Setting the stage for equity-sensitive monitoring of the maternal and child health MDGs

Forthcoming in *Bulletin of the World Health Organization*

Meg Wirth [a]
Deborah Balk[b]
Enrique Delamonica[c]
Adam Storeygard[b]
Emma Sacks[b]
Alberto Minujin[c]

[a]Independent consultant to Task Force 4, Child Health and Maternal Health, UN Millennium Project at the time this research was undertaken

[b] Center for International Earth Science Information Network (CIESIN), Columbia University; CIESIN - Columbia University, Lamont-Doherty Earth Observatory, 61 Route 9W, PO Box 1000, Palisades, NY 10964, USA; correspond with this author: balk@ciesin.columbia.edu

[c]Global Policy Section, Division of Policy and Planning, United Nations Children's Fund (UNICEF) at the time this research was undertaken; Graduate Program on International Affairs (GPIA), The New School for Social Research

Abstract

Objectives
This analysis seeks to set the stage for equity-sensitive monitoring of the health-related Millennium Development Goals (MDGs).
Methods
We use data from international household-level surveys (DHS and MICS) to demonstrate that establishing an equity baseline is necessary and feasible, even in low-income, data-poor countries. We examine six countries using 11 health indicators and six social strata to ground our recommendations in current data. Simple bivariate stratification is complemented by simultaneous stratification to expose the compound effect of multiple forms of vulnerability.
Findings
The data reveals that inequities are complex and interactive: one cannot draw inferences about the nature or extent of inequities in the health outcomes from a single stratifier or indicator.
Conclusion
The MDGs and other development initiatives must become more comprehensive and explicit in their analysis and tracking of inequities. And based upon these country-specific inequities, policies must be designed to narrow health gaps.

Key words: MDGs; indicators; equity; disparities; social determinants; gender; ethnicity; wealth quintiles; poverty; poor; maternal and child health

I. Rationale

Inequities in health are pervasive within countries, rich and poor alike. Even in countries where aggregate health indicators are improving, some health gaps between population groups are widening or remaining stagnant. The size and dynamics of these gaps vary considerably, depending on the indicator and country studied, as well as the means of stratifying the population into social groups. And yet, health equity analyses too often remain overly simplistic or nonexistent, even in key development initiatives like the Millennium Development Goals (MDGs) and Poverty Reduction Strategy Papers (PRSPs).

From an ethical and human rights perspective, narrowing avoidable disparities in health is imperative (*1*). An explicit and systematic commitment to equity must be made to ensure that poor, marginalized and vulnerable groups are given access to health services and opportunities for healthy lives (*2*,*3*).

Many recent studies have focused either on single health outcomes or on one or two stratifiers, demonstrating that inequities in health outcomes differ across and within countries and confirming the conventional wisdom that poor people suffer from ill-health more than the better-off (*4-15*). Other research has shown the extent to which expenditures on health and social services disproportionately favor privileged groups (*16*,*17*), quantifying the differentials in access to health care and in health outcomes. And increasing attention is being given to the wider set of social determinants that stratify health (*18-20*).

This analysis uses population-based surveys to examine multiple indicators and stratifiers, making the point that equity analyses in country-level adaptations of the MDGs and PRSPs should be more comprehensive. The paper is based on four arguments and assumptions: multiple health indicators give a more complete picture of inequalities in health; social disadvantage must be examined holistically to reflect its complexity beyond wealth; measuring inequalities is feasible using current data even in very poor countries; and the health MDGs should be framed in equity-sensitive terms.

II. Data and Methods

A. Data Sources

Data from recent Demographic and Health Surveys (DHS) and Multiple Indicator Cluster Surveys (MICS) was used to demonstrate that establishing an equity baseline is both *necessary and feasible* in low-income countries. Countries lacking vital registration systems currently rely on population-based surveys for MDG monitoring. This approach is generalizable to most resource-poor countries with at least one population-based household survey per country containing information on health and social characteristics. We examine six countries across 11 health indicators and six social strata to ground our recommendations.

Countries were selected to coincide with UN Millennium Project case studies. Data sources used were the DHS surveys for Cambodia (2000), the Dominican Republic (2002), Ethiopia (2000), Ghana (1998), and Kenya (1998), and the Tajikistan 2000 MICS (*21-26*). Tajikistan data comes from aggregate tables distributed by UNICEF. Most DHS measures are calculated at the individual level or derived from their reports and website. Indicator definitions were harmonized across the five DHS countries when possible. Some indicators reported differ from DHS reports (*27*). For example, values of "Don't Know" or "Missing" were excluded from our analysis, whereas in DHS reports these categories are sometimes explicitly reported, or considered equivalent to "No". Similarly, DHS reports contraceptive prevalence rates for women currently in union, whereas we report for all women. We report mean age at marriage as opposed to median.

Ethnicities were recoded into dominant, not dominant, and secondary dominant categories based on relevant literature to create larger classes of stratifiers (*28,29*). A "wealth by poverty line" variable was created using existing wealth indices (*30,31*) to complement the stratification by wealth quintile with a simple policy-relevant distinction between just two groups: 'poor' and 'not poor'. Data on the percentage of population living below the poverty line were applied to the wealth index data to create this variable *(32,33).*

B. Health Indicators

The health indicators used were selected to match the MDG child health and maternal health indicators, with a few exceptions (see Table 1). Their nature varies, ranging from outcomes (underweight, child mortality), access to care or preventative interventions (skilled attendant at

birth, measles and DPT vaccination, contraceptive prevalence rate), knowledge (AIDS) to fertility-related or women's status indicators (age at first marriage).

C. Social Stratifiers

An equity analysis requires division of a population into groups according to underlying social advantage. The social stratifier most frequently associated with inequities is wealth - measured according to a set of assets the family has,[1] rather than monetary income or expenditure, and divided into quintiles. However, stratification by wealth alone is not the most appropriate way to measure inequities in health; in countries with extreme poverty, the wealthiest quintile often resides only the capital.

Furthermore, multiple dimensions of inequality within countries - age, urban-rural residence, gender, ethnicity, occupation, geographic survey region, and education level – necessitate tracking and additional stratifiers.[2] Choice of stratifiers (and health measure) must be calibrated based upon health and human rights challenges and policy needs and opportunities in each country (*34*,*35*). Here we use six key stratifiers to illustrate our overarching points about the need for more nuanced equity analysis (see Table 2).[3] Our selection of variables is not exhaustive and is constrained by current availability in the study countries. Our stratifiers may be themselves proxies for other factors of interest. For example, 'Education of the mother' is also an imperfect proxy of women's empowerment.[4]

The number of regions per survey varies with the size of the sample and other factors. Especially when used in combination with another stratifier, sample sizes in individual regions can become too small to yield meaningful results. Examination of interaction effects between stratifiers allows for the quantification of cumulative disadvantages of multiple risks. Thus,

---

[1] Household-level measures, such as family assets, ignore intra-household inequalities, such as those conferred by gender, age or position within the household family structure. Data permitting, these inequalities should also be evaluated

[2] Ethnicity is difficult to classify and categorization by race or ethnicity is often a sensitive and problematic endeavor. Race, language, geographic location, economic class or other attributes that align with ethnic divides in certain situations can be used as proxies to help collect data or design targeted programming. However, language and other proxies can also mask the diversity within an ethnicity. Where possible, ethnic data should be collected directly and the heterogeneity of any given group or community should be taken into account.

[3] Elsewhere we examine a more extensive suite of stratifiers and indicators (*37*) (The full dataset with 20 health indicators in six countries is available online: http://www.unmillenniumproject.org/who/tf4docs.htm).

[4] Other aspects of gender inequality, such as measures of household decision-making or mobility (*36*) may affect women's ability to receive health and family services, and where data permit, should be included in an equity analysis.

simultaneous stratification is important; we note parenthetically when the sample sizes are low the results will require caution in interpretation.

D. Methods

Cross-classification of indicators captures the complexity of health disadvantage. Simple stratification (bivariate analysis) was conducted for 11 health indicators. Wherever possible, the values for health indicators were calculated for all stratifiers (see Table 3). In order to assess their impact both independently and interactively, simultaneous stratification (trivariate analysis) was then performed for each pair of stratifiers.[5] For example, ethnic group health outcomes were classified by sex, region, residence, wealth, etc., to determine the compounded effect of dual forms of vulnerability. Some pairings were not generated in the simultaneously stratified analysis because doing so would result in the majority of classes being null (e.g. ethnicity with regions). Multivariate analysis was not undertaken in order to make a point about simplicity of study design and ease of replication. Finally, statistical significance of the inequities in health status was assessed to identify where gaps result from random variation rather than the statistically valid considerations sought for evidence-based policy making.

The majority of values presented are the percentage fulfilling the requirement of the indicator (e.g. receiving a measles vaccination, being underweight, or using a modern form of contraception). 'Age at first marriage' represents a mean. A difference between means test was calculated for each single stratification class (e. g. education) to represent probabilities of the null hypothesis: that the values of an indicator for all classes defined by the stratifier (e.g. none, primary, secondary or more) are not statistically significantly different from each other. Analagous tests were carried out for selected portions of the simultaneously stratified data.[6] Tests of significance were not performed on the mortality rate indicators, because they are rates rather than proportions. National-level standard errors from DHS reports can be used as a general indication of likely significance between groups for national mortality rates.

III. Results

[5] Mortality indicators were not included in the simultaneous stratification, because the number of events (deaths) is too small to construct robust rates.

[6] All differences mentioned in the text are statistically significant at 95 percent unless otherwise indicated.

Our results are grouped by indicator with a first paragraph presenting 'expected results' and a second paragraph detailing 'unexpected results.' The literature suggests that most indicators are differentiated by wealth quintile, with less differentiation where interventions tend to be more universal. In general, we expected rural health outcomes to be worse than urban, poor worse than not poor and we expected a certain degree of heterogeneity between regions and across ethnic groups. We expected stratification across education of the mother for all of the health indicators.

Underweight children

Expected results: In Ghana, Kenya, Ethiopia and Cambodia, education, ethnicity, region and residence all significantly stratify underweight. In Kenya and Ethiopia wealth by quintile and poverty line also significantly stratify underweight. Ethnicity and region—and not wealth —were found to have the widest range of values for underweight in Ghana. In Ethiopia, the pattern is slightly different with region and education of the mother showing the widest range of values—ethnicity appears to be less of a dramatic stratifier here. And in Kenya, the pattern differs again, with education of the mother, ethnicity, region and wealth quintile all showing roughly equivalent ranges of values. In the simultaneous stratification for Kenya, for each maternal educational level, the proportion of underweight children is two to four times as great for the children in the poorest households as compared to the wealthiest households.[7] Rural children are more likely to be underweight, especially in families where the mother has no or only primary education.

Unexpected results: Somewhat unexpectedly, in Ethiopia, wealth does not appear to prevent underweight children. Even in the highest wealth quintile, education matters more: Children of mothers with no education are twice as likely to be underweight and six times as likely to be severely underweight. In Cambodia, the urban bias is concentrated among mothers who completed schooling. Among those with no formal education in Cambodia, there is no difference between rural and urban levels of underweight children. Sex did not differentiate underweight status in any country studied.

Immunization:

Expected results: For most countries studied, DPT3 and measles immunization are significantly stratified by not just wealth quintile but also by education of the mother, ethnicity and region.

[7] Note that for 'no education', the difference is only significant at the 90% level.

Urban versus rural residence also stratified all immunization indicators for Ghana and Ethiopia, and this disparity improves significantly with the level of education of the mothers in Cambodia. The regional differences in measles and DPT3 immunization in Tajikistan range from just above 60% to over 90%.

Unexpected results: Surprisingly, for all countries studied, sex did not significantly stratify immunization at the bivariate level, with the exception of DPT3 in the Dominican Republic. Rural/ urban residence was not a strong factor in immunization disparities in Cambodia and Kenya. In Tajikistan, there is no stepwise pattern 'up the wealth ladder' for immunization. In Kenya, simultaneous stratification shows that ethnicity stratifies immunization, with less dominant ethnic groups falling well behind—but with boys and girls receiving immunization relatively equitably for measles and less equitably for DPT3 especially in the non-dominant group (see Table 4). Simultaneous stratification for Ethiopia also reveals gender inequity in DPT3 immunization: sons of uneducated women have higher rates than daughters, children of primary-educated women have more or less equal rates, and daughters of women with secondary or more schooling have higher rates than sons (see Table 5)[8]. In Kenya, sex differentials also emerge with simultaneous stratification, with 98% of urban boys vaccinated against measles compared to 90% of urban girls. Thus in several countries it appears that basic immunization is inequitably distributed, suggesting significant challenges for implementation of vertical programs.

Child mortality rates:

Expected results: In Ghana, Ethiopia, Kenya and Cambodia, educational level of the mother, region and residence stratify under-five mortality rates (U5MR). In Kenya, ethnicity dramatically stratifies U5MR, with a range from 35 to 253 across groups. Additionally, the expected stepwise decrease in U5MR with increasing wealth quintile is observed. The capital of Cambodia consistently shows the lowest mortality, with mortality rates in the next best region almost twice as high. In Ghana, inequality in childhood mortality is closely aligned with differences in education and place of residence: more highly educated women and urban dwellers have much lower child mortality. And in Ethiopia, educational level of the mother very significantly stratifies NNMR, IMR and U5MR.

[8] Results for 'secondary education' are significant at the 90% level.

Unexpected results: In contrast, in Ethiopia, wealth quintile and urban/rural distinctions are not particularly strong stratifiers of outcomes. In fact, the richest quintile differs little from the poorest. And in Kenya, it appears that the difference between no maternal education and primary education does not yield large disparities in U5MR. Likewise in Ghana, primary education actually yields a higher NNMR and IMR than no education.

Skilled birth attendants (SBA):

Expected results: Education, ethnicity, region, residence and wealth quintile all significantly stratify SBA usage in Ethiopia, Ghana and Kenya. For instance, in Ethiopia, major differences are evident when the indicator is stratified by educational level with 3% using SBA for those with no education, 10% for those with primary and 45% for those with secondary or more. In Kenya, the Mijikenda/Swahili ethnic groups were at a low of 27% and the Kikuyu at a high of 71%. Similarly, in Ghana, ethnicity appears to dramatically affect delivery by SBA, with a near two-fold, statistically significant difference between the primary dominant (63%) and the not dominant groups (34%). The non-poor are almost twice as likely as the poor to have an SBA in Kenya. In Cambodia, almost 90% of the births in Phnom Penh are assisted by SBAs, a high level of coverage contrasting with a national average of only one-third. Education and rural/urban residence also stratify SBA in Cambodia. In Tajikistan, 55% of the lowest quintile and 87% of the highest use SBAs, and the rural/urban differential is 68 versus 84 %.

Unexpected results: In Kenya, simultaneous stratification reveals dramatic inequities by education, region and residence even amongst the non-poor (see Table 6). In the Dominican Republic, where national levels are relatively high, there exists relative equity in delivery by SBA in terms of maternal education and urban/rural residence.

AIDS Knowledge:

Expected results: In Ghana, Ethiopia and Kenya, AIDS knowledge (both indicators, see Table 1) is stratified significantly by education, ethnicity, region and residence, suggesting a rather unequal spread and uptake of critical information and education about HIV/AIDS. In Cambodia, knowledge that a healthy-looking person may have AIDS and that using a condom during sex can help prevent HIV infection is significantly stratified by mother's level of education, despite high overall knowledge (national average above 80% for both indicators). In Tajikistan, rural populations have much lower levels of AIDS knowledge. Wealth differentiates only the richest

group—20% of the top quintile know that condoms help prevent infection, compared to less than 5% for the rest of the population—and large differences exist between regions. In the Dominican Republic, knowledge varies by region, with a range from 78 to 96% for the indicator on 'a healthy-looking person may have AIDS.'

Unexpected results: Regional variation was pronounced in most of the countries studied and ethnic variation was particularly pronounced in Ghana and Ethiopia.

Contraceptive Prevalence Rate (CPR) using a modern method:

Expected results: In Ethiopia, Kenya and Ghana, CPR (modern method) is stratified significantly by all stratifiers. In Tajikistan, there is a clear educational gradient, with those with no education at 16 %, 26% for secondary education and 41% for tertiary. By wealth quintile, there is relatively more equitable distribution, although the richer groups have greater prevalence.

Unexpected results: Surprisingly, in the Dominican Republic, the percentage of women using a modern method of contraception declines as education increases, and the differences are statistically significant. Among women with no education, CPR is significantly higher in urban areas, but among women with primary education, use rates are slightly but significantly higher in rural areas. CPR decreases significantly with education at all levels in urban areas, and from primary to secondary in rural areas. Region and residence are the main stratifiers in Cambodia, with formal education found to be insignificant to access. In Ethiopia, the expected education effect applies only in the capital.

Age at first marriage (AAFM):

Expected results: For all of the countries with this indicator, the data revealed statistically significant educational gradients--those with secondary education married at least a year and in some cases four years later than those with no education. Rural women married earlier than urban women. Regional variation for AAFM was pronounced—for example ranging from 13.7 to 18.4 across regions in Ethiopia. And ethnicity was a significant stratifier in Ethiopia but not in Ghana or Kenya.

Unexpected results: Wealth quintile makes a bigger difference in AAFM in Kenya (2.6 years' difference from lowest to highest quintile) than education does. Strikingly, in Ethiopia, ethnicity and region stratify AAFM with as much as three years' difference between population groups. In Cambodia, the urban/rural differential is not statistically significant amongst those with no education or those with secondary education but is larger and significant for those with primary education.

IV. Discussion and Conclusions

Inequities in health exist even in the poorest countries. The analysis presented has shown that inequity baselines can be created to illuminate how different indicators and social stratifiers yield different patterns of disparity. Using population based surveys, such baselines can be established even in data-poor countries.

A few limitations of the analysis deserve mention here. Despite the richness of the data, this brief snapshot of health inequalities is not intended to form the complete baseline in the countries considered. Data sources other than DHS and MICS may be more appropriate to track all health indicators in a manner explicitly tailored to national circumstances. Sub-sampling from vital registration system, demographic surveillance system (DSS) data and facility-based surveys are important complements (*38*,*39*). Shortcomings in sampling frames cause vulnerable population groups such as refugee populations, urban slum dwellers, orphans and linguistic minorities to be excluded from survey analyses.

Our results confirm that the current focus on pro-poor health policies is an oversimplification that omits other core sources of health inequities (*39*). Stratification by wealth, ethnicity, educational level of the mother, sex, region and urban/rural residence yielded statistically significant disparities across a wide range of health indicators in six countries. In many cases, the ethnic, educational and regional variations were more pronounced than the disparities by wealth level.

Regions are often co-terminus with ethnic divisions or poverty profiles, although this codetermination is only revealed by simultaneous stratification. For example, measles vaccination rates seem to vary considerably by wealth, but when regions are added as substrata it

becomes clear that some districts represent the bottom quintiles of the population. While wealth is an important focus, the geographic elements of poverty would have been overlooked without disaggregation. Understanding the correlates of poverty will be an important element in reducing it. This analysis implies that in many countries, reducing inequality in health will require tailoring policies to specific geographic areas. Thus, geographic identifiers should be added to all surveys, including MICS and DHS, to allow countries to georeference survey information.

In addition, educational attainment of mothers is a critical social determinant of most health indicators. Investments in education must be seen as having a dual positive effect in both the education and health sectors. Simultaneously, health messages and programs should be designed to reach less educated mothers and their children. And ethnicity, a core form of marginalization, remains understudied in the health and development literature.

Importantly, different health indicators yielded different patterns of inequity. For example, AIDS knowledge may be high and somewhat equitably distributed, but delivery by skilled birth attendant and U5MR within the same country may be grossly inequitable (as in Cambodia). Inferences about the nature or extent of inequities in health cannot be drawn from a single indicator. Nor can we assume that groups disadvantaged in one indicator are necessarily disadvantaged in another. Our analysis strongly suggests that reliance on single indicators alone—and certainly national level averages—would lead to limited, misguided recommendations for policy.

Countries should start with a clear health (in)equity *baseline* based on the MDGs but tailored to their unique socio-cultural dynamics. Once the (in)equity baseline has been established, the difficult work begins. What are the policies and programs that will address these critical issues? Standard behavioral and social science methods must also be used to explain and augment the data and analysis described here. Multivariate quantitative analysis and qualitative studies are required to clarify causal pathways that lead certain groups to be disadvantaged relative to others.

And the health MDGs—indeed all relevant MDGs—must be reframed to prioritize marginalized groups. Equitable progress toward the MDG targets would mean that the health outcomes of the

disadvantaged improve at the same or faster rates as the better-off groups (*2, 40*). Poverty reduction strategies, a key instrument of current development policy, must be synchronized with the MDGs (*41*). Then, policy changes aligned with PRSP and MDG priorities ought to be designed and tracked so as to measure progress from the (in)equity baseline.

Health exclusion results from multiple and overlapping forms of social exclusion, in addition to differences in health systems. The full array of underlying social determinants of health must be addressed in both health research and development policy (*19*). And rather than a patchwork of 'pro-poor' interventions and ad hoc targeted programs, universal health systems dedicated to the inclusion of all population groups are needed to build more efficient, equitable and healthier societies. Analysis of the type presented here is a feasible first step toward these goals and toward equitable achievement of the MDGs.

Acknowledgment

This article is an abbreviated version of a Background Paper prepared for Task Force 4 (Child Health and Maternal Health) of the UN Millennium Project. We are grateful to Paula Braveman for input at all stages of the background paper, Mushtaque Chowdhury and Cesar Victora for input during the early stage of conceptualization of the paper, Davidson Gwatkin and Jeanette Vega for comments on a near final draft and Lynn Freedman of Task Force 4 for support throughout the process. We would also like to thank James Connolly for statistical and editorial support and Meredith Slopen for editing this version of the paper.

1. Braveman P, Gruskin S. Poverty, equity, human rights and health. *Bulletin of the World Health Organization,* 2003, **81**(7):539-545.

2. Freedman L, Waldman R, de Pinho H, Wirth, M, Chowdhury AMR, Rosenfield, A. *Who's got the power? Transforming health systems for women and children.* UN Millennium Project Task Force on Child Health and Maternal Health. London, Earthscan, 2005.

3. Gwatkin DR. *Who would gain most from efforts to reach the Millennium Development Goals for health?: An inquiry into the possibility of progress that fails to reach the poor*. HNP Discussion Paper. Washington, DC, The World Bank, 2002

4. Gwatkin DR, Rutstein S, Johnson K, Suliman EA, Wagastaff A. *Initial country-level information about socio-economic differences in health, nutrition, and population.* Washington, DC, The World Bank, 2003.

5. Minujin A, Delamonica E. Mind the gap! Widening child mortality disparities. *Journal of Human Development,* 2003, **4**(3): 397-418.

6. Victora CG, Wagstaff A, Schellenberg JA, Gwatkin DR, Claeson M, Habicht JP. Applying an equity lens to child health and mortality: more of the same is not enough. *Lancet,* 2003: **362**(9387):233-41.

7. Segone M. *Child poverty in Niger: longitudinal, gender, spatial and wealth analysis based on DHS 1992, MICS 1996, DHS 1998 and MICS 2000.* (Draft). UNICEF, October 2001.

8. Evans T, Whitehead M, Diderichsen F, Bhuiya A, Wirth M. *Challenging Inequities in Health: From Ethics to Action*. New York, Oxford University Press, 2001.

9. AbouZahr C, Wardlaw T. *Antenatal care in developing countries: Promises, achievements and missed opportunities: An analysis of trends, levels and differentials, 1990-2001*. WHO/UNICEF, 2004.

10. Victora CG, Vaughan, JP, Barros FC, Silva AC, Tomasi E. Explaining trends in inequities: evidence from Brazilian child health studies. *Lancet,* 2000, **356**(9235).

11. Wagstaff A. Poverty and health sector inequalities. *Bulletin of the World Health Organization,* 2003, **80**(2): 97-105.

12. Kunst A, Houweling T. A global picture of poor-rich differences in the utilisation of delivery care. In: Van Lerberghe W, De Brouwere V, eds. *Safe motherhood strategies: a review of the evidence*. Antwerp, ITG Press, 2001.

13. Schellenberg JA, Adam T, Mshinda H, Masanja H, Kabadi G, Mukasa O et al. Inequities among the very poor: healthcare for children in rural southern Tanzania. *Lancet*, 2003, **361**(9357): 561-66.

14. Wagstaff A,Watanabe N. *Socioeconomic inequalities in child malnutrition in the developing world*. Policy Research Working Papers. Washington D.C., The World Bank, 2000.

15. Wagstaff A, Bustreo F, Bryce J, Claeson M, Axelsson H. *Inequalities in child health: are we narrowing the gap?* HNP Discussion Paper. Washington D.C., The World Bank, 2003.

16. Castro-Leal F, Dayton J, Demery L, Mehra K. Public spending on health care in Africa: Do the poor benefit? *Bulletin of the World Health Organization*. 2000, **78**(1): 66-74.

17. McIntyre D Gilson L. In collaboration with EQUINET, the Regional Network for Equity in Health in Southern Africa. *Equitable health care financing and poverty challenges in the African context.* Paper Presented to Forum 9, Global Forum for Health Research Mumbai, September 12-16th, 2005. http://www.equinetafrica.org/bibl/docs/McIfin092005.pdf, Accessed October 1, 2005.

18. Casas JA, Dachs NW, Bambas A. Health disparities in Latin America and the Caribbean: the role of social and economic determinants. In: *Equity and Health: Views From the Pan American Sanitary Bureau*. Washington, DC, Pan American Health Organization, 2001.

19. Marmot M. Social determinants of health inequalities. *Lancet*, 2005, **365**:1099-104.

20. Vandemoortele J. *Absorbing social shocks, protecting children and reducing poverty: The role of basic social services*. UNICEF staff working papers, Evaluation, Policy and Planning Series no. 00-001. New York: UNICEF, 2000.

21. National Institute of Statistics, Directorate General for Health [Cambodia], and ORC Macro. *Cambodia Demographic and Health Survey 2000.* Phnom Penh, Cambodia, and Calverton, Maryland, USA, National Institute of Statistics, Directorate General for Health, and ORC Macro, 2001.

22. National Council for Population and Development (NCPD), Central Bureau of Statistics (CBS) (Office of the Vice President and Ministry of Planning and National Development) [Kenya], and Macro International Inc. (MI). *Kenya Demographic and Health Survey 1998*. Calverton, Maryland, NDPD, CBS, and MI, 1999.

23. Ghana Statistical Service (GSS) and Macro International Inc. (MI). *Ghana Demographic and Health Survey 1998*. Calverton, Maryland, GSS and MI, 1999.

24. Central Statistical Authority [Ethiopia] and ORC Macro. *Ethiopia Demographic and Health Survey 2000*. Addis Ababa, Ethiopia and Calverton, Maryland, USA, Central Statistical Authority and ORC Macro, 2001.

25. Centro de Estudios Sociales y Demográficos (CESDEM) and MEASURE DHS+/ORC Macro. *República Dominicana Encuesta de Demografía y Salud 2002*. [Dominican Republic Demographic and Health Survey 2002] Calverton, Maryland, USA, Centro de Estudios Sociales y Demográficos, CESDEM and MEASURE DHS+/ORC Macro, 2003. In Spanish.

26. United Nations Children's Fund (UNICEF). *Multiple Indicator Cluster Survey (MICS): Tajikistan*. Dushanbe, UNICEF, 2000.

27. Rutstein SO, Rojas G. *Guide to DHS Statistics*. Calverton, Maryland, ORC Macro, 2003.

28. Brockerhoff M, Hewett P. *Ethnicity and child mortality in sub-Saharan Africa*. Policy Research Division Working Paper No. 107. New York, The Population Council, 1998.

29. Moyo S. *Socio-economic dominance of ethnic and racial groups – the African experience.* Human Development Report Office. Occasional Paper, Background Paper for HDR 2004. 2004/8. New York, United Nations Development Programme, 2004.

30. Filmer, D, Pritchett L. Estimating wealth effects without expenditure data--or tears: an application to educational enrollments in states of India. *Demography,* 2001, **38**(1):115-32.

31. Sahn DE, Stifel DC. Poverty comparisons over time and across countries in Africa. *World Development* 2000, **28**(12):2123-2155.

32. UNDP (United Nations Development Programme). *Human Development Report 2001: Making Technology Work for Human Development*. New York, Oxford University Press. [http://hdr.undp.org/reports/global/2001/en/]. 2001.

33. UNDP (United Nations Development Programme). *Human Development Report 2003: Millennium Development Goals: A Compact among Nations to End Poverty*. New York, Oxford University Press, 2003.

34. Bambas Nolen L, Braveman P, Dachs JNW, Delgado I, Gakidou E, Moser K et al. Strengthening health information systems to address health equity challenges. *Bulletin of the World Health Organization*, 2004, **83**:597-603.

35. Braveman P. *Monitoring inequities in health: a policy-oriented approach in low- and middle-income countries*. WHO/CHS/HSS/98.1. Geneva, World Health Organization, 1998.

36. Balk D. Defying gender norms in rural Bangladesh: a social demographic analysis. *Population Studies*, 1997, **51**(2): 153–172.

37. Balk D, Wirth M, Delamonica E, Storeygard A, Sacks E, Minjin A. Multidimensional disparities in maternal and child health: Measuring a baseline, monitoring the future. In: Minujin A, Delamonica E, eds. *Poverty and Children. Policies to break the vicious cycle.* New York: New School University Press, forthcoming.

38. Ngom P, Phillips J, Pence B, MacLeod B. *Demographic surveillance and health equity in sub-Saharan Africa: past and present efforts.* African Population and Health Research Center. Working Paper Series. Nairobi: APHRC, 2003.

39. Vega J, Irwin A. Tackling health inequalities: new approaches in public policy. *Bulletin of the World Health Organization*, 2004, **82**(7): 482.

40. Minujin A, Delamonica E. *Equality matters for a world fit for children: Lessons from the 90s*. UNICEF Staff Working Papers, Division of Policy and Planning Series (Draft, Number DPP-03), New York, UNICEF, 2003.

41. UN Millennium Project. *Investing in Development: A Practical Plan to Achieve the Millennium Development Goals. Overview*. 2005.

Table 1. Definition of indicators used

Variable	Closest Related MDG Goal	Target	Indicator	Indicator Definition
Under-five Mortality Rate (U5MR)	4	5	13	*Mortality rate for children under five years old, per 1,000 live births*
Infant Mortality Rate (IMR)	4	5	14	Mortality rate for children under one year old, per 1,000 live births
Neonatal Mortality rate (NNMR)				Mortality rate for children under 30 days old, per 1,000 live births
Underweight	1	2	4	*%age of children under age five moderately or severely underweight*
Knowledge of AIDS	6	18	19b.	*%age of population aged 15-24 years with comprehensive correct knowledge of HIV/AIDS (UNICEF-WHO)* HIV knowledge, women aged 15-24 who know that a healthy-looking person can transmit HIV, % (UNICEF-UNAIDS-WHO) HIV knowledge, women aged 15-24 who know that a person can protect herself from HIV infection by consistent condom use, % (UNICEF-UNAIDS-WHO)
CPR	6	18	19c.	*Contraceptive prevalence rate (UN Population Division)* Contraceptive use among currently married women aged 15-49, modern methods, % (UN Population Division) (DHS definition of modern method: pill, IUD, injections, condom, female sterilization, male sterilization, implants, lactational amenorrhea, foam or jelly, emergency contraception; does not include withdrawal or periodic abstinence or folk methods; MICS definition is similar)
Measles	4	5	15	*Proportion of 1 year-old children immunized against measles (UNICEF-WHO)*
DPT3				Proportion of 1 year-old children immunized against Diphtheria, Pertussis and Tetanus (three doses)
Skilled Birth Attendant	5	6	17	*Proportion of births attended by skilled health personnel (UNICEF-WHO)* Refers exclusively to people with midwifery skills (for example, doctors, midwives, nurses) who have been trained to proficiency in the skills necessary to manage normal deliveries and diagnose or refer obstetric complications
Age at First Marriage				Average age at first union

Table 2. Definition of Stratifiers Used		
Stratifier	**Definition**	**Adjustments**
SEX	*Sex of child*	
EDUCATION	*Mother's highest level of education*	Grouped into None, Primary and Secondary. Non-formal curricula and strictly religious education excluded
RESIDENCE	*Urban or Rural*	
ETHNICITY	*Country-specific*	Uses standard DHS recodes (not available in MICS)
ETHNICITY RECODE (recoded by group dominance)	*Country-specific*	Divided into dominant, non-dominant, and secondary dominant (where available)
WEALTH by QUINTILE	*Quintiles of wealth (country-specific)*	Ranges from 1 = "poorest" to 5 = "richest"
WEALTH by POVERTY LINE	*Above or below national poverty line*	Poverty data from UNDP (32, 33) applied to the wealth index data to create two groups: ‘poor’ and ‘not poor’
REGION	*Country-specific*	

Table 3 Available Stratifiers for the Six Countries Analyzed

	Country						
Available Data		Cambodia	Dominican Republic	Ethiopia	Ghana	Kenya	Tajikistan
	Maternal Education	X	X	X	X	X	X
	Ethnicity			X	X	X	
	Ethnicity Recode	X		X	X	X	
	Sex	X	X	X	X	X	X
	Region	X	X	X	X	X	X
	Residence (Urban/Rural)	X	X	X	X	X	X
	Wealth by Quintile			X		X	X
	Wealth by Poverty Line			X		X	
	Note: National averages are available for all indicators in all countries. Some data, while available, was not calculated for mortality rates due to the difficulty of calculating a rate rather than a percentage (this is especially true for stratification by ethnicity).						

Table 4 Immunization in Kenya stratified by ethnicity grouping and sex

	DPT3			Measles		
Ethnicity Groupings	Male	Female	*Significance (p-value)* [a]	Male	Female	*Significance (p-value)* [a]
Dominant - Primary	91	96	*0.25*	97	99	0.31
Dominant - Secondary	78	91	*0.02*	83	83	0.99
Not Dominant	80	72	*0.02*	76	75	0.59
Significance (p-value) [b]	*0.18*	*0.00*		*0.00*	*0.00*	

Source: (*22*)

[a] The null hypothesis is male and female are the same in each row.

[b] The null hypothesis is that within this stratifier and each column, all ethnicity groups are the same

Table 5: Immunization in Ethiopia stratified by maternal education and sex

	DPT 3			Measles		
Maternal education	Male	Female	*Significance (p-value)* [a]	Male	Female	*Significance (p-value)* [a]
None	19	13	*0.05*	25	20	*0.45*
Primary	37	34	*0.65*	39	39	*0.89*
Secondary	53	59	*0.07*	48	76	*0.97*
Significance (p-value) [b]	*0.00*	*0.00*		*0.00*	*0.00*	

Source: (*24*)

[a] The null hypothesis is male and female are the same in each row.

[b] The null hypothesis is that within this stratifier and each column, all educational groups are the same

Table 6: Delivery assistant in Kenya: Poverty status simultaneously stratified by education, region and residence

		Poverty Line		
		Not Poor	Poor	*Significance (p-value)*[a]
Education	None	40	19	*0.00*
	Primary	45	24	*0.00*
	Secondary or more	77	43	*0.00*
	Significance (p-value)[b]	*0.00*	*0.00*	
Region	Central	70	n/a	*n/a*
	Coast	49	14	*0.00*
	Eastern	56	31	*0.00*
	Nairobi	78	n/a	*n/a*
	Nyanza	52	24	*0.00*
	Rift Valley	50	24	*0.00*
	Western	39	26	*0.00*
	Significance (p-value)[b]	*0.00*	*0.00*	
Residence	Rural	49	25	*0.00*
	Urban	72	40	*0.01*
	Significance (p-value)[b]	*0.00*	*0.01*	

Source: (22)

Note: N/A indicates that the cell comprises fewer than 25 cases.

[a] The null hypothesis is that poor and non-poor are the same in each row.

[b] The null hypothesis is that within this stratifier (i.e., education, region or residence) and each column, all classes are the same.