Misconceived Equity or Policy Ineffectiveness? Healthcare Resources, Community Poverty, and Child Health Disparities in Peru

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Abstract: Although a large volume of research has examined socioeconomic and other determinants of child health per se, fewer studies have examined what factors explain disparities in child health by geographic region. In this paper, we examine the relationship between regional disparities in child malnutrition and regional variation in two types of health resources in Peru: medical resources and overall living conditions, measured at district, province, and state level. Using Peruvian 2007-2008 Continuous Demography and Health Survey and regional data provided by Peruvian government, our analyses show that 1) only selective items of healthcare resources (outpatient visits and vaccination) are related to child nutritional status, 2) community level poverty was the most important factor in child health status, and, most importantly, 3) a significant portion of the regional differences of child health was explained by community poverty, while healthcare resources had little associations with regional health disparities. These findings suggest that local socioeconomic environment is the key determinant of not only health outcomes, but also regional health disparities.

Child health has attracted intense interest from social scientists, health professionals and policy makers, reflecting its profound short- and long-term implications for both individuals and entire societies. Early childhood nutrition and health predict a range of outcomes later in life, such as cognitive achievement and educational attainment (Pollitt et al., 1993; Alderman et al., 2006; Glewwe, Jacoby, and King, 2001), labor productivity (Strauss and Thomas, 1998), and mortality risk and chronic disease (Grantham-McGregor et al. 2007; Brown and Pollitt 1996). At the macro level, health indicators correlate with aggregate economic output, and investments in child health have particularly pronounced long-term consequences for productivity gains (Bloom, Canning, and Sevilla 2004; Bloom Canning and Jamison 2004; Gyimah-Brempong and Wilson 2004; Well 2007). Perhaps even more than investment in education, then, investment in child health constitutes one of the essential driving forces of economic growth (Bloom and Canning 2003). Child health has accordingly been a primary target of research designed to provide policy guidance on development strategies in lower and middle-income countries with relatively poor public health profiles (McGuire 2006; Thomas and Strauss 1996; Bhalotra 2007; Wang 2003).

But although a large volume of research has examined socioeconomic and other determinants of child health per se, fewer studies have examined what factors explain disparities in child health outcomes, especially disparities by geographic region in less developed nations (LDCs) (e.g., Zere et al. 2007; Fang 2010; Wagstaff, Doorslaer, and Watanabe 2001). This omission is striking insofar as pronounced regional health disparities remain common in LDCs—and, in many cases, have grown larger in recent decades, despite substantial investments in health resources and national-level improvements in child health outcomes (Onis, Frongillo, and Blössner, 2000; Fang 2010). Such improvements do not necessarily lead to reduced health inequalities—and may actually exacerbate them (Van de Poel 2008). Therefore, explaining health disparities requires identifying distinct mechanisms that may be very different from those that account for overall levels of children's health.

Many health researchers evaluate health inequalities using the concept of health equity, which frames avoidable differences in health as unjust and unfair (Woodward and Kawachi 2000; Wagstaff and Doorslaer 2000; Gwatkin 2000; Pradhan, Sahn, and Younger 2003; Daniels, Kennedy, and Kawachi 2004; Braveman et al. 2011). Although there are several definitions involving distinct concepts of needs, privileges, and social groups, all share the notion that health equity requires eliminating or at least minimizing avoidable disparities in physical and psychological wellbeing that are beyond individuals' control. Moreover, all emphasize that needs, rather than privileges, should be the primary basis for allocating resources (see Braveman [2006] for more discussion). Braveman's (2006) notion of health equity explicitly includes equitable distribution of the determinants of health in the definition, thereby directing attention to issues such as access to, utilization of, and quality of medical care, as well as physical and environmental resources that influence the distribution of health outcomes.

Our analysis evaluates two theoretical explanations for geographic disparities in child health outcomes in Peru. First, since healthcare systems are typically organized on a geographic basis and healthcare facilities such as hospitals and health centers tend to be geographically concentrated (Rice and Smith 2001), regional disparities in child health outcomes may reflect geographic variation in health resources or access to healthcare more directly than other types of health inequalities (e.g., by gender, income, or race/ethnicity). Second, environmental factors shape individual and household decisions about health (Woodward and Kawachi 2000; Jones, and Duncan 1995; Rice and Smith 2001). Local economic conditions, infrastructure and support systems (e.g. transport, social services, and education), and local cultures may influence health outcomes in a manner that is not reducible to the effects of individual demographic characteristics and socioeconomic position. Therefore, regional inequalities in child health outcomes may be indicative of variations in local living conditions that reflect regionally unequal distributions of material and cultural resources.

In this paper, we analyze the relationship between regional disparities in child health outcomes and regional variation in two broad types of health resources: medical resources and overall living conditions. We first estimate regional disparities in children's health outcomes net of individual and household characteristics. We then estimate the associations between child health outcomes and both medical resources and community poverty level, where the latter indicates overall environmental living conditions, in order to assess whether either type of regional health resources can account for any regional disparities in child health outcomes that remain after adjusting for individual and household characteristics. Lastly, we assess whether the association between medical resources and child health depends on community poverty level.

In the next section, we provide a brief description of the national context of Peru, focusing on the health reforms launched during the 1990s and regional inequalities in living conditions and child health. We then review theoretical perspectives on medical resources and community poverty as both influences on child health outcomes and potential contributors to regional disparities in child health. Using multilevel regression models, we next show that, unlike medical resources, community poverty substantially accounts for regional health inequalities in Peru. We conclude with a discussion of health equity in Peru and the policy implications of our findings.

COUNTRY BRIEFING OF PERU

As in other Latin American countries, major reforms of the primary-level public health system in Peru during the 1990s were characterized by increased private financing and decentralization of healthcare services, as specified in the government's health reform plans (Kim, Shakow, and Byona 1999; Iwami and Petchey 2002). These reforms institutionalized user fees for healthcare services in the public healthcare system, replacing the previous 'free of charge' system (Ewig 2006). The Ministry of Health (Ministrio de Salud, MINSA) encouraged the participation of private providers in health insurance plans available to workers (EPS), while continuing to play an active role in subsidizing primary health care provision for the poor and other vulnerable populations through basic health plans, such as Basic Health For All (Programa Salud Básica para Todos, PSBPT). However, these basic health plans covered only very limited healthcare expenses, such as immunizations, acute respiratory infectious control, diarrheal disease control, and family planning, and recipients had to assume all other healthcare costs (Kim, Shakow, and Byona 1999; Jenkins 2011). In the same year that Basic Health For All was implemented (1994), the Peruvian government began promoting the direct participation of the local communities in health services management through the Local Committees for Health Administration (CLAS) program. As non-profit community organizations, the CLAS were responsible for assessments of local health needs and determining local healthcare provision (Iwami and Petchey 2002; Ewig 2006).[1]

Ironically, researchers have pointed out that such neoliberal health reforms have had limited success in many low- and middle-income countries in reducing health disparities, even though these reforms have typically prioritized services for the most vulnerable populations (CITES?). In the Peruvian case, Cotlear (2000) maintains that the CLAS worked better in relatively well-off urban communities, where plan members could afford higher co-payments and required fewer fee waivers, given their relatively low poverty rates. Furthermore, well-connected, highly educated personnel in better-off communities could often provide better management, more funding and more political resources, which, in turn, facilitated access to better equipment and supplies (Cotlear 2000).

During the health reforms, a structurally unequal geographic pattern emerged across three distinctive regions of Peru. The Pacific Coast concentrates most of the largest cities in the country and most of the industrial, financial and managerial economic activities. The Andean region hosts the largest proportion of the traditional indigenous population in the country, along with agriculture and mining activities. The Amazon region houses a diverse indigenous population with a dispersed pattern of settlement, as well as primary extraction industries. Within each geographic zone, sharp differences also exist between urban and rural areas in terms of general socioeconomic profiles. In all three regions, the poverty rates of rural areas are approximately two to three times as high as those in their urban counterparts (INEI 2013)[2]. Child health indicators have improved in all three regions, but with dramatic differences in the pace of improvement by region. Metropolitan Lima and the rest of the Coast, already the most affluent areas with the lowest child malnutrition rates, have experienced the sharpest decreases in child malnutrition. As shown in Figure 1, child malnutrition in Metropolitan Lima decreased from 11.2 in 1991/2 to 4.1 in 2011, and from 29.3 to 7.7 in the rest of the Coastal area (63 percent and 74 percent decrease respectively). While the Andean and Amazon areas also showed significant decreases, the rate remains high and declines have been relatively slow. In 1991/2, the proportion of unnourished children was 41.4 percent in Amazon and 51.6 percent in Andean region, and they decreased to 21.2 and 25.1 respectively, amounting to a decrease of about 50 percent in both regions. Urban-Rural differentials in child chronic malnutrition show similar patterns as those of geographic variations. During the same period, urban areas underwent a 72 percent decrease in child malnutrition, compared to only 44 percent in rural areas. Consequently, regional and urban-rural disparities have actually increased, even though child health has improved in all areas.

[Figure 1 about here]

The rationale for expanding preventive and primary care services in poor areas was that these investments could be a cost-effective means to reduce regional and rural-urban inequities. However, Iwami and Petchey (2001) criticized the Peruvian health reforms' focus on efficiency rather than equity, particularly in light of justifications of the reforms that emphasized both. For example, the basic health package sought to expand the reach of basic public health services in remote rural and poor urban areas at minimal cost, which encouraged reliance on low-cost primary care interventions (Ewig 2006). Medical researchers, however, argue that there are conflicts between efficiency and equity; distributional objectives in health care and health policy are based on utility and medical costs, and, thus, redistribution programs often have limited success in improving equity (Culyer 1980; Wagstaff 1998)

HEALTHCARE RESOURCES AND CHILD HEALTH IN LDCs

Previous research has examined the relationships between healthcare resources and health outcomes using several different measures, including the number of medical professionals or healthcare facilities; per capita in- or outpatient visits; immunization; or public expenditures on health. Each of these measures highlights significantly different aspects of the significance of medical resources for public health. According to the WHO, medical professionals and health facilities/establishments per 10,000 inhabitants are indicators of *availability* of health services, measuring human capital and material resources respectively (WHO 2009). When these measures are used to compare administrative regional units, they serve to assess the supply and distribution of healthcare resources (de Freitas, Kupek, and Perraro 2001).). Also, researchers in public health area use health expenditure as quantity of healthcare made by government (Lichtenberg 2011). Conversely, immunization is regarded as a measure of the capacity of a health system to provide basic services specific to child health along with other services targeting specific public health issues, such as malaria control, safe motherhood, family planning, control of sexually transmitted diseases, HIV/AIDS, TB control, and non-communicable diseases (WHO 2009). Meanwhile, per capita in- and out-patient visits indicates *utilization* of healthcare services. According to WHO, utilization rates usually go up when barriers to access are removed by bringing services closer to the population or reducing user fees. Conversely, a low rate may imply both low availability and quality in the provision of services (WHO 2009). But while it is tempting to assume that more healthcare resources ensure better health outcomes, prior research provides mixed evidence about this association.

Public health expenditure is one of the most frequently used predictors of health outcomes, but the nature of the association between health expenditures and health outcomes is also among the most debated issues in the health literature (Farahani, Subramanian, and Canning 2010). Some studies have found that health spending measured as a percent of GDP is significantly associated with reduced risks of infant and child mortality (Gupta et al. 2002; Wagstaff 2003), but others emphasize the role of moderating factors. Specifically, several cross-national analyses suggest that health expenditures are associated with improved health outcomes in selected countries with specific profiles—for example, countries with good governance (Rajkumar and Swaroop 2002) or high poverty rates (Bidani and Ravallion 1997; Gupta, Verhoeven, and Tiongson 2003).

A number of studies, however, have found that the contribution of health expenditures to health outcomes is either weak or nonsignificant (Kim and Moody 1992, McGuire 2006; Musgrove 1996; Kumar, Ram, and Singh 2013; Filmer and Pritchett 1999). For example, Filmer and Pritchett's research (1999) reveals that cross-national variations in child and infant mortality are explained mostly by national income level, inequality of income distribution, the level of female education, and ethnic and religious characteristics, not by public spending on health. A study on India also found that regional socioeconomic conditions, but not public spending, significantly predicted child mortality rates (Kumar et al. 2013). As an alternative approach to the effects of public spending, Gajate Garrido (2011) emphasized that total public expenditure, not health expenditure alone, should be considered as a health predictor because comprehensive investments, including spending on social development and education, are closely related to public health.

Other indicators of healthcare resources show greater promise in explaining health outcomes (Farahani et al. 2009; Anand and Bärnighausen 2004; Thomas, Lavy, and Strauss 1996; McGuire 2005). In their recent study, Anand and Bärnighausen (2004) examined whether human resources measured by aggregate density of doctors and nurses is associated with various health outcomes using cross-country data. Their findings were mixed and varied by measures of both human resources and health outcomes. Increased density of doctors was significantly related to health outcomes, whereas density of nurses had limited effects. Human resources also have greater effects on maternal mortality than on infant mortality. Thomas and colleagues (1996) also examined an extensive range of health resources such as health personnel, health facilities, immunization and availability of drugs, as well as community infrastructure on child health in Côte d'Ivoire. Except the number of nurses and size of healthcare facilities, these measures were positively associated with better nutritional status among children, and the effects were generally greater for the poor and for the rural sector.

The clear divergence of findings on health expenditure as opposed to other healthcare resources may reflect differences in the mechanisms by which these resources affect health outcomes. In a cross-national study, McGuire (2006) argued that actual maternal and child healthcare provision and utilization of basic health services are better predictors of mortality among children under five than public healthcare spending. He attributed the weak association between health spending and health outcomes to the misallocation of spending and the ineffectiveness of public health interventions. Thus, his study suggests that the real effects of medical resources on health outcomes should be examined with actual medical practices or programs that reach the affected population directly rather than gross expenditure that could be spent on administrative or processing costs. Frankenberg and colleagues' (2005) study of a midwife program in Indonesia also supports this perspective. Their study showed that direct intervention of midwives during early childhood had strong positive effects on the nutritional status of children, and the effects were found both within and across communities. In spite of its significant contributions to the literature on public health, however, this line of research has several important limitations. First, these studies focus on the association between healthcare resources and health outcomes, but do not provide much insight into the factors underlying regional health inequalities. Generally, more physical medical resources mean better health outcomes compared to places where medical resources are scarce. However, medical resources that contribute to better health outcomes do not always reduce health inequalities, because people with greater social and material resources may be better positioned to take advantage of their health benefits. In fact, low levels of utilization, inefficient and low quality medical resources, and poor information networks tend to concentrate among more disadvantaged populations and areas (Wagstaff and Claeson 2004; Victora et al. 2003; Valdivia 2002). In turn, these low quality resources may lead to worse health outcomes among poorer populations and disadvantaged regions compared to their relatively well-off counterparts. Thus, the failure of medical resources that improve health outcomes to reduce regional inequalities may reflect the ineffectiveness of local delivery systems or regional divergences in the quality of services and resources. Moreover, good governance of healthcare resources—appropriate and capable personnel in institutional settings who can reduce fraud while promoting efficiency—could be critical at both the governmental and local community levels (McGuire 2006; Rajkumar and Swaroop 2002).

Second, most studies on health outcomes and medical resources have been based on cross-national analyses. As Farahani and colleagues (2010) maintained, a major weakness of current studies on medical resources and health outcomes is that they use aggregate data, which consider national level aggregate indicators and, consequently, ignore local, household, and individual level factors that may affect health outcomes. They also highlight another issue with this type of cross-national, macro-comparative studies: data heterogeneity. Several recent studies have examined within-country variations in health outcomes using state or province-level predictors by utilizing various data resources to minimize data heterogeneity (Bhalotra 2007; Kumar, Ram, and Singh 2013). However, only a few studies have examined associations between regional, household, and individual level factors and individual health outcomes. A few study have examined health resources measured at the community- or state-level, typically finding positive effects on health outcomes in general (Lavy, Strauss, Thomas and Vreyer 1996; Frankenberg, Suriastini, Thomas 2005; Thomas et al. 1996; Farahani et al. 2010).

COMMUNITY, CONCENTRATED POVERTY, AND HEALTH OUTCOMES

Local Communities and Health

Households' basic physical resources, such as clean water and sanitation infrastructure, improve the health of household members through direct and indirect paths (Brenneman and Kerf 2002; Fay et al. 2005; Lee, Rosenzweig and Pitt 1997; Newman et al. 2002; Jalan et al. 2003). Availability of electricity similarly contributes to enhanced health outcomes by providing energy to keep foods fresh or by functioning as a source of clean energy that eliminates hazardous indoor air pollution and thereby reduces the incidence of respiratory diseases (Birley and Lock 1998; Cabraal 2005; Desai et al. 2004; Smith 1993). Although these indicators of accessibility to infrastructure may be indicative of living conditions in the broader community where individual resides (e.g., lack of household access to clean water may reflect limited infrastructure for clean water storage in the area where the household resides), they are typically measured as aspects of household socioeconomic status.

Recent trends in health research emphasize specific aspects of community characteristics as important independent health determinants. According to Robert's conceptual model, community socioeconomic context affects individual health both through individual and community pathways (Robert 1999). Regarding individual pathways, communities with different socioeconomic resources affect individual health by exposing individuals and households to different levels of social and economic opportunities and constraints. These opportunities and constraints, in turn, shape individuals' behavioral patterns and socioeconomic status, which are directly relevant to their health outcomes (Ainsworth 2002; Duncan, Jones, and Moon 1996, 1999; Ennet et al. 1997; Karnoven & Rimpala, 1996, 1997; Roux et al. 2003; Foster &

Mclanahan 1996; Pong & Hao 2007; Schempf, Strobino, and O'campo 2009; Lantz et al. 2001).But as both Robert's (1999) conceptual model and the U.S. literature on community and neighborhood effects have emphasized, environmental and contextual influences may have direct effects on individual health, as well. In the United States, community and neighborhood characteristics, such as concentrated poverty, concentrated affluence and local unemployment rates, are significantly associated with a variety of health outcomes (Morenoff et al. 2007; Pearl, Braveman, and Abrams 2001; Pickett and Pearl 2001). These studies show that neighborhood- and community-level factors affect health outcomes even after adjusting for individual- and household-level risk factors (for review of these studies, see special issue of Social Science & Medicine 2007, November). However, relatively few empirical studies have been conducted focusing on the role of community or neighborhood factors in health outcomes among LDCs. This is in part due to the lack of reliable information at local level that could be used to test for associations between individual outcomes and contextual influences on health. As emphasized in several prior studies, the quality and availability of data has been one of the biggest concerns among researchers (see Farahani, Subramanian, and Canning 2009; Braveman and Tarimo 2002). Nevertheless, the number of studies focusing on the role of regional and local influences on individual health outcomes in the developing world has been growing with the increased availability of geo-referenced data in these countries during the past decades. In particular, studies from geography have emphasized factors such as access to clean water, natural resources, and population density as important determinants of the local prevalence of morbidity and disease (Balk et al. 2004; Kandala et al. 2007; Kazembe 2009). In the sociological tradition, Luke and Xu (2011) measured the mean years of parents' education and income at the level of geographic division and found that there were significant associations between these community-level variables and child weight-for-age at age one in South India. In the Peruvian context, Shin's (2007) multilevel analysis showed that community wealth level had significant effects on child health controlling for individual and household characteristics and community heterogeneity (see also Linnemayr, Alderman, and Ka 2008).

Some scholars emphasize the compositional aspect of community by focusing on shared characteristics of residents; people in similar socioeconomic status tend to live within geographical proximity and produce aggregate attributes of the area that they live (e.g. Shouls Congdon, Curtis 1996). Others stress ecological attributes of spatially defined areas that are distinct from community composition in terms of individual or household level characteristics (Macintyre, Ellaway, and Cummins 2002; Sampson 2012). Yet each of these approaches suggests that community characteristics have effects distinct from individual-level factors because interactions among neighborhood actors, such as households, businesses, and local governments, tend to reproduce community context and composition over time (Williams 2003; Sampson 2012).

Neighborhood Poverty, Equity, and Public Health

Our discussion of the association between regional environmental exposures and individual health outcomes takes as its starting point neighborhood effects theories largely derived from research on the U.S. (and, secondarily, Western European) context. In their study about Glasgow, England, Macintyre and Ellaway (2000) conceptualized material and infrastructural resources as the "opportunity structure" which is defined as "socially constructed and patterned features of the physical and social environment which may promote health either directly or indirectly through the possibilities they provide for people...(Macintyre and Ellaway, 2000:343)" Similarly, Robert (1999) conceptualizes local community socioeconomic context as an opportunity structure. These conceptualizations can be applied to community pathways relevant to health-related structural, social, and behavioral mechanisms in a manner similar to individual socioeconomic position. In addition to affecting individuals directly, the opportunity structure affects individuals' health differently across physical and social boundaries, conditioning the patterns of accessibility and utilization by region and social group. Based on this notion, they argue that geographic health inequalities reflect the unequal distribution of health-related resources available in individual's local environment.

This perspective is reflected in many studies on the association between neighborhood poverty and individual health outcomes. First, overall environmental quality is regarded as an important influence on the health of community residents. Economically and socially disadvantaged neighborhoods are more likely to have unsafe, substandard housing and high levels of air and water pollution (Lopez 2002; Morello-Frosch and Jesdale 2006). Exposure to such hazards is associated with increased risks respiratory disease, cancer, lead poisoning, infant mortality, and pesticide exposure (Yen and Syme 1999; William and Collins 1995; LaDuke 1999).

Second, local physical environments affect access to goods and services that are essential for health, such as affordable, nutritious food (Wallace & Wallace 1990; Zenk et al. 2005)[3] as well as social services such as schools or municipal facilities (Browning and Carney 2003). Over and above the sheer availability of material resources, their accessibility also matters, especially in LDCs where transportation infrastructure is less developed and more variable across regions. Communication and transportation infrastructure may enhance the access to essential goods and services by reducing geographic barriers, especially in rural and economically disadvantaged communities (Wagstaff and Claeson 2004). For example, distance to health-care facilities, knowledge of, where to go, and cost of care were reported as the most frequent problems presented by rural residents in Peru regarding health care (Reyes and Ochoa 2001). Recent studies, building on the framework of social disorganization theory and urban ecology, also emphasize how local social environments affect health independently from individual characteristics (Sampson, Morenoff, and Gannon-Rowley 2002; Browning and Cagney 2003; Altschuler, Somkin, and Adler 2004). Social cohesion, norms, trust, and support systems tend to reduce risky behaviors and promote healthy life styles (Kawachi & Kennedy 1997, Wilkinson 1996; Diez-Roux et al 1997). Although several studies have shown that social cohesion predicted indicators of community stability, such as delinquent behaviors among youth, independent of poverty level (Aneshensel & Sucoff 1996; Sampson, Raudenbush & Earls 1997), many studies suggest that the socioeconomic characteristics of communities are associated with community stability, which in turn directly or indirectly affect the health of community residents (Sampson and Morenoff 1997; Sooman and Macintyre 1995; Robert 1999).

One of the advantages of conceptualization of opportunity structure is that it makes possible to consider various types of physical and social resources composing the opportunity structure to explain individual health, because neighborhood resources work through the 'various sets of rules that govern access through various environments (Bernard et al. 2007)'. In addition, this framework facilitates how these available resources interact with community poverty level. According to the resource-substitution theory, the effect of having a specific resource is greater for those who have fewer alternative resources. For example, several studies have shown that maternal education has greater effects on child health in more disadvantaged groups such as lower SES group or rural areas (Mirowsky and Ross 2006; Shin 2007).

In our study, we estimate the association of medical resources with health outcome separately from the association of other components of community health resources with these outcomes to determine if the spatial health inequalities are related to a distribution of medical resources, to other poverty factors in community including accessibility to resources, or to both issues, which ultimately shows how the opportunity structure is constructed and functions.

DATA AND METHOD

Data for this study were taken from the Peruvian 2007-2008 Continuous Demography and Health Survey (below, DHS) of reproductive-age women (15-44). The DHS are nationally representative household surveys that provide a wide range of information about reproductive health, children's health, family violence, and AIDS and other sexually transmitted diseases from more than 80 developing countries since 1984. The Peruvian survey has been conducted by the Peruvian National Institute of Statistics and Informatics (Instituto Nacional de Estadistica e Informática, INEI) since 1986, and it has been done every four years from 1992 to 2000. Since 2004, the survey was conducted annually with five cycles each year as the Continuous DHS to address the needs for information to support the monitoring and evaluation of governmental programs and projects of population and health. For our study, we selected 2007-2008 subsample from the 2004-2008 Continuous DHS data.[4] The 2007-2008 subsample consists of the combination of two samples, one corresponding to the 2007-2008 Continuous DHS itself, and the other corresponding to the 2008 sample extension. The sample design of the Peruvian 2007-2008 DHS is probabilistic, self-weighting by departments (states) and areas, stratified, multistage and independent for each department, and the primary sampling frame of the survey comes from the 1993 and 2005 Peruvian National Population and Housing Census of Population and Housing

(Censos Nacionales de Población y Vivienda), with 2005 census specifically for 2008 sample extension.

Additionally, we used the Global Positioning System (GPS) data collected by DHS to identify the province and district where each household was located and to combine household and individual information with regional data. The Geographic data contains the codes and names of each cluster (called "community" in our paper), district, urban/rural classification, and other geographic information. Using DHS cluster number, we identified the name of the province and district corresponding to each household in survey data and combined individual information with regional variables measured at the district or province-level.[5] Thus, among 23,094 eligible women from 25,633 households from 1870 communities interviewed, 22,588 respondents completed the interview, with a response rate of 97.7 percent. The sample used in our research consisted of ever-married women and their children from 1 to 59 months old, yielding a total of 8,114 children and 6,639 mothers of these children from 965 communities across 157 provinces for this study. [6,7]

Measurement for health outcome

To measure nutritional status, we use height-for-age. While not a key indicator of mortality or emergent health crisis as weight-for-age is, height-for-age is an indicator of children's long-term health outcomes, especially adaptation to chronic undernourishment (Attanasio, Gomez, Rojas, & Vera-Hernandez, 2004; Hobcraft 1993). Furthermore, some diseases such as diarrhea and respiratory infections can cause a vicious cycle of malnutrition and illness (Gajate Garrido 2011).

Demographic and Health Survey data provide various anthropometric measures of children (percentiles, percent of median, and *z*-values) calculated using the reference population identified by the National Center for Health Statistics of the Centers for Disease Control and Prevention, and adopted by the World Health Organization for international use. Among these measures, we employ height-for-age z-score from the reference median for each child provided in the Demographic and Health Survey, in which sex and age of the child are taken into account.[8]

Community predictors

The central aim of our research is to examine regional variation in child health in Peru and to assess the extent to which specific regional factors to can account for this variation. Therefore, we include six geographic regions divided by geographic distinctiveness; urban coast (including Lima metropolitan area), urban sierra, urban selva, rural coast, rural sierra, and rural selva.

We estimated two different types of community variables on health outcomes using the provincial- and district-level data collected by Peruvian government institutes: medical resources and poverty rates. Community level (cluster in DHS) variables for medical resources and poverty rates were not available because 'cluster' is not a regional unit used by the Peruvian census but rather a sampling unit of DHS. Instead, we used poverty rate at the district level, three medical resources measures at the province level, and two medical resource measures at the state level as proxies for community level indicators.[9]

For the measures of medical resources, we selected five indicators using the information provided by Peruvian Ministry of Health (Ministerio de Salud del Perú, MINSA). First, we calculated the number of medical professionals per 10,000 inhabitants by province to measure the availability of human resources in medical sector. Since information on medical professionals for 2008 is not available, we combined the data from 2007 and 2009, and averaged the values of each province. Medical professionals were defined to include doctors (including dentists, obstetricians, and psychologist), nurses, pharmacists, and nutritionists, but not technicians working in relevant fields. Second, per capita outpatient visits in each province were employed as an indicator of utilization at the regional level. Immunization coverage was employed as an indicator of governmental provision of basic healthcare resources at the local level. MINSA provided information about vaccination coverage for a series of diseases. Among them, we selected three basic vaccinations generally given to babies under one year—BCG, DPT, and POLIO—and averaged the coverage percentages. The number of health establishments per 10,000 inhabitants and per capita health expenditure are measured for availability of health resources at state level, different from the other three healthcare sources, because of the reliability issue of the information at province level. We considered only Health Centers and Health Posts (excluding hospitals) both from Sector Salud and MINSA specifically to address the accessibility of health service to disadvantaged population.

As suggested by several studies, the most cost effective interventions are preventive care and essential clinic services rather than secondary healthcare services; the latter have been found to provide relatively few health benefits in developing countries (Sahn and Bernier, 1993; Pradhan 1996; Gupta, Verhoeven, and Tiongson 2002). For this reason, immunization coverage and the number of health centers are typically good indicators of the effects of medical resources on child health in Peru.

Another important regional variable was province poverty rates. Poverty rate at the district level was obtained from the Index of Unmet Basic Needs (Necesidades Básicas Insatisfechas, NBI) provided by the National Institute of Statistics and Informatics (Instituto Nacional de Estadística e Informática, INEI). We used 2009 poverty rates as a proxy since 2008 data were not available. Among various poverty measures, we used percentage of households below the poverty line in each district as an indicator of community poverty exposure. We divided the sample into district-poverty-rate quintiles to examine the effects of exposure to community poverty among children and their households on health outcomes.

Individual/household characteristics

We included three groups of control variables at the individual and household levels. First we included mother's education, childhood place of residence, ethnicity, and number of children as indicators of the socioeconomic background of the mother. Second, DHS also provides the wealth index and quintile calculated with the characteristics such as household's ownership of consumer items, dwelling characteristics, drinking water source, and toilet facilities. We use each wealth quintile as a dummy variable to control wealth of household. Third group is individual level utilization of healthcare service, measured by using of prenatal care and number of hospital visits during pregnancy. We use these variables to indicate mother's health-seeking behavior and accessibility to healthcare services at the individual level respectively. Prenatal care is coded 1 if a woman has ever received modern prenatal care or assistance from a trained health professional (such as doctor, nurse, or midwife) and coded 0 if she has not.

Method

To describe the unequal distribution of health resources by district in Peru, we employed concentration curves. Based on the Lorenz curve, developed to describe the inequality of wealth distribution, concentration curves have been used by health researchers in recent decades to explain unequal distribution of health outcomes and health resources by wealth level among individuals, regions, and countries (Zere et al. 2007; Wagstaff, Doorslaer, and Watanabe 2003). Concentration curves plot the cumulative proportion of y against the cumulative proportion of the sample (x), ranked by income or wealth, beginning with the most disadvantaged person or group. When the curve coincides with the diagonal (line of perfect equality), all individuals or groups have the same value of y, which means no inequality in the distribution of y. In a conventional Lorenz curve, y represents the cumulative share of income earned. Thus, a curve below the diagonal means that y is larger amongst the better-off, representing a higher level of inequality. In our application, we used the cumulative share of disadvantage measures for y; thus, y was typically larger amongst the worse-off if the curve was above the diagonal.

The concentration index is defined with reference to the concentration curve. It is calculated as twice the area between the concentration curve and the line of equality. The concentration curve is expressed as:

$$C = \frac{2}{\mathrm{n} \cdot \mu} \sum_{i=1}^{n} \mathrm{y}_{\mathrm{i}} R_{\mathrm{i}} - 1$$

where μ is the mean of y, R_{i} is the fractional rank of the *i*th observation in the income distribution with *i*=1 for the poorest and *i*=n for the richest. C is negative when the curve lies above the diagonal (O'Donnell et al. 2008; Wagstaff et al. 2003).

For the analysis of the associations between medical resources, poverty and regional child health disparities, we employed a random-intercept regression model. We assume that interrelated community characteristics jointly influence children's health outcomes and correlate the errors for observations within groups because unobserved common group characteristics are transferred to the error term. Variance of error is not constant because it depends on the error term at the group level as well as on the fixed covariates. Thus, the two assumptions of standard regressions are violated, and OLS estimates are biased and inefficient. The random intercept model for three levels is specified as:

$$Y_{ij} = \beta_0 + \beta_1 x_{ij} + \beta_2 z_j + u_j + \varepsilon_{ij}$$

$$u_j \sim N(0, \sigma_u^2),\ \varepsilon_{ij} \sim N(0, \sigma_\varepsilon^2)$$

where Y_{ij} is height-for-age z-score reference median of *i*th child in *j*th group. β_0 is a constant, and β_1 and β_2 are vectors of coefficients each corresponding to fixed covariates for individual level x_{ij}, and group level z_j. ε_{ijk}, an individual-error term, is associated with the *i*th child of the *j*th group and assumed to have a normal distribution with mean 0 and the varianceσ^2. A group-level random component u_j, assumed to be normally distributed with the expected value 0 and the variance σ_u^2 are included to account for the multilevel structure of the data. The random term u_j apply to all observations in a particular group, capturing unobserved group effects and accounting for the correlation among individuals nested in the same community. Inclusion of these errors allows for the possibility that dependent variables for individuals within groups may be correlated. In our study, the group in this model is identified with community, which is measured as "cluster" in the DHS data.

RESULTS

To address the issue of individual and regional health inequalities in Peru, we calculated concentration indexes using surveys and censuses. Figure 2 presents the changes in concentration of worse health outcomes at individual and regional level evaluated by household wealth (two years of DHS surveys) and province poverty rate (two years census) respectively in Peru over time. For the concentration curve of child malnutrition at individual/household level (graph A in Figure 2), we used negative height-for-age z score of children for vertical axis to present that y is larger accumulative worse health condition, following Wagstaff and colleagues (2003). Although both concentration curves for 1996 and 2008 dominate diagonal which is the line of perfect equality, the curve for 2008 is above the curve of 1996. The concentration index for 2008 is -

0.276 (standard error=0.0072) and for 1996 is -0.248 (standard error=0.0068) and the difference is statistically significant. This implies that the burden of malnutrition among children under five was getting disproportionately higher among children from poor compared to non-poor households. In addition, to examine the regional concentration of malnutrition, we used poverty rate of each province for the ranked economic condition of region, and the rate of stunting children for negative health outcome for 1993 and 2009. The regional concentration curves show similar trend with the ones estimated at individual level. The concentration index were -0.129 (standard error=0.0087) for 1993 and -0.168 (standard error=0.0160) for 2009 and the change was statistically significant, which implies that child malnutrition has concentrated more on poorer regions than better-off regions during this period. These results show that health inequalities not only still exist, but have actually increased among regions as well as individuals faced with different socioeconomic conditions.

[Figure 2 About here]

Figure 3 and table 1 present the regional variations in height-for-age z-scores of Peruvian children. The urban coastal region, which includes metropolitan Lima, had the highest median of z-score among regions, although all the regions have negative median values of height-for-age z-score. For metropolitan Lima, the mean value is -0.40 (median = -0.46), while the rural sierra, the poorest region in Peru, has the lowest mean and median of height-for-age z-score, followed by rural selva with a mean of -1.43. Interestingly, the mean and median of the rural coastal area are similar to those for the urban sierra (-1.11 and -1.20 for the former, and -1.15 and -1.10 for the latter), but the variance is higher (and the highest) in the rural coastal area, reflecting the compounding effects of both being in both a coastal region and a rural area.

[Figure 3 About here]

[Table 1 About here]

The individual and community variables used in our study are described in table 2. As shown in the table, there are huge variations across districts in both poverty rates and the availability of health resources. For example, the highest poverty rate is for a district located in the Andean (rural sierra) region with a rate of 95.9 percent, while the lowest rate (1.8 percent) is found in a district in Lima. Variation in per capita health expenditure is very pronounced, as well. The greatest per capita expenditure is in Lima (269 pesos per person), and the smallest amount was spent in the State of Puno in the Andean mountain area (10.54 pesos).

[Table 2 About here]

To further examine regional variations in child height, we first fit a model including the regional indicator variables only. The first model in table 3 shows confirms that there are significant differences across the regions. For example, living in the rural Andean area (rural sierra), the most disadvantaged region, is associated with a 1.17 standard deviation decrease in child height-for-age compared to living in urban coastal area.

[Table 3 About here]

The next model in the same table, which we refer to as the baseline model, estimates the regional differences adjusted for individual and household level covariates. As expected, maternal education has significant effects. One additional year of mother's schooling improves child's height z-score by 0.041.[10] Children whose mothers speak Spanish have better health status (about 0.151 standard deviation higher) than those whose mothers speak an indigenous language, which indicates that health disparities exist among different ethnic groups net of other indicators of socioeconomic status. Health related behavior is also relevant to child health outcomes. Each additional hospital visit by the mother during her pregnancy is associated with an increase in child height of 0.023 standard deviations. As expected, household wealth level is significantly associated with child nutritional outcome. Children from the households falling into the lowest 20 percent of the wealth level have the greatest variance from those from the wealthiest 20 percent (almost 0.6 standard deviations below). Most importantly for our analysis, regional disparities in child height-for-age are reduced net of individual and household level controls. Nevertheless, pronounced, statistically significant regional differences in children's health condition remain even with these controls. The relative difference in child height from the urban coastal region is the smallest in the rural coastal and urban selva regions, and the greatest in the rural sierra, consistent with the crude comparison of child height-for-age by region in Table 1.

Next, the five models in Table 3 add five measures of healthcare resources into the baseline model separately. The results suggest that the number of medical professionals per 10,000 residents is associated with child height; each additional medical professional in the province where the child resides is associated with an increase in height of 0.002 standard deviation. Per capita outpatient visits was also significantly related to child health status. On average, each additional visit per captial to a health institute is associated with a 0.5 standard deviation increase in the height of children residing in the province. Furthermore, average vaccination coverage in the province where a child resides was positively association with child height; the greater the percentage of vaccination coverage, the better the health outcomes of children living in that province. Per capita health expenditure and the number of health centers/posts was negatively associated with child height, but the relationship was not statistically significant. We assume that the negative relationship between health centers and child nutritional status is attributable to the fact that the siting of health centers and posts targets disadvantaged populations in poorer areas that are more likely to have relatively poor nutritional status.

Introduction of these province-level medical resources altered the estimated coefficients of each regional indicator variable to a limited extent, but the magnitudes of these changes was quite small and the direction of change was inconsistent. With per capita medical professionals, the regional effect of rural coastal on child health became nonsignificant. Also, there were significant decreases in coefficients for the urban selva and rural selva regions in this model. However, the point estimates and significance levels of these coefficients changed little in other models estimating the effects of medical resources.

The last model in table 3 estimated the effects of the poverty rate at district level on child nutritional status in order to examine how community-level deprivation affects child health and, most critically for our analysis, whether it could account for regional disparities. Children living in the richest 20 percent of districts were more likely to have better nutritional status than those living in other districts. These differences were statistically significant at the 0.01 level, controlling for individual and household characteristics. Adding the district-level poverty rate also substantially reduced the coefficients representing regional differences. The coefficient for the rural coastal decreased from -0.144 in the baseline model to -0.073 in the model with the regional poverty rate and was no longer statistically significant. Similar reductions in the size of effects and significance levels of differences in child height were observed across all regions, but especially in the most prominent in jungle areas; from -0.127 to -0.053 in the urban selva, and from -0.168 to -0.038 in rural selva. Nevertheless, the variations in child health between the urban coastal area and both urban and rural sierra areas remained statistically significant.

[Table 4 About here]

Table 4 presents the results of multilevel analyses that estimated the effects of health resources and district-level poverty rates together, controlling for individual and household-level characteristics and unobserved differences across communities. When estimated in the same model that included controls for regional poverty rates, the general effects of health resources were significantly reduced. The coefficient for medical professionals decreased by 50 percent and became nonsignificant, whereas the indicators of poverty rates in the same model continued to be significantly associated with child health. The effects of per capita outpatients visits on child health decreased by 32 percent but remained statistically significant ($p = 0.01$). Vaccination remained an influential predictor of child nutritional status; however, the magnitude of the coefficient and significance level were smaller in this model compared to the model that did not include the community poverty measures. Conversely, the measure of the availability of health centers became statistically significant.

Most noteworthy finding is that the effects of regions on child height in those models that estimate both health resources and poverty rates (models in table 4) do not change much from the model estimating district-level poverty measure only (the last model in table 3), implying very little association of health resources with regional variation in child height-for-age z-score. Conversely, in terms of comparison between the models in table 4 and those estimating health resources only, the changes are prominent. As in the model of district poverty only, the coefficients for the rural coastal and rural selva regions are not significant in all models—and the coefficient for the urban selva is only marginally significant—in all combined models that include both measures of medical resources and the district poverty rate. In sum, district-level poverty explains a significant portion of the regional variation in child health status, even after adjusting for local healthcare resources available to community children while medical resources explain relatively little of this variation.

[Table 5 about here]

Finally, we fit models to test for interactions between medical resources and the district poverty rate; the results are shown in Table 5. For convenience of interpretation, we employed a continuous measure of the poverty rate instead of the five indicator variables used in the previous models. No significant interaction effect was found in any model except the one including the interaction term for medical professionals and the poverty rate. Even this effect of this interaction was only marginal. The effect of medical professionals on child health tends to be stronger in poorer regions.

DISCUSSION

Are healthcare resources generally related to improved health outcomes? If so, do variations in healthcare resources also explain regional disparities in health outcomes in LDCs like Peru? Health researchers have long studied how various health resources are related to public health, and found a dilemmatic fact: individual health status is actually related with the availability or the utilization? of health resources and public health profile have improved with health reforms and health policies targeting disadvantaged segment of population and regions and; (but) significant health inequalities still persist and poor health outcomes tend to be more concentrated among the poor than before especially in low income countries (Zere, et al 2007; Fang et al. 2010; Wagstarff et al. 2001; Lindelow 2006).

However, due to the lack of appropriate data, prior studies on socioeconomic and regional health disparities among LDCs are scant. Moreover, relevant factors explaining regional health inequalities have been rarely studied. This study contributes to our understanding of regional inequalities in health by identifying which health resources are associated with child health outcome. Although it did not specifically focus on the increased inequalities over time, our study provided insightful evidences on the factors explaining regional inequalities and, thus, also suggested possible determinants of increased health inequalities.

Our study presented several important findings on the determinants of regional inequalities in child health. Despite healthcare reforms that were ostensibly targeted to improve health in the poorest regions of the country, regional disparities in child health outcomes not only remain pronounced, but have increased over time. Less clear was whether or to what extent this state of affairs reflected the failure of healthcare reforms to address regional inequities in the distribution of healthcare resources. . Healthcare reform might have failed to reduce regional inequalities if either of two conditions held. First, the rhetoric surrounding healthcare reform may have not been matched by meaningful changes in access to quality healthcare in the most disadvantaged regions, namely rural areas and areas remote from the wealthy coastal area. Second, healthcare may have proved ineffective as a means for improving child health outcomes in these same regions, given their high poverty levels and relative lack of socioeconomic development.

Consistent with the previous studies on healthcare resources, the results of our study present that only selective items of healthcare resources are related to child nutritional status. Only utilization of health facilities and the percentage of vaccination coverage were significantly associated with child health outcome, but health expenditure, human resources in medical sector, and the number of healthcare facilities were not. In other words, while actual utilization of health services was associated with health outcome, availability of healthcare resources was not a significant predictor of child health. However, none of these healthcare resources contributed to explain the regional differences of child malnutrition.

Second, our analyses confirmed that community poverty was the most important component in child health status and regional disparities of child health. The results of our study provided strong evidence that community poverty was significantly associated with child malnutrition net of individual and household characteristics. More importantly, a significant portion of the regional differences of child health outcome was explained by community poverty, while most healthcare resources had very limited associations with regional health disparities. Third, we examined whether healthcare resources work more efficiently among worse-off communities by testing interaction effects between community level poverty rate and healthcare resources on child health. We expected positive interaction effects on health outcome based on the ideas of resource substitution theory, which argues that the effect of having a specific resource is greater for those who have fewer alternative resources. However, there was very little evidence to support this theory in our analyses; only medical professionals turned out to work better for health outcome among poorer regions. There might be several possible explanations for this result, but we suspect that medical resources have not been successfully targeted to those most in need [?] These findings suggest that local socioeconomic environment, not healthcare resources, is the key determinant of not only health outcomes, but also regional health disparities. Also they imply that distribution of healthcare resources alone will not produce favorable outcomes at the national level without serious consideration of regional development and allocation of material and social resources among more disadvantaged regions. Although investments in social development have significantly enhanced overall living condition and quality of life in most countries during last several decades, the greatest beneficiaries of the expanded opportunities were relatively more affluent segments of the population (or region), which raised the issue of equity, especially in health sector.

Regarding the health disparities in many LDCs, Victora and colleagues (2003) wrote, "… The reality is the opposite. The poorest children are the least likely to be vaccinated, to receive vitamin A or to sleep under a treated net. Inequities in exposure and resistance are therefore compounded by inequities in coverage for preventive interventions, making poor children even more likely to become sick and in need of curative care compared with their better-off peers (2003:234)." This statement describes the classic example of problem in the distribution and allocation of health resources in many LDCs. Since child malnutrition is caused by overall deprivation in material and social condition, such as food deprivation, infectious diseases other sicknesses, lack of access to markets, deficient transportation, inadequate health and sanitary infrastructure and low level of education (Valdivia 2004, Aguiar et al 2007), provision of better opportunity structure would be the most equitable way of dealing with health inequality; increasing access to healthcare resources in these areas is less likely to have beneficial effects, especially if increases in available healthcare resources do not translate into higher levels of utilization.

Then, we can consider the features of various resources in terms of equity and make implications for decreased health disparities. Availability of healthcare resources such as medical professionals or the number of health facilities is the concept most loosely connected to health equity because available medical resources within community are not always utilized by residents. Available resources are less likely to be used by residents if the available resources require high cost for usage in various ways –high cost of drug or consultant as well as of access due to poor environment for utilization. One of the typical problems of recent health reforms in many countries is that actual outcome have often been contrary to their stated objectives due to exacerbated economic access for the poor and increased total costs for healthcare (Whitehead, Dahlgren, and Evans 2001). In addition, where the available resources are actually utilized, the quality of the resources matter as well. Recent Peruvian survey of health infrastructure reveals that healthcare facilities (health center and health posts) concentrated in rural and poor areas have much lower level of efficiency than hospitals mainly placed in better-off regions (71 and 58 percent versus 86 percent) (Madueño and Sanabria 2003). As addressed by Wagstaff and colleagues (2004), healthcare facilities in poor communities has usually low quality services and short supply of drugs. Likewise, other facilities (e.g., schools or regional offices of government) are less well organized and less convenient to use, such as early closing time of services or absence of personnel in poor communities (Victora et al. 2004; Chaudhury et al. 2006).

On the other hand, general development of disadvantaged communities should be considered. This regional development include overall improvement of basic infrastructure, and general accessibility to social resources relevant to health as well as to healthcare resources which is the basic condition for getting to services and might be more directly related with health disparities by community. Paved roads lower transportation costs, thus allowing social and medical services to reach to those people far away from the social services. Appropriate irrigation system in rural areas can improve the productivity and physical environment in the agricultural sector and consequently increase the food supply in specific community settings (Fan et al. 2000). Enhancement of social capital may provide important resources for better health especially in disadvantaged communities. This might be achieved by focusing on development of human capital and the establishment of community networks for reciprocity, directly or indirectly through improved socioeconomic development, As emphasized in previous research, overall public expenditure, not health expenditure by itself, may matter in determining health status.

Last, but not least, good governance of resources and policies as well as better organization of the roles of governmental (or public) and private sectors as providers of health service needs to be addressed for achievement of health equity. Although our study is limited to Peruvian context, the findings provide useful insights on the context of other countries considering that large number of health research, both in LDCs and MDCs, have presented similar pattern of the association between allocation of healthcare resource and health outcomes (or health disparities) (Bellanger and Jourdain 2004; Lopez-Casasnovas, Costa-Font, and Planas 2005). This question is generally relevant to the issues of healthcare resources and community development we discussed above, but we also address this issue in terms of policy efficacy as well, which does not always mean cost-effectiveness. Effectiveness of health policy might be related with improvement of operational performance, such as good management and high level capacity of central and local government in budgeting and implementation of policies. Also, low level of corruption and the good quality of bureaucracy should be achieved to avoid institutional inefficiencies such as leakage in public spending and weak institutional capacity and to make effective policy intervention of public health.

REFERENCES

Aguiar, Christine, Josh Rosenfeld, Beth Stevens, Sup Thanasombat, and Harika Masud. 2007. "An Analysis of Malnutrition Programming and Policies in Peru." *Documento preparado para el International Economic Development Program, University of Michigan*.

Ainsworth, James W. 2002. "Why does it take a village? The mediation of neighborhood effects on educational achievement." *Social Forces* 81: 117-152.

Alderman, Harold, Hoddinott, John and Kinsey, William. 2006. "Long-term consequences of early childhood malnutrition." *Oxford Economic Papers*, 58:450-474

Alleyne, George AO. 2001. "Equity and health." In *Equity and health: views from the Pan American Sanitary Bureau. Washington, DC: Pan American Health Organization*.

Altschuler, Andrea, Carol P. Somkin, and Nancy E. Adler. 2004. "Local services and amenities, neighborhood social capital, and health." *Social Science & Medicine* 59: 1219-1229.

Anand, Sudhir, and Till Bärnighausen. 2004. "Human resources and health outcomes: cross-country econometric study." *The Lancet* 364: 1603-1609.

Aneshensel, Carol S., and Clea A. Sucoff. 1996. "The neighborhood context of adolescent mental health." *Journal of health and social behavior* 37: 293-310.

Attanasio, Orazio, Luis Carlos Gomez, Ana Gomez Rojas, and Marcos Vera-Hernandez. 2004. "Child health in rural Colombia: determinants and policy interventions." *Economics & Human Biology* 2: 411-438.

Balk, Deborah, Thomas Pullum, Adam Storeygard, Fern Greenwell, and Melissa Neuman. 2004. "A spatial analysis of childhood mortality in West Africa." *Population, Space and Place* 10: 175-216.

Bellanger, Martine M., and Alain Jourdain. 2004. "Tackling regional health inequalities in France by resource allocation." *Applied health economics and health policy* 3: 243-250.

Bernard, Paul, Rana Charafeddine, Katherine L. Frohlich, Mark Daniel, Yan Kestens, and Louise Potvin. 2007. "Health inequalities and place: a theoretical conception of neighbourhood." *Social Science & Medicine* 65: 1839-1852.

Bhalotra, Sonia. 2007. "Spending to save? State health expenditure and infant mortality in India." *Health Economics* 16: 911-928.

Bidani, Benu, and Martin Ravallion. 1997. "Decomposing social indicators using distributional data." Journal of Econometrics 77: 125–139

Birley, Martin H., and Karen Lock. 1998. "Health and peri-urban natural resource production." *Environment and Urbanization* 10: 89-106.

Bloom, David E., David Canning, and Dean T. Jamison. 2004. "Health, wealth, and welfare." *Finance and development* 41: 10-15.

Bloom, David, and David Canning, and Jaypee Sevilla, 2004, "The Effect of Health on Economic Growth: A Production Function Approach," *World Development* 32: 1–13.

Bloom, David, and David Canning. 2003. "The Health and Poverty of Nations: From Theory to Practice," *Journal of Human Development* 4: 47–71.

Braveman, Paula A., Shiriki Kumanyika, Jonathan Fielding, Thomas LaVeist, Luisa N. Borrell, Ron Manderscheid, and Adewale Troutman. 2011. "Health Disparities and Health Equity: The Issue Is Justice." *American Journal of Public Health 101*: S149-S155.

Braveman, Paula, and Eleuther Tarimo. 2002. "Social inequalities in health within countries: not only an issue for affluent nations." *Social Science & Medicine* 54: 1621-1635.

Bravemen, Paula. 2006. “Health Disparities and Health Equity: Concepts and Measurement.” *Annual Review of Public Health* 27: 167-94.

Brenneman, Adam, and Michel Kerf. 2002. "Infrastructure & Poverty Linkages. A Literature Review.” *The World Bank, Washington, DC*.

Britton, Marcus, and Heeju Shin. Forthcoming. "Metropolitan Residential Segregation and Very Preterm Birth Among African American and Mexican-Origin Women." *Social Science & Medicine*.

Brown, J. Larry, and Ernesto Pollitt. 1996. "Malnutrition, poverty and intellectual development." *Scientific American* 274: 38-43.

Browning, Christopher R., and Kathleen A. Cagney. 2003. "Moving beyond poverty: neighborhood structure, social processes, and health." *Journal of Health and Social Behavior* 44: 552-571.

Cabraal, R. Anil, Douglas F. Barnes, and Sachin G. Agarwal. 2005. "Productive uses of energy for rural development." *Annual Review of Environmental Resources* 30: 117-144.

Carpiano, Richard M. 2007. "Neighborhood social capital and adult health: an empirical test of a Bourdieu-based model." *Health & Place* 13: 639-655.

Chaudhury, Nazmul, Jeffrey Hammer, Michael Kremer, Karthik Muralidharan, and F. Halsey Rogers. 2006. "Missing in action: teacher and health worker absence in developing countries." *The Journal of Economic Perspectives* 20: 91-116.

Cotlear, Daniel. "Peru: Reforming Health Care for the Poor. 2000. " *World Bank, Human Development Department (LCSHD) Paper Series* 57.

Culyer, Anthony J. 1980. *The political economy of social policy*. Oxford: Martin Robertson

Daniels, Norman, Bruce Kennedy, and Ichiro Kawachi. 2004. "Health and inequality, or, why justice is good for our health." In: S. Anand, F. Peter & A. Sen (eds.), *Public Health, Ethics and Equity:*: 63-91. New York: Oxford University Press

Desai, Manish A., Sumi Mehta, and K. Smith. 2004. "Indoor smoke from solid fuels: Assessing the environmental burden of disease at national and local levels." *Environmental Burden of Disease Series* No. 4

Diez Roux, Ana V. 2001. "Investigating neighborhood and area effects on health." *American journal of public health* 91: 1783-1789.

Diez Roux, AV, S. Stein Merkin, P. Hannan, David R. Jacobs, and Catarina I. Kiefe. 2003. "Area Characteristics, Individual-Level Socioeconomic Indicators, and Smoking in Young Adults The Coronary Artery Disease Risk Development in Young Adults Study." *American journal of epidemiology* 157: 315-326.

Duncan, Craig, Kelvyn Jones, and Graham Moon. 1996. "Health-related behaviour in context: a multilevel modelling approach." *Social Science & Medicine* 42: 817-830.

Duncan, Craig, Kelvyn Jones, and Graham Moon. 1999. "Smoking and deprivation: are there neighbourhood effects?" *Social Science & Medicine* 48: 497-505.

Ennett, Susan T., Robert L. Flewelling, Richard C. Lindrooth, and Edward C. Norton. 1997. "School and neighborhood characteristics associated with school rates of alcohol, cigarette, and marijuana use." *Journal of Health and Social Behavior 38*: 55-71.

Ewig, Christina. 2006. “Global processes, local consequences: Gender equity and health sector reform in Peru." *Social Politics: International Studies in Gender, State & Society* 13: 427-455.

Fagg, James, Sarah Curtis, Stephen Stansfeld, and Peter Congdon.2006. "Psychological distress among adolescents, and its relationship to individual, family and area characteristics in East London." *Social Science & Medicine* 63: 636-648.

Fan, Shenggen, Peter Hazell, and Sukhadeo Thorat. 2000. "Government spending, growth and poverty in rural India." *American Journal of Agricultural Economics* 82: 1038-1051

Fang, Pengqian, Siping Dong, Jingjing Xiao, Chaojie Liu, Xianwei Feng, and Yiping Wang. 2010. "Regional inequality in health and its determinants: evidence from China." *Health Policy* 94: 14-25.

Farahani, Mansour, S. V. Subramanian, and David Canning. 2009. "The effect of changes in health sector resources on infant mortality in the short-run and the long-run: A longitudinal econometric analysis." *Social Science & Medicine* 68: 1918-1925.

Farahani, Mansour, S. V. Subramanian, and David Canning. 2010. "Effects of state-level public spending on health on the mortality probability in India." *Health economics* 19: 1361-1376.

Fay, Marianne, Danny Leipziger, Quentin Wodon, and Tito Yepes. 2005. "Achieving child-health-related millennium development goals: The role of infrastructure." *World Development* 33: 1267-1284.

Filmer, Deon, and Lant Pritchett. 1999. “The impact of public spending on health: does money matter?” *Social Science & Medicine* 49: 1309-23.

Foster, E. Michael, and Sara McLanahan. 1996. "An illustration of the use of instrumental variables: Do neighborhood conditions affect a young person's chance of finishing high school?" *Psychological Methods* 1: 249-260.

Frankenberg, Elizabeth, Wayan Suriastini, and Duncan Thomas. 2005. "Can expanding access to basic healthcare improve children's health status? Lessons from Indonesia's ‘midwife in the village’programme." *Population Studies* 59: 5-19

Freitas, Sergio Fernando Torres de, Emil Kupek, and Mayra Chiaradia Perraro. 2001. "Distribuicao de recursos de saúde no estado de Santa Catarina, Brasil: um subsidio para discussoes sobre o financiamiento em saúde; The allocation of health care resources in the state of Santa Catarina, Brazil: a contribution to a discussion on health funding." *Rev. panam. salud pública* 10: 95-100.

Frohlich, Katherine L., Louise Potvin, Patrick Chabot, and Ellen Corin. 2002. "A theoretical and empirical analysis of context:: neighbourhoods, smoking and youth." *Social Science & Medicine* 54: 1401-1417.

Gajate Garrido, Gissele. 2011. "Excluding the Poor: The Impact of Public Expenditure on Child Malnutrition in Peru." Available at SSRN: http://ssrn.com/abstract=1879456 or http://dx.doi.org/10.2139/ssrn.1879456

Glewwe, Paul, Hanan G. Jacoby, and Elizabeth M. King. 2001. "Early childhood nutrition and academic achievement: a longitudinal analysis." *Journal of Public Economics* 81: 345-368.

Grantham-McGregor, Sally, Christine Powell, Susan Walker, Susan Chang, and Patricia Fletcher. 1994. "The Long-Term Follow-up of Severely Malnourished Children Who Participated in an Intervention Program." *Child development* 65: 428-439.

Grantham-McGregor, Sally, Yin Bun Cheung, Santiago Cueto, Paul Glewwe, Linda Richter, and Barbara Strupp. 2007. "Developmental potential in the first 5 years for children in developing countries." *The Lancet* 369: 60-70.

Gupta, Sanjeev, Marijn Verhoeven, and Erwin R. Tiongson. 2002. "The effectiveness of government spending on education and health care in developing and transition economies." *European Journal of Political Economy* 18: 717-737.

Gupta, Sanjeev, Marijn Verhoeven, and Erwin R. Tiongson. 2003. "Public spending on health care and the poor." *Health Economics* 12: 685-696.

Gwatkin, Davidson R. 2000. "Health inequalities and the health of the poor: what do we know? What can we do?" *Bulletin of the world health organization* 78: 3-18.

Gyimah-Brempong, Kwabena, and Mark Wilson. 2004. "Health human capital and economic growth in Sub-Saharan African and OECD countries." *The Quarterly Review of Economics and Finance* 44: 296-320.

Hobcraft, John. 1993. "Women's education, child welfare and child survival: a review of the evidence." *Health Transition Review 3*: 159-175.

Instituto Nacional de Estadística e Informática (INEI). 2009. Perú: Encuesta Demográfica y de Salud Familiar 2007-2008 INFORME PRINCIPAL

Instituto Nacional de Estadística e Informática (INEI). 2013. *Evolución de la Pobreza Monetaria. Informe Técnico 2007-2012*. Lima: INEI.

Iwami, Michiyo, and Roland Petchey. 2002. "A CLAS act? Community-based organizations, health service decentralization and primary care development in Peru." *Journal of Public Health* 24: 246-251.

Jalan, Jyotsna, and Martin Ravallion. 2003. "Does piped water reduce diarrhea for children in rural India?" *Journal of econometrics* 112: 153-173.

Jenkins, Katy. 2011. "Peruvian community health promoters: Expanding the spaces of health voluntarism." *Health & place* 17: 17-23.

Jones, Kelvyn, and Craig Duncan. 1995."Individuals and their ecologies: analyzing the geography of chronic illness within a multilevel modeling framework." *Health & Place* 1: 27-40.

Kandala, Ngianga-Bakwin, Chen Ji, Nigel Stallard, Saverio Stranges, and Francesco P. Cappuccio. 2007. "Spatial analysis of risk factors for childhood morbidity in Nigeria." *American Journal of Tropical Medicine and Hygiene* 77: 770-779.

Kandala, Ngianga-Bakwin, Monica Akinyi Magadi, and Nyovani Janet Madise. 2006. "An investigation of district spatial variations of childhood diarrhoea and fever morbidity in Malawi." *Social Science & Medicine* 62: 1138-1152.

Karvonen, Sakari, and Arja Rimpelä. 1996. "Socio-regional context as a determinant of adolescents' health behaviour in Finland." *Social Science & Medicine* 43: 1467-1474.

Karvonen, Sakari, and Arja Rimpelä. 1997. Urban small area variation in adolescents' health behaviour. *Social Science & Medicine* 45: 1089–1098.

Kazembe, Lawrence N., Adamson S. Muula, and Christopher Simoonga. 2009. "Joint spatial modelling of common morbidities of childhood fever and diarrhoea in Malawi." *Health & Place* 15: 165-172.

Kim, Kwangkee, and Philip M. Moody. 1992. "More resources better health? A cross-national perspective." *Social Science & Medicine* 34: 837-842.

Kim, Yong, A. Shakow, and J. Bayona. 1999. "The privatization of health care in Peru." *Development* 42: 121-125.

Ko, Hansoo, Jinseob Kim, Donggil Kim, Saerom Kim, Yukyung Park, and Chang-yup Kim. 2013. "Association Between Local Government Social Expenditures and Mortality Levels in Korea." *Journal of Preventive Medicine and Public Health* 46: 1-9

Krieger, Nancy, Sally Zierler, Joseph W. Hogan, Pamela Waterman, Jarvis Chen, Kerry Lemieux, Annie Gjelsvik, I. Kawachi, and L. F. Berkman. 2003. "Geocoding and measurement of neighborhood socioeconomic position: a US perspective." *Neighborhoods and health*: 147-178.

Kumar, Kaushalendra, Faujdar Ram, and Abhishek Singh. 2013. "Public Spending on Health and Childhood Mortality in India." Available at SSRN: http://ssrn.com/abstract=2240251 or http://dx.doi.org/10.2139/ssrn.2240251

LaDuke, Winona. 1999. *All Our Relations: Native Struggles for Land and Life*. Cambridge, MA: South End.

Lantz, Paula M., James S. House, James M. Lepkowski, David R. Williams, Richard P. Mero, and Jieming Chen. 1998. "Socioeconomic factors, health behaviors, and mortality." *JAMA: the journal of the American Medical Association* 279: 1703-1708.

Lantz, Paula M., John W. Lynch, James S. House, James M. Lepkowski, Richard P. Mero, Marc A. Musick, and David R. Williams.2001. "Socioeconomic disparities in health change in a longitudinal study of US adults: the role of health-risk behaviors." *Social Science & Medicine* 53: 29-40.

Lavy, Victor, John Strauss, Duncan Thomas, and Philippe De Vreyer (1996), “Quality of Health Care, Survival and Health Outcomes in Ghana”, *Journal of Health Economics* 15: 333-57.

Lee, Lung-fei, Mark R. Rosenzweig, and Mark M. Pitt. 1997. “The Effects of Improved Nutrition, Sanitation, and Water Quality on Child Health in High-Mortality Populations.” *Journal of Econometrics* 77: 209-35.

Leipziger, Danny, Marianne Fay, Quentin Wodon, and Tito Yepes. 2003. "Achieving the millennium development goals: the role of infrastructure." *World Bank Policy Research Working Paper* 3163.

Lichtenberg, Frank. R. 2011 “The quality of medical care, behavioral risks factors, and longevity growth”. *International Journal of Health Care Finance and Economics* 11(1): 1-34.

Lindelow, Magnus. 2006. Sometimes More Equal Than Others: How Health Inequalities Depend upon the Choice of Welfare Indicator.” *Health Economics* 15: 263-80.

Linnemayr, Sebastian, Harold Alderman, and Abdoulaye Ka. 2008. "Determinants of malnutrition in Senegal: Individual, household, community variables, and their interaction." *Economics & Human Biology* 6: 252-263.

Lopez, Russ. 2002. "Segregation and black/white differences in exposure to air toxics in 1990." *Environmental Health Perspectives* 110 (Suppl2): 289-295.

Lopez-Casasnovas, Guillem, Joan Costa-Font, and Ivan Planas. 2005. "Diversity and regional inequalities in the Spanish ‘system of health care services’." *Health Economics* 14: S221-S235.

Luke, Nancy, and Hongwei Xu. 2011. "Exploring the meaning of context for health: Community influences on child health in South India." *Demographic Research* 24: 345-374.

Macintyre, Sally, and Anne Ellaway. 2000. "Ecological approaches: the rediscovery of the role of the physical and social environment.” *Pp. 332–48. In Berkman L, Kawachi I, (eds.) Social epidemiology. New York: Oxford University Press.*

Macintyre, Sally, Anne Ellaway, and Steven Cummins. 2002. "Place effects on health: how can we conceptualise, operationalise and measure them?" *Social Science & Medicine* 55: 125-139.

Madueño, Miguel, and César Sanabria. September 2003. Estudio de oferta de los servicios de salud en el Perú y el análisis de brechas 2003-2020. Bethesda, MDÑ Proyecto socios para le Reformaplus del Sector Salud, Abt Associates Inc.

McGuire, James W. 2006. “Basic Health Care Provision and Under- Mortality: A Cross-National Study of Developing Countries” *World Development* 34: 405-425.

Morello-Frosch, Rachel, and Bill M. Jesdale.2006. "Separate and unequal: residential segregation and estimated cancer risks associated with ambient air toxics in US metropolitan areas." *Environmental Health Perspectives* 114: 386-394.

Musgrove, Philip. 1996. *Public and private roles in health*. World Bank.

Newman, John, Menno Pradhan, Laura B. Rawlings, Geert Ridder, Ramiro Coa, and Jose Luis Evia. 2002. “An Impact Valuation of Education, Health, and Water Supply Investments by the Bolivian Social Investment Fund.” *World Bank Economic Review* 16: 241-74.

O'Donnell, Owen, Eddy van Doorslaer, Adam Wagstaff, and Magnus Lindelow. 2008. *Analyzing health equity using household survey data: a guide to techniques and their implementation*. World Bank Institute.

Onis, Mercedes de, Edward A. Frongillo, and Monika Blössner. 2000. "Is malnutrition declining? An analysis of changes in levels of child malnutrition since 1980." *Bulletin of the World Health Organization* 78: 1222-1233.

Osypuk, Theresa L., and Dolores Acevedo-Garcia. 2010. Beyond individual neighborhoods: A geography of opportunity perspective for understanding racial/ethnic health disparities. *Health & Place* 16: 1113-1123.

Pearl, Michelle, Paula Braveman, and Barbara Abrams. 2001. "The relationship of neighborhood socioeconomic characteristics to birthweight among 5 ethnic groups in California." *Journal Information* 91: 1808-1814

Pollitt, Ernesto, Kathleen S. Gorman, Patrice L. Engle, Reynaldo Martorell, Juan Rivera, Theodore D. Wachs, and Nevin S. Scrimshaw. 1993. "Early supplementary feeding and cognition: effects over two decades." *Monographs of the Society for Research in Child Development* 58: i-118.

Pong, Suet-ling, and Lingxin Hao. 2007. "Neighborhood and School Factors in the School Performance of Immigrants' Children." *International Migration Review* 41: 206-241.

Pradhan, Menno, David E. Sahn, and Stephen D. Younger. 2003. "Decomposing world health inequality." *Journal of health economics* 22: 271-293.

Rajkumar, Andrew Sunil, and Vinaya Swaroop. 2008. "Public spending and outcomes: Does governance matter?" *Journal of development economics* 86: 96-111

Reyes, Jorge, and Luis M. Ochoa. "Encuesta demográfica y de salud familiar 2000." (2001). Lima, Perú: Instituto Nacional de Estadística e Informática

Rice, Nigel, and Peter C. Smith. 2001. "Ethics and geographical equity in health care." *Journal of Medical Ethics* 27: 256-261.

Robert, Stephanie A. 1999. "Socioeconomic position and health: the independent contribution of community socioeconomic context." *Annual Review of Sociology 25*: 489-516.

Ross, Catherine E. 2000. "Walking, Exercising, and Smoking: Does Neighborhood Matter?" *Social Science & Medicine* 51:265-74.

Ross, Catherine E., and John Mirowsky. 2006. "Sex differences in the effect of education on depression: resource multiplication or resource substitution?" *Social Science & Medicine* 63: 1400-1413.

Sahn, David. E, Bernier R. 1993. *Evidence From Africa on the Intrasectoral Allocation of Social Sector Expenditures***.** Cornell Food and Nutrition Policy Program Working Paper No. 45

Sampson, Robert J., and Jeffrey D. Morenoff. 1997. "Ecological perspectives on the neighborhood context of urban poverty: Past and present." In *Neighborhood poverty: policy implications in studying neighborhoods, ed. J Brooks-Gunn, GJ Duncan.* Pp 1-22. New York: Russell Sage

Sampson, Robert J., Jeffrey D. Morenoff, and Thomas Gannon-Rowley. 2002. "Assessing" neighborhood effects": Social processes and new directions in research." *Annual review of sociology 28*: 443-478.

Sampson, Robert J., Stephen W. Raudenbush, and Felton Earls. 1997. "Neighborhoods and violent crime: A multilevel study of collective efficacy." *Science* 277: 918-924.

Schempf, Ashley, Donna Strobino, and Patricia O'campo. 2009. "Neighborhood effects on birthweight: an exploration of psychosocial and behavioral pathways in Baltimore, 1995–1996." *Social Science & Medicine* 68: 100-110.

Shin, Heeju. 2007. "Child health in Peru: importance of regional variation and community effects on children's height and weight." *Journal of Health and Social Behavior* 48: 418-433.

Shouls, Susanna, Peter Congdon, and Sarah Curtis. 1996. "Modelling inequality in reported long term illness in the UK: combining individual and area characteristics." *Journal of Epidemiology and Community Health* 50: 366-376.

Smith, Kirk R. 1993. "Fuel combustion, air pollution exposure, and health: the situation in developing countries." *Annual Review of Energy and the Environment* 18: 529-566.

Smith, Lisa C., and Lawrence James Haddad. 2000. *Overcoming child malnutrition in developing countries: past achievements and future choices*. Washington, IFPRI.

Soja, Edward. 2000. Postmetropolis. Oxford: Blackwell Publishers.

Sooman, Anne, and Sally Macintyre. 1995. "Health and perceptions of the local environment in socially contrasting neighbourhoods in Glasgow." *Health & Place* 1: 15-26.

Strauss, John, and Duncan Thomas, 1998, "Health, Nutrition, and Economic Development," *Journal of Economic Literature* 36: 766–817.

Thomas, Duncan, Victor Lavy, and John Strauss. 1996. "Public policy and anthropometric outcomes in the Côte d'Ivoire." *Journal of public Economics* 61: 155-192.

Thomas, Duncan, Victor Lavy, and John Strauss.1996. "Public policy and anthropometric outcomes in the Côte d'Ivoire." *Journal of public Economics* 61: 155-192.

Valdivia, Martín. 2002. "Public health infrastructure and equity in the utilization of outpatient health care services in Peru." *Health Policy and Planning* 17: 12-19.

Valdivia, Martín. 2004. "Poverty, health infrastructure and the nutrition of Peruvian children." *Economics & Human Biology* 2: 489-510.

Van de Poel, Ellen, Ahmad Reza Hosseinpoor, Niko Speybroeck, Tom Van Ourti, and Jeanette Vega. 2008. "Socioeconomic inequality in malnutrition in developing countries." *Bulletin of the World Health Organization* 86: 282-291.

Victora, Cesar G., Adam Wagstaff, Joanna Armstrong Schellenberg, Davidson Gwatkin, Mariam Claeson, and Jean-Pierre Habicht. 2003. "Applying an equity lens to child health and mortality: more of the same is not enough." *The Lancet* 362: 233-241.

Wagstaff, A. and M. Claeson. 2004. The Millennium Development Goals for Heath: Rising to the Challenges, Washington (D.C.), World Bank.

Wagstaff, Adam, and Eddy Van Doorslaer. 2000. "Equity in health care finance and delivery." *Handbook of health economics* 1: 1803-1862.

Wagstaff, Adam, Eddy Van Doorslaer, and Naoko Watanabe. 2003. "On decomposing the causes of health sector inequalities with an application to malnutrition inequalities in Vietnam." *Journal of econometrics* 112: 207-223.

Wagstaff, Adam, Flavia Bustreo, Jennifer Bryce, and Mariam Claeson. 2004. "Child health: reaching the poor." *Journal Information* 94.Wang, Limin. 2003. "Determinants of child mortality in LDCs: empirical findings from demographic and health surveys." *Health policy* 65: 277-299.

Wallace, Rodrick, and Deborah Wallace. 1990. "Origins of public health collapse in New York City: the dynamics of planned shrinkage, contagious urban decay and social disintegration." *Bulletin of the New York Academy of Medicine* 66: 391-434.

Warwick, Hugh, and Alison Doig. 2004. "Smoke–the Killer in the Kitchen." *International Technology Development Group (ITDG).* Available at: http://www.itdg.org/html/smoke/sm oke_report_1. htm.

Well, David N. 2007. "Accounting for the effect of health on economic growth." *The quarterly journal of economics* 122: 1265-1306.

Whitehead, Margaret, Göran Dahlgren, and Timothy Evans. 2001. "Equity and health sector reforms: can low-income countries escape the medical poverty trap?" *The Lancet* 358: 833-836.

Wilkinson, Richard G. *Unhealthy societies: the afflictions of inequality*. Routledge, 2002.

Williams, David R., and Chiquita Collins. 1995. "US socioeconomic and racial differences in health: patterns and explanations." *Annual review of sociology*: 349-386.

Woodward, Alistair, and Ichiro Kawachi. 2000. "Why reduce health inequalities?" *Journal of epidemiology and community health* 54: 923-929.

World Health Organization. 2009. "Toolkit on monitoring health systems strengthening." *Medical products, vaccines and technologies: a toolkit for countries. Geneva: WHO.*

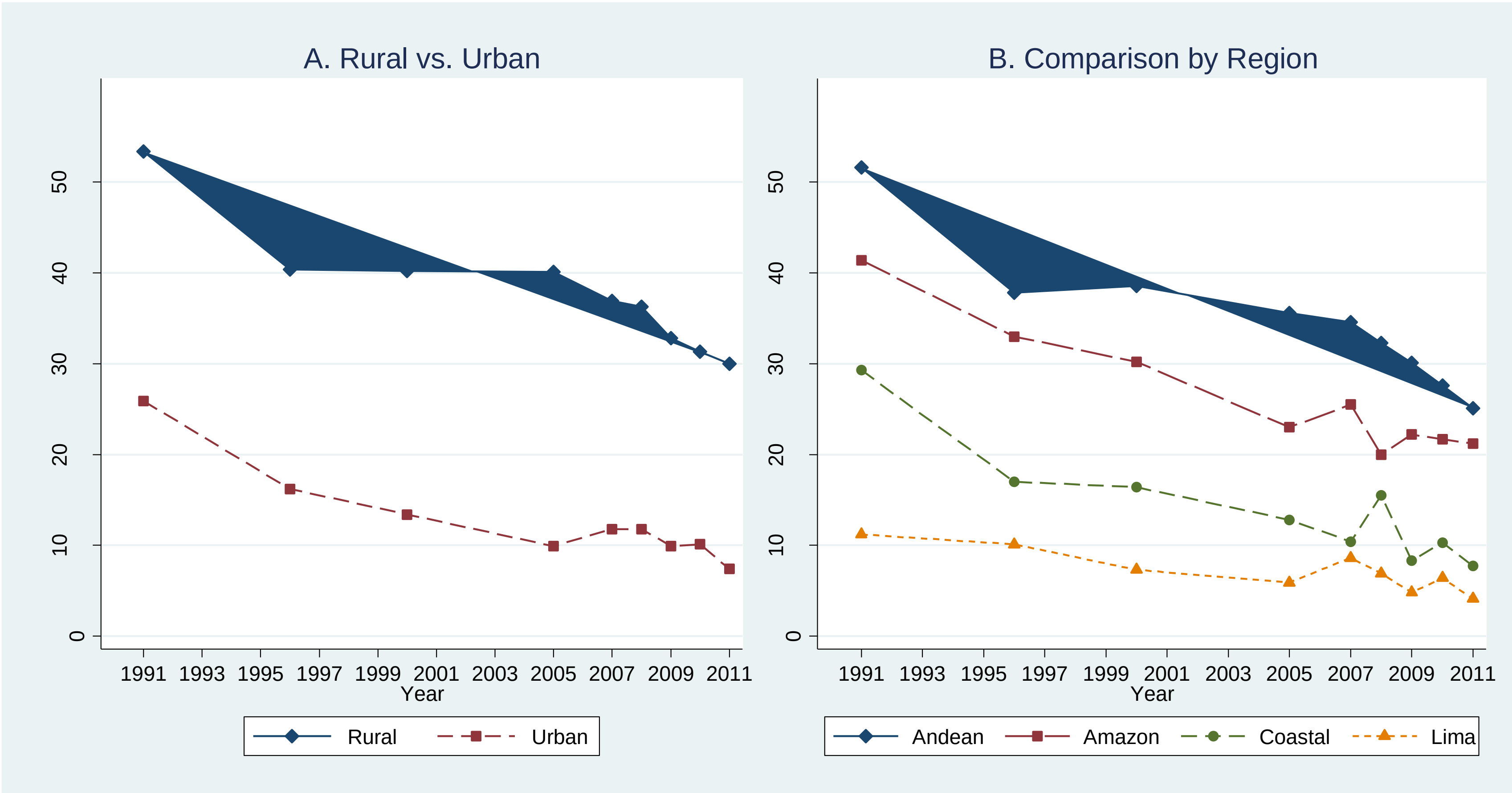
Yen, Irene H., and S. Leonard Syme. 1999. "The social environment and health: a discussion of the epidemiologic literature." *Annual review of public health* 20: 287-308.

Zenk, Shannon N., Amy J. Schulz, Barbara A. Israel, Sherman A. James, Shuming Bao, and Mark L. Wilson. 2005. "Neighborhood racial composition, neighborhood poverty, and the spatial accessibility of supermarkets in metropolitan Detroit." *Journal Information* 95: 660-667

Zere, Eyob, and Diane McIntyre.2003. "Inequities in under-five child malnutrition in South Africa." *International Journal for Equity in Health* 2: 7.

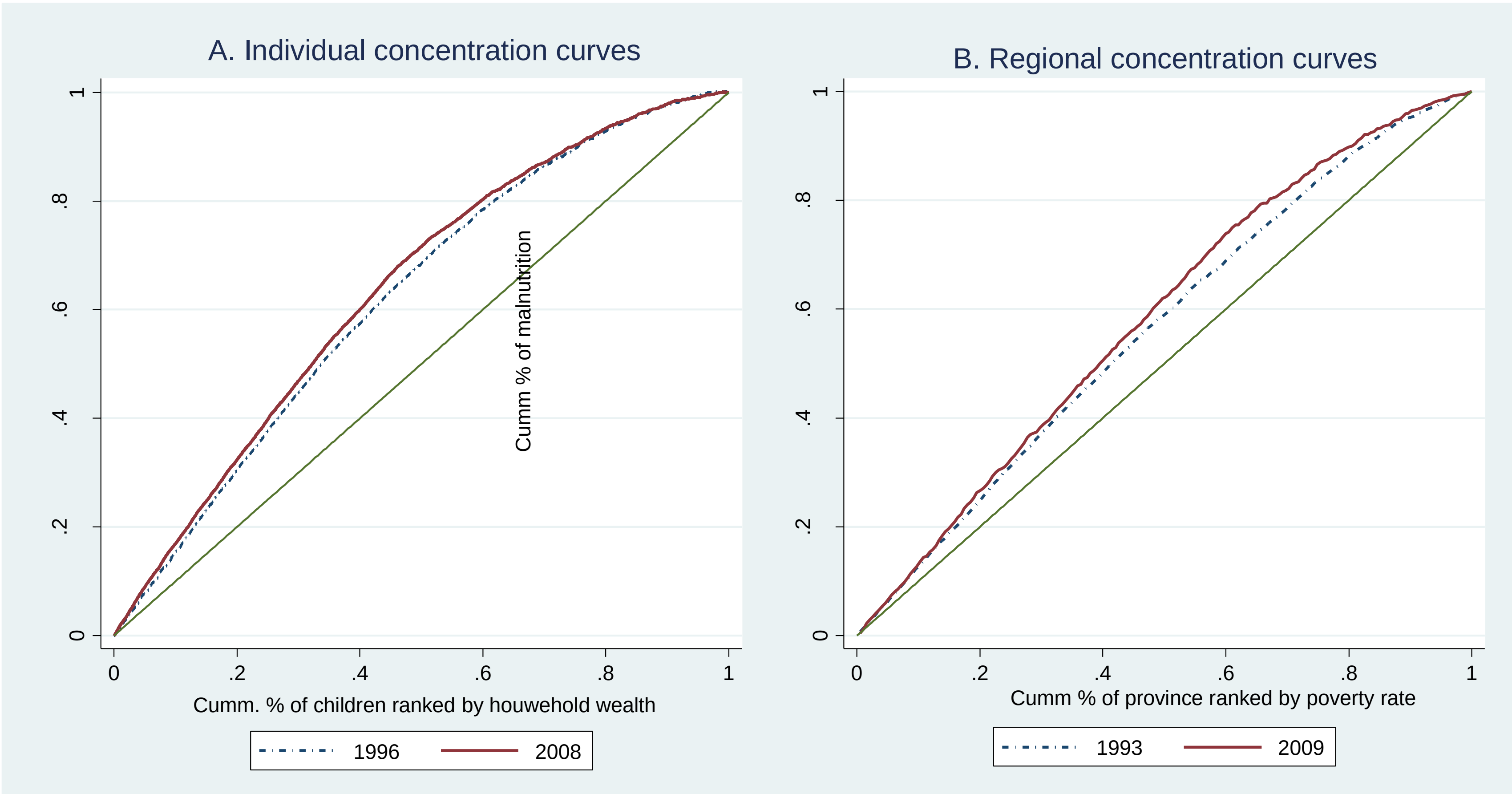
Zere, Eyob, Matshidiso Moeti, Joses Kirigia, Takondwa Mwase, and Edward Kataika. 2007. "Equity in health and healthcare in Malawi: analysis of trends." *BMC Public Health* 7: 78

Figure 1: Chronic Malnutrition of Peruvian Children over Time



Source: National Institute of Statistics and Information (Instituto Nacional de Estadistica e Informática, INEI)
http://www.inei.gob.pe/Sisd/index.asp

Figure 2: Concentration Curves of Children Malnutrition in Peru



Source: Demography and Health Survey (DHS) 1996 and 2008 for graph A

Necesidades Básicas Insatisfechas (Unsatisfied **Basic Needs,** NBI) of Peru, 1993 and 2009 for graph B

Figure 3: Box plots for height-for-age by geographic region

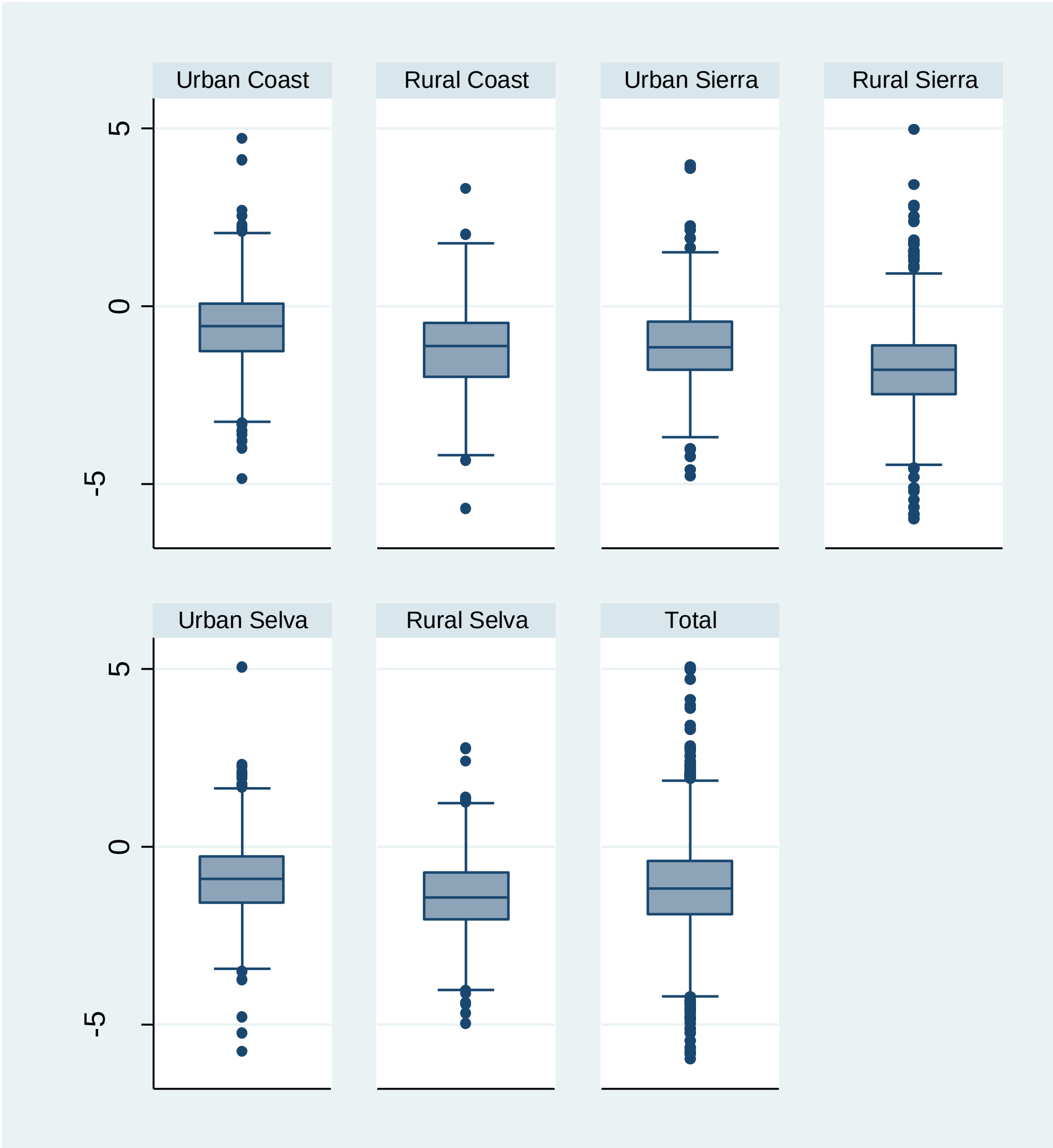


Table 1: Child Height-for-age z-score by region

	Mean	Median	SD
Lima	-0.40	-0.46	1.01
Urban Coast	-0.59	-0.59	1.04
Rural Coast	-1.11	-1.20	1.18
Urban Sierra	-1.15	-1.10	1.07
Rural Sierra	-1.78	-1.76	1.10
Urban Selva	-0.91	-0.91	1.05
Rural Selva	-1.43	-1.40	1.04

Table 2: Descriptive Statistics

Variable	Mean/Percentage	SD	Min	Max
Individual-Household (N=8114)				
Height-for-age z-score	-1.153	1.158	-5.980	5.05
Mother's education (yrs)	8.199	4.327	0	17
Child age (months)	30.136	16.964	0	59
Child sex (Male)	0.505	-	0	1
Mother age under 20	0.065	-	0	1
Age 20s	0.465	-	0	1
Age 30s	0.376	-	0	1
Age 40s	0.095	-	0	1
Prenatal Care (no care)	0.771	-	0	1
Hospital visits (#)	6.341	4.110	0	20
# of Children	2.904	1.909	1	12
Spanish (Indigenous)	0.849	-	0	1
HH wealth (poorest 20%)	0.134	-	0	1
HH wealth (20-40%)	0.161	-	0	1
HH wealth (40-60%)	0.266	-	0	1
HH wealth (60-80%)	0.299	-	0	1
HH wealth (richest 20%)	0.140	-	0	1
Urban Coast	0.258	-	0	1
Rural Coast	0.055	-	0	1
Urban Sierra	0.126	-	0	1
Rural Sierra	0.258	-	0	1
Urban Selva	0.150	-	0	1
Rural Selva	0.152	-	0	1
Community (N=965)				
Health Expenditure	48.389	75.545	10.54	269.61
Medical Profs	21.958	24.399	0.68	155.50
Outpatients	0.475	0.168	0.01	1.24
Vaccination	0.980	0.372	0.13	5.85
Health centers	8.119	5.617	1.47	23.76
District level poverty rate	39.974	23.971	1.80	95.90
District Poverty highest 20%	0.275	-	0	1
District Poverty 20-40%	0.218	-	0	1
District Poverty 40-60%	0.207	-	0	1
District Poverty 60-80%	0.160	-	0	1
District Poverty lowest 20%	0.141	-	0	1

Table 3: Regression Results: Baseline and Medical Resources/Poverty

	Regions		Baseline		Health Expenditure		Medical professionals	
VARIABLES	β	se	β	se	β	se	β	se
Mother's education (yrs)			0.041***	(0.004)	0.040***	(0.004)	0.040***	(0.004)
Child sex (Male)			-0.032	(0.022)	-0.033	(0.022)	-0.032	(0.022)
Mother age (under 20)								
Age 20s			0.064	(0.048)	0.064	(0.048)	0.066	(0.048)
Age 30s			0.176***	(0.053)	0.176***	(0.053)	0.177***	(0.053)
Age 40s			0.330***	(0.068)	0.330***	(0.068)	0.329***	(0.068)
Prenatal Care (no care)			-0.055	(0.053)	-0.056	(0.053)	-0.057	(0.053)
Hospital visits (#)			0.023***	(0.004)	0.023***	(0.004)	0.022***	(0.004)
# of Children			-0.069***	(0.009)	-0.069***	(0.009)	-0.069***	(0.009)
Spanish (Indigenous)			0.151***	(0.042)	0.150***	(0.042)	0.157***	(0.042)
HH wealth (Wealthiest 20%)								
20-40%			-0.196***	(0.043)	-0.199***	(0.043)	-0.206***	(0.043)
40-60%			-0.340***	(0.044)	-0.344***	(0.044)	-0.348***	(0.044)
60-80%			-0.455***	(0.053)	-0.459***	(0.053)	-0.460***	(0.053)
Lowest 20%			-0.616***	(0.064)	-0.621***	(0.064)	-0.621***	(0.064)
Region (Urban Coast)								
Rural Coastal	-0.584***	(0.087)	-0.144*	(0.072)	-0.148*	(0.072)	-0.130	(0.071)
Urban Sierra	-0.520***	(0.058)	-0.428***	(0.047)	-0.438***	(0.048)	-0.405***	(0.047)
Rural Sierra	-1.167***	(0.049)	-0.473***	(0.052)	-0.481***	(0.053)	-0.456***	(0.052)
Urban Selva	-0.361***	(0.059)	-0.127**	(0.047)	-0.137**	(0.049)	-0.101*	(0.048)
Rural Selva	-0.831***	(0.063)	-0.168**	(0.058)	-0.176**	(0.059)	-0.140*	(0.058)
Medical Resources								
Health Expenditure					-2.4E-4	(2.5E-4)		
Medical profs							0.002**	(0.001)
Outpatients								
Vaccination								
Health center/post								
Distr. poverty (Richest 20%)								
20-40%								
40-60%								
60-80%								
Poorest 20%								
Constant	-0.522***	(0.032)	-0.632***	(0.103)	-0.611***	(0.105)	-0.684***	(0.104)

* p<.1, ** p<.05 *** p<.01 (Two-tailed tests)

Table 3: Cont'd

	Outpatients		Vaccination		Health center/posts		Poverty	
VARIABLES	β	se	β	se	β	se	β	se
Mother's education (yrs)	0.041***	(0.004)	0.041***	(0.004)	0.041***	(0.004)	0.040***	(0.004)
Child sex (Male)	-0.034	(0.022)	-0.032	(0.022)	-0.033	(0.022)	-0.032	(0.022)
Mother age (under 20)								
Age 20s	0.065	(0.048)	0.065	(0.048)	0.064	(0.048)	0.068	(0.047)
Age 30s	0.175***	(0.053)	0.177***	(0.053)	0.176***	(0.053)	0.179***	(0.053)
Age 40s	0.327***	(0.068)	0.332***	(0.068)	0.330***	(0.068)	0.333***	(0.068)
Prenatal Care (no care)	-0.067	(0.053)	-0.056	(0.053)	-0.055	(0.053)	-0.060	(0.053)
Hospital visits (#)	0.022***	(0.004)	0.023***	(0.004)	0.023***	(0.004)	0.022***	(0.004)
# of Children	-0.068***	(0.009)	-0.069***	(0.009)	-0.069***	(0.009)	-0.068***	(0.009)
Spanish (Indigenous)	0.174***	(0.041)	0.157***	(0.042)	0.152***	(0.042)	0.137***	(0.042)
HH wealth (Wealthiest 20%)								
20-40%	-0.193***	(0.043)	-0.196***	(0.043)	-0.195***	(0.043)	-0.178***	(0.043)
40-60%	-0.328***	(0.044)	-0.339***	(0.044)	-0.336***	(0.044)	-0.306***	(0.044)
60-80%	-0.429***	(0.053)	-0.451***	(0.053)	-0.453***	(0.053)	-0.392***	(0.054)
Lowest 20%	-0.571***	(0.064)	-0.609***	(0.064)	-0.617***	(0.064)	-0.533***	(0.065)
Region (Urban Coast)								
Rural Coastal	-0.160*	(0.070)	-0.149*	(0.071)	-0.145*	(0.072)	-0.073	(0.070)
Urban Sierra	-0.470***	(0.046)	-0.425***	(0.047)	-0.413***	(0.050)	-0.263***	(0.051)
Rural Sierra	-0.531***	(0.052)	-0.469***	(0.052)	-0.455***	(0.056)	-0.258***	(0.059)
Urban Selva	-0.196***	(0.048)	-0.127**	(0.047)	-0.103	(0.055)	-0.053	(0.047)
Rural Selva	-0.226***	(0.058)	-0.166**	(0.058)	-0.142*	(0.065)	-0.038	(0.060)
Medical Resources								
Health Expenditure								
Medical profs								
Outpatients	0.550***	(0.084)						
Vaccination			0.111**	(0.038)				
Health center/post					-0.003	(0.003)		
Distr. poverty (Richest 20%)								
20-40%							-0.154***	(0.043)
40-60%							-0.272***	(0.047)
60-80%							-0.397***	(0.054)
Poorest 20%							-0.416***	(0.062)
Constant	-0.872***	(0.109)	-0.751***	(0.110)	-0.623***	(0.103)	-0.543***	(0.104)

* p<.1, ** p<.05 *** p<.01 (Two-tailed tests)

Table 4: Regression Results: Medical Resources + Province level Poverty

Variables	Health Expenditure β	se	Med. Professionals β	se	Outpatients β	se	Vaccination β	se	Health center/posts β	se
Mother's education (yrs)	0.040***	(0.004)	0.040***	(0.004)	0.040***	(0.004)	0.040***	(0.004)	0.040***	(0.004)
Child sex (Male)	-0.032	(0.022)	-0.032	(0.022)	-0.033	(0.022)	-0.032	(0.022)	-0.032	(0.022)
Mothers Age (under 20)	0.068	(0.047)	0.069	(0.047)	0.067	(0.047)	0.069	(0.047)	0.070	(0.047)
Age 20s										
Age 30s	0.178***	(0.053)	0.179***	(0.053)	0.177***	(0.053)	0.179***	(0.053)	0.181***	(0.053)
Age 40s	0.333***	(0.068)	0.331***	(0.068)	0.328***	(0.068)	0.334***	(0.068)	0.335***	(0.068)
Prenatal Care (no care)	-0.061	(0.053)	-0.061	(0.053)	-0.067	(0.053)	-0.062	(0.053)	-0.060	(0.053)
Hospital visits (#)	0.022***	(0.004)	0.022***	(0.004)	0.022***	(0.004)	0.022***	(0.004)	0.022***	(0.004)
# of Children	-0.069***	(0.009)	-0.068***	(0.009)	-0.068***	(0.009)	-0.068***	(0.009)	-0.068***	(0.009)
Spanish (Indigenous)	0.137**	(0.042)	0.140***	(0.042)	0.153***	(0.042)	0.141***	(0.042)	0.141***	(0.042)
HH wealth (Wealthiest 20%)										
20-40%	-0.182***	(0.043)	-0.184***	(0.043)	-0.180***	(0.043)	-0.178***	(0.043)	-0.174***	(0.043)
40-60%	-0.312***	(0.044)	-0.312***	(0.044)	-0.306***	(0.044)	-0.307***	(0.044)	-0.298***	(0.044)
60-80%	-0.398***	(0.054)	-0.397***	(0.054)	-0.386***	(0.053)	-0.389***	(0.054)	-0.386***	(0.054)
Lowest 20%	-0.539***	(0.065)	-0.538***	(0.065)	-0.515***	(0.065)	-0.527***	(0.065)	-0.533***	(0.064)
Region (Urban Coast)										
Rural Coastal	-0.078	(0.070)	-0.070	(0.070)	-0.099	(0.070)	-0.079	(0.070)	-0.073	(0.070)
Urban Sierra	-0.276***	(0.052)	-0.260***	(0.051)	-0.329***	(0.053)	-0.265***	(0.051)	-0.220***	(0.055)
Rural Sierra	-0.268***	(0.059)	-0.257***	(0.058)	-0.337***	(0.061)	-0.257***	(0.058)	-0.210***	(0.063)
Urban Selva	-0.067	(0.048)	-0.044	(0.047)	-0.117*	(0.049)	-0.055	(0.047)	0.010	(0.056)
Rural Selva	-0.048	(0.060)	-0.030	(0.060)	-0.106	(0.061)	-0.041	(0.059)	0.031	(0.068)
Medical Resources										
Health expenditure	-3.4E-4	(-2.4E-4)								
Medical profs			0.001	(0.001)						
Outpatients					0.374***	(0.090)				
Vaccination							0.092*	(0.037)		
Health center/post									-0.007*	(0.003)
Distr. poverty (Richest 20%)										
20-40%	-0.156***	(0.043)	-0.138**	(0.044)	-0.109*	(0.044)	-0.145***	(0.043)	-0.177***	(0.044)
40-60%	-0.277***	(0.047)	-0.253***	(0.049)	-0.195***	(0.050)	-0.263***	(0.047)	-0.285***	(0.047)
60-80%	-0.401***	(0.054)	-0.379***	(0.055)	-0.318***	(0.057)	-0.384***	(0.054)	-0.419***	(0.055)
Poorest 20%	-0.419***	(0.062)	-0.398***	(0.063)	-0.339***	(0.064)	-0.415***	(0.062)	-0.428***	(0.062)
Constant	-0.512***	(0.106)	-0.576***	(0.106)	-0.728***	(0.113)	-0.644***	(0.112)	-0.515***	(0.105)

* p<.1, ** p<.05 *** p<.01 (Two-tailed tests)

Table 5: Regression Results: Interaction Models between Poverty and Medical Resources

	Health Expenditure		Med. Professionals		Outpatients		Vaccination		Health center/posts	
Variables	β	se	β	se	β	se	β	se	β	se
Medical Resources										
Health expenditure	-0.001	(0.000)								
Medical profs			-0.001	(0.001)						
Outpatients					0.642***	(0.175)				
Vaccination							0.161	(0.110)		
Health center/post									-0.001	(0.006)
District Poverty (rate)	-0.008***	(0.001)	-0.008***	(0.001)	-0.003	(0.002)	-0.006***	(0.002)	-0.006***	(0.002)
Interactions										
Hlth exp. x pov	1.9E-5	(1.8E-5)								
Med. Profs x pov			7.8E-4**	(9.1E-4)						
Outpatients x pov					-0.006	(0.004)				
Vaccination x pov							-0.001	(0.002)		
Health center x pov									-6E-5	(1.2E-4)
Constant	-0.410***	(0.108)	-0.456***	(0.107)	-0.773***	(0.135)	-0.623***	(0.155)	-0.458***	(0.112)

* p<.1, ** p<.05 *** p<.01 (Two-tailed tests)

ENDNOTES

[1] CLAS members were elected by the local community and subscribed a three-year contract with the Ministry of Health to administer a health post. Consequentially, resources for the facilities were transferred from the public sector to CLAS. As an autonomous organization, CLAS could secure other sources of funding by means of partnerships, donations and contributions from community activities and collected user fees from the health services provided.

[2] For instance, monetary poverty in 2012, measured as the proportion of the population that cannot afford a basic grocery basket, affects 14% of the Metropolitan Lima population compared to 17% of the Urban Coast and 31% of the rural Coast. Rural areas in the Andes and Amazon have the highest poverty rates than their urban counterparts and present the highest poverty incidence in the country. In 2012, 58% of the population in the rural Andes versus 17% of its population in the urban counterpart were poor. Likewise 46% of the population in rural areas in the Amazon compared to 22% of the urban population experienced monetary poverty

[3] The presence of grocery stores itself does not always good indicator of better diet of residents of neighborhood. However, large stores generally provides a variety of foods for selection, and high quality and low price of foods compared to small stores (Zenk et al. 2003).

[4] In addition to the common and general questionnaires of DHS, 2007-2008 Continuous DHS includes questions about treatment and prevalence of diarrheal diseases (ADD), respiratory infections (ARI), immunization, breastfeeding and supplementary feeding, nutritional status of children under five years and women's childbearing age, infant mortality, knowledge and attitudes towards AIDS, access to governmental or private health services, and violence against women and children (INEI 2009).

[5] Although the GPS data contains a cluster ID that corresponds to the cluster ID of the survey, the GPS data correspond to the survey data in a one-to-many relationship because multiple individuals and households are assigned the same cluster number.

[6] There are 1,475 mothers that have more than two children included in our sample (18.2 percent of total). To avoid biased estimations from mother-fixed effects on child health, we tested the same models using the most recent-born children sample (N=6,639) and got the same results as those from the all children sample.

[7] In2007-2008 DHS survey data, GPS information for 437 clusters out of 1851 is missing because these clusters are newly added. For this reason, we manually compared the numeric information for province and district of these clusters in DHS and those of clusters of which province and districts were classified. However, still we could not identify the district of 221 clusters due to the lack of information (especially those clusters whose district were not surveyed in previous survey period), thus and the exact number of districts used in this study is not known. This resulted 205 clusters (1678 observations, 21% of our sample size) without district names in our sample.

[8] In cross-national studies of malnutrition, the height-for-age and weight-for-age *z*-scores based on National Center for Health Statistics and World Health Organization international references are used to decide if a child is stunted or underweight (Smith and Haddad 2000).

[9] In Peru, there are 195 provinces and 1,838 districts as of 2012. The average populations of districts and provinces are about 14,700 and 140,000, respectively (INE). In our original data, each province covers 4 districts, and each district includes 2.4 clusters on average.

[10] We included mother's occupation and her childhood residence as indicators of mother's background, but not presented in table, because none of these variables is statistically significant in all models we fit in this study.