health outcomes that were confirmed were as follows: in the rural setting there was a positive relationship between mothers’ schooling and child weight-for-age (WAZ), and an inverse relationship between mothers’ schooling and odds of child diarrhea. In data from the urban and rural sites combined, mothers’ schooling was positively related to children’s language development, and fathers’ schooling was positively associated with children’s change in weight over time. The association between fathers’ schooling and children’s change in weight appeared to be mediated by fathers’ health literacy, and the relationships between mothers’ schooling and children’s WAZ and language development were shown not to be mediated by mothers’ Amharic literacy (or, in the case of WAZ, only weakly so), but child WAZ was potentially mediated by mothers’ developmental expectations, i.e. the age at which mothers expected children to begin school.

In sum, while 6 hypothetical pathways were supported, a further 9 were not supported, including the propositions that mothers’ schooling would predict more use of recommended therapies for diarrhea and malaria, lower incidence of child illnesses, earlier age at first walking, and greater height for age and weight for height. The weakness or absence of statistical associations for these pathways between maternal schooling and child health outcomes may be considered as one of the most important

findings of this study. As indicated by the words of Caldwell (1994) quoted at the beginning of this section, the strength and consistency of the relationship between mothers' schooling and child survival is frequently asserted, and is sometimes assumed to be stronger than all other socio-economic influences, including lack of access to medical services (e.g. Caldwell & McDonald 1982). Several other studies before this one have demonstrated threshold effects in the relationship between mothers' schooling and child survival, most of them in sub-Saharan Africa (e.g. Millard et al. 1990; van den Broeck 1996; cf. Jejeebhoy 1995). Few other studies, however, have investigated these cases in depth to assess potential explanations.

One possible explanation for the lack of support for several of the proposed hypotheses that must be acknowledged is the small sample size of the study. Sample size constituted the greatest limitation when it came to assessing the influence of correlates of mothers' schooling in rural Qarsa, where only one woman out of 53 had more than 4 years of schooling. This made it particularly difficult to assess the potential mediation of school effects by literacy, since the range of literacy abilities among rural women was so low.

In other respects, however, there is reason to be confident in the data gathered for this study, both on grounds of external quality checks, and on account of the longitudinal design of the project. In the sample as a whole, reports of mothers' schooling were significantly correlated with directly assessed literacy scores; children's ages were cross-checked against local event calendars; prevalence of diarrea by age showed the same inverted-U pattern by age that is documented in many other settings; and the multiple measures of growth taken over the course of the study tended to minimize

the risk of measurement errors. However, the data on children's language abilities currently available for analysis, which came from only two rounds of the study, and included children with a wide range of ages, should be considered less reliable.

The mixture of qualitative and quantitative methods used in this study provide extra credibility for the findings. Some support for the mechanism connecting parents' schooling to child language development, for example, was derived from the observation of the game of naming body parts in English, which was observed both at primary school in Jimma and in Binyam's home. The observations of hygiene drill in primary school lend support to the hypothesis that mothers' schooling should lead to lower odds of child diarrhea. And the familiarity with the local environment that I gained from living and working in Jimma for more than 2 years helped in interpreting the strong statistical effects of urban versus rural place of residence on children's health. My assertions that the study communities differed greatly in access to health services and clean water (and in language and culture), for instance, are based not only on survey data but also on cumulative experience.

In summary, the contrast between the many potential influences on health demonstrated through school observations and the weak effects of parents' schooling on child health demonstrated in the longitudinal survey suggests that the community-level factors, such as absence of piped water and obstacles in accessing medical services, may overwhelm the potential benefits for children's health that might otherwise follow from learning that occurs in school. This core finding has implications both for theories of maternal schooling and child mortality decline and for education and public health policies in Ethiopia and the developing world.

*Implications for theory*

Knowledge, Attitudes, and Practices, which is the most influential explanatory framework in studies of maternal schooling and child survival in the public health and demography literature, was explicated in this dissertation through the example of health content learned in school, leading to use of ORS to treat bouts of child diarrhea. Analyses demonstrated that the prediction that women's schooling should increase knowledge of ORS was supported, but neither knowledge of Coartem nor use of ORS or Coartem in treatment of diarrhea or malaria were significantly more common among women with schooling. It is nevertheless possible that other kinds of health knowledge, and other attitudes including a sense of autonomy among women, may be more widespread among women with more schooling, with effects on household hygiene, feeding, or care-seeking in time of illness (Das Gupta 1995; Jejeebhoy 1995).

Modernization theory was engaged in the form of Caldwell's wealth flows hypothesis, which predicted that a schema of the Western nuclear family encountered in school should lead to strengthened emotional attachments between parents and children, and consequently to greater investment in children's health. While school observations demonstrated that the nuclear family was a salient theme in primary school texts and discourse, interviews with mothers about their expectations for children's activities in future showed that women with schooling did not expect significantly fewer contributions to household work from children, or for children to start contributing at later ages. It is possible, however, that the schema of the family encountered at school may lead to increased investment in children without affecting expectations of children's work. Future research to test this pathway should

incorporate direct assessment of household resource allocation in addition to measures of parents' attitudes to children's work.

Marxism was invoked in this dissertation in the form of the selection hypothesis, which emphasized the importance of background characteristics of women who had attained higher levels of schooling, including better health and wealth, and the structural confounding hypothesis, which highlighted the pervasive influence of place of residence, particularly the disparity in access to medical services in rural compared to urban environments, on children's survival. Since the most malnourished children and the least educated mothers are clustered in rural communities, there is great potential for structural confounding in the Jimma area. When data were disaggregated by residence, and household wealth was accounted for, the independent effects of years of mothers' schooling on children's weight for age (WAZ), however, emerged as stronger in rural communities than in Jimma town, suggesting that the school experience of women in these rural areas, ranging from 1 to 5 years, might have a real influence on their health behaviors and thus their children's risks of mortality. This relationship was all the more remarkable because the same or higher levels of schooling among men in rural communities had no discernable influence on child health. There remains a possibility, nonetheless, that the association between mothers' schooling and child WAZ in these communities was due to selection effects based on conditions of wealth and health in mothers' natal homes.

The theory that informed the competition hypothesis, the theory of life chances derived from Weber, suggested that the expansion of schooling underway in Ethiopia represents the opening up of a new configuration of options on the one hand (for

example opportunities for waged employment in the city or abroad and increased autonomy in relation to kin and natal community), and ligatures on the other (for example dependence on the availability of waged labor to make one's living, and a new set of obligations and attachments to the state) (Dahrendorf 1979). The earlier ages at which mothers with schooling expected their children to start school, I suggested, might reflect their endorsement of their children pursuing lives along these lines. The evidence that age at starting school potentially mediated the relationship between maternal schooling and child WAZ constituted support for this interpretation. The mechanism connecting expected age at starting school to maternal health behaviors is, however, indirect and speculative, resting on observations of the competitive environment of the school, but also on as yet untested assumptions about how this might affect investment in children. The developmental expectations interview demonstrated a way of approaching research on motives or attitudes acquired at school that might mediate between maternal schooling and child health. Other investigations in this vein could help to evaluate the relative importance of mothers' attitudes or motives as opposed to skills, knowledge, or credentials acquired at school for influencing children's health.

Weber's theory of bureaucracy, which directs our attention to the similarities in forms of communication between schools and clinics, informed the program of literacy testing in this project. Surprisingly, although mothers' schooling was closely correlated with academic literacy abilities, especially in Amharic and English, and with health literacy abilities as measured by a test of interpreting items such as medicine packets and hospital forms, none of the relationships between mothers' schooling and child health could be explained in terms literacy abilities. The only

relationship in which literacy fulfilled the criteria of statistical mediation was between fathers' schooling and children's change in weight, and in this case fathers' health literacy, but not academic literacy in Amharic, was a significant predictor. This finding is challenging to explain, partly because change in weight could reflect either catch-up growth after illness or short periods of saltation in children's growth trajectories. One possibility is that the association is due to more appropriate management of children's illnesses and faster recovery after illness among children whose fathers are able to negotiate effectively with health systems. The role of fathers' schooling as an influence on child health is a relatively neglected subject, and deserves further investigation.

*Commonalities among theories*

Although I have concentrated on the differences in the implications of the various theories that might explain the relationship between mothers' schooling and child survival, there are also important commonalities among them. Both KAP and the Weberian theories of bureaucratization, for example, point to the importance of literacy skills learned at school in helping mothers access information and negotiate with health institutions. The wealth flows and competition hypotheses both predict greater efforts invested in protecting the health of individual children. Important theories that I have not addressed in depth here include women's autonomy (which overlaps in part with Marxism) and human capital (Becker 1983), a rational actor approach that overlaps with KAP. The findings of this project do not rule out any of the theoretical pathways between parents' schooling and child survival discussed here, but provide support for the bureaucratic socialization and competition hypotheses derived from Weber, for LeVine's pedagogic childcare hypothesis, and

for the structural confounding hypothesis derived from Marx. There is no reason to assume that these pathways between parents' schooling and child survival are mutually exclusive, and much reason to assume that they have interactive effects.

*Policy implications*

The policy implications of this research for Ethiopia include the promotion of mass schooling as a means of combating child mortality. Adult literacy programs, which have a history in Ethiopia extending back to the 1960s (Alem 1996), might assist in the project of spreading literacy. Such programs could be complemented by collaboration with the religious institutions that constitute important foci of community activity throughout the country – including in areas where government institutions are relatively scarce – to promote nonformal education (i.e. vocational or literacy training conducted outside of conventional school settings), as advocated by Tekeste (1996). Distilled versions of the health education lessons currently offered at schools, for instance in relation to hygiene and infectious disease, might be incorporated in such programs, to spread the potential benefits to sections of the population who have as yet had little contact with schools. To be accessible to the greatest number of people, these programs should be conducted in local languages, such as *afaan* Oromo, rather than in Amharic.

This dissertation also shows that there are strong effects on children's health from factors other than parents' education – for instance, the great burden of infection from illnesses associated not so much with ignorance or illiteracy as with poverty and structural barriers to accessing medical care, the high risks of malaria, and the pervasive malnutrition that affects a majority of children in Ethiopia. This suggests

that expanding schooling alone is not an adequate response to securing child survival. Simultaneous efforts to improve the efficiency of medical services, to reduce the barriers of access to these services to the poor, and to support sustainable agricultural development and the provision of meaningful, remunerative work are also essential to improve the life chances of people in Ethiopia.

One important component of programs to improve the efficiency of medical services would be to teach medical professionals how to interact more effectively with patients who are unfamiliar with the communicative routines of the clinic. The story of Amina, whose son died of malaria despite her obtaining medicine that could have saved his life, suggests that miscommunication in the clinic setting can have tragic consequences. Had the nurse who prescribed Coartem to Amina explained clearly how she should crush the pills (or shown her how to do it) before giving them to Abi, his life might have been saved. The case for doctors being sensitive to the perspective of patients in the intercultural dialog of the clinical encounter has been made forcefully in the context of multicultural Western societies (e.g. Kleinman & Benson 2006); it is no less important in developing countries where doctor and patient are often communicating across a divide between the schooled and the unschooled, in addition to barriers of language and ethnicity.

Education is valuable in its own right, and policy decisions about schooling should not rest only on its relationship to health or to economic development (Highet 1954; Wolf 2007). For children's health, faster and more direct interventions than schooling exist: interventions such as vaccination campaigns and health outreach can reduce child mortality in the absence of increases in women's schooling (Kundstadter et al.

1992; Levine 2004; Muhuri 1995). Women's schooling is attractive because it appears to offer the prospect of righting two wrongs at once – the limitations on women's access to literacy and life chances, and the limitations on children's prospects of survival – and offers the potential of promoting human capital development at the same time. And yet unless we acknowledge the contribution of selection effects and structural confounding to the associations between maternal schooling and child survival, we will likely overestimate the benefits of investments in women's schooling for child health that are due to schooling *per se*. In the worst scenario, this misestimation may skew policy priorities so that education for relatively privileged, urban minorities is financed on the basis of "regressive taxation" from disadvantaged rural populations (Illich 1971).

*Suggestions for future research*

To clarify the potentials and the limitations of women's schooling to safeguard children's survival in the face of threats of poverty and infectious disease, there is more that could be done using existing quantitative datasets, especially the Demographic and Health Surveys. As yet, there is, for example, no published equivalent for *under-five* mortality of Desai & Alva's (1998) analysis of the influence of community-level factors (the clusters used as sampling units in the DHS) on *infant* mortality. Data are becoming available from a growing number of countries, including multiple rounds of nationally representative data (e.g. for Ethiopia in 2000 and 2005). More sophisticated methods for assessing statistical mediation exist (e.g. Preacher & Hayes 2004), and ought to be employed in future.

Getting inside the "black box" between mothers' school experience and child survival, however, will also require more research in each of the settings investigated in this dissertation – the school, the home, and the clinic – and replicating the process in other countries with differing levels of women's schooling, and under differing social and economic conditions. One model for such a project is the work of LeVine and colleagues (2001; in press), which has focused on the literacy pathway between schooling and child health, with parallel studies in Mexico, Venezuela, Zambia, and Nepal. With the exception of the Nepal and Mexico study sites, the study communities in LeVine's project were selected partly on the basis of unusually high levels of schooling, which permitted assessment of the relationship between a full range of women's schooling and behavioral outcomes. This dissertation points to the value of including communities with generally low levels of schooling and with sharply contrasting access to medical services and waged employment. In an ideal study design, families should also be followed across generations, to account for selection effects of natal homes. A research project that includes all of these components has yet to be carried out. Ethiopia, where the majority of the population is only now gaining access to schooling, would be an appropriate setting for such a project.

The systematic observation of classroom activities conducted for this dissertation has rarely been used as part of research directed at questions of demographic behavior (*pace* Johnson-Hanks 2006). More extended observations in schools might help to identify particular health topics that are most heavily reinforced, which could serve as a better foundation for focused investigation of domestic health behaviors. To identify corresponding domestic behaviors would also require attention to parents'

interpretations of signs and symptoms of diseases (e.g. acute diarrhea, acute respiratory infections, and malarial fevers), and detailed accounts of management of illness bouts. Similarly, identifying parental behaviors associated with improved nutrition would require systematic observation of feeding behaviors (as e.g. by Guldan et al. 1993).

Observing interactions between parents and health providers in clinical settings is also important for assessing how schooling affects parents' negotiation with health systems. While elicitation of health narratives, and their scoring in terms of clarity and organization by health professionals, has provided support for the hypothesis that schooling and literacy assist in these negotiations (Schnell-Anzola et al. 2005; LeVine et al. in press), following mothers and children in actual encounters with health professionals would give a better sense of the obstacles that women face in these settings, and the ways in which they may deploy school learning in addition to the use of decontextualized language. As the story of Amina and Abi demonstrated, misunderstandings in the clinic can have fatal results.

Combining ethnographic methods with survey methods in future research should help illuminate influences on children's health that might otherwise be overlooked, for instance the role of literacy skills in the ability to negotiate with officials for the installation of a water pipe or to secure a pay check, or attitudes acquired as school that might lead to new motives and effort invested in childcare. The diversity of influences on child health that were highlighted in the ethnographic vignettes in this dissertation included marital strife and *qat* use (as in the case of Fatuma), the support and attention provided to children by neighbors or siblings (as in the case of Sitina

and Biqiltu), and the positive, engaged role of some fathers in caring for their children (as in the case of Teodros and Binyam). Theories that purport to explain relationships between mothers' schooling and children's health and survival find their ultimate test in explaining the forces that play out the lives of families and children such as these. And it is these families and children whose lives, and life chances, are at stake in policy decisions about education and health.

Appendix 1

**Table of events in the history of Jimma and Ethiopia**

| | |
|---|---|
| 1500s | Oromo migration to the Gibe region of Ethiopia |
| 1800s | founding of the Oromo kingdom of Jimma |
| | Islamic revival in Sudan spreads to western Ethiopia;<br>Jimma converted to Islam |
| 1884 | Battle of Embabo hands western Ethiopia to king Menelik of Shewa;<br>Jimma is incorporated in Abyssinian empire as a semi-autonomous state |
| 1898 | forces of Emperor Menelik defeat Italians at Adwa,<br>preventing European colonization of Ethiopia |
| 1905 | opening of first government school in Addis Ababa |
| 1930 | coronation of Ras Tafari as Emperor Haile Selassie I |
| 1932 | death of King Abba Jifar II of Jimma;<br>Haile Selassie incorporates Jimma in his empire under Amhara governorship |
| 1932 | opening of first girls' school in Ethiopia |
| | opening of first school in Jimma |
| 1936 | Italian occupation of Ethiopia; all schools closed to Ethiopians. |
| | Italians expand national road network |
| | Italians lay out town plan of modern Jimma |
| 1942 | Italians ejected from Ethiopia by combined Ethiopian and British forces;<br>Haile Selassie reinstated |
| 1962 | first medical school established in Addis Ababa |
| 1974 | Ethiopian revolution, overthrow of Haile Selassie by military;<br>formation of Soviet-aligned government, known as the Derg ('Committee') |
| | Development through Cooperation campaign launched,<br>including rural literacy training |
| 1979 | National Literacy Campaign launched;<br>*afaan* Oromo is used in government education programs for the first time |
| 1980s | Jimma Health Science Institute established |

1991 fall of the Derg government;
transitional government formed
by forces of the Tigray People's Liberation Front

1994 new constitution published;
inauguration of the Federal Democratic Republic of Ethiopia

*afaan* Oromo becomes official language in the federal state of Oromia,
and is used as language of instruction in Oromia's schools

2000 first openly contested multi-party elections in Ethiopia

2005 second openly contested multi-party elections,
followed by arrest of leading opposition politicians and their supporters;
dozens of demonstrators shot by military police in Addis Ababa

Appendix 2

**Age reckoning**

Age reckoning was initially based on the reports of caregivers. At the second household visit, we checked reported ages against local event calendars devised for the city and the rural area. At this point we discovered that several children whom we had originally included were more than 13 months old. In some cases, the error seemed to be due to a simple mistake on the part of the mothers; in other cases (especially in the case of children more than 18 months old) the initial response seemed to be calculated with a view to inclusion in the study, in expectation of gifts or other benefits for participation. In the course of subsequent rounds we realized that other children in our sample were also older than initially reported. Due to the longitudinal design of the survey, we were able to check and recheck children's ages. Of the 13 children we identified as being over 13 months, we kept 10 in the study, and followed them over the course of the year – the total sample size was thus 154. The age range of this undifferentiated sample at baseline was approximately one week to 28 months. The problems of age reporting that we encountered, even when using locally developed event calendars, suggests that child age data from large scale cross-sectional surveys (such as DHS 2000, 2005) should be interpreted with caution.

Appendix 3

**Matching of JLFSY dataset with data from this study**

Due to the complexity of relations between the JLFSY sample frame households and the participants in the current study – a mixture of grandparents, co-wives, other relatives, and relationships that are uncertain – the data that the JLFSY provides on these households may not accurately reflect the economic resources available to the children in the study. To maximize the use of the data, I classified households into four groups according to the degree of correspondence between the JLFSY household and ours. The breakdown of these categories is shown in Table A.

**Table A: Quality of connection between households in JLFSY and this study**

| | Category | n | urban : rural |
|---|---|---|---|
| 1 | **Good**: Mother of child is listed as wife of household head in 2005; household head is father of study child; or mother has married into the household, becoming wife of household head. | 90 | 31: 59 |
| 2 | **Fair**: Mother or father of study child are listed as son or daughter of the household in 2005 | 31 | 15 : 16 |
| 3 | **Poor**: Relationship between household and study mother and father is tenuous – grandchild, zemed, or other | 7 | 7 : 0 |
| 4 | **Very poor**: unclear whether the household in JLFSY and the current study are linked at all | 13 | 9 : 4 |
| 5 | **Separate sample**: Households recruited independently of the JLFSY | 12 | 10 : 0 |
| | total | 151 | 72 : 79 |

In 13 cases the households in the JLFSY in Jimma town do not correspond in any clear way to those in our sample. Standard microeconomic assumptions – that family resources are shared either equally among the household members, or according to need – cannot be invoked when neither the mother nor the father of the child are heads of household, and do not control the family purse. This constitutes a limitation on the usefulness of the SES data from the JLFSY in particular.

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