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Socioeconomic inequities in the health and nutrition of children in low/middle income countries

Iniqüidades sociais na saúde e nutrição de crianças em países de renda baixa e média

ABSTRACT

OBJECTIVE: To describe the effects of social inequities on the health and nutrition of children in low and middle income countries.

METHODS: We reviewed existing data on socioeconomic disparities within-countries relative to the use of services, nutritional status, morbidity, and mortality. A conceptual framework including five major hierarchical categories affecting inequities was adopted: socioeconomic context and position, differential exposure, differential vulnerability, differential health outcomes, and differential consequences. The search of the PubMed database since 1990 identified 244 articles related to the theme. Results were also analyzed from almost 100 recent national surveys, including Demographic Health Surveys and the UNICEF Multiple Indicator Cluster Surveys.

RESULTS: Children from poor families are more likely, relative to those from better-off families, to be exposed to pathogenic agents; once they are exposed, they are more likely to become ill because of their lower resistance and lower coverage with preventive interventions. Once they become ill, they are less likely to have access to health services and the quality of these services is likely to be lower, with less access to life-saving treatments. As a consequence, children from poor family have higher mortality rates and are more likely to be undernourished.

CONCLUSIONS: Except for child obesity and inadequate breastfeeding practices, all the other adverse conditions analyzed were more prevalent in children from less well-off families. Careful documentation of the multiple levels of determination of socioeconomic inequities in child health is essential for understanding the nature of this problem and for establishing interventions that can reduce these differences.

DESCRIPTORS: Child. Nutritional Status. Socioeconomic Factors. Health Inequalities. Developed Countries. Developing Countries. Nutritional Epidemiology. Review Literature as Topic.

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RESUMO

OBJETIVO: Descrever o efeito das iniqüidades sociais sobre a nutrição e saúde de crianças de países de renda baixa e média.

MÉTODOS: Foram revisadas informações disponíveis sobre disparidades socioeconômicas intra-países, relativas a uso de serviços de saúde, estado nutricional, morbidade e mortalidade. Adotou-se um modelo conceitual com cinco categorias hierárquicas na produção de iniqüidades: contexto e posição socioeconômica, diferenças na exposição, na vulnerabilidade, nos desfechos de saúde e nas conseqüências. Em pesquisa realizada na base PubMed, no período de 1990-2007 foram encontrados 244 artigos relacionados ao tema. Foram também analisados os resultados de cerca de 100 inquéritos de âmbito nacional recentes, incluindo Pesquisas Nacionais de Demografia e Saúde e Inquéritos por Conglomerados de Múltiplos Indicadores, do Fundo das Nações Unidas para a Infância.

RESULTADOS: Crianças de famílias pobres, em comparação com aquelas de famílias mais ricas, são mais suscetíveis à exposição a agentes patogênicos; uma vez expostas, têm um risco aumentado de adoecer, devido à sua menor resistência e menor cobertura de medidas preventivas. Uma vez que se tornam doentes, têm menor acesso a serviços de saúde, a qualidade dos serviços que logram utilizar tende a ser inferior, com menor acesso a tratamentos médicos que garantam sua sobrevivência. Como conseqüência, crianças de famílias mais pobres apresentam maiores taxas de mortalidade e maior risco de serem subnutridas.

CONCLUSÕES: Exceto obesidade infantil e práticas inadequadas de aleitamento materno, todas as outras condições adversas analisadas tiveram maior prevalência entre as crianças de famílias menos favorecidas. A documentação cuidadosa dos múltiplos níveis de determinantes das iniqüidades socioeconômicas em saúde infantil é essencial para o entendimento da natureza do problema, e para o estabelecimento de intervenções que possam reduzir estas diferenças.

DESCRITORES: Criança. Estado Nutricional. Fatores Socioeconômicos. Desigualdades em Saúde. Países Desenvolvidos. Países em Desenvolvimento. Epidemiologia Nutricional. Literatura de Revisão como Assunto.

INTRODUCTION

Equity in health implies that ideally all individuals should attain their full health potential. Socioeconomic inequities include differences that are "systematic, socially produced (and therefore modifiable) and unfair".[71] Because young children are developing physically and mentally and because they depend on others to ensure their health, they are particularly susceptible to socioeconomic inequities that lead to marked differences in terms of morbidity and mortality.

Globally, most deaths of children under five years of age are caused by a few conditions, namely neonatal causes, pneumonia, diarrhea, malaria, measles and HIV/AIDS,[8] with malnutrition being an underlying cause in about a third of these deaths.[9] There are huge inequities in child undernutrition and mortality between and within countries.[8,17] Although under-five mortality rates have recently declined in most low and middle income countries (LMICs), equity analyses have shown that the relative mortality gap is widening, between rich and poor countries and widening within most countries between rich and poor children, because mortality reductions tend to be greater among the better-off.[43,65]

Addressing socioeconomic inequities in child health and nutrition will be essential to achieve the Millennium Development Goals, as current rates of progress in most LMICs are insufficient.[59] However, countries can get on track "if they can combine good policies with expanded funding for programs that address both the direct and the underlying determinants of the health-

related goals",[69] meaning, effective programs take equity considerations into account.

Socioeconomic factors are not the only type of inequities that are relevant to child health. Geographic inequities – for example urban/rural differences – are also relevant, particularly as these affect the availability of health care.[24] In addition, the magnitude of socioeconomic inequities is often different in urban and rural areas.[24] Cultural factors, such as gender inequities, are important in some societies.[65] Although this study will concentrate on socioeconomic inequities, other disparities will be discussed when relevant.

The present article had the objective of describing inequities in the health and nutrition of children under five years of age living in low and middle income countries.

METHODS

Literature review

A conceptual model is required to properly understand socioeconomic inequities. We adopted the framework developed by the Commission of Social Determinants of Health (CSDH) Priority Public Health Conditions Knowledge Network (PPHC-KN) (Table 1) that organizes the role of social determinants of health into five major hierarchical categories: socioeconomic context and position, differential exposure, differential vulnerability, differential health outcomes, and differential consequences.[a]

Our review starts describing differentials in terms of socioeconomic context and position, differential exposure and vulnerability, as well as access to health services and coverage of health interventions. We then address differentials in child morbidity and nutritional status, and finally, we discuss differentials in survival and the long-term consequences of inequities, in terms of human capital.

Throughout this review, in order to understand differentials between population subgroups through a stratification variable, we have primarily relied on the description of socioeconomic inequities using wealth quintiles based on household assets. We opted for the use of asset quintiles because these are available in a comparable format for almost 100 countries, providing data on dozens of health indicators. These indices are discussed below.

In addition to the analyses of national surveys, a literature review was performed in PubMed Publication years were restricted tothe period 1990-present, except for classical references such as highly influential articles prepared prior to that date. Several keyword combinations of "socioeconomic factors" or synonyms of terms related to child morbidity, mortality, nutrition, services utilization and coverage were used. The search was restricted to articles from low and middle income countries or global analyses.

All the following search terms were used: *Child Behavior Disorders/epidemiology AND Vulnerable Populations; Child Development AND (Socioeconomic Factors OR Social class); Child Health Services/ standards/trends AND (Socioeconomic Factors OR Social class); Child Mortality AND Communicable Disease Control/ methods; Child Mortality AND Poverty; Child Nutrition AND Poverty; Child Nutrition Disorders AND (Socioeconomic Factors OR Social class); Child Welfare/ statistics & numerical data; Diarrhea, Infantile/ epidemiology AND (Socioeconomic Factors OR Social class); Educational Status AND Health Status AND (Socioeconomic Factors OR Social class); Equity [ti] AND child*; Health Care Surveys AND Vaccination/ statistics & numerical data/utilization; Health Care Surveys AND (Social Justice OR Social Problems); Health disparities [ti]; Health Services Accessibility AND Income/statistics & numerical data; Health Services Accessibility AND Infant Mortality; Health Services Accessibility AND Mothers; Health Services AND Population Characteristics; Health Services AND Population Characteristics; Health Status AND epidemiology; Health Status Indicators AND Infant Mortality; Health Status Indicators AND Poverty; Health Status Indicators AND Residence Characteristics; Health Surveys AND (Socioeconomic Factors OR Social class); Healthy People Programs AND Pregnancy; Inequalities [ti] AND child*; Inequality [ti] AND child*; Inequality AND developing Countries; Inequality AND Infant Mortality AND Mothers; Inequity [ti] AND child*; Infant Mortality AND (Socioeconomic Factors OR Social class); Infant Mortality AND Residence Characteristics; Infant Mortality/trends AND Water Supply; Infant Welfare/ statistics & numerical data (Socioeconomic Factors OR Social class; Infant, Low Birth Weight AND (Socioeconomic Factors OR Social class); Infant, Small for Gestational Age; Maternal Mortality AND (Socioeconomic Factors OR Social class); Maternal Welfare/ statistics & numerical data; Mothers AND Developing Countries; Mothers AND Population Surveillance; Nutrition Disorders AND Developing Countries; Under-five mortality AND socioeconomic factors.*

This search led to the identification of 9,284 articles. Their abstracts were reviewed to identify all articles presenting breakdowns of maternal and child health

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[a] World Health Organization. Commission on Social Determinants of Health. Priority Public Health Conditions Knowledge Network. Scoping paper: priority public health conditions. Geneva; 2007. [Internet]. [cited 2009 Nov 24]. Available from: http://www.who.int/social_determinants/resources/pphc_scoping_paper.pdf

indicators (see list of keywords in the previous paragraph), according to any socioeconomic stratification variable. This led to the identification of 244 articles, which were obtained in full and read. Forty-five additional references were identified by examining the references cited by these articles.

Other sources of data were the Demographic and Health Surveys (DHS[a]) and the UNICEF Multiple Indicators Cluster Surveys (MICS[b]). The World Bank's PovertyNet initiative[c] used DHS data to produce tables on a variety of indicators of child health and nutrition for 56 countries, broken down by asset quintiles.[27] We abstracted the relevant results in 27 tables that are available online (webannex).[d] Additional data were obtained from the UNICEF Multiple Indicator Cluster Surveys. All 59 country reports and/or standard tables from the second (circa 2000) and third (circa 2005) rounds of MICS that were available by mid-2007 were reviewed (24 web tables). For those who want more details of the information provided in this paper, these 51 tables can be accessed online.

Evaluation of inequities in the studied outcomes

There are several summary measures for evaluating the magnitude of inequities in health. In this paper we present the frequency of the health indicator for the families in the lowest and highest socioecomomic status (SES) quintiles and present the ratio between the lowest and highest quintiles (low/high ratio). We also present the concentration index, which compares the distribution of a specific variable or outcome between different strata of SES groups.[30,70] The concentration index provides a means of quantifying the degree of wealth-related inequality in a specific health variable. It is derived from a concentration curve, which graphs on the x-axis the cumulative percentage of the sample, ranked by living standards, beginning with the poorest, and on the y-axis the cumulative percentage of the health variable corresponding to each cumulative percentage of the distribution of the living standard variable. The concentration index is defined as twice the area between the concentration curve, $L(p)$, and the line of equality (the 45 degrees line running from the bottom-left corner to the top-right). So, in the case where there is no income-related inequality, the concentration index is zero. The convention is that the index takes a negative value when the curve lies above the line of equality, indicating disproportionate concentration of

the health variable among the poor, and a positive value when it lies below the line of equality. If the variable reflects morbidity or mortality, the concentration index will usually be negative, meaning that ill health is more frequent among the poor. For coverage indicators, the concentration index is usually positive, as these tend to be higher among the rich.[70]

Levels of parental education and family income have been traditionally used to quantify SES, but recently many researchers and institutions, including the World Bank, have supported the use of household asset indices for this purpose. Responses to questions on assets (e.g. radio, television, refrigerator, and others) and building characteristics (e.g, type of floor, walls, number of rooms) serve as the basis for constructing a single, consolidated index of living standards, using principal components analysis to generate a weight for each item covered by the questionnaire. All mothers and children living in each household are assigned its standardized wealth index score, and the sample is then divided into quintiles. These simple indices allow equity analyses in the databases provided by the Demographic and Health Surveys (DHS), available for a large number of less developed countries.[e] Concentration indices were already available from the DHS tables analyzed by PovertyNet. For MICS, we calculated these indices using a standard spreadsheet.[f]

The tables in the webannex show measures of health and nutrition for each region of the world (DHS tables) or for selected countries (MICs tables). The large amount of information from DHS is summarized in Table 2, which shows the overall value for the whole population and for the two extreme SES groups (first and fifth quintiles), the ratio of the values in the extreme groups, and the concentration index. We could not present summary information derived from DHS for five indicators, as the original tables did not contain data for the overall population. In addition, it was not possible to summarize the MICS results in a single table, as these usually refer to a small group of selected countries which vary according to the indicator analyzed. The main findings from the MICS analyses are described in the text, and readers can access detailed information in the full tables available in the webannex.

Our results are primarily descriptive and cannot legitimately be taken to imply a direct causal relationship between wealth and health for several reasons. First, wealth or asset possession *per se* may determine health

[a] Demographic and Health Surveys. Available from: http://www.measuredhs.com/aboutsurveys/dhs/start.cfm
[b] UNICEF Multiple Indicators Cluster Surveys. Available from: http://www.childinfo.org/mics3_surveys.html
[c] World Bank's PovertyNet Initiative. Available from: www.worldbank.org/poverty/
[d] All the 51 tables are available from the Internet, by acessing Revista de Saúde Pública 44(1) at: www. scielo.br/rsp
[e] Quantitative techniques for health equity analysis. Available from: http://siteresources.worldbank.org/INTPAH/Resources/Publications/ Quantitative-Techniques/health_eq_tn07.pdf
[f] The World Bank. Analyzing health equity using household survey data. Available from: http://web.worldbank.org/WBSITE/EXTERNAL/ TOPICS/EXTHEALTHNUTRITIONANDPOPULATION/EXTPAH/0,,contentMDK:20216933~menuPK:400482~pagePK:148956~piPK:216618~t heSitePK:400476,00.html

status. Rather, the determining factors could be other characteristics (such as education or ethnic background) that are simultaneously associated with both asset ownership and health. It is also possible that the health-poverty relationships are driven by particular items included in the index (e.g., water and sanitation). Should this be the case, improvements in the health conditions among the poor might be more effectively brought about by focusing on changing those particular components of the wealth index rather than by a general effort to increase economic status as measured by the index as a whole.

The differentials presented in the tables were not tested for statistical significance because, due to the complex variance structure of the surveys, it would be necessary to carry out data analyses in order to perform such tests. However, DHS and MICS datasets usually include thousands of children, and the equity gradients consistently observed in most countries leave little doubt that the associations are not due to chance.

RESULTS AND DISCUSSION

Table 1 shows the framework for the analysis, separated by the five PPHC-KN categories andlisting the indicators studied according to the source of information – DHS, MICS or literature review. This section is organized in the same order as that framework.

Socioeconomic context and position

As already described, asset indices were used to stratify families with young children according to their relative wealth in each country. This stratification was used to document inequities for several determinants of child health and nutrition. There is a close association between family wealth and parent's education (Table 2). For all regions, the percent of women with five years or more of education was close to 80% for the wealthiest quintile compared to about 30% for the poorest; for men, the corresponding figures were about 85% and 45%.

This review does not attempt to disentangle the effects of education from those of wealth.[18] Nevertheless, several studies show that maternal education is strongly associated with child health, even when other socioeconomic factors are held constant.[13,63] Improvements in parental education account for part of the progress in child survival in past decades.[14] Maternal education may impact on child survival in several ways, including increasing the mother's ability to contribute to the family's income and to reinforce her authority and ability to make decisions in the family, to make better use of existing services, and to provide better child care. Before asset indices became widely used, maternal education was the most frequently used socioeconomic factor in analyses of inequities in child survival.

Differential exposure

Environmental conditions are important determinants of child health. Poor water, sanitation and hygiene conditions are associated with increased incidence of waterborne diseases, particularly diarrhea; crowding is associated with increased incidence of pneumonia, measles and other airborne infections; indoor pollution increases the risk of respiratory conditions; and vector density affects many diseases, particularly malaria.[33]

There is a clear association between the wealth of a country and the availability of water and sanitation to its population.[a] Because water and sanitation variables are included in the calculation of standard asset indices,[23,27] it is not surprising that asset indices are strongly associated with wealth. For example, in seven countries analyzed by MICS (five of them in Sub-Saharan Africa), there were marked differences according to asset indices, especially for those very poor, as is the case of Sierra Leone, where the concentration indices were 0.346 for drinking water and 0.507 for sanitation (webtables 3.1 and 3.2). Blakely et al[10] avoided this pitfall by using a simplified index based on only four assets, and they were able to document important socioeconomic differences in exposure to poor water and sanitation in 11 different regions of the world.

The literature also shows direct associations between adequate water and sanitation with socioeconomic indicators such as maternal education[28] and family income.[5] Several MICS confirm this association (data not shown).

Two behavioral practices – hand washing and sanitary disposal of infant feces – affect exposure to pathogens. Thirteen DHS conducted predominantly in African countries all show direct associations between wealth and the provide information on the presence of hand washing facilities in the households (webtable 2.3). Sixteen DHS reported on hand washing prior to food preparation (webtable 2.4). In 12 countries, nine or more out of ten informants reported that they washed their hands, in all asset quintiles. This raises the possibility of reporting bias, as described in previous studies comparing reported to observed hygiene behaviors.[15]

Twenty-five DHS provided information on the sanitary disposal of children's stools (webtable 2.5), with studies predominantly in Sub-Saharan Africa and Latin America. All but one survey show that this practice tends to be more frequent among the rich than among the poor. Information from MICS in five countries

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[a] United Nations Development Program. Human development report 2006. Beyond scarcity: power, poverty and the global water crisis. New York; 2006. [Internet]. [cited 2009 Nov 24]. Available from: http://www.globalpolicy.org/socecon/gpg/2006/1109humdev.htm

(three in Africa, Tajikistan and Dominican Republic) shows that poor households are consistently more likely to use solid fuels for cooking than wealthy households (webtable 3.3). The Blakely analyses confirm this association in most of the regions studied.[10]

Crowding within households is well known to increase the risk of infectious diseases.[34] Crowding at community level is also important, as demonstrated by increased infectious morbidity in slums.[51] A close proxy for crowding – the total fertility rate (TFR) – is twice as high among the poorest quintile as in the wealthiest one (Table 2), with a negative concentration index of -0.124. A Brazilian study shows that the number of persons per bedroom also presents important socioeconomic gradients.[4]

Table 1. Framework for the analysis of inequities in child health and nutrition: indicators and their availability in studies.

Relevant factors for child health/nutrition	Indicators	DHS	MICs	Literature Review
Socioeconomic context and position:				
Family income / assets	Asset index	X	X	X
Parental education	Education among women	X	X	X
	Education among men	X	-	X
Differential exposure:				
Water / sanitation / hand washing	Water supply	-	X	X
	Sanitation	-	X	X
	Hand washing facility in household	X	-	X
	Sanitary disposal of children's stools	X	-	X
Crowding / housing / air pollution	Solid fuel for cooking	-	X	X
	Crowding	X	-	X
Disease vectors	Exposure to disease vectors	-	-	X
Differential vulnerability (Factors affecting incidence):				
Immunization[a]		-	-	-
Infant and young child feeding	Timely initiation of BF	X	X	X
	Exclusive breastfeeding	X	-	X
	Bottle feeding	X	X	X
	Timely complementary feeding	-	-	X
Antenatal and delivery care	Antenatal care	X	X	X
	Skilled delivery care	X	X	X
	Postnatal visit	-	-	X
HIV prevention[a]		-	-	-
ITN	Bednet/ ITN use	X	X	X
Differential vulnerability (Factors affecting severity):				
Poor nutrition (breastfeeding, complementary feeding, micronutrients – vitamin A, zinc, iron, iodine)	Vitamin A intake	X	X	X
	Zinc supplementation	-	-	X
	Iron supplementation	-	-	X
	Use of iodized salt	-	X	X
Case-management (access to first level and referral care) of diarrhea, pneumonia, sepsis, malaria (including IPT), measles, HIV,[b] severe malnutrition, neonatal morbidity	Care seeking for ARI	X	X	X
	Antibiotics for pneumonia	-	X	X
	Care seeking for diarrhea	X	-	X
	ORT to treat diarrhea	X	X	X
	Care seeking for fever	X	-	X
	Antimalarial treatment	-	X	X
	Quality of care	-	-	X
	Referral care	-	-	X

To be continued

Table 1 continuation

Relevant factors for child health/nutrition	Indicators	DHS	MICs	Literature Review
Differential health outcomes:				
Morbidity	Diarrhea prevalence	X	X	X
	ARI prevalence	X	X	X
	Fever prevalence	X	X	X
Undernutrition: stunting, wasting, underweight	Anemia	X	-	X
	Low birth weight	-	b	X
	Stunting	X	X	X
	Underweight	X	X	X
	Wasting	X	X	X
Overweight/obesity	Overweight/obesity	-	X	X
Differential consequences:				
Mortality	Neonatal mortality	X	-	X
	Infant mortality	X	X	X
	Under-five mortality	X	X	X
	Cause-specific mortality	-	-	X
Disability	Prevalence of disability	-	-	X
Human capital (height, reproductive performance, schooling, income)	Human capital	-	-	X
Economic consequences to the family	Economic losses	-	-	X

DHS: Demography and Health Studies
MICS: UNICEF Multiple Indicators Cluster Surveys
BF: Breastfeeding
ITN: Insecticide-treated bednets
ARI: Acute respiratory infection
IPT: Intermitent presumptive treatment
[a] Not covered in the review
[b] Data available but quality of the information is questionable

Disease vector concentration is another environmental factor that may also be higher in poor households than in wealthy ones. Several studies in Africa and Asia have found significantly higher densities of the malaria vector, the *Anopheles* mosquitoes, in the types of houses that poorer families tend to live in, that is, those with open eaves and windows, with walls of mud rather than brick, with a roof of thatch rather than tile or metal, and without a ceiling.[1,36,41,47,55,73] House location is also a risk factor: higher mosquito densities have been found in houses near to breeding sites[61] and in houses around the periphery of villages, where the poorest families tend to live.[57]

Summing up, children from poor households are at consistently higher risk of being exposed to inadequate water and sanitation, crowding, and indoor pollution than are children from wealthy families. Their care-takers are also less likely to adopt behaviors, such as hand washing or safe disposal of stools, that are associated with reduced risk of exposure to infectious agents. There is also evidence on higher exposure of poor children to *Anopheles* mosquitoes. Greater risk of exposure will likely lead to increased disease incidence, as will be subsequently discussed.

Differential vulnerability: factors affecting disease incidence

Poverty also affects how vulnerable children are to disease. We will now focus on factors associated with disease incidence, such as behaviors (breastfeeding), home practices (use of insecticide-treated mosquito nets) and utilization of health services (antenatal and perinatal). Later we will discuss variables associated with disease severity. Data on disease incidence rates will be presented in the section on differential health and nutrition outcomes.

Immunization coverage is a major factor affecting the incidence of certain diseases, and there is a large body of evidence, both from DHS and MICS, showing that immunization coverage tends to be consistently higher among rich than among poor children.[27]

Breastfeeding reduces both the incidence and severity of infectious diseases. Except for Sub-Saharan Africa, where the frequency of exclusive breastfeeding (among children under six months of age) does not show an association with wealth, in all other regions this

Table 2. Average and extreme values (first and fifth quintiles), low/high ratios and concentration indices of selected indicators for all regions of the world analyzed by DHS. (All values are percentages, except the mortally rates).

Outcome	Webtable	Average value	Lowest quintile value	Highest quintile value	Low/high ratio	Concentration index
Socioeconomic context and position						
School completion among women	2.1	53.7	32.3	77.3	0.42	0.291
School completion among men	2.2	64.6	43.4	85.7	0.51	0.190
Differential exposure						
Total fertility rates (number of births)	2.6	4.4	5.7	3.0	1.90	-0.124
Differential vulnerability						
Exclusive breastfeeding 0-3 months	2.7	36.4	38.4	32.9	1.16	-0.008
Bottle feeding at age 12 months	2.8	24.4	17.1	39.0	0.44	0.312
Timely complementary feeding 6-9 months	2.9	64.1	61.9	62.2	1.00	0.010
Antenatal care coverage	2.10	76.1	62.1	92.6	0.67	0. 109
Delivery by a trained person	2.11	55.3	35.8	85.0	0.42	0.274
Bednet use by children[a]	2.12	24.5	21.5	35.1	0.61	0.205
Vitamin A consumption 6 months-5 years	2.13	40.0	35.2	47.9	0.73	0.074
Use of oral rehydration for diarrhea	2.15	62.9	56.2	70.7	0.80	0.045
Medical treatment of diarrhea	2.16	32.8	27.6	42.8	0.65	0.098
Medical treatment of acute respiratory infection	2.17	46.1	36.4	59.7	0.61	0.129
Medical treatment of fever	2.18	37.2	29.8	51.2	0.58	0.126
Differential health outcomes						
Prevalence of fever in children	2.19	29.9	31.1	25.9	1.20	-0.024
Prevalence of diarrhea in children	2.20	17.2	19.0	13.9	1.36	-0.057
Prevalence of ARI in children	2.21	16.0	16.9	13.6	1.25	-0.020
Prevalence of stunting in children	2.24	33.1	40.5	21.0	1.93	-0.114
Prevalence of underweight in children	2.25	23.3	29.6	13.9	2.13	-0.134
Differential consequences						
Infant mortality rates	2.26	72.9	85.0	50.1	1.70	-0.098
Under-five mortality rates	2.27	115.2	135.4	73.5	1.84	-0.115

[a] For Sub-Saharan African countries only

practice is more common among the poor than among the better-off. (Figure 1 and Table 2). On the other hand, the practice of bottle-feeding shows remarkably consistent patterns throughout the world – children from wealthy families are much more likely to be bottle-fed than those from poor families (Table 2).

Regarding timely complementary feeding (breastfeeding plus complementary foods among children aged 6-8 months), although the overall picture for all regions shows very similar results for the rich and the poor (Table 2), there are differences according to the prevalence of breastfeeding. In countries where breastfeeding at ages 6-8 months is nearly universal, timely complementary feeding tends to be more prevalent among the rich who introduce other foods and also continue to breastfeed. In regions where breastfeeding duration is

short, children from wealthy families are taken off the breast earlier and do not receive timely complementary feeding whereas the poor are more likely to comply because they are still breastfeeding.

These analyses confirm earlier observations that breastfeeding is the only known beneficial practice that, in many countries, is more prevalent among the poor than among the rich,[58] unlike what happens in developed countries.[40] There is a concern that, as the economic situation of LMICs improve, the developed country pattern may be observed in the future.[67]

Early initiation of breastfeeding is important for neonatal health.[20] The DHS analyses do not include this variable, but tabulations by maternal education are available for Benin, where the highly educated are

more likely to practice early initiation[a], and available for Brazil, where the opposite trend is observed.[b]

Antenatal care and delivery by a skilled attendant are essential for preventing a large number of neonatal and child conditions.[16] Extensive information is available on inequities in these two indicators. DHS (Figure 2 and Table 2) and MICS (webtables 3.6 and 3.7) surveys consistently show gradients in all regions of the world. Antenatal and delivery care show "top inequity"[66] in Africa, where access among the top wealth quintile is considerably greater than the rest of the population, whereas in regions with high overall coverage, such as Europe, East Asia and Latin America, a "bottom-inequity" pattern is often observed, where the poorest quintile are considerably worse-off. This pattern is clearer when countries are analyzed separately instead of regionally.[27]

These inequities are also observed for delivery by a medically trained person (Table 2). Gwatkin et al[26] analyzed inequities in antenatal and delivery care in the private and public sector, showing that inequities are considerable greater among women attending private services.

Access to emergency obstetric and newborn care can represent the difference between life and death for mothers and newborns. Using DHS data from 42 countries, Ronsmans et al[52] found that in 37 of these countries women belonging to the poorest socioeconomic quintile had caesarean sections rates below 5% – regarded as the minimum required for saving maternal and newborn lives.[19]
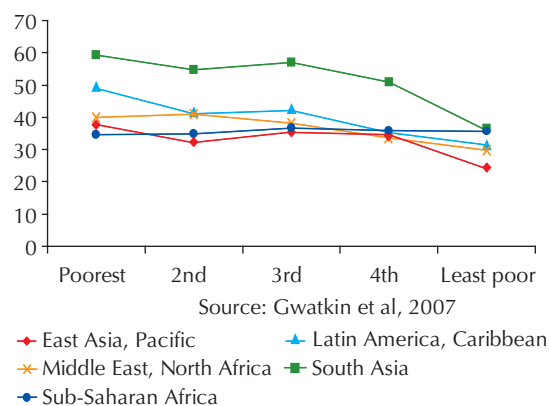
Several studies from Brazil show that, although coverage with one or more visits for antenatal care is high, poor mothers are likely to have fewer visits and to start at advanced gestational ages[4,12,29,39] and that the quality of care provided to poor women is worse than that received by the rich.[12,49]

A post-natal visit around the third day after delivery is strongly recommended for ensuring the health of mothers and newborns. Although this indicator is currently being incorporated in many surveys, few results are yet available. In Ghana[c] and Bangladesh,[50] clear socioeconomic inequities were observed for both variables.

Insecticide-treated mosquito nets are the main preventive measure against malaria. DHS results from 16 Sub-Saharan African countries show that overall net use by children (not necessarily insecticide treated) is more common among the rich than the poor (Table 2). This pattern was observed in 13 countries whereas the opposite pattern was observed in Namibia and Nigeria and there was no difference between the better-off and the poor in Gabon. MICS results confirm this pattern (webtable 3.8). Specific information on whether the child slept under an insecticide-treated mosquito net is available from 21 MICS countries, of which all but The Gambia, Ghana and Vietnam showed greater use by the better-off (Figure 3).

The review of inequities regarding vulnerability to disease incidence showed that, with the exception of breastfeeding practices, all other vulnerability indicators tend to be more prevalent among the poor than among the wealthy.
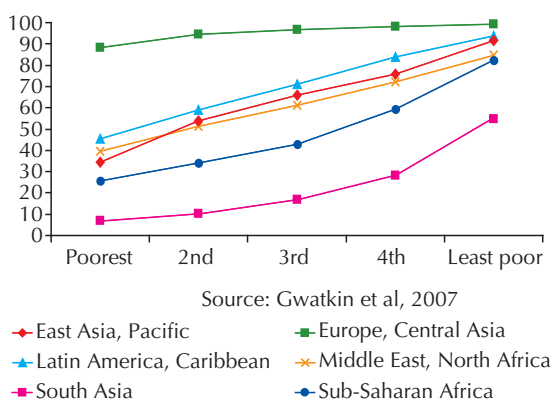

Source: Gwatkin et al, 2007

East Asia, Pacific
Latin America, Caribbean
Middle East, North Africa
South Asia
Sub-Saharan Africa

Figure 1. Prevalence of exclusive breastfeeding in children 0-3 months, by wealth quintile and region of the world.

Source: Gwatkin et al, 2007

East Asia, Pacific
Europe, Central Asia
Latin America, Caribbean
Middle East, North Africa
South Asia
Sub-Saharan Africa

Figure 2. Skilled delivery care, by wealth quintile and region of the world.

[a] Institut National de la Statistique et de l'Analyse Economique Cotonou. Benin DHS 2001:final report. Calverton: ORC Macro; 2001.
[b] Sociedade Civil de Bem-Estar Familiar. Brazil DHS, 1996: final report. Rio de Janeiro; 1996.
[c] Ghana Statistical Service / ORT Macro. Ghana DHS 2003: final report. Calverton: ORT Macro; 2003.
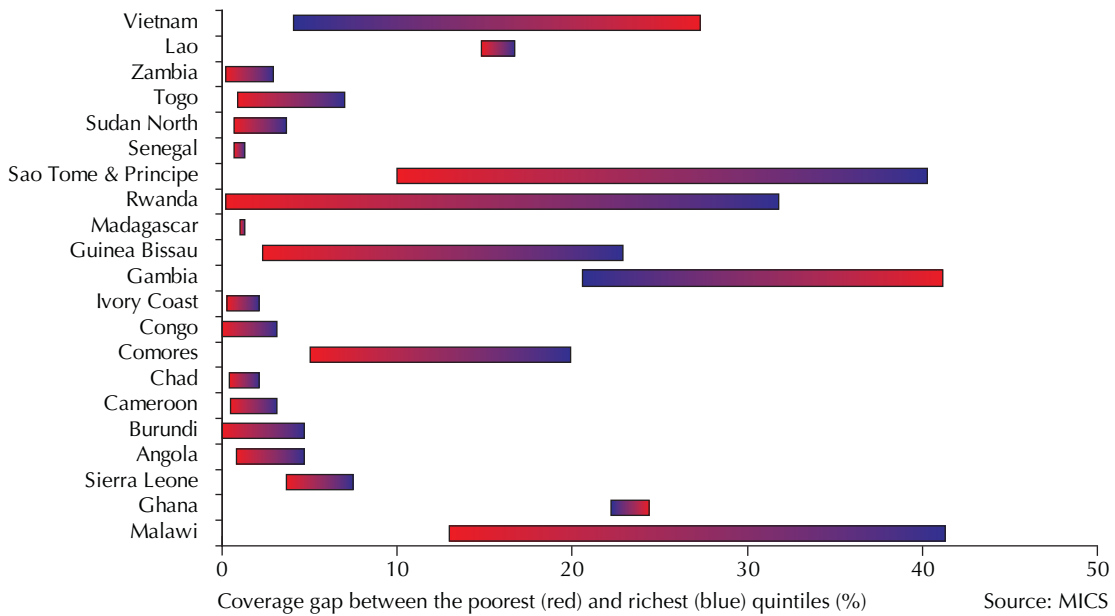
Figure 3. Equity gaps in ITN use by children, for selected countries.

Vulnerability: factors affecting disease severity

Once a child acquires an infectious illness, the severity of the episode is largely determined by his or her nutritional status and specific nutrient deficiencies, as well as by the coverage of effective curative interventions. Undernutrition is both a contributing cause and a consequence of morbidity.[9] As mentioned before, breastfeeding helps reducing the severity of infectious diseases, by providing active and passive immunity as well as antimicrobial substances.

Zinc and vitamin A play important roles in reducing the severity of infectious diseases.[9] In non-malarious areas, iron is also a key micronutrient; however, recent research has shown that where malaria is prevalent iron supplementation can increase severe morbidity.[53]

Animal-based foods are excellent sources of dietary zinc and iron. Low intake of these foods is part of the causal pathway leading from poverty to undernutrition. Figure 4 shows the gaps in the proportion of one-year-olds who ate meat, poultry, fish or eggs in the 24 hours preceding 12 DHS surveys. Except for Nepal where differences are small, children from poor families are consistently less likely to eat such foods. No studies were located on use of zinc supplements according to socioeconomic position.

Low vitamin A intake due to poor diets is another aspect of undernutrition, and many countries have adopted vitamin A supplementation programs to correct this deficiency. With a few exceptions in 50 different surveys, vitamin A coverage was higher among the rich than the poor (Table 2). The small gaps in Latin America may

be due to the fact that supplementation only occurs in restricted areas where few better-off families live.

Another important micronutrient is iodine, and most countries have salt fortification programs. Household use of adequately iodized salt was estimated through the combination of two variables collected through MICS (webtable 3.11), namely percent of households with salt at the time of the visit and the proportion of salt samples that tested positive for iodine. In 20 out of 25 countries with available data, iodized salt use was directly related to wealth. Information is also available from 12 DHS surveys (webtable 2.14) showing equity gaps in nearly all countries studied except in three Latin American countries (Bolivia, Guatemala and Haiti).

Instead of evaluating the effect of separate interventions, one may also assess how many of these essential interventions each child receives – in other words, the co-coverage of interventions.[66] An analysis of DHS datasets showed that the eight interventions studied – including three vaccines (BCG, DPT and measles), tetanus toxoid (TT) for the mother, vitamin A supplementation, antenatal care, skilled delivery and safe water – were clustered on wealthy children, who often received most available interventions, while many poor children received few or none. This finding was confirmed in a larger number of countries.[11] The analysis of co-coverage also showed variability in the patterns of inequity (Figure 5). Whereas in countries with high coverage such as Brazil and Nicaragua the poorest quintile lagged significantly behind the other four, in low coverage countries – such as Haiti and Cambodia – the richest quintile tended to be
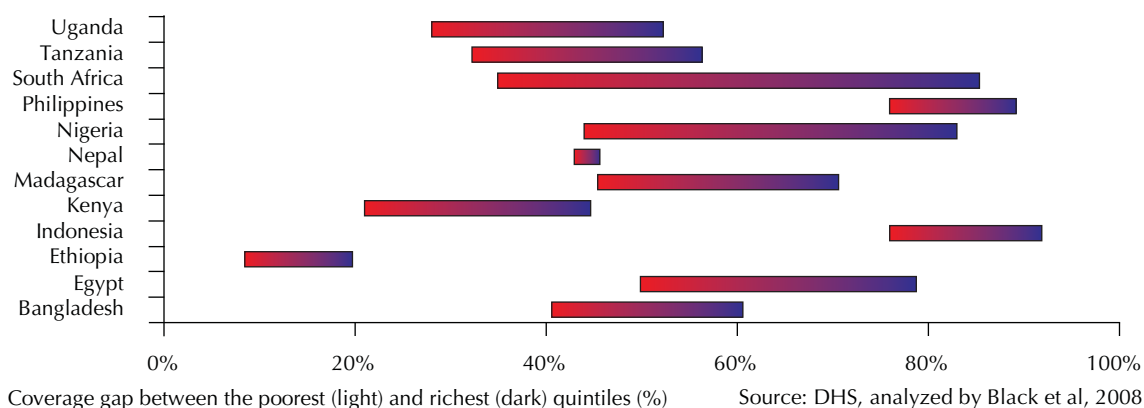
Figure 4. Equity gaps in intake of meat, fish, poultry or eggs, for selected countries.

substantially ahead of the rest. These patterns were described as "bottom inequity" and "top inequity",[66] or alternatively as "marginal exclusion" or "massive deprivation".[72]

Regarding curative interventions, in order to have access to curative care, families should be able to recognize signs and symptoms requiring professional care and have geographical and economic access to health care. A survey in rural Tanzania[54] showed that mothers from the top quintile were more likely to know about danger signs, to live near a health facility, and to attend a facility when ill.

Data on oral rehydration therapy during diarrhea are available for several DHS and MICS. DHS results (Figure 6 and Table 2) show consistent results for all regions of the world, with higher use among the better-off, a pattern that is also evident in 17 of the 26 MICS (webtable 3.12). DHS data also show that care seeking for diarrhea at a health facility was clearly higher for children from wealthier families (Table 2).

Care seeking from a qualified provider during acute respiratory infections was studied by DHS (Table 2), and again clear socioeconomic gradients were observed. This was confirmed in 20 of the 26 available MICS (webtable 3.13). The latter also provide information on coverage with antibiotic treatment for probable pneumonia for Dominican Republic, Malawi, Sierra Leone, and Ghana (webtable 3.14). With the exception of Ghana, where use was similar in the extreme quintiles, the other three countries showed direct associations with wealth.

Finally, we reviewed results on treatment of fever with antimalarials in under-fives. In 17 of the 20 countries studied by MICS (webtable 3.15), antimalarial treatment coverage increased with wealth. No information is available on whether or not effective antimalarials were being used. Care seeking for fever from a health provider was markedly greater among the better-off (Table 2).

Intermittent presumptive treatment of malaria during pregnancy is effective in reducing low birth weight.[38] Data for 17 Sub-Saharan African countries showed that the use of prophylactic malarial treatment was higher among women in the highest quintile (53.4%) than in those of the lowest quintile (34.4%). [27]

Regarding the choice of health care providers, a survey in Bangladesh showed that children from wealthy families are substantially more likely to be brought to a medical doctor when suffering from diarrhea, while poorer children were often taken to unqualified practitioners.[37]

Compliance with the advice provided by health workers is also essential, but data are limited on this topic. In Sudan, compliance with referral was greater among more educated mothers,[2] but in rural Tanzania, reported compliance with recommended follow-up visits, referral or treatment was similar in all socioeconomic groups.[54]

Summing up, this section documented important socioeconomic differentials in terms of vulnerability to severe illness. Poverty is associated with lower dietary quality, lower coverage with vitamin A supplementation and less frequent use of iodine-fortified salt. Once a child is ill, care seeking and treatment practices are consistently worse among children from poor families than for the better-off. Less evidence is available on the quality of care received by poor and wealth children within facilities, but isolated studies suggest that the better-off are more likely to be taken to qualified providers.

Differentials in health and nutrition outcomes morbidity

Both DHS and MICS provide information on the prevalence of diarrhea, acute respiratory infections and fever among children. Fever prevalence was higher for poor than for rich children in most countries, although differences were small (Table 2). Recently, several large-scale cross-sectional surveys show higher
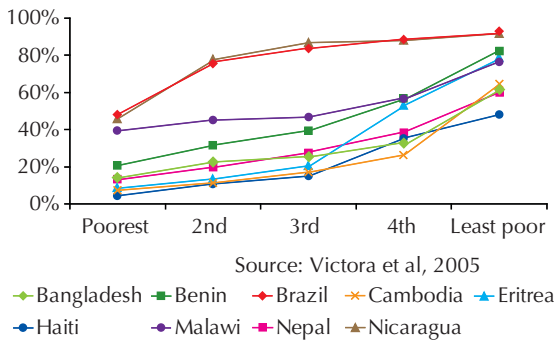
Figure 5. Percent of underfive children receiving six or more child survival interventions, by wealth quintile and country.

Figure 6. Oral rehydration therapy during diarrhea, by wealth quintile and region of the world.

frequencies of malaria infection among the poor in Asia and Africa.[21,32,35,45]

In the vast majority of DHS and MICS, caretakers of poor children reported that diarrhea prevalence among poor children was 30% or more than the rate in the top quintile (Figure 7 and Table 2). Similar results were obtained in 20 out of the 26 MICS countries with such information (webtable 3.17). Also, most MICS countries (webtable 3.18) reported that cough – a proxy for acute respiratory illness – was more frequent among the poor than among the better-off. DHS results confirm the MICS findings (Table 2).

In short, reported morbidity tended to be more common among the poor, but the magnitude of the differences was often small, with a 20%-40% excess risk relative to the better-off.

Malnutrition

The term malnutrition covers undernutrition – expressed either as anthropometric deficits or micronutrient deficiencies – as well as overnutrition or obesity.
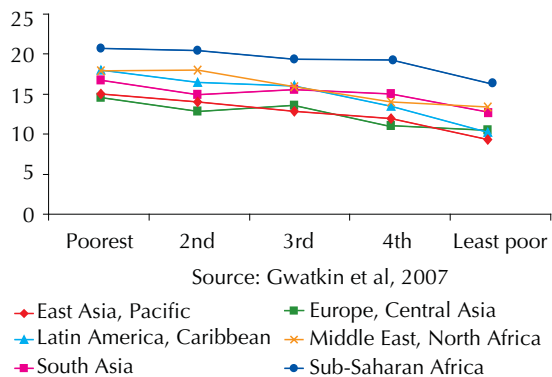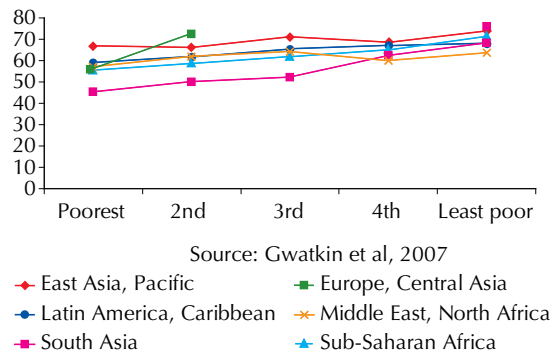
Micronutrient deficiencies are more common among the poor. DHS information on anemia – for which the main causes are iron deficiency and malaria – is available for 18 countries around the world (webtables 2.22 and 2.23), and there are clear inverse socioeconomic gradients with wealth in all but one country (Turkmenistan). Vitamin A deficiency has been historically associated with poverty.[46]

Low birth weight is used in LMICs as an indicator of fetal malnutrition. WHO and UNICEF estimated the prevalence of low birth weight for over 170 countries, showing a strong inverse correlation with the level of development.[60] In countries where a high proportion of newborns are weighed, such as Brazil, there is evidence of a direct association between birth weight and wealth.[3,7,56]

Table 2 shows that stunting and underweight are substantially more prevalent among poor than rich children in all regions of the world, usually by a factor of two. Information on wasting, or weight-for-height

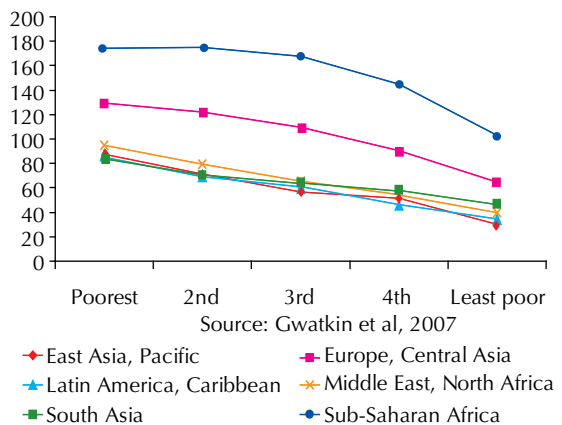Figure 7. Prevalence of diarrhea, by wealth quintile and region of the world.

Figure 8. Underfive mortality rate, by wealth quintile and region of the world.

deficits, based on 24 countries studied in MICS, also shows consistent socioeconomic gradients in nearly all countries, although the magnitude of the gaps tends to be smaller. African children in the top quintile show a sharp reduction in undernutrition compared to the other four wealth groups whereas in the other regions, patterns are more or less linear, when data from all countries are pooled.

Childhood overweight is a growing global concern.[48] MICS results from four countries (Ghana, Sierra Leone, Tajikistan and Dominican Republic) show that prevalence tends to be higher among the rich than among the poor, with concentration indices between 0.076 and 0.215 (webtable 3.22). Other studies – mostly from middle-income countries – reveal similar trends.[6,31]

In summary, with the single exception of overweight, nutritional and morbidity outcomes are considerably worse among poor than among better-off children. Because inadequate nutritional status is part of the vicious cycle of malnutrition and infection, higher prevalence of undernutrition further contributes to the incidence, severity and case-fatality of childhood illnesses.

DIFFERENTIAL CONSEQUENCES

Mortality

Socioeconomic differentials in child death rates are consistently found throughout the globe. Wide socioeconomic differentials in infant and under-five mortality are present (Figure 8 and Table 2). Socioeconomic inequities tend to be slightly more marked for the latter, suggesting that deaths of children 1-4 years are more strongly determined by SES. The magnitude of poor/rich mortality ratios tends to be inversely related to the overall mortality rate in the country. In Africa, mortality in the highest quintile is considerably lower than in the other four, poorer quintiles. In the other regions, inequity patterns are quite linear, but when countries are analyzed separately,[27] a common pattern in low-mortality countries is the poorest quintile showing considerably higher mortality than the other four.

The importance of neonatal mortality as a major component of under-five deaths has received growing attention.[38] DHS data reveal consistently higher neonatal mortality rates for those in the poorest 20% of households than for those in the top quintile.[22] The disparity is higher for post-neonatal deaths than for neonatal deaths and higher for child (1-4 year olds) deaths than for infant deaths, because later deaths are more easily avoided.

Although aggregate national level estimates of cause-specific under-five mortality are now available,[a] neither DHS nor MICS provide breakdowns by socioeconomic indicators. Isolated studies, however, suggest that the inequities observed for all-cause mortality also apply to individual causes, as is the case for malaria in Tanzania,[b] infectious diseases in Brazil,[62,63] and dysentery, acute watery diarrhea, measles, unspecified fever, and drowning, but not respiratory diseases in Bangladesh.[44]

Inequities in mortality are closely related to differentials in nutritional status, as poor nutrition is an underlying cause of about a quarter of all under-five deaths.[9] Socioeconomic differentials in under-five mortality are much wider than those observed for morbidity. This suggests that mortality gaps are largely due to differences in disease severity and case-management, rather than differences in incidence.

Human capital

There is limited information on the long-term consequences of growing up in poverty in LMICs, because such evidence is derived from long-term follow-up studies that are uncommon. Recent analyses of five cohort studies from LMICs showed strong associations between poverty in childhood and adult human capital outcomes including attained height, achieved schooling, income and offspring birth weight,[68] as well as with low cognitive development at later ages.[25] At least part of the link between early poverty and poor intellectual performance is mediated through nutrition, as studies of iron deficiency in Costa Rica show.[42]

CONCLUSIONS

We employed a conceptual framework to search the published literature and databases from two major survey initiatives (DHS and MICS) on the topic of socioeconomic differentials in child health and nutrition. Data from nearly 100 countries suggest that poor children and their mothers lag well behind the better-off in terms of mortality and undernutrition. These inequities in health outcomes result from the fact that poor children, relative to those from wealthy families, are more likely to be exposed to disease-causing agents; once they are exposed, they are more vulnerable due to lower resistance and low coverage with preventive interventions; once they acquire a disease that requires medical treatment, they are less likely to have access to services, the quality of these services is likely to be lower, and life-saving treatments are less readily available. As a consequence, the odds are stacked against poor children, throughout these different steps in a causal chain. There were very few exceptions to

[a] World Health Organization. World health statistics 2007. Geneva; 2007.
[b] Mwageni E, Masanja H, Juma Z, Momburi D, Mkilindi Y, Mbuya C, et al. Risks of malaria mortality in relation to household wealth in the Rufiji DSS area. In: Multilateral Initiative on Malaria African Malaria Conference, 2002. Arusha, Tanzania.

this pattern: child obesity and inadequate breastfeeding practices were the only conditions more often reported among the rich than the poor.

This study was purposefully biased towards interventions that can be delivered within the health sector. At the very least, health workers should be aware that the way in which they implement preventive and curative interventions often contributes to further increasing inequities.[64,66] Mainstreaming equity considerations in the health sector is essential for ensuring that we become part of the solution, rather than part of the problem.

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