Urbanization and Health Inequalities in Developing Countries

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Abstract

Continued population growth and increasing urbanization have led to the formation of large informal urban settlements in many developing countries in recent decades. The high prevalence of poverty, overcrowding and poor sanitation observed in these settlements, commonly referred to as “slums”, suggest that slum residence constitutes a major health risk for children. In this paper, we use data from 191 DHS surveys across 73 developing countries to investigate this claim empirically. The data analyzed suggest that compared to children living in rural areas children in slums have significantly better health but that children residing in slums generally fare worse than children in better-off neighborhoods of the same urban settlements. A large fraction of the observed health differences appears to be explained by pronounced differences in maternal education, household wealth and access to health services across residential areas. Once we control for these characteristics, children growing up in the slums and better-off neighborhoods of smaller urban settlements show levels of morbidity and mortality that are not statistically different from those of children living in rural areas. Children living within large urban agglomerations (irrespective of slum or formal residence) fare better with respect to mortality and stunting than rural children, but not with respect to short-term morbidity outcomes, when socio-economic differences are controlled for.

Key Words: Urbanization, mortality, child health, slums, DHS

Introduction

Urban populations have grown rapidly over recent decades in both absolute and relative terms, with more than 50% of the global population living in urban areas in 2010. This trend is expected to continue, such that more than 60% of the world's population is expected to live in urban areas by 2030 (UN 2011). The increasingly large numbers of people living in, and moving to, urban areas in developing countries have led to the formation of large and rapidly growing informal urban settlements often referred to as "slums". More than 1 billion people, or about 14 percent of the total global population, were estimated to live in slums in 2007 (UN–HABITAT 2007).

The density of slum settlements and poverty of their residents combined with the general absence of water and sanitation facilities have raised serious concerns about the health of slum dwellers in general, and the health of children growing up in slums in particular. In many respects, modern day slums in sub-Saharan Africa, Asia and Latin America resemble low-income areas of major European cities of the 19^{th} century. Accordingly, it is often assumed that residents of today's urban slums face the same health disadvantage that residents of European cities faced in the 19^{th} century relative to their rural counterparts (Preston and Haines 1991; Cain and Hong 2009; Woods 2003); and that the additional health risks generated by the rapid growth of slums may even delay the mortality transition in low and middle income countries. (Konteh 2009; Moore, Gouldet and BS 2003; Sclar, Garau and Carolini 2005).

Evidence on mortality differentials between rural and urban areas, and of slum areas in particular, is scarce and far from conclusive. Montgomery et al.(2003) analyze data from 56

Demographic and Health Surveys (DHS) and document generally lower childhood mortality for urban households in relation to rural populations, while emphasizing that specific urban sub-populations might face higher mortality risks than rural populations. Using data from 43 DHS surveys, Brockerhoff and Brennan (1998) analyzed differences in infant mortality between small towns and large cities and found that in sub-Saharan Africa infant mortality is lower in cities, whereas it is lower in towns in Latin America and Asia; they also found that the mortality gap between rural and urban areas has been decreasing over time. Fotso et al. (2010) use DHS data from African cities supplemented with data from demographic surveillance sites to examine trends in urban child mortality. They find that the pace of decline in urban mortality in sub-Saharan Africa has in most countries not been sufficient to achieve the target of Millennium Development Goal 4, i.e. to reduce the under-5 mortality rate by two-thirds between 1990 and 2015. They also note the emergence of intra-urban mortality differentials in their analysis. In a study of 18 African countries, Bocquier et al. (2011) find that after controlling for known demographic and socio-economic correlates of childhood mortality, urban advantages are greatly reduced or indeed reversed; similar results were found by Van de Poel et al. (2009). Analyzing 85 DHS surveys Montgomery and Hewett (2008) find that poor households are often spatially intermingled with well-off households in urban areas, but also that areas of concentrated poverty are generally associated with lower rates of health service utilization. Günther and Harttgen (2012) analyze data from 18 African countries and find that child mortality rates in slum areas are significantly higher than in non-slum urban areas but lower than in rural areas in most countries. Timæus and Lush (1995) analyze intra-urban differentials in child health for four countries and find that the mortality difference between the urban poor and non-poor is larger than the difference between rural and urban populations.

We build on this previous literature, but expand the scope of the existing research in four directions. First, rather than working with selected countries, we combine all data available from Demographic and Health Surveys (DHS) into a pooled data set covering 1.38 million children under the age of five across 191 surveys in 73 low and middle income countries. Second, we extend the analysis of the health effects of urban and urban slum residence beyond child mortality, analyzing diarrhea and acute respiratory infection as measures of acute health conditions, and stunting as a measure of cumulative exposure to infectious disease or lacking nutrition. While a large literature has documented the impact of poverty and lack of access to water and sanitation on child health and child development (Fink, Gunther and Hill 2011; Grantham-McGregor et al. 2007; Walker et al. 2011), no study has, to our knowledge, systematically assessed the association between urban (slum) residence and such a broad array of child health outcomes, although Fotso (2007) and Van de Poel et al. (2007) analyze differences in stunting between rural and urban areas. Both studies find that whereas children in urban areas are better nourished than children in rural areas, the gap has been narrowing over time.

Third, we improve upon most of the existing literature by reviewing the slum concepts commonly used, and introducing a community-based measure for "slum residence". While household based definitions are common in the literature following the UN Habitat definition (UN–HABITAT 2007), we argue that defining a household residents as slum dwellers based on the lack of infrastructure of their own household alone, with no neighborhood context, is counterintuitive and likely to miss a key aspect of slum residence – the large negative effects on children growing up in environments with low hygiene and generally poor security standards.

Last, in an effort to align our study more closely with public perceptions of slum settlements, in our analysis we explicitly distinguish slums in small and medium sized towns from those in large (metropolitan) urban areas, on the grounds that the notion of "slum" is generally linked to informal settlements within major urban centers (such as the slums in Sao Paulo, Brazil, Mumbai, India or Nairobi, Kenya) and that previous studies have argued that health disadvantages should be largest in (the slums of) major cities (Brokerhoff and Brennan 1998; Cain and Hong 2009; Gould 1998).

Data and Methods

Data

The data used in this paper are from the Demographic and Health Surveys (DHS). The DHS are nationally representative population-based surveys which have historically had a primary focus on fertility and reproductive health, but also cover a large array of child health outcomes and household characteristics beyond standard child survival measures. Largely funded by USAID, more than 230 standard DHS surveys have been conducted in 86 countries since 1986.[1] The individual-level data sets are generally publicly available. Some of the earlier surveys do not include information on household characteristics needed for the classification of urban residence, resulting in a final sample of 191 surveys across 73 countries. Figure 1 shows the spatial distribution of these surveys. About half of the surveys cover sub-Saharan African countries with the remainder roughly equally distributed between Asia and Latin America. A full list of all surveys is provided in Appendix Table A1.

[1] Numbers reflect list as of November 2012, www.measuredhs.com.

[Figure 1 about here]

Classification of Residence

The principal geographic identifier contained in all DHS's is the region the person interviewed resides in (administrative level one units corresponding to states or regions), which is captured in the DHS standard recode variable hv024. In addition to the region identifier, DHS data sets contain a variable capturing the "type" of residence (hv025) which primarily distinguishes between rural and urban areas, and a variable capturing the "place" of residence (hv026), which provides a slightly less coarse division of households into rural, small town, and larger city residence. It should be noted that definitions of what constitutes an urban area are not consistent across countries, and the DHS uses whatever classification a particular country has adopted. Given that the common perception of slum settlements is generally linked to major urban settlements (such as the slums in Accra, Ghana, Mumbai, India, Nairobi, Kenya, and Sao Paulo, Brazil), we made an explicit distinction between informal settlements within large urban agglomerations and those in smaller urban areas. We classify urban settlements as "cities" if the United Nations population estimate for 2010 exceeds one million (UN 2011), and refer to smaller urban settlements (and slums within these settlements) as "towns".

Distinguishing towns from cities in DHS surveys requires some additional coding. In many cases large urban agglomerations, and especially capital cities, constitute separate administrative regions (that correspond to one particular region of hv024). All households in such regions can be classified as city households, though in some cases, such regions may also include small rural settlements. To make sure these boundary households do not affect the estimation, all households

classified as “rural” according to hv025 within larger metropolitan areas were coded as rural households. For fourteen countries (Brazil, Colombia, Egypt, Honduras, India, Indonesia, Morocco, Nigeria, Pakistan, South Africa, Ukraine, Turkey, Vietnam and Yemen), large metropolitan areas did not overlap perfectly with the administrative units provided by DHS. For surveys of these countries, the “type of place” variable (hv026) was used to categorize households into rural, town and city residence. Given that DHS surveys do not follow a standardized definition of “city”, some households that should be classified as “town” households according to our criteria may be misclassified as “city” households using this approach.

Most developing countries have only one or two large metropolitan areas, one of them usually being the capital city. In the data set analyzed, two countries –Brazil and India – strongly differ from this pattern, with over 20 agglomerations with populations in excess of one million inhabitants. Appendix Table A1 shows the complete list of metropolitan areas in the sample analyzed.

Classification of Slums

The only formal definition available of a slum is the one proposed by UN Habitat (UN–HABITAT 2007). UN Habitat defines a household as a slum household if it lacks **any** one of the following five elements:

- Access to improved water (*access to sufficient amount of water for family use, at an affordable price, available to household members without being subject to extreme effort);*

- Access to improved sanitation (*access to an excreta disposal system, either in the form of a private toilet or a public toilet shared with a reasonable number of people);*
- Durability of housing (*permanent and adequate structure in non-hazardous location)*
- Sufficient living area (*not more than two people sharing the same room)*
- Security of tenure (*evidence of documentation to prove secure tenure status or de facto or perceived protection from evictions*)

Two features of this definition stand out: first, the inclusion criteria are very broad; and second, there is a complete absence of neighborhood characteristics. While all five elements listed are undoubtedly part of proper living conditions, immediately classifying a household not meeting any one of these items as a slum household is counter-intuitive, since it implies that, for example, all households in an urban area without (or with expensive) local water supply would be considered slum households. Moreover, the exclusive focus in this definition on household characteristics appears inconsistent with the more commonly or colloquially used concept of a slum. The definition in Merriam Webster's dictionary describes a slum as "*a densely populated usually urban area marked by crowding, dirty run-down housing, poverty, and social disorganization*" (Merriam Webster, 2011). A slum is thus generally thought of as an area, neighborhood or group of buildings with certain characteristics, and not as a single household lacking specific amenities.

Following the approach proposed by Günther and Harttgen (2012), we use a neighborhood- rather than household-based definition of slums in this paper. To operationalize this definition we take advantage of the cluster sampling approach used by DHS surveys. DHS surveys typically use a two stage sampling approach, the first stage being the sampling of census

enumeration areas (EAs), and the second stage being the sampling of households within the selected EA's. Census EAs are generally defined by national statistical offices to have clearly defined boundaries and to contain a number of households that a single census interviewer can cover in one day. Given these features, DHS sample clusters will often (though not always) fall within a neighborhood rather than straddling two or more neighborhoods. We thus base our definition of slum neighborhoods on the characteristics of sample clusters. A typical EA consists of about 200 households, of which 20 to 25 are selected at the second sampling stage. Thus a full set of household characteristics is available for 20 to 25 households in each neighborhood.

In detail, we use the following approach. In a first step, a count variable was generated for each household to capture the total number of dwelling characteristics – water, sanitation, building material, crowding - that failed to meet the UN Habitat standards. The DHS surveys contain detailed information on these characteristics, but not on security of tenure. Tenure security is generally hard to measure in developing countries, where property rights are often poorly defined and frequently assigned through communities rather than through formal legal systems. For this reason, we restricted our coding to the first four criteria (water, sanitation, building material and crowding)[2]. Households with a count of zero satisfied all UN criteria; households with a score of

[2] Households are considered without access to safe water if the household does not have access to a private or public pipe, bore hole, or a protected well or spring. Households are defined as being deprived of basic sanitation if they either rely on open defecation or use an unimproved pit latrine. Shared sanitation facilities are considered as basic sanitation if they provide access to a flush toilet or ventilated improved pit latrine. A dwelling is considered as overcrowded if there are more than three persons per habitable room. If the floor material of a house is made of earth, dung, sand or wood its structure is considered inadequate. The information in the DHS thus allows us to closely approximate the UN Habitat criteria.

4 lacked all of the four characteristics analyzed.[3] In a second step, these household variables were aggregated at the neighborhood level.

To provide a better sense of how frequently households lack these four basic conditions, and the associated difficulty with generating a plausible rule for defining slum neighborhoods, we show some basic classification results in Figure 2. Column 1 of Figure 2 shows the results for the coding proposed by UN Habitat, which is based on observing households lacking any of the four basic dwelling features described above; on this basis, over 70% of urban households in our sample would be classified as slum households. This is not surprising and highlights the general absence of improved sanitation as well as the frequency of improper building materials in urban areas of developing countries (Günther and Harttgen 2012). An even larger fraction of households would be classified as slum households if a simple majority rule was applied at the neighborhood level (column 2), classifying all households in a sample cluster as slum households if at least 50% of them lack at least one of the four housing characteristics. Even if the threshold were increased to 75% of cluster households lacking at least one amenity, 60 % of urban households would be considered as slum households (column 3). We regard it as implausible to classify the majority of urban households in the developing world as slum households, so a series of more restrictive definitions were considered.

[Figure 2 about here]

[3] In some of the DHS surveys information on one of the four housing characteristics (mostly crowding) was missing. To maintain as large a sample size as possible, in such cases we imputed a positive value, i.e. that the household was not overcrowded, or had good water supply or sanitation. As a result, we may have somewhat underestimated the share of slum dwellers. For our regression results (Table 2) this means that we might have underestimated the difference in health between urban non-slum areas and slum areas on the one hand and non-slum urban areas and rural areas on the other hand.

Given that most households in developing countries lack at least one amenity, we next defined sub-standard households as households lacking *two* or more of the key household characteristics in a second classification. Considering enumeration areas with a majority (>=50%) of sub-standard households under this classification, 35% of all urban households would be coded as slum households (Figure 2, column 5). If the slum threshold is increased to require at least 75% sub-standard households, the fraction of urban households considered slum households drops to 19 % (Figure 2, column 6).

Since the primary focus of this paper lies in the living conditions of the poorest urban neighborhoods, we adopted the most restrictive coding rule for most of the analysis, namely all households in clusters in which at least 75% of households lacked two or more amenities; alternative coding rules were considered as part of the robustness checks (Section 4). The use of cluster-level characteristics for the residential coding has important implications for the interpretation of the estimated coefficients on the slum variable. In our definition, households lacking basic facilities but not located in a "slum" cluster are not defined as slum households. On the other hand, households that are not themselves substandard but are located in a cluster where 75% of other households do lack basic infrastructure are considered as slum households.

Child Mortality and Morbidity Outcome Measures

In order to provide a comprehensive assessment of the effect of slum residence on child health, a range of mortality and morbidity outcomes are analyzed. Childhood mortality outcomes were divided into three age ranges, reflecting phases of early childhood with different patterns of risk

factors. Neonatal mortality was defined as any child death occurring during the first month after birth. In this phase of childhood, risk factors associated with pregnancy and delivery may be expected to dominate. Post-neonatal mortality was defined as any death occurring between the 1st and 12th months of a child's life; the greatest risks are likely to be associated with infectious diseases. What we will call "child mortality" was defined as the death of a child between the ages of 1 and 3 years (between the 12th and 36th months). In this age range infectious diseases will remain important risks, but external injuries will also increase as children become more mobile. We deviated from the usual age range of under-5 mortality in order to keep the risk of incorrect residence coding due to population mobility to a minimum. For neonatal mortality, children born in the month of the interview were excluded. For post-neonatal mortality, only children born at least 12 months prior to the interview and who were alive at the age of one month were analyzed. Similarly, for child mortality, the analysis was restricted to children who were born 36 to 59 months prior to the interview and who survived to the age of 12 months.

To capture morbidity effects, three additional variables were analyzed: the prevalence of acute lower respiratory infection (ALRI) in the two weeks prior to the interview, the prevalence of diarrhea in the two weeks prior to the interview, and stunting at the time of interview. A child was coded as a case of ALRI if the mother reported both coughing and short, rapid breaths during the two weeks preceding the interview. A child was coded as a case of diarrhea if the mother reported that the child had had diarrhea during the two weeks before the interview. Stunting was defined as height for age two or more standard deviations below the WHO reference median (WHO Multicentre Growth Reference Study Group 2006), and can be

interpreted as the cumulative outcome of lifetime disadvantage (generated by poor nutritional intake and illness episodes).

Methodology

The empirical analysis was conducted in three steps. In a first step, unconditional associations between child mortality or morbidity and location of residence were estimated for all six outcome measures. The basic logistic model employed in this part of the analysis is as follows:

$$\ln\left(\frac{p_{ick}}{1-p_{ick}}\right) = \alpha + \sum_{j=1}^{4} R_j \beta_j + \sum_{k=1}^{71} S_k \delta_k + \varepsilon_{ick}, \tag{1}$$

where p_{ik} is the probability of the health outcome (death, stunting, diarrhea and cough) of child i in cluster (neighborhood) c and survey k in the interval of interest, α is a generic constant, R_j are indicator variables for residential categories (rural as reference group and indicators for town, city, town slum, city slum residence), and S_k are survey fixed effects to capture country-period or survey fixed factors affecting all children in a given survey. Standard errors are clustered at the neighborhood level (primary sampling unit).

In a second step, child characteristics (sex, whether a twin, birth order and preceding birth interval), mother's education, and a household asset indicator capturing household access to electricity as well as ownership of radio, TV, motorcycle, car or truck and refrigerator), were included in order to investigate the degree to which differences across residential areas are explained by observable economic and social differences between households living in different areas. In the third and last step, two additional variables to control for health access were

included in order to assess the degree to which residential health differences can be explained by access to health services. Specifically, we include maternal responses to the following DHS questions: "*Many different factors can prevent women from getting medical advice or treatment for themselves. When you are sick and want to get medical advice or treatment, is getting money needed for treatment (*or in the second question, *the distance to the health facility) a big problem or not?*" We code the answers to both questions into binary indicator variables (1 if the woman considers money/distance a big problem, 0 otherwise).

Since some of these variables were not collected in all 191 surveys, we show separate results for the (full) sample where outcome variables are available, as well as for the restricted (full information) sample where all covariates of interest were available.

Results

Descriptive Statistics

Table 1 shows the means for all variables of interest for each of the five residential areas analyzed. Note that the measures in Table 1 are derived from unweighted observations and thus should not be interpreted as representative for low and middle income countries at large. A few patterns are worth highlighting. First, unconditional on any covariates, even though slum mortality is higher than in other urban areas, rural mortality is generally higher than in slums in general, and higher than in city slums in particular. The same is true for stunting as a measure of cumulative exposure to childhood adversity. The picture is less clear for short-term acute illness: with respect to diarrhea, children living in slums appear to fare worse than children living in non-

slum urban areas and than children in rural areas. The prevalence of ALRI appears to be similar across all residential groups.

With respect to the dynamics of childbearing, the main difference between rural and urban areas is family size, with an average of 4.1 children born to mothers in rural areas, but only 3.2 and 3.0 children to mothers in towns and cities, respectively. Interestingly, slum areas appear to be roughly halfway in between non-slum urban areas and rural areas with respect to family size. Lower rates of fertility are also reflected in child birth order, with rural areas having a lower fraction of children who are first-borns, and a higher fraction of children of birth order five and over. Somewhat surprisingly, no systematic differences in birth spacing were found, with 16-18% of children born within less than 2 years of the preceding birth across all birth orders and residential areas.

Large differences by residence are apparent with respect to maternal education and household wealth. Urban mothers have on average completed more than twice the number of years of schooling of rural mothers; similarly, the average asset score of rural households is 1.16 (out of a maximum score of 6), less than half the asset score of urban households. Once again, town and city slums are roughly halfway between rural and non-slum urban areas. With respect to access to health services, additional stark differences are apparent. While only 20% of mothers in urban areas considered distance to a health facility as an obstacle to treatment seeking, 50% of mothers in rural areas considered distance an obstacle. Financial constraints also appear more challenging for rural residents, with 60% of mothers reporting insufficient financial resources as a reason for

not seeking treatment compared to 40% in non-slum urban areas, and 46% and 57% in city and town slums respectively.

Last, non-slum urban areas also have large advantages over both urban slums and rural areas with respect to water, sanitation, dwelling and space. In comparison to urban areas, more than twice as many children in rural and slum areas lack access to sanitation, and more than three times as many children lack access to an improved water source. Urban slums fare somewhat better on water supply and floor material than rural households, but do slightly worse with respect to sanitation. The only domain where slum dwellers fare substantially worse compared to rural residents is space, with more than three-quarters of slum dwellings being categorized as overcrowded, i.e. with more than 3 persons per habitable room (see also footnote 3).

[Table 1 about here]

The multivariate logistic models estimated and shown in Table 2 report unconditional associations between residence and child health: the only covariates included are the residential indicators as well as a vector of survey fixed effects to control for unobserved factors specific to a given DHS survey. The top panel of Table 2 (Panel A) shows the estimated associations for the full sample; the bottom panel (Panel B) shows the same associations in the restricted sample for which all covariates of interest (see Table 1) are available. Even though the restricted data set is substantially smaller, the estimated associations change only marginally, suggesting that the more restricted sample is fairly representative of the larger DHS sample.

Overall, the estimated associations displayed in Table 2 closely mirror the basic patterns outlined in Table 1. Mortality rates are lowest in cities, where children face between 38% (neonatal) and 58% (child mortality) lower odds of dying compared to the rural reference group. The protective effect of town residence is slightly smaller, with an estimated reduction in the odds of neonatal mortality of 15% for neonatal death, and an estimated reduction of 33% in the odds of child mortality. The estimated risks for children in city slums are higher than for those in non-slum areas of cities, but appear to be fairly similar to the risks faced by children in non-slum areas of towns. The mortality risks faced by children in town slums appear similar to those in rural areas, but with a small protective effect of town slums on neonatal and post-neonatal mortality

The differences across residential areas with respect to stunting, the most commonly used broader measure of child development, are generally even larger than for mortality. Moreover, town and city slums appear similar with respect to stunting, with estimated reductions in the odds of stunting of 20.1% (town slums) and 22.6% (city) slums, respectively. Once again, non-slum city residents fare best, with an estimated risk odds ratio of 0.48, compared to 0.57 for town residents. In contrast, for the two acute morbidity measures, the residential gradient appears weaker than for mortality or stunting. Town and city residence has protective effects on diarrhea, with estimated odds ratios of 0.85 (town) and 0.78 (city), respectively; no statistically significant difference was found between rural residents and slum dwellers for diarrhea. Slum dwellers do, however, appear to face somewhat lower risks of ALRI compared to the rural reference group, with estimated odds ratios of 0.94 (town slum) and 0.87 (city slum) respectively.

[Table 2 about here]

In Table 3, we show how the estimated associations change once child, mother and household characteristics are controlled for. In the top panel of Table 3 (Panel A) we replicate the estimates from Table 2 (Panel B), but add controls for children's age (for morbidity outcomes), sex, twin births, parity and birth spacing. The results are virtually identical, which confirms the observation from Table 1 that there is little relation between residence and birth spacing. In the bottom part of Table 3 (Panel B) we include the full set of controls as shown in Table 1; specifically, we control for maternal education, household asset ownership and health access in addition to the child characteristics described above.

The inclusion of the full set of covariates (Table 3, Panel B) reduces the estimated associations between residence and child health substantially. Once all characteristics are controlled for, significant risk reductions for town residence are only found for stunting (non-slum and slum) and ALRI (non-slum only). Conditional on all covariates, town slum residence is now even associated with increased risk of post-neonatal mortality and diarrhea. City residence continues to be associated with reduced risk for the mortality outcomes and for stunting, but the estimated protective effect is reduced by 30-50%, depending on the outcome. Moreover, conditional on all covariates, (non-slum and slum) city residence no longer significantly decreases the risk of diarrhea or the risk of ALRI.

[Table 3 about here]

In order to provide a better sense of the factors driving the unconditional differences observed in Table 2, Panel A, we estimated a range of partial models, where we sequentially included groups of covariates. More specifically, we estimate five separate models: 1) a model without any

control variables; 2) a model with controls for child characteristics and maternal education; 3) a model with controls for child characteristics and household wealth; 4) a model with controls for child characteristics and the two health access variables; and 5) a model where we control for all variables simultaneously. All models control for survey fixed effects. The results for these models are summarized in Figure 3. All controls generally weaken the associations between residence and child health in broadly similar ways. Household wealth and maternal education reduce the basic associations between long-term health outcomes and urban residence by between 30% and 50%; the same is true for health access, even though the reductions in the estimated associations appear smaller in comparison with maternal education and household wealth. The effects of wealth, education and health access on recent morbidities tend to be much smaller on average.

[Figure 3 about here]

Robustness Checks

One of the concerns surrounding the associations between residence and health outcomes is the frequently temporary nature of household residence. While we tried to minimize estimation bias generated by residential mobility by restricting our analytical time horizon to the five years preceding the surveys, the estimated associations could be biased if households self-select into neighborhoods based on children's health. In order to ensure our estimates are not affected by residential mobility and selection, we estimate a set of models restricted to mothers without recent moves. DHS surveys do not collect detailed migration histories; they do, however, ask mothers about the duration of current residence (standard recode variable v104). We use this

variable to divide the sample into women with and without migration history (never moved), and show separate estimates for the "never moved" sample in Table 4. As in Table 3, we first show residence associations conditional only on child characteristics and the mother's fertility history (Panel A), and then show results for the fully adjusted models (Panel B). Even though the restriction on non-migrating mothers reduces the sample by more than 50%, the overall results change only marginally.

[Table 4 about here]

A second concern regarding our main results relates to the specific slum definition chosen. As Figure 2 shows, the slum definition used for the purpose of this paper corresponds to the most restrictive option among the strategies considered, which results in slightly less than 20% of urban households being classified as slum residents. By choosing a highly restrictive definition, we expect to identify only the worst-off urban areas and thus maximize the likelihood that we would find slums associated with adverse outcomes for children. To address this concern, we re-estimate our empirical model with a more "inclusive" definition, and define slums as neighborhoods where at least 75% of households lack at least *one* (and not two) of the critical amenities. As shown in column 3 of Figure 2, this leads to a classification whereby 60% of urban residents are being considered slum dwellers. The empirical results based on this alternative classification are displayed in Table 5. Since we now include marginally "better-off" neighborhoods in the slum category, the observed protective effects of slum residence increase. , which are now restricted to the top 40% of urban households in terms of asset holdings. The overall pattern observed is rather clear: given that urban areas are characterized by a rather

pronounced socioeconomic gradient, more stringent definitions of slums mechanically make slums look more similar to the rural reference group. To the extent that the definition chosen for our main result is more stringent than commonly used definitions in the existing literature, the main effects reported here can be considered as lower bounds of the true protective effects of slum residence (in comparison to rural areas).

[Table 5 about here]

Discussion

The objective of the analysis in this paper was to empirically assess the validity of the popular perception of slums, and particularly slums in large urban agglomerations, such as Sao Paulo, Brazil, Mumbai, India or Nairobi, Kenya, as extremely unhealthy environments for children. Using data from 191 highly standardized, nationally-representative DHS surveys carried out in 73 low- and middle-income countries, we estimated models with both no controls, which identify differences in health outcomes by type of place of residence alone, and adjusted models, through which we tried to assess the effect of slums conditional on maternal and household characteristics. Overall, the patterns observed are rather clear: compared to children living in rural areas, children in slums have significantly better health, even though they generally fare worse than children in better-off neighborhoods of the same urban settlements. Our results suggest that a large fraction of the observed residential health differentials is explained by differences in maternal education, household wealth and access to health services. However, some urban and urban slum advantages persist even when all three factors are controlled for.

For mortality, independent of the age interval analyzed, children from non-slum city neighborhoods face the lowest risk, followed by city slum residents, non-slum towns, and town slum residents. Once we control for maternal education, household wealth, and access to health services, the ordering of type of urban residence remains mostly the same, but the differences to rural children become substantially smaller and mostly insignificant for town residents living in slums or better-off neighborhoods. For stunting as a cumulative measure of children's nutrition and health experiences, significant protective effects are found for all urban dwellers, with the largest protective effects for non-slum city and town residence, even when controlling for a range of control variables. While we cannot directly assess the causal mechanisms underlying these urban advantages, consistent access to (a wider variety of) food appears to be a plausible explanation for the observed gaps.

Different results were found for acute morbidity measures based on maternal self-reports. In the uncontrolled models, all urban children have an advantage over rural children in ALRI, but only non-slum urban children have a health advantage in diarrhea incidence. In general, the urban health advantage is lower for short-term morbidity than for mortality or stunting. Once controls are introduced, the protective effect of urban residence on diarrhea and ALRI disappears; children in town slums are now even at higher risk of being reported to have had an episode of diarrhea in the past two weeks than rural children; and surprisingly non-slum city children are now at higher risk of ALRI than other groups, which one could interpret as evidence of the adverse effect to increased exposure to poor air quality, but which may also reflect reporting differentials across residential areas.

In terms of the relative effects of different types of control variable, it is interesting to note that fertility dynamics have little to do with urban-rural differences in child health (compare Table 2, Panel B with Table 3, Panel A), despite the fact that urban fertility is usually substantially lower than rural fertility (see Table 1). The effect modification estimates shown in Figure 3 suggest that maternal education and household wealth are equally important in protecting urban children from health risks. The effect of access to health services, incorporated in the models on the basis of mother's responses as to whether they regard distance to a health facility or cost of services to be barriers to seeking service, is more modest, but has to be interpreted with caution, since the two variables used are based on maternal self-reports, and are thus unlikely to fully capture differences in actual access to health care services.

This study has three remaining limitations. First, the results presented are neither representative of a specific country nor of low- and middle-income countries more generally, but rather average estimates based on the pooled and un-weighted sample of all DHS surveys. Even though the sample is very large and even though we consistently use survey fixed effects in all of our models to capture differences in data collection or response rates across countries, across time and across surveys, the population analyzed may differ from the average developing country population today, and the presented estimates may thus not apply globally. Second, the analysis presented is descriptive in nature, and the reported point estimates should not be interpreted as causal effects of randomly moving a child from one type of residence to another, but rather as a description of actual differences (controlled for some observable characteristics). All the reported estimates are conditional associations, which may, but do not necessarily, represent causal effects of the residential variables analyzed.

A third limitation of the paper is the uncertainty surrounding the correct definition and empirical identification of slums. While this paper follows the approach suggested in Günther and Harttgen (2012) in focusing on neighborhoods rather than households, defining slum neighborhoods is complex, and might have an impact on the magnitude of the relationships estimated. A related critical issue is whether DHS sample clusters can be regarded as neighborhoods. There is no definitive answer to this concern, but given that sample clusters are normally based upon census enumeration areas that are quite small and have clearly-defined boundaries, we believe that in most cases a sample cluster can be regarded as a neighborhood. Of course there is wide heterogeneity of built environments in urban areas, and there will be instances of sample clusters that include small areas of disadvantaged households mixed in with more affluent households; we will fail to classify such households correctly, but we argue that the effects of such a failure are likely to be negligible since such households are unlikely to do worse than larger areas of concentrated disadvantage.

Conclusions

In this paper, we have presented evidence from a pooled sample of 1.3 million children across 73 low- and middle-income countries to show that children in slums face higher health risks compared to urban residents not residing in slums, but lower risks compared to children living in rural areas. A large share of these observed differences are explained by differences in maternal education, wealth and health access. Once these factors are controlled for, children in slums of smaller urban areas (less than one million population) and even in non-slum neighborhoods of such towns do not have health advantages over rural children except with respect to stunting. Children in cities – clearly for non-slum neighborhoods and to some extent also for slum

neighborhoods for most outcomes – continue to have an advantage in mortality and stunting even after controls are added for observable factors. For short-term morbidity any health advantages also disappear for city residence. Three points stand out: that children in cities have relatively good health outcomes regardless of the nature of their neighborhood; that children in smaller urban areas – and especially in slums of such towns – do less well, and scarcely better than rural children on most outcomes; and that the indicator showing the most consistent urban advantage is stunting.

Appendix 1: Countries, Years, Observations, Survey Information and Cities

	Year	Observations	Diarrhea	Cough	Stunted	Death	DPT	Distance	Money	Cities (urban agglomerations with >1 Mill. residents)
Albania	2008	1616	1	1	1	1	1	1	1	
Angola	2006	1698				1				Luanda
Armenia	2000	1726	1	1	1	1	1	1	1	Yerevan
Armenia	2005	1430	1	1	1	1	1	1	1	Yerevan
Azerbaijan	2006	2297	1	1	1	1	1	1	1	Baku
Bangladesh	1993	3874	1	1		1	1			Chittagong, Dhaka, Khulna
Bangladesh	1996	6189	1	1	1	1	1			Chittagong, Dhaka, Khulna
Bangladesh	2000	6832	1	1	1	1	1			Chittagong, Dhaka, Khulna
Bangladesh	2004	6908	1	1	1	1	1	1	1	Chittagong, Dhaka, Khulna
Bangladesh	2007	6150	1	1	1	1	1			Chittagong, Dhaka, Khulna
Benin	1996	3011	1	1	1	1	1			
Benin	2001	5349	1	1	1	1	1	1	1	
Benin	2006	16075	1	1	1	1	1			
Bolivia	1989	5804	1		1	1	1			La Paz
Bolivia	1993	3654	1	1	1	1	1			La Paz
Bolivia	1998	7304	1	1	1	1	1			La Paz
Bolivia	2003	10448	1	1	1	1	1	1	1	La Paz, Santa

										Cruz
Bolivia	2008	8605	1	1	1	1	1	1	1	La Paz, Santa Cruz
Brazil	1986	3573	1		1	1	1			11 cities
Brazil	1991	3159	1	1		1	1			14 cities
Brazil	1996	5045	1	1	1	1	1			15 cities
Burkina Faso	1992	5828	1	1	1	1	1			
Burkina Faso	1998	5953	1	1	1	1	1			
Burkina Faso	2003	10645	1	1	1	1	1	1	1	Ouagadougou
Burundi	1987	3811	1	1	1	1	1			
Cambodia	2000	8834	1	1	1	1	1	1	1	Phnom Pen
Cambodia	2005	8290	1	1	1	1	1	1	1	Phnom Pen
Cambodia	2010	8232	1	1	1	1	1	1	1	Phnom Pen
Cameroon	1991	3350	1	1	1	1	1			
Cameroon	1998	2317	1	1	1	1	1			Douala
Cameroon	2004	8125	1	1	1	1	1	1	1	Douala, Yaounde
CAR	1994	2816	1	1	1	1	1			
Chad	1996	7408	1	1	1	1	1			
Chad	2004	5635	1	1	1	1	1			
Colombia	1986	2715	1	1	1	1	1			Barrangquilla, Bogota, Cali, Medellin
Colombia	1990	3751	1			1	1			Barrangquilla, Bogota, Cali,

										Medellin
Colombia	1995	5141	1	1	1	1	1			Barrangquilla, Bogota, Cali, Medellin
Colombia	2000	4670	1	1	1	1	1			Barrangquilla, Bogota, Cali, Medellin
Colombia	2004	14621	1	1	1	1	1			Barrangquilla, Bogota, Cali, Medellin
Comoros	1996	1145	1	1	1	1	1			
Congo, Dem. Rep.	2007	8992	1	1	1	1	1	1	1	Kinshasa, Lubumbasi, Mbuji-Mayi
Congo, Rep.	2005	4835	1	1	1	1	1			Brazzaville
Cote d'Ivoire	1994	3998	1	1	1	1	1			Abidjan
Cote d'Ivoire	1998	1992	1	1	1	1	1			Abidjan
Cote d'Ivoire	2005	3633				1				Abidjan
Dominican Republic	1986	4767	1		1	1	1			Santo Domingo
Dominican Republic	1991	4164	1	1	1	1	1			Santo Domingo
Dominican Republic	1996	4643	1	1	1	1	1			Santo Domingo

Dominican Republic	1999	597	1	1		1	1			Santo Domingo
Dominican Republic	2002	11362	1	1	1	1	1	1	1	Santo Domingo
Dominican Republic	2007	12023	1	1	1	1	1	1	1	Santo Domingo
Ecuador	1987	3051				1				Guayaquil, Quito
Egypt, Arab Rep.	1988	8647			1	1	1			Cairo, Alexandria
Egypt, Arab Rep.	1992	8764	1	1	1	1	1			Cairo, Alexandria
Egypt, Arab Rep.	1995	12135	1	1	1	1	1			Cairo, Alexandria
Egypt, Arab Rep.	2000	11467	1	1	1	1	1	1	1	Cairo, Alexandria
Egypt, Arab Rep.	2003	6661	1	1	1	1	1			Cairo, Alexandria
Egypt, Arab Rep.	2005	13851	1	1	1	1	1	1	1	Cairo, Alexandria
Egypt, Arab Rep.	2008	10872	1	1	1	1	1	1	1	Cairo, Alexandria
Ethiopia	2000	10873	1	1	1	1	1			Addis Abeba
Ethiopia	2005	9861	1	1	1	1	1	1	1	Addis Abeba
Gabon	2000	4405	1	1	1	1	1			
Ghana	1988	4136	1	1	1	1	1			Accra
Ghana	1993	2204	1	1	1	1	1			Accra
Ghana	1998	3298	1	1	1	1	1			Accra

Ghana	2003	3844	1	1	1	1	1	1	1	Accra, Kumasi
Ghana	2008	2992	1	1	1	1	1	1	1	Accra, Kumasi
Guatemala	1987	4627	1		1	1	1			
Guatemala	1995	9952	1	1	1	1	1			
Guatemala	1998	4943	1	1	1	1	1			
Guinea	1999	5834	1	1	1	1	1			Conakry
Guinea	2005	6364	1	1	1	1	1	1	1	Conakry
Guyana	2005	929		1		1				
Guyana	2009	2178	1	1	1	1	1	1	1	
Haiti	1994	3564	1	1	1	1	1			Port-au-Prince
Haiti	2000	6685	1	1	1	1	1	1	1	Port-au-Prince
Haiti	2005	6015	1	1	1	1	1	1	1	Port-au-Prince
Honduras	2005	10800	1	1	1	1	1	1	1	
India	1992	48959	1	1	1	1	1			23 cities
India	1998	33026	1	1	1	1	1			31 cities
India	2005	51555	1	1	1	1	1	1	1	38 cities
Indonesia	1987	8140				1				Bandung, Jakarta, Medan, Semarang, Surabaya
Indonesia	1991	31416	1	1		1	1			Bandung, Jakarta, Medan, Palembang, Semarang, Surabaya
Indonesia	1994	18196	1	1		1	1			Bandung, Jakarta, Medan, Palembang,

										Semarang, Surabaya
Indonesia	1997	17444	1	1		1	1			Bandung, Jakarta, Medan, Palembang, Semarang, Surabaya
Indonesia	2007	18645	1	1		1	1	1	1	Bandung, Jakarta, Medan, Palembang, Semarang, Surabaya, Uyung Pandang
Jordan	1990	8364	1	1	1	1	1			
Jordan	1997	6490	1	1	1	1	1			
Jordan	2002	6073	1	1	1	1	1	1	1	Amman
Jordan	2007	10426	1	1	1	1	1	1	1	Amman
Kazakhstan	1995	846	1	1	1	1	1			Almaty
Kazakhstan	1999	1345	1	1	1	1	1			Almaty
Kenya	1988	6980	1	1		1	1			Nairobi
Kenya	1993	6115	1	1	1	1	1			Nairobi
Kenya	1998	3531	1	1	1	1	1			Nairobi
Kenya	2003	5949	1	1	1	1	1			Nairobi
Kenya	2008	6079	1	1	1	1	1			Nairobi
Kyrgyz Republic	1997	1127	1	1	1	1	1			
Lesotho	2004	3697	1	1	1	1	1	1	1	

Liberia	1986	3215	1	1		1	1			
Liberia	2006	5799	1	1	1	1	1	1	1	
Liberia	2008	4193				1				
Madagascar	1992	5273	1	1	1	1	1			
Madagascar	1997	3681	1	1	1	1	1			Antananarivo
Madagascar	2003	5415	1	1	1	1	1	1	1	Antananarivo
Madagascar	2008	12448	1	1		1	1	1	1	Antananarivo
Malawi	1992	4495	1	1	1	1	1			
Malawi	2000	11926	1	1	1	1	1			
Malawi	2004	10914	1	1	1	1	1	1	1	
Malawi	2010	19967	1	1	1	1	1	1	1	
Mali	1987	3358	1	1	1	1	1			
Mali	1995	6031	1	1	1	1	1			
Mali	2001	13097	1	1	1	1	1	1	1	Bamako
Mali	2006	14238	1	1	1	1	1	1	1	Bamako
Moldova	2005	1552	1	1	1	1	1	1	1	
Morocco	1987	6102	1		1	1	1			Casablanca
Morocco	1992	5197	1	1	1	1	1			Casablanca, Rabat
Morocco	2003	6180	1	1	1	1	1	1	1	Casablanca, Rabat
Mozambique	1997	4122	1	1	1	1	1			
Mozambique	2003	10326	1	1	1	1	1	1	1	Maputo
Namibia	1992	3916	1	1	1	1	1			
Namibia	2000	3989	1	1	1	1	1	1	1	
Namibia	2006	5168	1	1	1	1	1	1	1	
Nepal	1996	4417	1	1	1	1	1			
Nepal	2001	6931	1	1	1	1	1	1	1	

Nepal	2006	5783	1	1	1	1	1	1	1	
Nicaragua	1997	8454	1	1	1	1	1			
Nicaragua	2001	6986	1	1	1	1	1	1	1	
Niger	1992	6899	1	1	1	1	1			
Niger	1998	4798	1	1	1	1	1			
Niger	2006	9193	1	1	1	1	1	1	1	
Nigeria	1990	7902	1	1	1	1	1			Ibadan, Kano, Lagos
Nigeria	1999	3552	1	1	1	1	1			Ibadan, Kaduna, Kano, Lagos
Nigeria	2003	6029	1	1	1	1	1	1	1	Abuja, Benin City, Ibadan, Kaduna, Kano, Lagos
Nigeria	2008	28647	1	1	1	1	1	1	1	Abuja, Benin City, Ibadan, Kaduna, Kano, Lagos, Ogbomosho, Port Harcourt
Pakistan	1990	6428	1	1	1	1	1			Faisalabad, Karachi, Lahore, Rawalpindi
Pakistan	2006	9177	1	1		1	1			Faisalabad, Gujranwala, Hyderabad, Karachi, Lahore,

										Multan, Peshawar, Rawalpindi
Paraguay	1990	4246	1		1	1	1			Asuncion
Peru	1986	3131	1			1	1			Lima
Peru	1991	9362	1	1	1	1	1			Lima
Peru	1996	17549	1	1	1	1	1			Lima
Peru	2000	13697	1	1	1	1	1	1	1	Lima
Peru	2003	17189	1	1	1	1	1	1	1	Lima
Philippines	1993	9195	1	1		1	1			Manila
Philippines	1998	8083	1	1		1	1			Davao, Manila
Philippines	2003	7145	1	1		1	1	1	1	Davao, Manila
Philippines	2008	6572	1	1		1	1	1	1	Davao, Manila
Rwanda	1992	5510	1	1	1	1	1			
Rwanda	2000	7922	1	1	1	1	1	1	1	
Rwanda	2005	8649	1	1	1	1	1	1	1	
Senegal	1986	4287	1		1	1	1			Dakar
Senegal	1992	5645	1	1	1	1	1			Dakar
Senegal	1997	7372	1			1				Dakar
Senegal	2005	10944	1	1	1	1	1	1	1	Dakar
Senegal	2006	4808				1				Dakar
Senegal	2008	15595				1				Dakar
Sierra Leone	2008	5631	1	1	1	1	1	1	1	
South Africa	1998	5066	1	1		1	1			Cape Town, Durban, East Rand, Johannesburg, Pretoria

Sri Lanka	1987	4010	1		1	1	1			
Sudan	1989	6644	1			1	1			Al-Khartum
Swaziland	2006	2812	1	1	1	1	1	1	1	
Tanzania	1991	8138	1	1	1	1	1			Daressalam
Tanzania	1996	6789	1	1	1	1	1			Daressalam
Tanzania	1999	3203	1	1	1	1	1			Daressalam
Tanzania	2004	8564	1	1	1	1	1	1	1	Daressalam
Tanzania	2007	7502				1				Daressalam
Thailand	1987	3627	1		1	1	1			Bangkok
Togo	1988	3134	1		1	1				
Togo	1998	4168	1	1	1	1	1			Lome
Trinidad and Tobago	1987	1946	1		1	1	1			
Tunisia	1988	4477	1		1	1	1			
Turkey	1993	3724	1	1	1	1	1			Adana, Ankara, Istanbul, Izmir
Turkey	1998	3565	1		1	1	1			Adana, Ankara, Bursa, Istanbul, Izmir
Turkey	2003	4533		1	1	1	1			Adana, Ankara, Bursa, Istanbul, Izmir
Uganda	1988	4959	1	1	1	1	1			
Uganda	1995	5756	1	1	1	1	1			
Uganda	2000	7113	1	1	1	1	1	1	1	Kampala
Uganda	2006	8369	1	1	1	1	1	1	1	Kampala
Ukraine	2007	1221				1				Dnipropetrovsk,

										Kharkiv, Kiev, Odesa
Uzbekistan	1996	1324	1	1	1	1	1			Tashkent
Vietnam	1997	1775	1	1		1	1			Ha Noi, Hai Phong, Ho Chi Minh City
Vietnam	2000	1317	1	1		1	1			Ha Noi, Hai Phong, Ho Chi Minh City
Yemen, Rep.	1991	7286	1	1	1	1	1			
Zambia	1992	6299	1	1	1	1	1			
Zambia	1996	7248	1	1	1	1	1			
Zambia	2001	6877	1	1	1	1	1	1	1	Lusaka
Zambia	2007	6401	1	1	1	1	1	1	1	Lusaka
Zimbabwe	1988	3358	1		1	1	1			
Zimbabwe	1994	2438	1	1	1	1	1			Harare
Zimbabwe	1999	3643	1	1	1	1	1	1	1	Harare
Zimbabwe	2005	5246	1	1	1	1	1	1	1	Harare

Source: World Population Prospects: The 2008 Revision; World Urbanization Prospects: The 2009 Revision; DHS Surveys

References

Bocquier, P., N. Madise, and E. Zulu. (2011). "Is There an Urban Advantage in Child Survival in Sub-Saharan Africa? Evidence From 18 Countries in the 1990s." *Demography* 48(2):531-558.

Brokerhoff, M.and E. Brennan. (1998). "The Poverty of Cities in Developing Regions." *Population and Development Review* 24(1):75-114.

Cain, L.and S. Hong. (2009). "Survival in 19th Century Cities: The Larger the City, the Smaller Your Chances." *Explorations in Economic History* 46(4)):450-463.

Fink, G., I. Gunther, and K. Hill. (2011). "The effect of water and sanitation on child health: evidence from the demographic and health surveys 1986-2007." *International Journal of Epidemiology* 40(5):1196-1204.

Fotso, J.C. (2007). "Urban-rural differentials in child malnutrition: Trends and socioeconomic correlates in sub-Saharan Africa." *Health and Place* 13(1):205-223.

Fotso, J.C., J. Cleland, B. Mberu, M. Mutua, and P. Elungata. (2010). "Birth Spacing and Child Mortality: An Analysis of Prospective Data from the Nairobi Urban Health and Demographic Surveillance System." *Journal of Biosocial Science*:1-20.

Garenne, M.M. (2008). *Fertility Changes in Sub-Saharan Africa.* Calverton, Maryland, USA: : Macro International Inc.

Gould, W.T. (1998). "African Mortality and the New 'Urban Penalty'." *Health and Place* 4(2):171-181.

Grantham-McGregor, S., Y.B. Cheung, S. Cueto, P. Glewwe, L. Richter, B. Strupp, and International Child Development Steering Group. (2007). "Developmental potential in the first 5 years for children in developing countries." *Lancet* 369:60-70.

Günther, I.and K. Harttgen. (2012). "Deadly Cities? Inequalities in Mortality in Sub-Saharan Africa." *Population and Development Review* 38(3):469-486.

Konteh, F. (2009). "Urban sanitation and health in the developing world: reminiscing the nineteenth century industrial nations." *Health and Place* 15(1):69-78.

Montgomery, M.R., R. Stren, B. Cohen, and H.E. Reed. (2003). "Cities Transformed: Demographic Change and Its Implications in the Developing World ". Washington D.C.: National Academies Press.

Moore, M., P. Gouldet, and K. BS. (2003). "Global urbanization and impact on health." *International Journal of Hygiene and Environmental*
Health Affairs 206:269-278.

Poel, E., O. O'donnell, and E. Doorslaer. (2009). "What explains the rural-urban gap in infant mortality: Household or community characteristics?" *Demography,* 46(4):827-850.

Sclar, E., P. Garau, and G. Carolini. (2005). "The 21st century health challenge of slums and cities." *Lancet Infectious Diseases* 365(9462):901-903.

Timaeus, I.M.and L. Lush. (1995). "Intra-urban differentials in child health." *Health Transition Review* 5:163-190.

UN–HABITAT. (2007). *State of the World's Cities 2006/7*. London: Earthscan Publications Ltd.

UN. (2011). "World Urbanization Prospects: The 2009 Revision." United Nations Population Division.

Van de Poel, E., O. O'Donnell, and E. Van Doorslaer. (2007). "Are urban children really healthier? Evidence from 47 developing countries." *Social Science and Medicine* 65(10):1986-2003.

Walker, S.P., T.D. Wachs, S. Grantham-McGregor, M.M. Black, C.A. Nelson, S.L.H. man, H. Baker-Henningham, S.M. Chang, J.D. Hamadani, B. Lozoff, J.M.M. Gardner, C.A.

Powell, A. Rahman, and L. Richter. (2011). "Inequality in early childhood: risk and protective factors for early child development." *The Lancet* 378:1325–1338.

WHO Multicentre Growth Reference Study Group. (2006). *WHO Child Growth Standards: Length/height-for-age, weight-for-age, weight-for-length, weight-for-height and body mass index-for-age: Methods and development*. Geneva: World Health Organization.

Table 1: Descriptive Statistics

	Rural	Town[d.]	City[d.]	Town Slum	City Slum
Sample size	909,515	253,332	126,574	68,780	21,056
Health Outcomes					
Neonatal death	0.034	0.026	0.021	0.031	0.026
Post-neonatal death	0.036	0.021	0.016	0.036	0.029
Child Death (12-35 months)	0.029	0.015	0.010	0.031	0.024
Diarrhea	0.170	0.147	0.140	0.181	0.192
ALRI	0.161	0.150	0.148	0.160	0.155
Stunted (12-25 months)	0.441	0.260	0.229	0.382	0.341
Child Characteristics					
Child age in months	27.90	28.61	28.50	28.18	27.47
Child is male	0.51	0.51	0.51	0.51	0.51
Child is twin	0.03	0.02	0.02	0.03	0.03
Child is firstborn	0.22	0.31	0.33	0.24	0.26
Parity 2-4, 24 months or more spacing[a.]	0.36	0.39	0.39	0.36	0.37
Parity 2-4, less than 24 months spacing	0.11	0.12	0.12	0.11	0.12
Parity 5 or higher, 24 months or more spacing	0.24	0.14	0.12	0.22	0.19
Parity 5 or higher, less than 24 months spacing	0.07	0.04	0.04	0.07	0.06
Number of children born to mother	4.07	3.23	3.04	3.88	3.63
Maternal Education and Household Wealth					
Education mother	3.26	6.96	7.62	4.47	5.07
Household asset score[b.]	1.16	2.78	3.08	1.64	1.90
Health Infrastructure					
Problem Distance to Health Center	0.507	0.208	0.207	0.300	0.226
Problem Money to Treat Disease	0.608	0.407	0.378	0.565	0.459
Household Characteristics for Slum Coding					
Household is overcrowded[c.]	0.69	0.59	0.62	0.76	0.82
Lacks improved sanitation [c.]	0.85	0.44	0.40	0.87	0.86
Lacks improved water [c.]	0.52	0.16	0.11	0.48	0.38
Lacks solid floor material[c.]	0.72	0.19	0.13	0.62	0.42

Notes: a. Parity refers to the birth order of the child, spacing refers to the birth interval (in moths) since the previous child. b. The asset index is an additive composite indicator of the following six household features: access to electricity, ownership of radio, TV, motorcycle, car or truck, refrigerator. c. For a definition of what constitutes unimproved sanitation and water, dwelling material and overcrowding see footnote 3. d. Town and City only refer to the non-slum areas of towns and cities.

Table 2: Unconditional Association between Residence and Child Health

Panel A: Unconditional: Full Sample

	Observations	Rural	Town	City	Town Slum	City Slum
Neonatal mortality	1,374,449	Ref.	0.848***	0.654***	0.907***	0.731***
			(0.0136)	(0.0154)	(0.0239)	(0.0351)
Post-neonatal mortality	1,042,917	Ref.	0.700***	0.498***	0.937**	0.697***
			(0.0135)	(0.0148)	(0.0259)	(0.0381)
Child mortality	466,721	Ref.	0.669***	0.420***	1.009	0.697***
			(0.0220)	(0.0221)	(0.0421)	(0.0645)
Stunting	541,504	Ref.	0.571***	0.481***	0.800***	0.671***
			(0.00621)	(0.00667)	(0.0131)	(0.0176)
Diarrhea	1,190,888	Ref.	0.853***	0.781***	1.008	0.996
			(0.00804)	(0.00937)	(0.0157)	(0.0245)
ALRI	1,126,587	Ref.	0.856***	0.839***	0.943***	0.870***
			(0.00879)	(0.0107)	(0.0159)	(0.0258)

Panel B: Unconditional: Restricted Sample

	Observations	Rural	Town	City	Town Slum	City Slum
Neonatal mortality	539,602	Ref.	0.868***	0.631***	0.972	0.638***
			(0.0224)	(0.0256)	(0.0416)	(0.0579)
Post-neonatal mortality	415,856	Ref.	0.723***	0.509***	0.954	0.669***
			(0.0217)	(0.0256)	(0.0434)	(0.0731)
Child mortality	199,803	Ref.	0.671***	0.413***	0.964	0.693**
			(0.0326)	(0.0346)	(0.0658)	(0.116)
Stunting	210,436	Ref.	0.597***	0.496***	0.799***	0.774***
			(0.00998)	(0.0113)	(0.0219)	(0.0390)
Diarrhea	489,948	Ref.	0.848***	0.792***	1.015	0.909**
			(0.0126)	(0.0155)	(0.0284)	(0.0443)
ALRI	489,593	Ref.	0.833***	0.902***	0.952*	0.864**
			(0.0133)	(0.0193)	(0.0271)	(0.0518)

Notes: Standard errors are clustered at the survey-cluster level. Panel A regressions usse all available information (full sample). Panel B regressions use only the sample where all control variables are available. All regressions in Panel A and B include survey fixed effects. Coefficients are presented as odds ratios; robust standard errors in parentheses are clustered at the survey cluster level.

Table 3: Conditional Associations between Residence and Child Health

Panel A: Conditional on Child Characteristics and Fertility History						
	Observations	Rural	Town	City	Town Slum	City Slum
Neonatal mortality	539,602	Ref.	0.865***	0.633***	0.976	0.638***
			0.990	(0.0259)	(0.0418)	(0.0580)
Post-neonatal mortality	415,856	Ref.	0.731***	0.520***	0.961	0.676***
			(0.0220)	(0.0263)	(0.0437)	(0.0730)
Child mortality	199,803	Ref.	0.680***	0.424***	0.966	0.706**
			(0.0332)	(0.0357)	(0.0659)	(0.118)
Stunting	210,436	Ref.	0.589***	0.490***	0.794***	0.758***
			(0.0103)	(0.0116)	(0.0225)	(0.0393)
Diarrhea	489,948	Ref.	0.849***	0.792***	1.016	0.907**
			(0.0129)	(0.0158)	(0.0288)	(0.0451)
ALRI	489,593	Ref.	0.835***	0.906***	0.953*	0.865**
			(0.0135)	(0.0195)	(0.0272)	(0.0520)

Panel B: Conditional on Child Characteristics, Fertility History, Education, Wealth & Health Access						
	Observations	Rural	Town	City	Town Slum	City Slum
Neonatal mortality	539,602	Ref.	0.990	0.750***	1.036	0.697***
			(0.0276)	(0.0322)	(0.0444)	(0.0631)
Post-neonatal mortality	415,856	Ref.	0.959	0.739***	1.081*	0.832*
			(0.0307)	(0.0390)	(0.0492)	(0.0897)
Child mortality	199,803	Ref.	0.925	0.642***	1.109	0.897*
			(0.0483)	(0.0572)	(0.0756)	(0.150)
Stunting	210,436	Ref.	0.810***	0.721***	0.910***	0.926
			(0.0147)	(0.0173)	(0.0252)	(0.0466)
Diarrhea	489,948	Ref.	1.009	0.975	1.098***	1.024
			(0.0164)	(0.0204)	(0.0311)	(0.0505)
ALRI	489,593	Ref.	0.956***	1.062***	1.019	0.955
			(0.0166)	(0.0243)	(0.0292)	(0.0570)

Notes: All coefficients displayed are odds ratios. Standard errors are in parentheses are clustered at the survey-cluster level. Panel A regressions control for survey fixed effects, sex and age of children, twin births, child's birth order, and birth spacing. Panel B regressions include the full set of controls listed in Table 2, i.e. mother's education, household wealth and health access.

Table 4: Conditional Associations Restricted to Permanent Residents

Panel A: Conditional on Child Characteristics and Fertility History

	Observations	Rural	Town	City	Town Slum	City Slum
Neonatal mortality	219,611	Ref.	0.849***	0.601***	1.003	0.661***
			0.943	(0.0422)	(0.0684)	(0.0981)
Post-neonatal mortality	168,870	Ref.	0.742***	0.520***	1.043	0.748*
			(0.0389)	(0.0450)	(0.0690)	(0.127)
Child mortality	80,244	Ref.	0.650***	0.363***	1.023	0.712
			(0.0560)	(0.0546)	(0.107)	(0.209)
Stunting	89,082	Ref.	0.589***	0.455***	0.779***	0.670***
			(0.0160)	(0.0162)	(0.0338)	(0.0595)
Diarrhea	200,637	Ref.	0.872***	0.822***	1.042	1.022
			(0.0204)	(0.0253)	(0.0432)	(0.0789)
ALRI	200,503	Ref.	0.879***	1.005	0.990	0.969
			(0.0217)	(0.0322)	(0.0433)	(0.0907)

Panel B: Conditional on Child Characteristics, Fertility History, Education, Wealth & Health Access

	Observations	Rural	Town	City	Town Slum	City Slum
Neonatal mortality	219,611	Ref.	0.943	0.692***	1.052	0.721**
			(0.0455)	(0.0522)	(0.0721)	(0.107)
Post-neonatal mortality	168,870	Ref.	0.962	0.764***	1.152**	0.939
			(0.0539)	(0.0695)	(0.0765)	(0.160)
Child mortality	80,244	Ref.	0.835**	0.544***	1.121	0.882
			(0.0765)	(0.0884)	(0.119)	(0.258)
Stunting	89,082	Ref.	0.793***	0.675***	0.884***	0.844*
			(0.0229)	(0.0251)	(0.0382)	(0.0739)
Diarrhea	200,637	Ref.	1.026	1.011	1.119***	1.162*
			(0.0260)	(0.0336)	(0.0466)	(0.0900)
ALRI	200,503	Ref.	0.994	1.171***	1.049	1.064
			(0.0266)	(0.0410)	(0.0462)	(0.0991)

Notes: Coefficients displayed are odds ratios. Standard errors in parentheses are clustered at the survey-cluster level. Panel A regressions control for survey fixed effects, sex and age of children, twin births, child's birth order, and birth spacing. Panel B regressions include the full set of controls.

Table 5: Conditional Associations with a Broader Slum Definition

Panel A: Conditional on Child Characteristics and Fertility History

	Observations	Rural	Town	City	Town Slum	City Slum
Neonatal mortality	539,602	Ref.	0.863***	0.608***	0.903***	0.650***
			(0.0329)	(0.0385)	(0.0244)	(0.0295)
Post-neonatal mortality	415,856	Ref.	0.666***	0.467***	0.840***	0.585***
			(0.0311)	(0.0378)	(0.0250)	(0.0325)
Child mortality	199,803	Ref.	0.586***	0.374***	0.811***	0.510***
			(0.0470)	(0.0492)	(0.0373)	(0.0466)
Stunting	210,436	Ref.	0.524***	0.414***	0.689***	0.598***
			(0.0134)	(0.0145)	(0.0125)	(0.0159)
Diarrhea	489,948	Ref.	0.796***	0.745***	0.932***	0.849***
			(0.0167)	(0.0208)	(0.0156)	(0.0202)
ALRI	489,593	Ref.	0.805***	0.935**	0.890***	0.879***
			(0.0178)	(0.0281)	(0.0156)	(0.0230)

Panel B: Conditional on Child Characteristics, Fertility History, Education, Wealth & Health Access

	Observations	Rural	Town	City	Town Slum	City Slum
Neonatal mortality	539,602	Ref.	1.021	0.741***	0.995	0.745***
			(0.0409)	(0.0483)	(0.0278)	(0.0346)
Post-neonatal mortality	415,856	Ref.	0.934	0.700***	1.016	0.784***
			(0.0451)	(0.0580)	(0.0313)	(0.0444)
Child mortality	199,803	Ref.	0.870*	0.607***	1.012	0.721***
			(0.0722)	(0.0819)	(0.0485)	(0.0681)
Stunting	210,436	Ref.	0.773***	0.641***	0.860***	0.819***
			(0.0204)	(0.0226)	(0.0157)	(0.0217)
Diarrhea	489,948	Ref.	0.973	0.937**	1.057***	1.009
			(0.0212)	(0.0267)	(0.0182)	(0.0246)
ALRI	489,593	Ref.	0.939***	1.113***	0.987	1.007
			(0.0219)	(0.0347)	(0.0179)	(0.0271)

Notes: Coefficients displayed are odds ratios. Standard errors in parentheses are clustered at the survey-cluster level. Panel A regressions control for survey fixed effects, sex and age of children, twin births, child's birth order, and birth spacing. Panel B regressions include the full set of controls.

Figure 1: Spatial Distribution of Sample Surveys

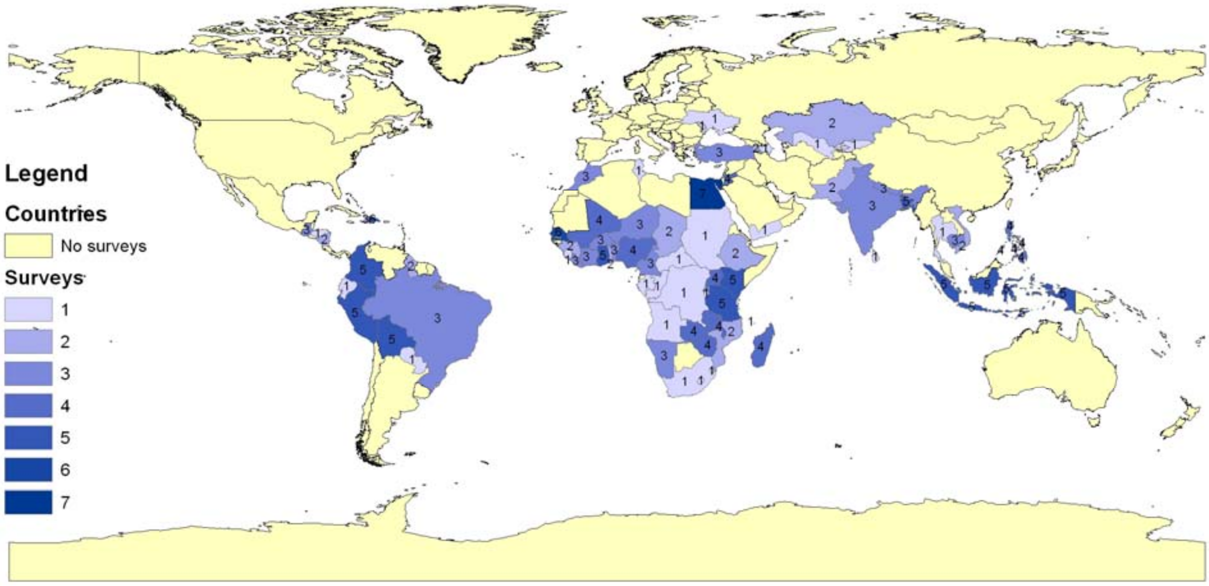


Figure 2: Prevalence of slums according to different definitions

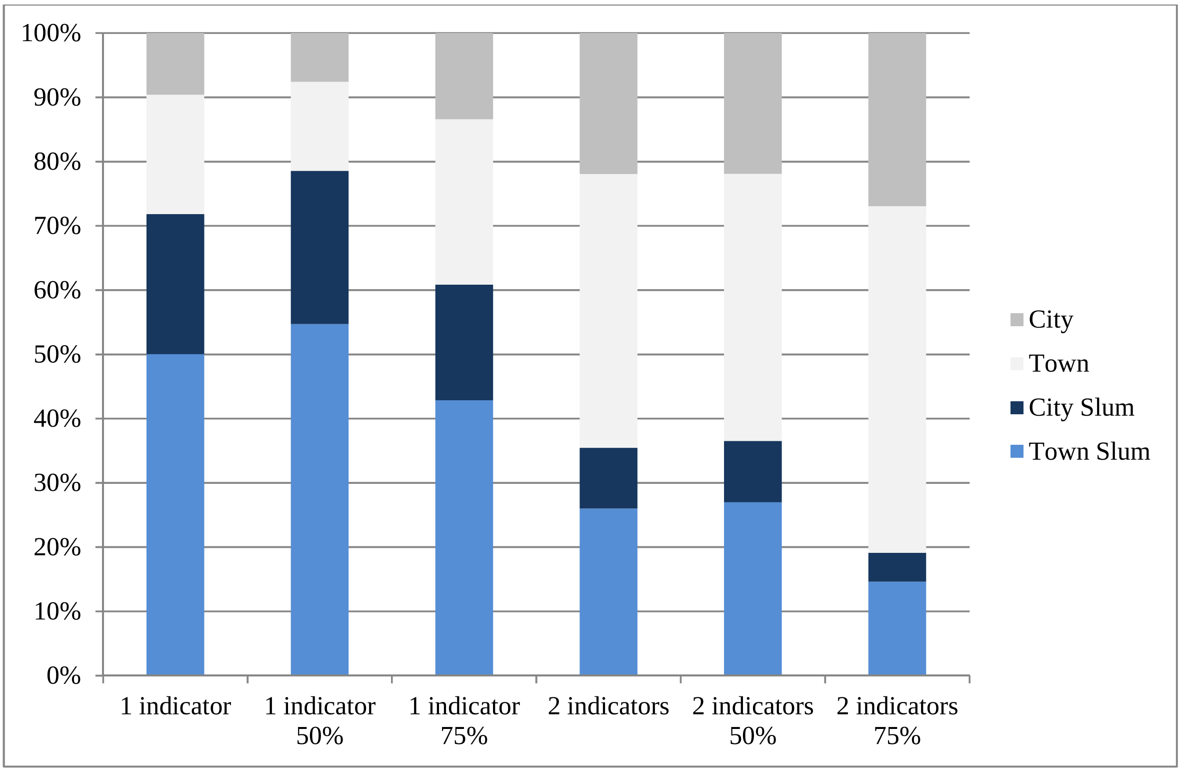
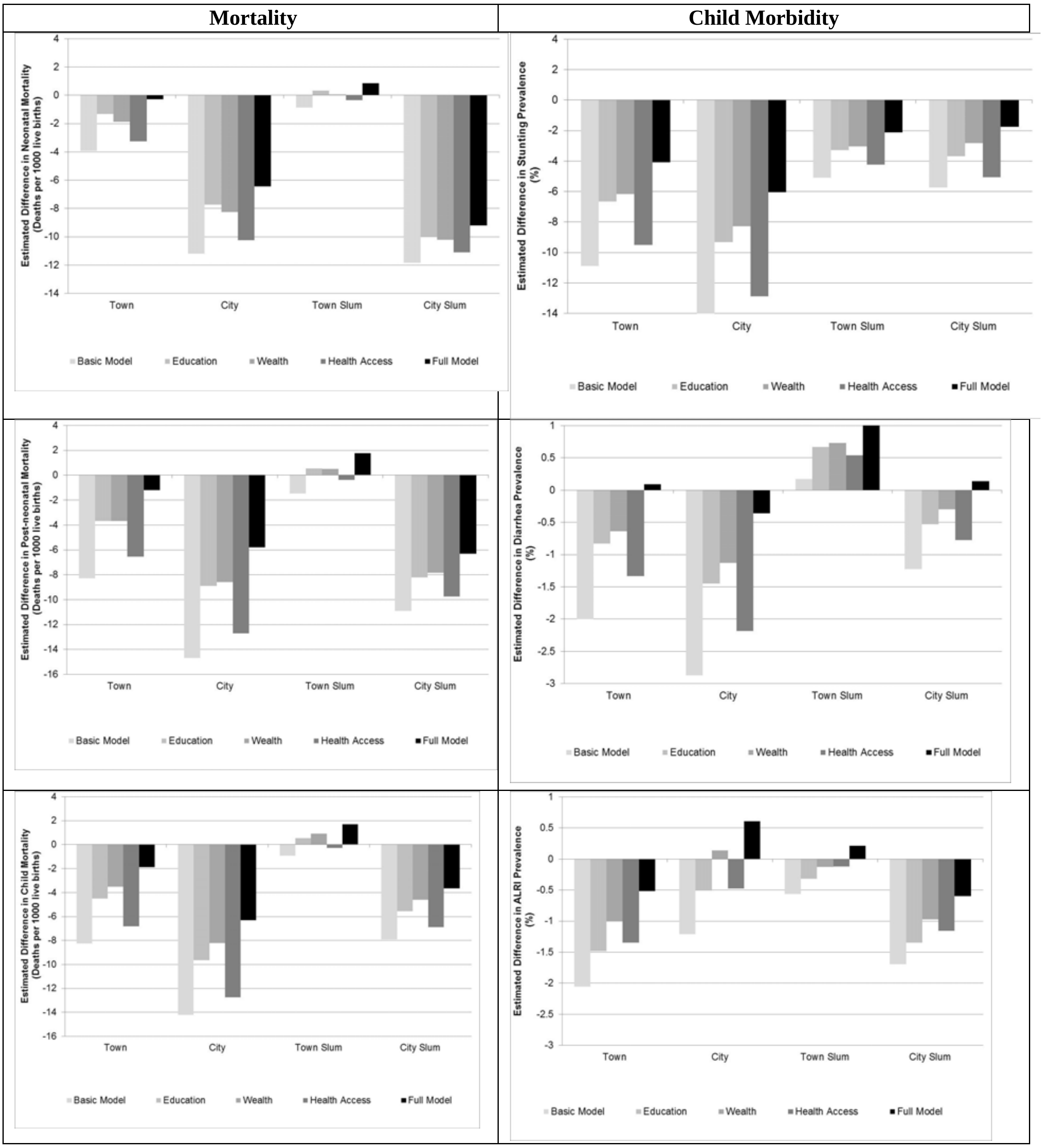


Figure 3: Conditional Associations between Residence and Child Health



Notes: Differences are always in relation to children living in rural areas. All models control for child characteristics. Basic Model: no additional controls. Education: controls for child characteristics and mother's education. Wealth: controls for child characteristics and household wealth. Health Access: controls for child characteristics and health access variables. Full model includes all controls.