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The history, geography and sociology of slums and the health problems of people who live in slums

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Summary
Massive slums have become major features of cities in many low- and middle-income countries. In this, the first in a series of two papers, we show why slums are unhealthy places with particularly high risks of infection and injury. We show that children are especially vulnerable, and that the combination of malnutrition and recurrent diarrhoea leads to stunted growth and longer term effects on cognitive development. We find that the literature on slum health is underdeveloped in comparison to urban health, and poverty and health. This is important because health is likely to be influenced by factors arising from the shared physical and social environment, which have effects beyond those of poverty alone.

In the second paper we will consider what can be done to improve health and make recommendations for the development of slum health as a field of study.

Introduction
Homo sapiens is undergoing a radical transformation of its ecology. During the last two centuries the proportion of the world’s population living in cities and towns has grown from about 5% to more than 50%. This process of rapid ‘urbanisation’, which started in Europe and North America following the Industrial Revolution, was accompanied by the development of large slums including famous examples, such as La Chapelle in Paris, France, the Gorbals in Glasgow, Scotland, and Khitrov in Moscow, Russia. The last fifty years has seen massive urban growth in low- and middle-income countries (LMICs) characterised by sprawling slums that are now home to more than half of the population in cities such as Mumbai, India, Nairobi, Kenya, and Mexico City, Mexico. This dramatic growth in slums has provoked increasing international interest, and the United Nations Sustainable Development Goals (SDGs) specify a target to address the ‘plight of slums’.

The broad purpose of this series of two articles is to investigate how this might be achieved with respect to health. This, the first paper in the series, is organised as follows. First, we
provide some background to slums covering terminology and definitions, the size of slum populations, and the dynamics of their growth. Second, we make a theoretical argument that slum health should be a substantive topic for study, distinct from urban health, and from poverty and health. Third, we examine the extent and nature of previous research in slum health. Fourth, we describe the physical and social factors affecting health in slums. Fifth, we describe the particular health problems of people who live in slums, insofar as this can be discerned from the literature. Finally, we conclude.

**Background**

**Terminology and Definitions**

Concerns have been expressed that the term ‘*slum*’ is emotive and pejorative. The term ‘*informal settlement*’ has been suggested as an alternative. However, the United Nations continues to refer to ‘*slums*’, for example in the ‘Sustainable Development Goals’; ‘*informal settlement*’ and ‘*slum*’ are not synonymous.

The United Nations Educational Scientific and Cultural Organisation (UNESCO) defines a slum in terms of an urban space, as “a contiguous settlement where the inhabitants are characterised as having inadequate housing and basic services”. However, the most widely used definition, promulgated by the United Nations Human Settlements Programme (UN-Habitat), is based on households where a slum household is defined as: “a group of individuals that live under the same roof that lack one or more of the following conditions; access to improved water, access to improved sanitation, sufficient living space, durability of housing and secure tenure”. Each of these five conditions is defined in more detail, for example by specifying what type of sanitation qualifies as ‘improved’. Two issues arise from these contrasting definitions. First, ‘slum’ is a construct composed of many dimensions – five in the case of the UN-Habitat definition – such that no single definition can be entirely satisfactory. Second, while people intuitively think of slums as collections of dwellings, this
spatial construct is not included in the UN-Habitat definition. The concept of slums as spatial entities is a unifying theme across both papers in this series.

Population of Slums

Measuring slum populations is not an exact science for reasons given in Panel A. The most recent UN-Habitat estimates for slum populations suggest that 881 million people lived in slums in the developing world in 2014, up from 689 million in 1990. The number of people living in slums is increasing and remains particularly high in sub-Saharan Africa (56% of the urban population lives in slums) and Southern and Southeast Asia. It is estimated that by 2030, approximately 5 billion of the world’s projected 8.1 billion people will live in urban areas. Of these, about 2 billion will live in slums, primarily in Africa and Asia. Most of this growth will occur in smaller (tier two) cities where urbanisation continues without adequate planning or expansion of infrastructure. What is driving this growth in slum populations?

Panel A: Counting people in slums

Data used by UN-Habitat to estimate slum populations emanate from two main sources – population and housing censuses (conducted every ten years in most countries), and national surveys that are often based on sampling frames from censuses. Making an assessment of the size of slums is not an exact science because:

1. There is more than one definition of a slum and any particular definition may be applied inconsistently. A given definition may change over time; for example, the living space threshold of the UN-Habitat definition was increased from over one to over two persons per room in 2008.

2. There are technical difficulties in the enumeration of slum populations; they are a ‘hard to reach’ group since householders are frequently absent; people may rent rooms by the
3. Many slum communities are not officially gazetted as residential areas and are therefore underrepresented in censuses and in national sampling frames.\textsuperscript{7, 8} China provides an example where many “城中村” – literally villages in the city – are populated by unregistered migrant workers.\textsuperscript{9, 10} In some cases, the exact opposite is witnessed, where governments over-count slum dwellers either for political motives/support, or for budgetary allocations related to service delivery.

4. Even where data for the UN definition of slums are available for a nation, they are only collected every few years, so annual reporting of slum populations has to rely on estimates and projections. Projecting the future size of slums is further complicated by different rates at which slums are upgraded to non-slum across LMICs.

5. The threshold for definition of water supply and sanitation is set low, and the worldwide estimates of slum populations would inflate by several hundred million if the threshold were raised to a level sufficient to protect health.\textsuperscript{11} In addition, applying the UN slum definitions to high-income nations may suggest that they have no slums – but they may still have significant proportions of their population living in ‘inadequate housing’.

The population of slums can be stated as totals or as proportions in which case the denominator can be either national or urban populations. These different methods can yield diverging trends. For example, in most regions of the world the percentage of the urban population living in slums has been declining since 1990, while the total numbers are rising.\textsuperscript{6}

### Dynamics and Underlying Causes of Slum Growth

Urbanisation can be prevented by restricting people’s movement. For example, ‘pass laws’ limited internal migration in many colonial countries, while the Chinese government went
further still by reversing the flow between countryside and city during the Cultural Revolution.

Removal of restrictions is typically followed by rapid urban migration as happened, for example, following the abolition of slavery in Brazil in 1888.\textsuperscript{12}

Once a population is free to move they will be motivated or constrained by many factors (Table 1.1). The increase or decrease in slum populations is a dynamic process involving flows of people from countryside and other city precincts, flows in the reverse directions, conversion of city districts and peripheral land sites to slums (and vice versa), and the balance of births and deaths (natural growth) in the slum itself. As slums age, the proportion of growth that is natural (balance of births and deaths) increases, reaching figures as high as 75\% in Mexico City.\textsuperscript{13} We model this dynamic process in Figure 1.1.

\textbf{[Figure 1.1]}

\textbf{Table 1.1. Factors associated with rural/urban migration}\textsuperscript{*}

<table>
<thead>
<tr>
<th>Demand (pull) factors</th>
<th>Supply side (push) factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Thriving informal economy.\textsuperscript{14}</td>
<td>1. Environmental degradation.\textsuperscript{19}</td>
</tr>
<tr>
<td>2. Unrealistic expectations due to optimism bias, inadequate information, or distorted market signals, but people and information travel back and forth between countryside and city so this factor should not be over-emphasised.\textsuperscript{14}</td>
<td>2. Famine.\textsuperscript{19}</td>
</tr>
<tr>
<td>3. Informed risk-taking, whereby people consciously trade a small probability of large gains for the status quo, or even ending up worse off.\textsuperscript{14}</td>
<td>3. Improved agricultural labour productivity through mechanisation.\textsuperscript{19}</td>
</tr>
<tr>
<td>4. Altruistic desire to make reparations to family in the countryside,\textsuperscript{16} and to hedge urban and rural risks over the family.\textsuperscript{13}</td>
<td>4. Volatile commodity prices and economic shocks.\textsuperscript{19}</td>
</tr>
<tr>
<td>5. A sense of adventure and the desire to escape the monotony of subsistence farming.\textsuperscript{17}</td>
<td>5. Ethnic violence.\textsuperscript{19}</td>
</tr>
<tr>
<td>6. Displacement, for example from ‘development’ projects, such as construction of dams.\textsuperscript{19}</td>
<td>6. Displacement, for example from ‘development’ projects, such as construction of dams.\textsuperscript{19}</td>
</tr>
<tr>
<td>7. A desire to escape adverse social conditions, such as</td>
<td>7. A desire to escape adverse social conditions, such as</td>
</tr>
</tbody>
</table>

\textsuperscript{*}Note: This table is not exhaustive and should be expanded depending on the context and region of interest.
6. Lack of barriers to migration (such as a large family), and facilitators (such as an existing social network in the city to provide temporary accommodation, support, and advice).  

| rural caste discrimination in India.  |

*These factors do not, of course, explain growth and persistence of slums – see text.

Explaining what motivates individuals or families to move or stay where they are under prevailing conditions, does not explain why the prevailing conditions are as they are. It does not account for the enormous size of slums, the number of people who become ‘trapped’ in slums over generations,  

| the deepening poverty into which many people sink.  |

| Nor does it explain decoupling of economic and slum population growth – no less than 66 countries experienced a five year period of urbanisation without concurrent national economic growth between 1960 and 1995.  |

| Many reasons have been proposed to explain why slums form, persist, and grow including: national economic stagnation, failure of redistribution, market distortion in favour of extractive elites, colonial legacies, lack of planning, corruption, ‘clientism’, and anti-urban biases by national governments and international agencies. Fox provides a sure-footed account of how these factors have played out over time;  |

| Roy et al. offer a recent systematic review of models of slum growth under sub-optimal international and national policies;  |

| and UN-Habitat has published a report on factors that are associated with success in reducing slum growth among 100 countries over a 20 year period.  |

| These macro-level factors must be left to further enquiry by historians, political scientists, and economists while we will focus on the slums themselves.  |

**Why Slum Health?**

Not all people living in slums live in poverty and many who live in urban poverty reside outside of slum areas. Over half of dwellings classified as ‘slum households’ (according to the Un-Habitat definition) in Chennai, Delhi and Hyderabad, India fall outside of areas
classified as slums (according to the Indian definition of 60 contiguous slum households). This means that the health of poor city dwellers is not necessarily a reflection of the health of those who live in slums. There are three reasons why living in a slum and living in poverty may produce different health outcomes:

1. People who live in slums share environmental risks, such as those arising from poor sanitation – they experience ‘neighbourhood effects’ (Panel B).

2. Likewise they benefit collectively from interventions, such as improved sanitation, in ways that will be explicated in paper two.

3. Social and health improvement interventions that work in non-slum localities may not be transferrable to slum areas. For example, pit latrines are particularly unsuitable for slums (see paper two).

The health of people who congregate in slums should not be subsumed in urban health or in studies of poverty and health. Rather, slums should be studied as spatial entities. Yet, censuses, in all but a small number of LMICs, do not identify slum from non-slum urban areas. The result is that national surveys, such as Demographic and Health Surveys (DHS), which are based on sampling frames derived from national censuses, do not distinguish between households that are or are not located in a slum area of a city. Surveys based on such censuses simply replicate the well-known association between poverty and health, ignoring the salience of space. We will argue in paper two that this should change and that all countries should identify urban census tracts (enumeration areas) as slum or non-slum.

**Panel B: Neighbourhood effects**

A large body of literature attests to the existence of ‘neighbourhood effects’ on health. Neighbourhood effects refer to factors that influence health at the community level independent of individual household level factors, including individual household levels of poverty/deprivation. They encompass pervasive effects operating across the spaces in
which people live. The mechanisms by which neighbourhoods exert their effects have been
classified in various ways. We provide examples of neighbourhood effects based on one
such classification system \(^{32}\) in the Table.

**Table: General and slum-specific evidence of neighbourhood effects**

<table>
<thead>
<tr>
<th>Type of neighbourhood effect (^{32})</th>
<th>Example</th>
<th>Example from slum context</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical environment</td>
<td>The risk of childhood illness in Indian families is more strongly correlated with a neighbour’s defecation patterns than with the family’s defecation behaviour.(^{33})</td>
<td>Slum environment and water supply is heavily contaminated with faeces in many slums.(^{34})</td>
</tr>
<tr>
<td>Social interactions</td>
<td>An experimental study in the USA showed that providing vouchers to move to a better-off neighbourhood improved health in the short-term, and young children’s prospects in the long-term.(^{35})</td>
<td>Crime rates vary considerably among slums, reflecting different cultures that have developed within them.(^{2})</td>
</tr>
<tr>
<td>Geographic factors</td>
<td>Poor people in rich cities in the USA have better health than equally poor people in poor cities.(^{31})</td>
<td>Many slums are exposed to geographic hazards, such as flooding, subsidence, and local pollution from factories.(^{36})</td>
</tr>
<tr>
<td>Institutional factors</td>
<td>Teachers may have lower expectations of pupils who live in poor neighbourhoods.(^{32})</td>
<td>Some slums are stigmatised so that residents’ rights are infringed to the point of expropriation.(^{37})</td>
</tr>
</tbody>
</table>

Many authors \(^{38-40}\) have examined slum effects in observational studies using multi-variate
modelling techniques to separate individual, household, and neighbourhood contributors to
health. However, identification of neighbourhood effects from observational studies is fraught
with difficulty that might lead to under- and/or over-estimation.\(^{41}\) The study of neighbourhood
effects thus leans heavily on studies of underlying mechanisms (for example, showing that
soil and water are contaminated by faeces, or that overcrowding is associated with stress),
and studies where the environment is manipulated under experimental (or quasi-
experimental) control (discussed in paper two). Rare instances exist where it has been
possible to observe the effects of taking part in a lottery that allows some people to move to a new environment while others remain in their original neighbourhood – the Moving to Opportunity experiments in the USA \(^{35}\) and India,\(^{42}\) for example.

The idea of slums as spaces is central to the notion of slum health. That said, it is also the case that while slums exist in space, these spaces are not homogenous but vary considerably within and between slums in terms of population density, security of tenure, official recognition, provision of services, topography, and social and economic make-up.\(^{43}\)

Context can have a large effect on the effectiveness of interventions as we discuss in paper two.

**Slum Health – a Neglected Subject?**

We describe our literature retrieval algorithms in Panel C. Our intention was not only to obtain literature to examine slum health but also, given the salience of neighbourhood effects, to compare and contrast this literature with the literature on urban health generally, rural health, and poverty and health.

**Panel C: Search strategy and selection criteria**

To gauge the relative attention the topic of slum health has received in medical research and to characterise the nature of academic literature on slum health, we firstly carried out bibliometric analyses of the relative volume of research studies concerning rural, urban and slum settings (Web Appendix 1.2.1) and the number of registered clinical trials in these settings in low- and middle-income countries (Web Appendix 1.2.2).

In order to identify key literature for the diffuse topic of slum health, we conducted a systematic overview of reviews covering determinants of health in slum settings and/or interventions that aim to improve the health of slum dwellers. Given that the identified
literature on determinants of health mainly draws evidence from cross-sectional studies that
are subject to selection effects as described in the text, we undertook a further systematic
review of cohort studies in slums. Acknowledging the important roles that international,
governmental and non-governmental organisations play in this area, we also systematically
searched the grey literature and reviewed relevant documents. Details of literature search
and study selection criteria for these reviews are provided in the text below.

1. Systematic overview of reviews concerned with slum health

We searched the following eight databases in January 2016: MEDLINE, including in-process
and non-indexed citations, Embase, PsycINFO, LILACS, SciELO, WHO Global Health
Library, Database of Abstracts of Reviews of Effects, maintained by the NHS Centre for
Reviews and Dissemination, and CINAHL (all but two of the reviews detailed here were
found in MEDLINE or Embase). We put no limits on dates covered. In order to make the
search as sensitive as possible we included a wide range of synonyms for slums, derived
from a list in a UN-Habitat report and augmented by other terms we have encountered:
baladi, bandas de miseria, barraca, barrio marginal, barrio, bidonville, brarek, bustee, chalis,
chereka bete, dagatan, estero, favela, galoos, gecekondu, ghetto, hrushebi, informal
settlement, ishash, karyan, katras, looban, loteamento, medina achouaia, morro, mudun safi,
musseque, shanty town, slum, solares, tanake, taudis, township, tugurio, udukku,
umjondolo, watta, and zopadpattis. We further broadened our search by combining free-text
synonyms with controlled vocabulary for slums and, where supported in the database, filters
for systematic reviews. No language restrictions were applied. We examined the titles and
abstracts of unique records and selected reviews (both systematic and narrative reviews)
that: 1) specifically provided results for people who live in slums; 2) specifically included
people who live in slums but did not provide specific results for the sub-group; and 3)
included the urban poor and hence were likely to have included slum dwellers, although this
was not specified. We selected reviews dealing with: a) the distribution and determinants of health relevant to slum settings, which are included in the evidence base for paper one (for a summary of identified studies see Web Appendix 1.4, Table A5); and b) interventions for slum populations, reporting health outcomes, which are included in the evidence base for paper two (for a summary of identified studies see Table 2.2, paper two). Please note that some of the identified reviews reported both on the epidemiology of health conditions, and interventions to improve these health conditions, in which case they are included in the evidence base for both papers. A flow diagram for study retrieval and selection is available in Web Appendix 1.3.1

2. Systematic review of primary cohort studies relating to slum health

We searched for primary cohort studies using MEDLINE and Embase (which support the necessary search filter for cohort studies) relating to slum populations, using the same free-text and controlled vocabulary terms for slums as stated in search one above. After examining the titles and abstracts of the unique records this search returned, we selected relevant studies (studies that prospectively recruited people living in slums and observed them over at least two occasions over time). We located 128 studies meeting this criteria and classified them by key themes (e.g. paediatric nutrition and diarrhea; injury), integrating these throughout the text as appropriate with other relevant studies. There was only one study found in search two that had been picked up by the reviews identified through search one. The study retrieval and selection process is also shown in the flow diagram in Web Appendix 1.3.1

3. Systematic review of the grey literature

We searched the grey literature by reviewing official reports from the publication databases of the World Bank, World Health Organization, and UN-Habitat on the basis of expert advice
from the authors. We covered the literature from January 2010 to February 2016. Our search terms included synonyms for slums in searches one and two above. Eight hundred and eighty-four results were returned, and after examining the titles, abstracts, and text of these studies and reports we selected 245 publications that dealt partially or wholly with issues arising in slums. For a breakdown of publications see Web Appendix 1.3.2. Many important articles were found in this literature, including those relating to the economics of slum formation, system level interventions (such as the effect of providing tenure/title), and certain notable large scale studies, including a randomised trial of home improvement.

We supplement the above three reviews with additional searches as needed on the advice of experts (such as the searches for literature related to neighbourhood effects in slums, Web Appendix 1.3.3), and further extended these with authors’ collections of references and additional papers identified by subject experts.

The bibliometric analysis supports the hypothesis that slum health has received scant attention compared with rural health, urban health, and poverty and health:

1. Studies on slum health make up only a small proportion of the LMIC literature. For instance only 2.8% of LMIC papers on MEDLINE and Embase that stated where the study was carried out were based in a slum location (Web Appendix 1.2.1).

2. Only 7% LMIC trials registered on the WHO Clinical Trials Registry Platform that stated where the trial was carried out were based in a slum location and in many cases slums were chosen as a convenience sample, for instance to study the effects of a new vaccine, rather than to examine slum health or how to improve it (Web Appendix 1.2.2).

3. There is no MeSH term for ‘slum’ or its synonyms on MEDLINE or Embase.

Further evidence that slum health is a neglected topic can be found by examining the location of the 38 Demographic Surveillance Sites based in Africa; only one (the Nairobi
Urban Health and Demographic Surveillance System) is based entirely in a slum area. In addition, slums are not identified as a determinant of health in the influential Global Burden of Disease report. Before moving on to discuss the findings on health and its determinants it is worth mentioning the type of literature retrieved and its possible biases. Most literature on health and welfare in slums is based on cross-sectional studies that are subject to selection effects, including:

1. Those who migrate are healthier on average than those who remain in rural settings (healthy mover effect).
2. Those who transition rapidly through the slums are under-represented relative to all who have been exposed to slums (a form of ‘rate bias’).

These factors may lead to potential bias when seeking to make an inference about the effect of moving to a slum from another place, or the net effect of slums on health or wellbeing. The second factor can be mitigated by use of longitudinal studies; the rationale for a specific search for such studies (Panel C).

Living and Working Conditions in Slums

Slums are usually formed close to areas where work is available. Under population pressures the slum pushes upward (stories added to dwellings) and outward. Competition for sites close to places of work causes inflation in rents and land prices so that landlords in central locations may end up quite well-off, while those at the periphery become progressively disadvantaged; the Gini coefficient (a measure of income inequality) in Bangladesh is larger within slums than across the country as a whole. This is important because increasing poverty generates health inequality, which in turn leads to deeper poverty creating a vicious circle (or poverty trap).
Security of tenure is a key issue for slum households. Slums are often set up on unclaimed or municipal land. It is then up to the authorities to decide whether or not to recognise the slum and confer residency rights on citizens – such ‘notified’ locations make up only about half of all slums in India, for example. People with no rights have little incentive to invest in healthier homes and may be evicted without compensation to provide more lucrative middle-class housing to the benefit of an ‘extractive elite’; slum landlords and local government officials may be one and the same. Large scale evictions have taken place under apartheid in South Africa, state capitalism in China, and even democratic local government in Brazil. The injustice and inhumanity of these evictions is compounded by the plight of the displaced settlers who must move to new locations that are even more disadvantaged, in terms of access to the labour market and environmental safety, than their original slum habitat, again widening inequalities.

Whether through eviction or a shortage of space, people in slums may inhabit dangerous locations such as ravines, where they are subject to landslides (Caracas, Venezuela), flood plains, where they are subject to drowning and loss of homes (Manila, Philippines), and under power lines increasing the risk of fires (Nairobi). In Quito, Ecuador, people who live in slums have been forced above the 2850 metre city limit that marks the highest level that can be serviced by the municipal water distribution system. People who live in slums are also especially vulnerable to the effects of global warming. For example, poorly constructed homes are ill-equipped to withstand the elements and mortality risk from tropical cyclones (after controlling for storm intensity) is over a hundred times greater in low-income compared to high-income countries.

Slums provide access to markets for millions of people and provide conditions where micro-enterprises become established. The informal sector is worth US$10 trillion per year globally and employs 80% of the workforce in LMICs. But people live hand to mouth as day-to-day existence requires out-of-pocket payments, not just for food and accommodation, but for basic amenities, such as water, access to toilets, cooking fuel, transportation, and
education. Informal sector workers with minimal statutory rights and who lose income when they are absent from work are at a particular disadvantage if they live in slum areas with long and costly commutes. Health facilities, if present, are closed when they return from work and they cannot attend appointments for immunisation, antenatal care, or care of long-term conditions. Women, earn on average only a third of men's earnings in urban areas of sub-Saharan Africa.

Not only is there an economic and social gradient within slums, but slums themselves may differ from each other, not just economically, but socially. This is illustrated with respect to crime where some slums (e.g. Kumasi in Ghana and Surabaya in Indonesia) have low crime rates, while others are dominated by criminal gangs, as in Rio de Janeiro, Brazil and Caracas, Venezuela leading to the concept of 'slums of hope and slums of despair'. It would be useful if high risk localities could be identified on the basis of their characteristics and a study across 48 slum areas in Mumbai, India identified maternal and child health risk areas with high specificity but low sensitivity on the basis of access to water and sanitation, housing quality, and tenancy status. We have not located studies to identify risk by higher level factors such as size of slums, and have cited limited information suggesting that large established slums have lower social capital than newer slums. There is a positive correlation between average duration of residence in a slum and the prevalence of violence in that slum. Strong social pressures in slums can affect drug use and teenage sexual behaviour at the community level. We explore some of these through the words of mothers of teenage children in Web Appendix 1.1.

Slum dwellings are loosely fitted together from available materials allowing easy access for vectors of disease. Under the sun corrugated iron dwellings become oppressively hot, while at night temperatures in high altitude cities can plummet to lows of -4.4°C in Mexico City, Mexico and -0.5°C in Addis Ababa, Ethiopia. Many slums households do not have piped water or lavatories. Pit-latrines contaminate the environment and the water supply is prone to contamination at multiple points. Homes are crowded and afford little privacy. Cooking
and heating with solid fuels in confined spaces pollutes the air with noxious fumes and particulate matter. Streets and lanes are unpaved with no drainage and are therefore converted to mud and stagnant pools when it rains. Garbage collects in huge, malodourous piles and often contains excrement. There is little open space where children can play safely or where adults can relax.

The determinants of health interact and are highly reinforcing. For instance, poor maternal mental health postnatally reduces willingness to breastfeed and also affects the mother's bonding to her child, placing the child at risk physically and socially. Early weaning, failure to immunise, exposure to contaminated water, and malnutrition interact producing enteropathy and stunting, which in turn predispose to reduced school performance, and reduced life chances. If a mother does not breastfeed, her fertility will return quickly after childbirth, resulting in reduced spacing between children. As a result less time, money, and loving support can be given to each child. If a parent develops a serious disease, such as recurrent tuberculosis, the family will suffer catastrophic financial loss (due to cost of healthcare and loss of earnings) reducing educational opportunities. It is time to examine in more detail how slum neighbourhoods predispose their inhabitants to disease.

**Health in Slums: Child Mortality**

It is difficult to measure the life expectancy of people who live in slums because they move to and fro and may return to rural areas to die. However, child mortality is easier to ascertain. While child mortality is similar between rural and urban locations overall comparisons between slum areas specifically and the countryside tell a different story. Higher infant and/or neonatal mortality in slum versus rural areas has been found in Kenya, Ecuador, Brazil, Haiti, and in the Philippines, although rural areas with particularly high malaria exposures may experience even higher child mortality rates than high altitude slums. We have examined this issue further by analysing survey data from Bangladesh and Kenya; two
countries where the census distinguishes between slum and non-slum urban areas (Table 1.2). We find that slums have worse health outcomes for children than the rural populations of both countries. Even if we define the rural poor as the lowest tertile by socioeconomic status, children have higher mortality rates in the slums of Nairobi. Diarrhoea and pneumonia are the two main worldwide killers of children under five years $^{71,72}$ and there seems little doubt that young children (under five years) are at particularly high risk in slums as discussed below in more detail.
Table 1.2: Comparison of levels and trends in early childhood mortality among slum and other sub-populations in Bangladesh and Kenya

### BANGLADESH CHILD MORTALITY - 2006/07

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<tr>
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<th>UHS* 2006</th>
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<tr>
<td>Infant Mortality rate</td>
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<tr>
<td>Under-five mortality</td>
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*Urban Health Survey

**Nairobi Cross-sectional Slum Survey

All mortality rates are per 1,000 live births.

Neonatal mortality rate: the probability of dying within the first month of life.

Infant mortality rate: the probability of dying before the first birthday.

Under-five mortality rate: the probability of dying between birth and the fifth birthday.
Table 1.2 Legend: For the comparison of early childhood mortality among slums, rural poor, all urban, and national populations, we used data from slum surveys and the DHS. For Kenya, data for slums were extracted from the Nairobi Cross-sectional Slum survey 2000, and 2012, and for all other residential domains, data were extracted from DHS 2003, and 2014. In Bangladesh, indicators for slum population were extracted from the Urban Health Survey 2006, and 2013. The corresponding indicator data for other residential domains were extracted from Bangladesh DHS 2007, and 2014.

This study was made possible by slum-specific indicators that are tagged on to residential domains in census and surveys in Bangladesh and Kenya. In Kenya, the selection of slums for the survey was informed by 1999 and 2009 census listings that identified slum enumeration areas. A weighted cross-sectional sample was designed, representative of households in all slum clusters of Nairobi in 2000 and 2012. In the Urban Health Survey in Bangladesh slums were defined as areas of concentrated vulnerability. Using satellite images from census 2005 as a starting point, four criteria for identifying slums were used: poor housing conditions, high overall density, poor environmental services, and high prevalence (over 75 percent) of people with income below the poverty level. The rural poor were classified as the lower tertile of the rural population based on wealth scores data from the respective DHS.

It is noteworthy that mortality rates are declining in both countries in both rural and slum areas. In Nairobi, however, the situation of children in the slum areas relative to rural poor children appears to have worsened over time.
When children move to slums from the countryside they are most vulnerable immediately following their arrival, presumably because they have little immunity to the organisms in their new neighbourhood. When compared to children whose parents do not leave for the city, children left behind in the countryside have unchanged or even improved health – perhaps as the result of remittances.

**Infectious diseases**

Pit latrines with slabs qualify as ‘improved sanitation’ in the World Health Organization (WHO) / United Nations Children’s Fund (UNICEF) Joint Monitoring Programme definition. Yet such facilities are inappropriate in a crowded slum environment. Even when judged against this low standard, only 40% of the urban population in sub-Saharan Africa had ‘improved sanitation’, while 33% had piped water in their homes in 2015. The situation in slums specifically can only be worse. Gastrointestinal infections are highly prevalent in slums and children under five years old are particularly vulnerable (see below). Two systematic reviews of cholera outbreaks in Africa identified slum neighbourhoods as the usual source of the epidemic. Slum dwellers perceive water and sanitation as their most pressing need. Interestingly, slum life may protect children from the effects of polio because the virus is likely to be contracted at a particularly early age in slum areas, and hence at a stage when the baby is still protected by maternal antibodies.

Accumulation of rubbish and poor housing provide breeding grounds for parasites and vectors of disease. Leptospirosis is a particular problem, resulting from the proliferation of rats in garbage and persistence of the bacterium in surface water and mud. Dengue fever is one of the few infectious diseases that is increasing globally, and its vector, the *Aedes* mosquito, is particularly adapted to survival in slum areas, in contrast to the *Anopheles* mosquito, which thrives in high sunlight and plentiful vegetation.
Social factors affect transmission of disease. Sojourns in rural areas bring ‘rural’ diseases (e.g. schistosomiasis) into the city. Overcrowding contributes to the high prevalence of tuberculosis. Slum residents are a young, highly mobile population contributing to the higher incidence of HIV in slums compared to non-slum city areas. In the recent Ebola epidemic in West Africa, slum conditions amplified spread of the disease.

Under-nutrition and malnutrition

Under-nutrition is the leading indirect cause of childhood mortality and morbidity in sub-Saharan Africa. Recent surveys of food insecurity specifically in slums found rates of 85% of households in Nairobi, 77% in Northern India, and 74% in Addis Ababa, Ethiopia. Three reviews examining diet and nutrition in slums all showed that people who live in slums were at a nutritional disadvantage compared with other urban residents. People who live in slums rely on street vendors of pre-cooked foods for about a fifth of their calorie intake.

Under-nutrition interacts with recurrent diarrhoea in children leading to stunted growth. A systematic review reports that across multiple regions (including the Democratic Republic of Congo, Bolivia, India, Bangladesh, and Kenya) the rate of stunting in children residing in slums is higher than in non-slum urban or rural areas. Early childhood diarrhoea also impacts child cognitive development, the economic consequences of which are overlooked in cost-effectiveness studies of slum improvement (paper two).

Exclusive breastfeeding to age six months and partial breastfeeding from 6-23 months reduce incidence of, and mortality from, diarrhoea and pneumonia, and also reduces all-cause mortality in LMICs. Breastfeeding rates are low in slums, partly due to labour market conditions that make it difficult for mothers to either stay at home or take their babies to work with them.
Injury, accidents and violence

Trauma accounts for 10% of deaths worldwide and this proportion is increasing.\textsuperscript{45} According to a recent study in Nairobi in slums, injury accounted for 22% of all deaths among adults, over a half of all deaths among men under 35 years, and 69% of deaths in young men aged 15-19. Over half of all injury related deaths resulted from assault.\textsuperscript{109} Although data are not available for control areas, we have noted that the social environment differs greatly across slums and this is likely to influence crime and hence injury rates as discussed earlier.

A review on child health reported that paediatric burns are more frequent in slums than in non-slum urban, or rural areas,\textsuperscript{77} largely due to cooking methods. A cohort study of children in the Kibera slum, Kenya found an incidence of burns that was ten times higher than across LMICs as a whole.\textsuperscript{110}

Mental health

Neuropsychiatric conditions are, according to one estimate, the single leading cause of years of life lost to ill-health, disability, or early death (DALYs) worldwide.\textsuperscript{111} The living and working conditions in slums predisposes to stress (as described above) and stress leads to psychological disorders\textsuperscript{112} such as those seen among workers in garment factories in Bangladesh.\textsuperscript{113} We found one systematic review which reported that children living in slums experience more behavioural and emotional problems than children living in rural or non-slum urban areas.\textsuperscript{77} Our principle finding is that there is very little direct literature on slum mental health or how it may be affected by the social milieu in slum neighbourhoods.

Non-communicable diseases

Non-communicable diseases now outweigh communicable diseases as a cause of loss of life years even in LMICs.\textsuperscript{45} Just two reviews examined non-communicable diseases in
slums, both focussed on the high prevalence of childhood asthma. Indoor cooking with solid fuels is a cause of respiratory disease in poor households generally, and the unsanitary conditions in slums are associated with up-regulation of inflammatory responses leading to a high prevalence of non-atopic asthma, in contrast to high-income countries where, according to the hygiene hypothesis, allergy results from excessive cleanliness.

Rates for hypertension were slightly lower in slums than in other populations both in a Kenyan and Brazilian study. The former study also examined treatment and control of hypertension, which was less comprehensive in the slum setting – a finding consistent with the above mentioned problem of accessing healthcare in slums. With respect to other major non-communicable diseases, cardiovascular disease, cancer and diabetes, the risk among people who live in slums is poorly documented. Cigarettes are unaffordable to many and there is evidence that the number of cigarettes consumed by smokers in slums is very much lower than smokers in general. Women and men in slums are heavier and exercise less rural dwellers but have more exercise and are less obese than non-slum urban controls.

Conclusion

Nearly a billion people live in slums and this is projected to double by 2030. This is not reflected in the literature, which is rudimentary when compared to the heft of the literature on urban health generally, rural health, and the relationship between poverty and health. Yet there are good reasons to study slum health specifically, since slums are spaces where neighbourhood effects are likely to exist, mediated through factors such as faecal contamination of the environment, garbage mountains, stagnant ground water, overcrowding, poorly constructed homes, physical hazards (such as burns, scalds, and accidental fires), and indoor and outdoor pollution. More generic determinants of health include job insecurity, lack of tenure/title, poor transport networks, stigmatisation, and the social structures within slums that vary from supportive to highly toxic.
Given these determinants it comes as no surprise that people in slums have much worse health than those in non-slum urban areas. More controversial is the effect of slum versus rural habitation. Here we find that the so-called ‘urban bias’ in favour of urban areas, does not necessarily extend to slums, and that, at least in some slums and on some dimensions of health, people who live in slums have worse health than the rural poor. This, of course, does not mean that people have made a miscalculation in moving to slums because those with short sojourn times are under-represented in cross-sectional samples. However, those who remain in slums can enter a downward spiral of ill health and financial distress leading to ‘poverty traps’ from which escape is difficult, as Jeffrey Sachs has shown.23, 120

Another important finding relates to the particular vulnerability of children in slums. They are more susceptible to infections, such as diarrhoea, and suffer long-term consequences in terms of health and life chances – the topic of a recent systematic review.107 It is for this reason that we will stress the plight of children in paper two. Another particularly stark finding is the high rate of violent death among young adult males – a topic worthy of further enquiry. The literature on mental health and chronic disease in slum populations is disproportionately small. Such evidence as we have been able to glean suggests that hypertension, an enormous emerging problem in sub-Saharan Africa is, in fact, less prevalent in slums than in other urban areas. Likewise, smokers tend to smoke a considerably smaller number of cigarettes in slums than elsewhere. We have not examined evidence on obesity and diabetes in slum populations, although we have received anecdotal reports that this is a rising problem.

In paper two we will turn our attention to what can be done to improve health in slums and to show that neighbourhood effects can be turned to advantage when interventions are promulgated. We will also make positive suggestions to make slums more visible to policymakers and to enhance the depth and breadth of research in support of people who live in slums.
Key messages

1. The population of slums has increased massively in size over the last 60 years and slums now dominate many cities in LMICs, and are increasing in total population size, particularly in Africa.

2. Slum health issues are widely subsumed in urban health and the relationship between poverty and health. Failure to recognise slums as spatial entities obscures neighbourhood effects that are likely to have potential influence on health in slums.

3. There is a long and unfortunate history in which people in slums have been marginalised and even stigmatised with the result that they experience expropriation of property, displacement, and denial of access to basic services.

4. People in slums frequently live hand to mouth so that when illness occurs the victim is likely to fall into extreme poverty, which in turn leads to worse health leading to extreme inequality and poverty traps.

5. Inadequate water supply, sanitation, drainage, and garbage collection in a crowded environment predisposes to recurrent diarrhoea and diseases such as typhoid, hookworm, and cholera.

6. Children are especially vulnerable in slums because of low breastfeeding rates, under-nutrition, and poor sanitation, predisposing to chronic diarrhoea, stunting, and impaired cognitive development. Child health was found to be even worse in slums than among the rural poor in numerous studies.

7. Reservoirs and vectors for infectious diseases such as dengue, leishmaniasis, and leptospirosis flourish in slum environments.

8. The shared physical and social environment of slums exposes residents to health risks of injury from fire, extreme weather, and crime.

9. Insufficient attention has been paid to mental health and non-communicable diseases in stressful slum environments, or of how slum characteristics might influence health outcomes.
10. Slum health should be distinguished from urban health and mainstreamed in the implementation of the Sustainable Development Goals and the New Urban Agenda.
Contributors

This series on slum health has been an international collaboration led by the University of Warwick, African Population and Health Research Centre, United Nations Human Settlements Programme (UN-Habitat), International Institute for Environment and Development, United Nations University, and the Federal University of Minas Gerais. The idea for this series came from RJL and AE who jointly conceptualised the framework and initial draft of this paper. GJMT, JS and YFC conducted the systematic review and OO led on the health aspects. All authors provided references and material and contributed actively to the drafting and reviewing of the manuscript.

Declaration of interests

The authors declare no competing interests

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research and the views expressed are those of the author(s) and not necessarily those of
the funding sources, the National Health Service (NHS), or the UK Department of Health.
Figure Legends

Figure 1.1: Basic model depicting population flows between countryside and the city and between formal versus slum precincts of the city

* Use of yearly transition rates enable dynamic flow to be modelled net of seasonal fluctuations.

A key transition in the *generation* of slums is movement between countryside and city – $t_1$ and $t_3$. According to a famous model from Harris and Todaro, migration from the countryside is propelled by surplus labour on the land in the run up to the demographic transition and a growing demand for labour in the cities, which generates a gap in expected wealth.

Transitions from city to countryside are represented by $t_2$ and $t_4$. A sustained period (five years or more) where migration from city to countryside exceeded migration from countryside to city ($t_2$ and $t_4$) > ($t_1$ and $t_3$) happened in only five LMICs in a 35 year period (1960-1995) and these include the massive upheavals in China and Cambodia.

People move from formal city precincts to slums because of their financial circumstances, but this transition ($t_5$) also occurs when previously better off areas fall into decay through economic recession and middle-class flight, as happened in previously fashionable precincts of Lima, Peru. The reverse transition ($t_6$) can also come about because people move from slum to formal precincts or because a slum is upgraded to a non-slum area. The balance between $t_5$ and $t_6$ is, of course, critical to the question of whether slums expand or contract, as discussed in the text.
References


