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Slums Are Not Places for Children to Live

Vulnerabilities, Health Outcomes, and Possible Interventions

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Keywords

• Children • Slums/informal settlements • Poverty • Health • Education • Social • Interventions

Key points

- Describe the geographic distribution of slum areas and assess the conditions of informal settlements or slums.
- Illustrate how and to what magnitude these conditions are associated with poor child health outcomes.
- Demonstrate health, economic, and social disparities between children living in slums and nonslum portions of the city and in rural areas.
- Summarize successful interventions that have either directly improved child health outcomes or improved conditions associated with residing in slum areas.

INTRODUCTION

> "… I would describe people living here as those who are surviving purely by luck. They live from day to day. When it comes to living conditions it is quite hard, here I am living with my son and my grandchildren. There is no freedom at all. God did not create a human to live like the way we are living here" (Never-married woman, 63 years old, Korogocho) [1].

Slums. Little to no infrastructure, filthy conditions, staggering poverty; adults living in these conditions, such as the woman cited above, will undoubtedly

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experience poor health outcomes. But children who grow up under these conditions suffer a dual burden, as they have yet to fully develop physically and mentally. What are the primary factors that drive poor health outcomes of children residing in slum conditions and what can be done to reduce these disparities? Fairly recently, global attention has turned toward the conditions in slum areas with the inclusion of Millennium Development Goal (MDG) 7 Target 7D: "By 2020, to have achieved a significant improvement in the lives of at least 100 million slum dwellers" [2]. That seemingly lofty goal is followed by "slum improvements, though considerable, are failing to keep pace with the growing ranks of the urban poor." That is a gross understatement. Even the MDG target falls far short of the need. The number of slum dwellers is growing at an alarming rate: a tripling of slum dwellers in less than 3 decades [3]. In 1976, 1.5 billion people lived in urban areas, and one-third were slum dwellers. In 2002, 3 billion or 47% of the world's population lived in cities and 1 billion or 16% lived in slums. It is expected that this number will double by 2030 [4]. Most of the urbanization is occurring in the least developed countries and many municipalities do not have the infrastructure to deal with the rapid expansion and lack the financial and human resources to provide basic utilities. In all regions of the developing world, the growth of slums, also known as informal settlements, is appallingly apparent. In Africa alone, close to 70 million live in slums; 6 of every 10 urban dwellers [5]. This will likely continue to expand, as currently, 38% of the 297 million Africans live in urban areas [6], with an additional 60 million migrating into urban areas every year [5]. In India, as of 2007, approximately 170 million people lived in slums and one-third of them were children.

The rapid pace of urbanization is global. Families and individuals move from rural to urban areas for several key perceptions, many are misperceptions: (1) employment opportunities and higher incomes, (2) availability of more and better social services and health care, (3) improved water supply and infrastructure, (4) a greater variety of educational opportunities, and (5) the reality of increasingly fractionated family lands yet more mouths to feed, declining crop production, and/or decreasing income from sale of crops. Many rural-urban migrants are poorer and less educated than their nonmigrant neighbors. As an example, in Nigeria, 62% of rural to urban migrants met the poor index compared with 13% of rural nonmigrants, and with 19% of those living in the city [7]. Sixty-five percent of the mothers leaving the rural areas had no education, as compared with 28% of those who did not migrate and 44% of those living in the city. Seeking a new and better life in the urban areas, these poorest of the poor and less educated from rural communities immigrate to the city. Yet on arrival, work is often scarce and individuals and families find themselves joining the urban poor. Residing in slum areas, they may find less access to the resources and services they were seeking when they left the rural areas (Table 1).

The plight of children living in slums or informal settlements is the theme of this article; it is a call to arms. Although the task is daunting, there are

Table 1
Trade-offs for migration from rural to urban areas

Urban-poor advantage	Urban-poor penalty
Perceived improved opportunities for employment	Less food security
Considered a transient location	Crowded living conditions
Closer to services and perceived to be more accessible	Increased exposure to contagious diseases
Higher immunization coverage	Indoor air pollution
More family planning programs	Decreased social, family, and financial support (at least initially)
Averages of health indicators exceed rural averages (may be misleading as averages mask wide socioeconomic disparities)	Less child care advice from elders
Home ownership relates to greater independence and satisfaction to overcoming living conditions	Lack of social capital, trust, or personal security
Others could include:	Mental health issues
Freedom/independence from strict family/gender expectations?	Lack of clean water
Better educational opportunities?	Insufficient sanitary facilities
Desire to be modern/Western/developed?	Fee-for-services predominate with government services, although usually free, being crowded
	Quality of closer services is low and costly
	Lack access to emergency transport services
	Schools a distance from living area
	Insecurity and violence
	No security of tenure
	Many have been forced to leave rural areas (husband's choice or financial reasons)
	Expectations not met

successful model programs that have been implemented to improve health outcomes for children in slums. Pediatricians are in a unique position to raise awareness of what happens to this vulnerable population and advocate for just and successful policies. As advocates of the young, we have an obligation to accept the challenge to speak out and enlist the ministries and politicians to enact policies that will improve the lives of all children.

AIM

The objective of this article was to describe the geographic distribution of slum areas and then progressively assess the conditions of informal settlements or slums, demonstrate how and to what magnitude these conditions are associated with poor child health outcomes compared with rural and nonslum urban areas, and, finally, to optimistically describe successful interventions that have either directly improved health outcomes or improved conditions associated with residing in slum areas.

METHODS

Data collection

The primary variable proportion of urban populations residing in slums was downloaded from the United Nations (UN) publically available Web site for

all countries, with data available from 2005 to present [8]. Condition variables and child health and development variables were downloaded from the Henry J. Kaiser Family Foundation (HJKFF) for US Global Health Policy Web site [9]. Data presented on the HJKFF Web site originate from multiple sources, including the World Bank (WB), the World Health Organization, and the UN. National-level slum population indicators included proportions of the population dwelling in urban areas, urban population residing in slums, and total national population in slums. Confounding factors included gross domestic product (GDP) per capita, proportion of population earning less than $1.25 per day, access to clean water and sanitation, and the unemployment rate. Childhood health outcomes included coverage with measles-containing vaccine (MCV), child malnutrition, low birth weight babies, total birth rate, neonatal mortality, infant mortality, under-5 mortality, and maternal mortality ratio. Of the immunizations available, MCV was chosen because of the relevance of MCV vaccine in slum settings with the very crowded conditions and the range in coverage that was seen across countries (Table 2).

Analyses

Worldwide geographic distribution of slum areas

Mapping software, ArcMap version 10.0 (Environmental Systems Resource Institute, Redlands, CA), was used to create a map of slum populations as a percentage of urban populations (Fig. 1). Table 1 lists the countries singly with data on urban slums and health outcomes that were outlined previously.

Relative disparities in pediatric health outcomes among rural, urban, and urban-slum populations

Searches were made to identify reports that analyzed key pediatric health outcomes by region: rural, urban slum, urban nonslum. Relative percent difference was calculated between urban-slum and rural to determine if residing in slums is associated with better or worse health outcomes.

Associations between proportion of slum dwellers and pediatric health outcomes

Associations between percentage of national populations residing in slums and key pediatric health outcomes were taken from the UN-STATS for MDG 7 Target 7D. Unadjusted Pearson correlations were calculated using SAS 9.2 (SAS, Inc., Cary, NC) and presented with the correlation coefficient and *P* value.

Multivariate analyses were further conducted to determine if the associations between child health outcomes and proportion of the urban population residing in slum areas persisted after adjustment for percentage of country's population that resided in urban areas, GDP per capita, percentage of population living on less than $1.25 per day, and region of the world (Asia, North Africa, sub-Saharan Africa, Latin America, Caribbean). Selected child health indicators included low birth weight, malnutrition, proportion of population receiving MCV vaccination, infant mortality, under-5 mortality, and maternal mortality.

Literature review

A critical review of the peer-reviewed and gray literature was conducted to identify proximal and distal characteristics of the slums that may be associated with child health outcomes, the extent to which these factors influence child health, and to identify and present model interventions that have either directly or indirectly influenced the health of the child residing in slums.

RESULTS

Geographic distribution of slums worldwide

Slums in the developing world constitute a significant portion of the population (see Table 2). Although most urban dwellers in sub-Saharan Africa reside in slum areas, the total proportion of the population residing in slums in sub-Saharan Africa has not surpassed a third of the national population except in Angola (39%), Guinea-Bissau (36%), Sierra Leone (39%), and Central African Republic (36%). In Latin America, urban dwellers constitute a much higher proportion of the population but the highest proportion of a national population residing in slum areas is in Bolivia (31%), followed by Peru (27%) and Nicaragua (26%). In Asia, Iraq (35%), Lebanon (46%), and Mongolia (36%) top the list for proportion of national population residing in slum areas. As seen in Fig. 1, the proportion of urban dwellers residing in slums is not necessarily in the same countries in which the highest proportion of a national population resides in slums.

Relative disparities in pediatric health outcomes among rural, urban-nonslum, and urban-slum populations

Most country-level reports do not separate out urban-slum from other urban areas. We identified 2 reports, one from Kenya and one from Bangladesh, that highlight the disparity among urban nonslum, urban slum, and rural. For most indicators, both reports indicated rural dwellers had overall better health outcomes than urban-slum dwellers (Table 3) [10,11].

Associations between proportion of slum dwellers and pediatric health outcomes

Unadjusted correlations are high between both exposure variables and child health indicators (Table 4). Only unemployment is not correlated significantly with the proportion of the population residing in a slum area. After adjustment for other factors, multinomial linear regression indicates that the proportion of the urban population residing in slums is highly correlated with MCV immunization coverage, infant mortality, under-5 mortality, and the maternal mortality ratio. It is not however, independently associated with childhood malnutrition or proportion of low birth weight infants after adjustment for the other factors (Table 5).

Literature review

Overview of slum regions

Factors detrimental to child health and development cluster in slum areas despite their sometimes startlingly close geographic proximity to where some of the best resources in a nation are located (Fig. 2). Settlements are generally

Table 2
Country-level indicators of slum populations and related exposures and health outcomes

Indicators of slum populations		Health outcomes										
Region	Country	Year slum data collected	Percent urbanites, %	Percent urbanites in slums	Percent citizens in slums, %	MCV coverage rate, %	Low birth weight, %	Child malnutrition, %	Birth rate (newborns/ pop)	Infant mortality rate	Under-5 mortality rate	Maternal mortality ratio
Asia	Bangladesh	2009	25	61.6	15	96	22	40	23	49	46	240
	Cambodia	2005	21	78.9	17	93	9	29	25	54	43	250
	China	2009	51	29.1	15	99	3	3	12	16	15	37
	India	2009	31	29.4	9	74	28	43	21	46	61	200
	Indonesia	2009	43	23	10	89	9	19	18	27	32	220
	Iraq	2009	67	52.8	35	76	15	7	28	40	38	63
	Jordan	2009	83	19.6	16	98	13	2	27	16	21	63
	Laos	2005	27	79.3	21	69	11	31	26	58	42	470
	Lebanon	2005	87	53.1	46	79	N/A	N/A	15	15	9	25
	Mongolia	2007	63	57.9	36	98	5	5	21	36	31	63
	Myanmar (Burma)	2005	31	45.6	14	99	9	N/A	19	48	62	200
	Nepal	2009	17	58.1	10	88	21	38	22	43	48	170
	Pakistan	2009	35	46.6	16	80	32	N/A	24	61	72	260
	Philippines	2009	63	40.9	26	79	21	21	25	19	25	99
	Saudi Arabia	2005	81	18	15	98	N/A	5	19	16	9	24
	Syria	2007	54	22.5	12	80	10	10	24	15	15	70
	Thailand	2009	34	27	9	98	7	7	13	16	12	48
	Turkey	2009	77	13	10	97	11	N/A	18	23	15	20
	Vietnam	2009	31	35.2	11	96	5	20	17	20	22	59
	Yemen	2007	34	76.8	26	71	10	26	37	77	168	540

Caribbean	Dominican Republic	2009	66	14.8	10	79	11	3	19	21	25	150
	Haiti	2009	47	70.1	33	59	25	17	24	52	70	350
	Jamaica	2005	52	60.5	31	88	12	2	19	14	18	110
	St. Lucia	2005	28	11.9	3	95	11	N/A	14	12	16	35
	Trinidad and Tobago	2005	13	24.7	3	92	19	N/A	14	27	28	46
Latin America	Argentina	2009	91	20.8	19	93	7	2	17	11	14	77
	Belize	2007	44	18.7	8	98	14	4	26	21	17	53
	Bolivia	2009	66	47.3	31	84	6	4	24	41	51	190
	Brazil	2009	84	26.9	23	97	8	2	17	21	16	56
	Chile	2005	87	9	8	91	6	1	14	7	9	25
	Colombia	2009	76	14.3	11	88	6	3	17	16	18	92
	Costa Rica	2005	62	10.9	7	83	7	1	16	9	10	40
	Ecuador	2005	66	21.5	14	98	10	N/A	20	19	23	110
	El Salvador	2005	63	28.9	18	89	N/A	7	17	20	15	81
	French Guiana	2005	81	10.5	9	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Guatemala	2009	50	38.7	19	87	11	12	26	25	30	120
	Guyana	2009	29	33.2	10	98	19	10	17	36	36	280
	Honduras	2005	50	34.9	17	99	10	8	25	20	21	100
	Mexico	2007	77	14.4	11	98	7	3	19	17	16	50
	Nicaragua	2007	57	45.5	26	99	9	6	19	22	26	95
	Panama	2005	65	23	15	97	N/A	N/A	19	11	20	92
	Paraguay	2005	59	17.6	10	93	6	3	17	22	22	99
	Peru	2007	74	36.1	27	96	8	5	19	22	18	67
	Suriname	2005	67	3.9	3	85	11	7	17	29	30	130
North Africa	Egypt	2009	43	13.1	6	96	13	5	24	24	21	66
	Morocco	2009	58	13.1	8	95	N/A	N/A	19	26	33	100

(*continued on next page*)

Table 2
(*continued*)

Indicators of slum populations		Health outcomes										
Region	Country	Year slum data collected	Percent urbanites, %	Percent urbanites in slums	Percent citizens in slums, %	MCV coverage rate, %	Low birth weight, %	Child malnutrition, %	Birth rate (newborns/ pop)	Infant mortality rate	Under-5 mortality rate	Maternal mortality ratio
Sub-Saharan Africa	Angola	2009	59	65.8	39	88	N/A	15	39	84	158	450
	Benin	2009	44	69.8	31	72	15	18	38	60	106	350
	Burkina Faso	2007	24	59.5	14	63	16	25	43	80	146	300
	Burundi	2005	10	64.3	6	92	11	35	41	60	139	800
	Cameroon	2009	49	46.1	23	76	11	14	32	60	127	690
	Central African Republic	2009	38	95.9	36	62	13	N/A	36	97	164	890
	Chad	2009	28	89.3	25	28	N/A	N/A	39	94	169	1100
	Comoros	2007	28	68.9	19	72	N/A	N/A	31	69	79	280
	Congo	2009	63	49.9	31	90	13	11	40	74	99	560
	Equatorial Guinea	2005	40	66.3	27	51	N/A	N/A	35	75	118	240
	Ethiopia	2009	17	76.4	13	57	20	33	43	75	77	350
	Gabon	2005	73	38.7	28	55	N/A	N/A	35	49	66	230
	Gambia, The	2007	59	34.8	21	91	11	15	33	70	101	360
	Ghana	2009	44	40.1	18	91	13	13	27	47	78	350
	Guinea	2007	28	45.7	13	58	12	20	37	59	126	610
	Guinea-Bissau	2005	43	83.1	36	61	11	17	35	94	161	790
	Ivory Coast	2009	50	57	29	49	17	28	30	63	115	400

Kenya	2009	32	54.7	18	87	8	16	32	44	73	360
Lesotho	2009	23	53.7	12	85	N/A	16	27	53	86	620
Liberia	2009	47	68.3	32	40	14	19	36	73	78	770
Madagascar	2009	31	76.2	24	70	16	N/A	37	50	62	240
Malawi	2009	15	68.9	10	96	14	13	40	79	83	460
Mali	2009	33	65.9	22	56	19	26	45	109	176	540
Mozambique	2009	31	80.5	25	82	15	16	39	77	103	490
Namibia	2009	39	33.5	13	74	16	17	21	46	42	200
Niger	2009	20	81.7	16	76	27	38	50	110	125	590
Nigeria	2009	51	62.7	32	71	12	25	39	74	124	630
Rwanda	2009	17	65.1	11	95	6	17	36	63	54	340
Senegal	2009	42	38.8	16	82	19	14	36	55	65	370
Sierra Leone	2005	40	97	39	80	14	19	38	77	185	890
Somalia	2009	34	73.6	25	46	N/A	31	42	104	180	1000
South Africa	2009	62	23	14	78	N/A	9	19	43	47	300
Tanzania	2009	26	63.5	17	93	10	15	32	66	68	460
Togo	2005	37	62.1	23	67	11	21	35	50	110	300
Uganda	2009	15	60.1	9	75	14	15	47	61	90	310
Zaire	2007	29	51.7	15	71	N/A	N/A	33	54	77	200
Zambia	2009	39	57.3	22	83	11	13	44	65	83	440
Zimbabwe	2009	29	24.1	7	92	11	13	32	28	67	570

Abbreviation: N/A, not available.

Data from Kaiser Family Foundation. Country Data: Customized data sheets, 2012. Available at: http://kff.org/globaldata/. Accessed May 16, 2013.

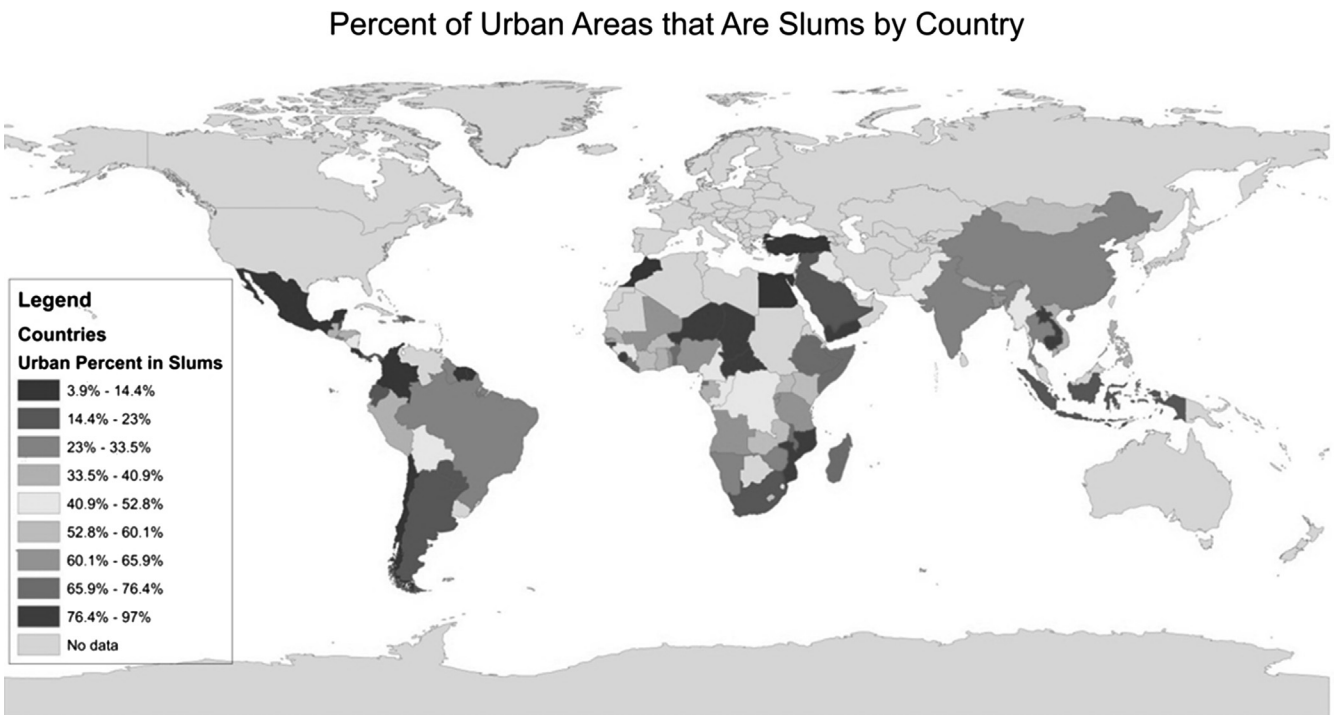

Fig. 1. Distribution of urban slums worldwide. (*Data from* Kaiser Family Foundation. Country Data: Customized data sheets, 2012. Available at: http://kff.org/globaldata/. Accessed May 16, 2013.)

Table 3
Health outcomes in urban-nonslum, urban-slum, and rural areas in Kenya and Bangladesh

Country	Health indicator	Urban nonslum	Urban slum	Rural	Slums worse than rural
Kenya	Infant mortality	39	91	76	15 per 1000
	Under-5 mortality (per 1000)	62	150	114	36 per 1000
	Stunting	24%	47%	32%	15%
	Primary school attendance ages 6–13	97%	91%	90%	1%
	Secondary attendance ages 14–17	66%	65%	80%	15%
Bangladesh	Under-5 mortality (per 1000)	53	95	66	29%
	Skilled birth attendant	45	15	19	4%
	Improved sanitation	54	9	54	43%
	Secondary school attendance	53	18	48	30%
	Gender parity in school attendance	1.08	1.26	1.18	

Data from African Population, Health Research Center. Population and health dynamics in Nairobi's informal settlements. Nairobi (Kenya): African Population and Health Research Center; 2002; and UNICEF Bangladesh. Understanding urban inequalities in Bangladesh: a prerequisite for achieving vision 2021. A study based on the 2009 multiple indicator cluster survey. Bangladesh: UNICEF; 2010.

informal, springing up around areas of higher economic growth without approval or planning and often on land deemed undesirable (hillsides subject to flood and erosion, toxic landfills, or waste dumps). As a result, water and sanitation facilities are not planned and dwellings are often temporary and unstable. In these areas, there is little government investment in the construction

Table 4
Pearson's coefficients (*r*) between proportion of urban populations residing in slums and health outcomes and exposure variables for countries in the developing world: an ecological analysis

	Correlation coefficient and *P* value	
	r	*P*
Exposure variables		
Access to clean water (n = 66)[a]	−0.765	<.0001
Access to sanitation (n = 66)	−0.756	<.0001
Proportion of population <$1.25 per day (n = 63)	0.777	<.0001
Percentage of population that resides in urban areas (n = 69)	−0.529	<.0001
GDP of country (n = 66)	−0.469	<.0001
Birth rate (n = 83)	0.718	<.0001
Unemployment rate (n = 51)	0.238	.09
Health outcome variables		
Low birth weight (n = 58)	0.303	.02
Child malnutrition (n = 54)	0.591	<.0001
MCV immunization coverage rate (n = 68)	−0.573	<.0001
Infant mortality rate (n = 83)	0.816	<.0001
Under-5 mortality rate (n = 83)	0.741	<.0001
Maternal mortality ratio (n = 82)	0.711	<.0001

Abbreviations: GDP, gross domestic product; MCV, measles-containing vaccine.
[a]Number of countries (n) varies by availability of data.

Table 5
Multiple linear regression of health indicators with percentage of urban population residing in a slum area as the primary predictor for developing countries

Health outcome	β	*P*
Low birth weight (n = 58)	0.009	.848
Child malnutrition (n = 54)	0.070	.401
MCV immunization coverage rate (n = 68)	−0.379	.005
Infant mortality rate (n = 83)	0.556	<.0001
Under-5 mortality rate (n = 83)	0.724	.013
Maternal mortality ratio (n = 82)	3.73	.015

All models adjusted for percentage of country residing in urban areas, gross domestic product per capita, percentage of population living on less than $1.25 per day and world region.
Abbreviation: MCV, measles-containing vaccine.

of roads, schools, and health facilities. In the most extreme cases, the governments may demolish slum areas as a way of forcing these large populations to move elsewhere. This cycle leads to less investment of the slum dwellers in improving their own conditions, as all could be eliminated by someone else at any time without notice. All of these factors work synergistically to affect multiple facets of child health and development. This is described in detail from both short-term and long-term perspectives.

Fig. 2. A startling contrast: slums adjacent to high-income apartment complexes. Favela de Paraisópolis. The favela (shanti town) on the left is ironically called Paraisópolis (Paradise City). Paraisópolis is situated in the center of metropolitan São Paulo, bordering on middle-income and upper-income residential areas. It lies in a large steep-sided ravine and has a physically challenging geography. It is an extremely densely populated area, with an estimated population of 80,000 to 100,000 people. Photo: Tuca Vieira.

Slum development and land tenure

Typically etched into outskirts or inner parts of cities, slums usually begin unplanned and often are located in areas with a high risk for landslides, floods, and other natural disasters [12]. Hazardous and toxic waste and fumes are commonplace in these informal settlements. Land ownership is the exception rather than the rule [12–15]. WB evidence suggests that in developing countries, as many as half of urban residents do not possess any type of legal document demonstrating that they have tenure security or own the land or property [16]. The socio-political context of slum areas limits the residents' ability to secure tenure or land ownership [13–15]. In Nigeria, for example, an urban land-seeker waits an average of 274 days and pays more than 27% of the property value in "official fees" before securing a land registration title [17]. To obtain governmental services, documentation, such as utility bills, identification cards, voter registration forms, and municipal tax receipts, is often required and whereas private services often do not require such documentation, these fee-based services are unaffordable for most slum residents [12].

Most developing countries do not formally count slum dwellers in their census; therefore effectively concealing the existence of slums and increasing slum residents' vulnerability to unlawful evictions. Indeed, available data indicate that forcible evictions are increasing. Between 2000 and 2002, 6.7 million residents were evicted; 2.5 million more than the 4.2 million evicted during the preceding 2 years, 1998 to 2000 [18]. Evictions and demolition of slum areas are commonplace and have been reported in every region [13,19–21]. Evictions and demolitions may precede redevelopment efforts and can greatly disturb the livelihoods of both communities and individual residents, place huge psychological and economic stress on individuals and families, and expose these groups to increased risk of violence and exploitation [22,23].

Slum infrastructure

Water and sanitation

Access to clean water and adequate sanitation are often quite limited in slum areas. Without any planning for the informal settlements, laying of pipes for water and sewage are rarely put in place. Our analysis demonstrates that in countries with higher urban-slum populations, water and sanitation access is lower (see Table 4). Regionally, sub-Saharan Africa has the least number of household connections to water, with rates as high as 99% in Liberia, followed by Asia, with a high of 85% in Afghanistan, and Latin America, with a high of 19% in El Salvador [24]. Rates of access are highly variable, even within country. In Kenya, for example, although 52% of urban households have access to residential water [24], a survey in a Nairobi slum indicated only 19% of the population has household connections [25]. Water access in these slum communities may be from a combination of public standpipes, unprotected wells, and water from vendors. Although boreholes and protected wells may be developed in the informal settlements, it does not guarantee the availability of safe water, because of a lack of sanitation and the resulting groundwater contamination [24].

Lack of infrastructure for disposing of waste is readily apparent in slum areas. Not only is waste generated within the slum itself, but often slums are located adjacent to larger community dumpsites. Human waste disposal is of particular concern. Community-shared toilets are the norm. However, community toilets may not be maintained, may be far too few in number, or may not exist at all. In Kibera, a large slum in Nairobi, 40,000 people shared 10 latrines (1998) and in a slum in India 120,000 people shared 19 latrines [26]. The result is open defecation or "flying toilet" (disposal of excrement in a plastic bag that is thrown into the environment) [27]. National-level statistics do not distinguish between urban areas and urban-slum areas, and conditions in slum areas are often far worse than that reported on a country level. Improved sanitation, as defined by MDG, includes household-owned flush toilets, piped sewer systems, ventilated improved pit latrines, pit latrines with slab, or composting toilets. In Uganda, improved sanitation in urban areas is 34% overall with 50% of the population using shared toilets [28]. However, in a focused survey undertaken in a large Ugandan slum, only 20% of individuals had access to their own toilet facility, but many do not qualify as improved facilities; 79% of residents used shared or public toilet facilities [29].

Roads

Despite being close to large urban areas with many resources, the infrastructure to travel relatively short distances from the slums to the inner city is generally nonexistent. Most residents of slum areas restrict travel outside the slum area to obtain only those things deemed to be absolutely necessary [30,31]. In some of the older, more-established slum areas, transport is more readily available; major roadways have been paved, making access easier [12]. Most slums, however, consist of a haphazard mix of paved and dirt roads, with narrow side roads and paths zigzagging throughout. Moreover, public transportation is rarely available and/or exorbitantly expensive in urban low-income areas throughout the world [30,31].

Electrification

Electrification of slums is a contentious and complex issue, although increasingly gaining attention and support by governments of developing countries because of an ever-growing number of slum dwellers and to discourage illegal service providers [32]. Many slum residents and communities are either unable to afford the service fees or lack the necessary documents (such as legality of tenure) to set up electrification. Therefore, many private electricity companies have historically avoided servicing these areas. This situation does not mean, however, that slum households do not have electricity. Rather, many slum dwellers obtain electricity for their homes through illegal channels, as these service providers are easier to find and engage than are the legal services [33]. Evidence from the World Research Institute (WRI) suggests that as much as 7% of slum household expenditures go toward energy; this percentage grows as incomes lessen. Specifically, for slum households in Asia, energy expenditures are second only to food costs, whereas energy ranks third after housing

and food for households with a low socioeconomic status in Latin American, Africa, and Eastern Europe [32]. Many of the slum dwellers with electricity use outdated appliances and/or the illegal service providers connect them in ways that make their consumption of electricity unnecessarily high, resulting in their payment to the illegal electricians very high [34]. This electrification context also exposes occupants to increased risk of electrical injuries and multiple-house fires [35]. Given the inability or difficulty to access electricity, many urban-slum dwellers rely on cook stoves and open fires to prepare food. In 8 major cities in India, the use of solid fuels that require ventilation are twofold to fivefold higher in slum areas than in nonslum areas [36].

Housing conditions

Slums are inextricably linked to inadequate, flimsy, and insecure housing. The very definition of a slum includes components related to housing, durability, tenure security, and the number of occupants [5,12]. Definitions for "durability of housing," "security of tenure," and "overcrowding" vary by country and agencies but data suggest that globally, 18% of urban homes are nonpermanent structures and more than 25% do not meet urban building regulations or codes [37]. Most of these are likely located in slum areas of the city. The vast majority of slum residents do not hold secure tenure, and as many as 20% of the world's urban population lives in overcrowded conditions [12]. This section briefly describes the general housing situation in slums through focus on housing durability and occupancy and, where available, provides short regional examples (tenure has been discussed previously).

Housing durability. Commonly understood as "permanent and adequate structure in a nonhazardous location, protecting its inhabitants from the extremes of climatic conditions, such as rain, heat, cold, or humidity," durability is sorely lacking in most slum dwellings the world over [12]. In a slum, it is rare that the home the occupants first erect has wall, roof, and floor that are made of permanent materials. A house might begin as a shelter of cardboard and other scraps that slowly are replaced by less temporary materials, such as a corrugated iron roof or a cement floor. Although the permanency and durability of the structure varies generally, housing in slums is marked by their hazardous, temporary materials located on the outskirts of cities. In Addis Ababa, Ethiopia, nearly three-quarters of slum dwellers used temporary materials to erect their walls, as opposed to 58% of nonslum residents [38]. Regional variations suggest the housing durability, as measured by floor material, is most flimsy in Asia and relatively strong in Latin America. More than 73% of urban dwellers reside in nonpermanent dwellings in Asia and more than half of these are in Southern Asia [39]. In Bangladesh, Nepal, and Pakistan almost a third of urban residents lack durable housing [12]. One in 10 urban residents in sub-Saharan Africa lives in nonpermanent structures versus fewer than 1 in 100 of urban North Africans.

Occupancy. Crowded conditions are commonplace in the slum areas. The standardized indicator for overcrowding developed by UN-HABITAT is more

than 3 people sharing the same room [12]. Millions of the individuals who live in slums inhabit 1 room that is shared with 5, 6, or 7 others, all occupying a small space that may serve as kitchen, bedroom, and sitting room. Living in congested spaces not only limits privacy and safety, but it also exposes occupants to increased disease transmission and infection via the poor ventilation of small, overcrowded dwellings. The risk of eviction is heightened, as the overcrowding often violates rental agreements and/or damages property. Overcrowding varies by region. In Nairobi, Kenya, an example from sub-Saharan Africa, more than half of urban residents reside in slum communities that occupy only 5% of the land area of the city. Density in the slum area is 75,758 people per square mile versus 3.987 people per square mile in the non-slum areas, an almost 19-fold difference [10]. As many as two-thirds of the urban population in Asia is considered overcrowded, whereas in Latin America and the Caribbean, it ranges from 10% to 30% of the urban population [12,39].

Access to social services

The social-political context

The limitation on delivery of social services to urban-slum dwellers does not occur in a vacuum. Global and national-level policies have highly influenced access to health care and education in many developing nations. Following independence, many newly emerging nations began to accumulate a large amount of debt and experienced a growing financial imbalance. Loans were sought from the WB and the International Monetary Fund (IMF). Large loans were given with the stipulation that the country would restructure its economy by improving the management of payments, increase economic efficiency, and encourage private sector investments: Structured Adjustment Programs (SAP). The emphasis was on economic development, not social services. Education and health services were viewed as nonproductive, and to "save the country's economy" many service programs were sold to private firms where unfortunately, profits took priority over services. Governmental social safety nets were lost as user fees for health care and education were another stipulation for WB and IMF loans. Local governments received an immediate cash flow and shed the responsibilities and expense of providing services to the citizens. Local officials were happy but the people suffered. Relegating social services to the private sector meant limiting access to health care and education. User fees for these services, including the purchase of clean water, deepened the level of poverty and of health as the poor could not afford even modest fees and did without. Some SAPs demanded an increase in exports of goods and food, which limited domestic consumption. To their credit, members of the WB saw the deterioration of health care and educational opportunities, and recently have tried to reverse these trends. But it is too little too late, certainly too late to meet the MDGs. Skosireva and Holaday state that: "SAPs have either created or worsened poverty levels or, at the very least, have ignored the adverse effects of the program on the poor [40]."

Health care

Access to health care in urban slums varies not only by country but also by region within countries. Matthews and colleagues [41] analyzed Demographic and Health Survey (DHS) data from 30 developing countries in Africa, Asia, and Latin America to determine indicators of maternal health care among the urban poor, as compared with the rural population. Their purpose was to see if there was an "urban advantage" or "urban penalty" for women. The investigators recognized a gap between different urban populations and speculated that the urban poor in many countries were at a disadvantage from their previous rural neighbors who did not migrate to the city. They found massive inequality in both urban and rural areas but greater inequality between slum urbanites or nonslum urbanites. The inequalities arose from exclusion; the urban poor did not have access to health care services and in some cities the slum dwellers were treated as if they did not even exist. However, there was a vast difference in the service gap among different countries. In some, the exclusion was not limited to the poor; services were insufficient for all strata of wealth. In others, it was primarily the poor who were excluded. And in some countries the urban population was well served without wealth or class distinction; a goal to strive for!

Even when governmental programs to provide public clinics are established in a country, few of these are constructed in slum areas because of their tenuous nature [42]. Health care access is minimal at best in urban slums and is often predominated by private for-profit clinics [43]. Government investment in health care infrastructure in slums is limited. A study in Nairobi slums indicated that of 503 clinics serving what is reportedly the largest slum community in all of sub-Saharan Africa, only 6 (1%) were public and 79 (16%) were private not-for-profit clinics. Nearly all of the private for-profit clinics 418 (83%) in Nairobi slums are of dubious quality [44,45]. The more qualified practices are expensive, forcing the use of cheaper private facilities that are often not licensed and operate out of small shacks and maternity homes without complying with any standards of care. Despite the poor quality, it is the less expensive private facilities that are the ones most often used by the residents. Women residing in slum areas, as elsewhere, prefer to deliver their babies in health care facilities where access is easy and quality is perceived to be high [46]. Given the difficulties already illustrated in transportation, access to public and nonprofit clinics of higher quality outside the slum areas is problematic; however, a lack of health care facilities is not apparent in all slum areas. In Chennai, India, slum residents were satisfied with their access to health care facilities with a mix of both government and private clinics within close proximity to residents; however, government clinics here were also somewhat limited, and individuals preferred the private clinics, considering them to provide better services [47].

Education

Being an unrecognized population affects not only the health sector but the education sector as well. National-level standards for school access are not

being met in urban-slum areas. For example, in an Indian slum in Mumbai, the distance to elementary schools exceeds 2 km, despite a 1993 mandate that all children reside within 1 km of elementary schools. Investment in this infrastructure in these "hidden" populations is scanty. Again this acts synergistically with the inaccessibility of public transportation. Schools are not within walking distance but cannot be accessed by public transportation in a timely and economically feasible manner [48]. This has resulted in great disparities in access to education for the children living in urban slums. For example, in Guatemala (1999) only 54% of children living in slums were enrolled in primary education, as compared with 61% in rural areas and 73% in nonslum urban areas [12]. In Nairobi slums, educational achievement was far below that of their nonslum urban counterparts. Maternal education is strongly correlated with the educational achievement of a child. Women with no education in the slums constituted 5.1% of the population compared with 1.2% in the rest of the city. And in the nonslum areas, 54% of women had achieved at least some secondary school as compared with only 32% in slum areas [10]. This slum/nonslum education gap is persistent across generations and world region. In Delhi, India, 10% of the slum children never attended school compared with 31% of nonslum children [49]. In Bangladesh, evidence suggests that children in urban slums have less achievement in education than do their rural counterparts. Literacy rates are 52% in children from urban slums as compared with 70% in rural areas [49]. Even if children do begin school in a slum region, their education may be summarily disrupted. Many parents face the pragmatic pull between needs for basic sustenance and education for their children. Parents living in informal settlements have little if any savings and loss of livelihood, whether from natural disaster, illnesses, or loss of their or their children's employment directly affects their ability to buy food and pay bills, including fees for their children's education [50]. And those children who are able to remain in school face issues of school quality. Classrooms are often overcrowded and lack instructional materials and enough desks and/or chairs. Many students do not even have shoes, pens, or paper.

CHILD HEALTH IMPACTS

The preceding describes the abhorrent conditions found in slum areas. These exposures exert a detrimental and often lifelong impact on nearly all aspects of the health and development of children. Our review of the literature indicated that there are 6 primary domains in which these conditions influence health and survival through childhood; (1) the maternal and neonatal period, (2) nutritional status, (3) mental health and development, (4) frequency of infectious diseases, (5) exposure to and perpetration of violence, and (6) unintended accidents and injury.

Overall, the likelihood of a child surviving life in slum areas is less than counterparts living in other urban areas and less than those in rural areas. Even within slums, children have differing health outcomes (see Table 3). The literature is contradictory as to whether children born into slums are at

greater or lesser risk of death than those who migrate in as older children [51,52]. However, the most vulnerable periods were immediately following migration [51,52]. With the rapid influx of new migrants into the city, this observation will have a large negative impact on MDG 4: reduce child mortality.

Maternal and neonatal vulnerabilities

Influences on child health and development begin at conception. Maternal surroundings and care received during the prenatal period can greatly influence both immediate and longer-term outcomes. In urban-slum areas, a large problem is inaccessible health care. Antenatal monitoring, delivery care, and newborn care are all extremely important to maternal and neonatal and infant survival. Maternal mortality is often overlooked as a pediatric health issue; yet, if a mother dies, the chances of survival of her newborn child are dramatically reduced and the impact on older surviving children can be devastating [53–55]. The primary causes of maternal death are hemorrhage, sepsis, hypertensive disorders, prolonged or obstructed labor, and unsafe abortion; conditions generally addressable through the availability of quality care before, during, and after delivery. In Bangladesh, only 15% of women in urban slums had a skilled attendant at birth compared with 19% in rural areas and 45% in urban-nonslum areas [11]. In neighboring India, only 41% of births of the urban very poor were attended by a medical doctor or nurse midwife compared with 87.2% of the nonpoor. Maternal mortality is disproportionately higher in slum areas than nationally [56]. In the slums of Nairobi, neonatal mortality was 50% higher (30.4 per 1000 live births) as compared with the rest of the city (20.8 per 1000 live births) and postneonatal mortality in the slums was 60.9 per 1000 live births as compared with 16.9 per 1000 live births in the rest of the city. The high rate of neonatal deaths in the first few days of life is largely the result of asphyxia or sepsis. To address those 2 problems, it is essential that the attending person is trained in the skills needed to recognize and address them and has the resources necessary to respond quickly to asphyxia and to take the appropriate action to manage sepsis.

It is not just that services are inadequate in the slums, maternal factors and environmental exposures also play a role: age, nutritional status before and during the pregnancy, child spacing, parity, and exposure to toxins put slum families at a disadvantage. Of adolescent girls aged 15 to 17 living in Nairobi slums, 19% have given birth compared with 2.5% in the other parts of Nairobi and 9.3% of those living in rural communities. By age 18 to 20, the percentage in the slums has increased to 52%, in the nonslum area of Nairobi to 24%, and in rural Kenya to 44% [10]. Highest risks for the under-5 mortality rates were seen in children born to women younger than 20 (150.0), women 40 to 49 years old (281.7), and in multiparous ($\geq$7) women (255.5) [10].

Mental health and development

Just as the home environment affects child physical health, it also affects children's mental health. Children in single-family detached dwellings enjoy better

mental health then children living with multiple families living within the same building [57]. Additional evidence suggests that children living in urban poor conditions where violence and eviction are real possibilities experience more behavioral and emotional problems compared with children living in rural areas or nonslum locales [58,59]. Uncertainty is an everyday reality in slums, where many residents are unsure of their employment, their next meal, or shelter tenure. This insecurity is a constant purveyor of anxiety and stress [60]. Numerous studies document that the tenuous conditions so typical of informal settlements negatively affect children's relationships with their family and peers, slows their growth and development and cognitive abilities, and worsens self-esteem and educational attainment [5,61–63]. In developing nations and especially in informal settlements, community resources to address mental health disparities and support those children with mental and behavioral health issues are severely limited [58].

Infectious disease

Slum conditions are an ideal incubator for infectious diseases and their transmission. Rural to urban migration and peri-urban slums are cited as one of the leading social factors related to emerging and reemerging infectious disease [64]. The chances of infectious disease introduction are higher with poor sanitation and a constant influx of in-migrating individuals. Once introduced, the extremely crowded conditions in the slums ensures close contact with infected individuals and creates a haven for the rapid spread of contagion from the infected to the unexpecting. Outbreaks spread quickly. The severe acute respiratory syndrome (SARs) epidemic in Hong Kong in 2002 and 2003 exemplifies how a disease originating in a somewhat isolated rural area can explode in an urban setting [64]. But it is not just new infections, but age-old infections that disproportionately burden slum dwellers. Tuberculosis transmission dramatically increases with overcrowding and is a magnitude higher in slum regions, exposing the young and the very young [65–71]. Lack of access to clean water in the slums has led to multiple cholera outbreaks [72–75]. Poor infrastructure to keep out flood waters has led to outbreaks of leptospirosis [76,77]. High levels of infection in the slums set up a vicious cycle of poverty. Some infections, such as HIV/AIDS, meningitis, and malaria, have a direct impact on mental development. Other common illnesses, such as diarrhea and respiratory infections, reduce school enrollment and attendance [78–83]. Even if preventive measures, such as vaccinations, are available for a disease, children residing in slums are less likely to be vaccinated [84–86], and lack of access to screening and treatment for all infectious diseases perpetuates the disease transmission cycle, as carriers of infectious agents pass them to others over longer periods of time. The very nature of slums has an indirect influence on disease transmission. Sexual debut in urban-slum areas is earlier and abject poverty and homelessness in the slums can force adolescents into the commercial sex trade at a very young age [87–92]; factors highly correlated with sexually transmitted infections.

Food security and malnutrition

Undernutrition is a major underlying factor in one-third to one-half of all childhood deaths. Both short-term and long-term lack of food leads to malnutrition. In urban slums, food is almost exclusively obtained from the market [93]. Household food security and thus nutritional status is determined by the in-hand cash the family has to purchase food. With ever-increasing housing prices and the need to pay exorbitant fees for utilities, purchasing of food is often sacrificed and the food that is purchased may be of low nutritional value; particularly detrimental for the urban poor who, if working, are most often engaged in hard manual labor [94,95]. These factors paired with high levels of diarrheal disease and frequent respiratory infections lead to poor childhood nutrition [96]. Overall, malnutrition has been shown to be lower in urban areas in developing countries; however, this masks the great disparity between urban-nonslum areas and urban slums. A regional analysis indicated that when stratified by socioeconomic status, intraurban inequities were more pronounced that urban-rural inequities [97]. This greater disparity in urban areas was also supported by our findings in Kenya and Bangladesh (see Table 2).

Malnutrition manifests itself in different ways, but stunting, a sign of chronic malnutrition, is an often-used measure to determine the nutritional status of a population. Across multiple regions, analyses have demonstrated that stunting in children residing in urban slums is high and higher than in nonslum urban areas and even higher than in rural areas [98–101]. In Niger, stunted development affects twice as many children in rural and poor urban areas as in children from nonslum areas of the cities: 4 to 5 of 10 as compared with 1 of 4. Children living in rural areas and in city slums were 4 times more likely to be malnourished than children from nonslum urban areas. In the Democratic Republic of Congo, malnutrition affected 41% of children from poor urban areas and only 16% from nonslum urban areas. Likewise in Bolivia, India, and Bangladesh, malnutrition is twice as prevalent in the city slums and rural areas as in the nonslum areas of the cities. In children older than 15 months, the prevalence of stunting in Nairobi is close to 27%, whereas in the slums of Nairobi, stunting was more than twice that at 57% [102]. The impact of climate change and flooding has also been associated with food insecurity and malnutrition [95], and the threats of environmental disaster are a constant presence in many urban slum communities. The situation is dire in urban slums and some argue that there is a need to rethink Food Program strategies that in the past have focused primarily on rural areas and refugee resettlements [98].

Accidents and injuries

The World Health Organization report of 2008 estimates that nearly 1,000,000 children die each year from unintentional injuries [103]. Such injuries are much higher in low-income and middle-income countries, higher in urban than rural areas, and highest in city slums, and include burns, poisoning, falls, and traffic accidents.

In 2004, the global death toll for children from fire was nearly 96,000, with low-income and middle-income countries baring the greatest burden: 11 times the rate of high-income countries (4.3 vs 0.4/100,000) [103]. Fire is a major hazard in slum areas. Crowded and highly flammable tinderbox dwellings with often illegal and unsafe electrification and open fires for cooking that use solid fuel or kerosene invite fires that are often uncontrollable. In such an environment, fires spread quickly. Once one shack is ignited, adjacent structures quickly incinerate. Because many cities do not recognize these informal settlements, fire departments are not responsible for responding and even if they do, there is no infrastructure for piped water to extinguish the flames. As a result, whole communities are lost and families are forced to fend for themselves once again [103]. Less dramatic but extremely common are household burns from scalding. Research has consistently shown that pediatric burns are much greater in slum areas and are the result of disorganized homes, lower maternal education, and/or lack of parental supervision [104–106].

Kerosene, also known as paraffin oil, is used for cooking and not only presents a fire hazard but is often kept in soft drink bottles, inviting unintended poisonings. In dilapidated homes with no locked cabinets, the bottles are easily accessed by young ones. Although not isolated to informal settlement housing, Ahmed and colleagues [107] report that low socioeconomic status increases the odds ratio of unintentional poisonings 9.2 times that of a control group. In families in which the mother had no formal education, the odds of an unintentional poisoning were 4.2. Socioeconomic status is a strong risk factor for poisonings because of limited or no storage space at all to guard dangerous substances and keep them out of reach of children, and the risk is even greater as many parents in slums are less aware of the dangers these items present.

Traffic deaths are high and in most resource-limited settings; infant seats, seat belts, and helmets are virtually nonexistent. In low-income and middle-income countries, most people walk, roads are not well maintained, traffic is chaotic, and often motorists with little regard for those on the side of the road simply speed along with horn blaring as those on foot scamper to get out of the way. Children are vulnerable and injuries are common. The proportion of childhood pedestrian accidents from road traffic crashes in high-income countries is between 5% and 10%, whereas in low-income and middle-income countries it ranges between 30% and 40% [103].

Violence

Not unlike other places where a lack of employment options and limited safe recreational options intersects with increased access to illegal substances, children living in slums are more likely than their nonslum peers to abuse illegal substances and participate in street gangs and violence [108]. In its 2011 World Development Report, the WB outlines the major contributors to violence and conflict, several of which mirror the characteristics of slums (low income, youth unemployment, and rapid urbanization). In other words, slums and the conditions that lead to their existence perpetuate and encourage violence. Based on

surveys conducted among children and adolescents in urban areas of Colombia, the Democratic Republic of Congo, Côte d'Ivoire, Gaza, Mali, Sierra Leone, and the West Bank, the WB finds that "the main motivations young people cited for becoming rebels or gang members are very similar–unemployment, idleness, [seeking] self-respect, and self-protection, all well ahead of revenge, injustice, or belief in the cause" [109]. Even if children do not join gangs or militias, or are victims of violence, the chronic experience of living in an insecure, violent atmosphere can have a severe adverse effect on the development of children. Child exposure to crime and violence, both in developing and developed countries, has been associated with poor academic performance and higher school dropout rates, aggression, anxiety, depression, and other behavior problems [110].

Violence is not solely relegated to the external slum environment, but also to within households. Impoverished areas are known to have higher rates of spousal and child abuse [111,112]. Witnessing and being victims to this type of abuse are highly correlated with negative physical and mental health outcomes in children [113].

Most recently available data suggest that of the children who engage in labor (215 million), most are in urban areas and at least half (115 million) are working under hazardous conditions [114]. From domestic labor and factory work to armed conflict and gang membership to food preparation and shoe shining, children in informal settlements are often forced to participate in dangerous, illegal work to help support their families and to survive [5]. Young girls, in particular, are often forced to work in the sex trade, and as domestic workers are at risk for sexual abuse. Evidence from Kenya suggests that domestic workers experience increased psychological problems, such as bedwetting and insomnia, compared with other children [115].

INTERVENTIONS

Working to reduce pediatric health disparities in slums can seem an overwhelming task, given the multitude of adverse conditions and all the health outcomes that are in jeopardy. Approaches can be arranged into 2 major strategies: top-down or bottom-up. Top-down approaches usually involve governmental or nongovernmental agencies undertaking broad-scale programs. Bottom-up approaches generally are community-based initiatives that use community resources internal to the slums to bring about change from within. Both of these strategies may involve more fundamental infrastructure changes and include improving housing structure, developing roadways, and access to water and sanitation that have a distal impact on health. Interventions that work to effect more immediate change in health outcomes include improved access to quality health care and respectable local schools and the training of community health workers. There are success stories in both of these strategies. This section highlights several examples of programs that have reduced health disparities in the urban poor.

The concept of slum upgrading is to improve the well-being of individuals residing in slum areas by providing infrastructure improvements coupled with social interventions are generally performed by a governmental entity

or a well-funded large nongovernmental organization (NGO). Common infrastructure improvements include water, sanitation, waste collection, housing, access roads, footpaths, storm drainage, lighting, public telephones, schools, health posts, and community centers. Social improvements can include better provision of health and education services, regularization of areas with insecure tenure, day care, training, and social protection programs (Fig. 3) [116].

City Alliance for Cities without Slums is a global coalition of cities and their development partners that was initiated in 1999 and provides funding for projects to reduce urban poverty in developing nations. It was created by the WB and the UN Centre for Human Settlements (Habitat) in response to MDG 11. The focus is to fund city development projects and slum upgrading projects that address issues from a physical, social, economic, organizational, and environmental perspective. It seeks to integrate a top-down approach but also enlists community involvement from local citizens, community groups, and business partners. All aspects of slum upgrading were allowed to be addressed by proposals including development of infrastructure, removal of environmental hazards, construction of community facilities, improved access to social development, and development of a land tenure system. To date, nearly 400 projects in developing nations have been funded through Cities Alliance addressing multiple aspects of slum improvement [117].

Despite the pervasive nature of slum upgrading programs, rigorous evaluation of their efficacy is lacking [118]. A recent analysis was made of the effects of upgrading in Ahmedabad, India, a city with more than 3.9 million people, 40% of whom reside in slums. The strategy was solely infrastructure improvement and included connections to a water supply for individual households, toilets and underground sewage for individual households, storm water drainage, stone paving of internal and approach roads, solid waste management, and street lighting. Participating individuals paid the equivalent of $40 USD to participate. An assessment of insurance claims data from the local micro-insurance cooperative demonstrated a highly significant reduction in diarrheal disease from 32.0% to 13.5%.

Fig. 3. Slum renovations in Brazil. A typical slum (*left*) … transformed in Brazil (*right*). Upgrading of unserviced settlements is justified as the centerpiece of a global strategy for improving the living conditions of the urban poor. (*Reprinted* with permission from WHO.)

To get at the core of slum rejuvenation, one must address urban poverty. This requires a long-lasting commitment to make improvements that take a long and sustained concerted effort. Communities in Bahia (Salvador), Brazil, and their partners have demonstrated this commitment through a near decade-long endeavor to improve the lives of people living in the Alagados district of Salvador. Alagados long stood as one of the worst areas in Brazil. Despite multiple governmental interventions from the 1960s to 1990s, permanent change was never achieved. In the 1990s,the existing *Novos Alagados* scheme joined with the *Ribiera Azul* initiative, a cooperative of Cities Alliance that provided technical support from the Bahia state government and the Italian government. The area was divided into 2 regions: one slated for infrastructure and social improvements and one restricted to only social improvements. The infrastructure improvements included access to main roads, storm water drainage, water supply, basic sanitation, and solid waste collection, whereas the social improvements in both sectors included health, education, provision of day care centers, food and nutritional aid, support for young people and children at risk, professional skills training, and income generation through providing support to local cooperatives. Although no health outcome changes were assessed, there were significant improvements in factors associated with improved health outcomes. From 2000 to 2006, garbage collection improved from 50% to 80%, water network connection increased from 37% to 71%, electricity 72% to 88%, sewage 21% to 84%, and homes without sanitary facilities decreased from 31% to 3%. In addition, social programs trained 1339 social agents, 306 individuals trained in job skills, and 68 young people found jobs [119].

Infrastructure spending can elevate the slums to the standards of the rest of the urban areas. It is estimated that a 1% increase in health expenditure as a share of GDP is associated with a 5.1% to 5.7% reduction in slum areas. This finding is consistent with that of Edelman and Mitra [120], who showed an inverse association between public spending on health and slum regions at the state level in India. Increased infrastructure spending can also encourage families to make self-improvements to their housing [121,122]. Furthermore, investment in shared infrastructure, including access to clean water, sanitation, and power supply, can serve as a means for preventing the formation of new slums, reducing the health burden faced by slum dwellers and delivering major benefits in economic growth, poverty alleviation, and environmental sustainability.

Yet, large-scale infrastructure interventions are not always required to make improvements in the health and well-being of slum dwellers and in some cases a highly top-down redevelopment program can be devastating to communities [22]. Empowerment programs are an alternative way to create change from within the slum [122]. They are designed to develop the capacity of individuals and communities negotiating and coordinating with existing institutions and government to improve their own health. Several models of successful empowerment programs are illustrated [123]. BRAC (Bangladesh Rural Action Committee) started as a relief organization in 1972 in a remote rural village in Bangladesh. It has expanded to 11 countries in Asia, Africa, the Caribbean,

and, most recently, the Philippines. BRAC is reportedly the largest development organization in the world, touching the lives of 126 million people. The basis of its operation is organizing poor communities using their own human and material resources "creating an ecosystem in which the poor have the chance to seize control of their own lives." BRAC works with the marginalized and the disadvantaged who have been excluded from the mainstream. The focus is on women (women make up 95% of the membership) and on organizing the poor through Village Organizations (VOs). Each VO has 30 to 40 women with access to a variety of services, such as microfinance, education, health care, agriculture, handicrafts, environmental sustainability, and disaster preparedness, as well as social and legal issues. A central goal is to empower women who in their homes have had little decision making, but as a group can come together to voice their concerns and offer advice and solutions for community problems. They influence change. BRAC works under the premise that people are not poor because they have no potential but because they lack opportunities. The goal of BRAC is to provide individuals with opportunities and unleash the potential.

Focused small-scale interventions have also had impacts in urban slum communities. A hand-washing intervention in Nepal delivered hand hygiene messaging through community health workers on a daily basis for 2 weeks in the homes of mothers of 3-month-old to 12-month-old infants followed with biweekly meetings over a 6-month period with a community motivator. Diarrheal morbidity in the intervention group was 41% less than the control group [123]. Low-cost interventions to improve behavior have also improved exclusive breastfeeding rates in Kenyan slums. Peer training was conducted and home-based intensive counseling sessions were performed 7 times following delivery. At 6 months, exclusive breastfeeding was 2.5 times higher in the home-based intervention group [124]. Both studies indicate that even with very limited resources, small improvements to the health and well-being of children in urban slums can be achieved.

DISCUSSION

Our investigations into the effects of residing in slum areas have demonstrated consistent relationships between the appalling environmental conditions and impacts on infant and childhood development, morbidity, and mortality. The problem is global. Even after controlling for region and other explanatory factors, there were strong relationships between infant mortality and under-5 mortality and the proportion of populations in a country residing in slums. In Africa, most of the urban population resides in slums and in Asia a large and growing population resides in urban slums. Interestingly, we did not find an association between urban-slum population and low birth weight or childhood malnutrition. These correlations are at a national level and certainly other studies have indicated that stunting is higher in urban-slum areas. It is possible that our aggregate analysis masked individual associations that would have been identified at the household levels.

The findings in Kenya and Bangladesh were striking. When urban-slum and urban-nonslum areas are disaggregate, health outcomes were consistently poorer in urban slums than in rural areas. This implies that the urban penalties may exceed the urban advantages for many slum dwellers. Certainly these analyses need to be replicated across multiple countries and regions to determine if this is isolated to these 2 countries or if it is consistent across the globe. Yet, it is unlikely that this will impact the steady stream of migrants from rural to urban areas. Although the chances of success may be slim in the immigration process, the ceiling for opportunities in rural areas is much lower.

Although cross-cutting measures, such as slum upgrading projects and small focused interventions, can have an impact, the real roots of the problem lie not just in the infrastructure and access to social programs in these areas, but in the lack of real and perceived opportunities for these marginalized populations. Individuals residing in slums rank low on the social gradient and political agendas. The lower the socioeconomic position a person occupies, the worse the health and the lower the life expectancy. Some of the specific social determinates that affect health include the wealth index of the household, the employment of the head of the household, the presence of the mother to care for the children, the level of social support, the degree of crowding within the home, the educational attainment of the mother, food security, access to clean potable water, sufficient sanitary facilities, and available close-by quality health services and schools. Slum dwellers score low on these determinates. These social determinates of health are largely responsible for the great differences in the types of morbidities, the severity of illnesses, and the level of access to treatment for them. Although country-level disparities are readily apparent, many statistics internal to a nation merely dichotomize by urban versus rural. This hides the slum outcomes in the urban figures, thereby worsening the urban figures and making rural dwellers a bit better off than all those who live in the city. Yet in reality, rural dwellers fair better than those who live in slums, but far worse than those urbanites that do not live in slums [81]. Household-level factors, combined with an overarching lack of recognition from local and national governments, manifested through lack of land rights, exclusion from census, and lack of investment in schools and health care centers delivers the message of "no worth"; the ultimate in exclusion. Many slum communities border on the edge of the wealthy urbanite communities, accentuating the divide between the populations. This added stress enhances morbidities and shortens lives.

But children can be successfully brought out of the slums and out of poverty. Programs must provide opportunities for the mental development of children and need to be paired with programs to keep their bodies healthy if the cycle is going to be broken. If either component is lacking, the struggle to rise from their existing circumstances will be increased. Mental development must be achieved through both formal education and programs that instill confidence in a child's ability to make a difference in his or her surroundings.

What does all this mean for the clinicians practicing in areas with slum residents or pediatricians who want to make a difference? Other than through

often long-range advocacy efforts, it is difficult for pediatricians to see what effect they can have. However, we should not despair, for the intermediate and the proximate determinants (immunization rate, knowledge of oral rehydration therapy, and access to sanitation) had a stronger influence on child mortality than did gross national income per capita [125]. In addition, pediatricians can facilitate those from marginalized populations accessing health care by removing the barriers of misperceptions of families and judgmental attitudes of providers. Many marginalized groups are hesitant to access even existing health care facilities when the staff and clinicians are seen as nonresponsive to their needs or lack understanding of their cultural beliefs [126]. Learning more about the communities and getting involved can go a long way in making in-roads in the receptivity of parents to simple behavior modifications that will improve child health. All of these areas are within the realm of the pediatrician (Table 6).

SUMMARY AND RECOMMENDATIONS

The abhorrent conditions found in slum areas are neither right nor just for children. Their health is jeopardized. Their education is hampered. Their potential is thwarted. They are devoid of opportunities. Slum living is disastrous for children and ensures a waste of the world's "most precious resource." The conditions found in slums break almost every article in the UN Convention on the Rights of the Child; a convention that all but 2 sovereign nations have ratified [127]. To allow children to grow up in slums even violates the convention's preamble: "Recalling that, in the Universal Declaration of Human Rights, the United Nations has proclaimed that childhood is entitled to special care and assistance, Convinced that the family, as the fundamental group of society and the natural environment for the growth and well-being of all its members and particularly children, should be afforded the necessary protection and assistance so that it can fully assume its responsibilities within the community, Recognizing that the child, for the full and harmonious development of his or her personality, should grow up in a family environment, in an atmosphere of happiness, love and understanding." And Article 27: "1. States Parties recognize the right of every child to a standard of living adequate for the child's physical, mental, spiritual, moral and social development. 2. The parent(s) or others responsible for the child have the primary responsibility to secure, within their abilities and financial capacities, the conditions of living necessary for the child's development. 3. States Parties, in accordance with national conditions and within their means, shall take appropriate measures to assist parents and others responsible for the child to implement this right and shall in case of need provide material assistance and support programs, particularly with regard to nutrition, clothing and housing."

The cycle of family poverty reaching its zenith in slum dwellers predetermines that the children will be malnourished, have repeated bouts of illness, and lack even basic education, all of which ensnares the young adult in low-paying jobs or no job at all, perpetuating the cycle of poverty. Families stuck

Table 6
Taking action: recommendations for pediatricians to improve health equity in urban slums

Realm of action	What you can do
Visit the depressed areas of cities in the countries you visit	If you have a close open relationship with your colleagues in countries you visit, discuss the situation with them.
Listen and observe	Apply the strategies of ''positive deviants'' and learn from the families who are doing well and invite them to teach those who are not.
Educate local community health workers	Discuss with these influential women and encourage them to empower the mothers in slum areas. It is they who will make a difference and your interest and encouragement will help. (Pediatricians know how to educate mothers and spend their lives empowering mothers to take charge of their lives and the lives of their children.) [125]
Study the pertinent international conventions (Convention on the Rights of the Child) and the policies of the government	Add the appropriate articles of the conventions to your discussions with your colleagues and those in power.
Advocate while there	Encourage your local colleagues to discuss the inequalities with those in political position to improve the lives of children and their families.
Advocate while at home	Bring the plight of these children to the attention of your representatives and your friends: expose the injustices.
Investigate and learn the problems	Go beyond the direct medical problem at hand and inquire about health behaviors at home to address underlying issues if possible.
Connect with others	Maintain lists of local community programs and social services that patients in need can be connected to.

in the morass of slum living cannot emerge without some assistance. A just and fair society demands that governments recognize this growing population and accept the responsibility of providing the basic services and the opportunities to extract families from this vicious cycle; some governments have done so and more are attempting to do so. NGOs usually accept 1 or 2 pieces of the puzzle and often do a good job. Pediatricians are in a unique position to assist families at a household level to break the cycle. These providers are thrown into the arena in caring for children who are affected by this dynamic. They may act as a bridge for mother and child to see opportunities outside of the slums. It is our challenge to take a holistic view and see the children as the pivotal point and do everything possible to intercept the cycle and prevent its recurrence.

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