Shaping the world to illustrate inequalities in health

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Visualizing inequalities in health at the world scale is not easily achieved from tables of mortality rates. Maps that show rates using a colour scale often are less informative than many map-readers realize. For instance, a country with a very small land area receives less attention, whereas a large, sparsely populated area on a map is more obvious. Furthermore, unlike our visual ability to compare the lengths of bars in a chart, we do not have a natural aptitude for translating different colours or shades to the magnitudes they represent. Here we introduce another approach to mapping the world that can be useful for illustrating inequalities in health.

Where do you think most infants in the world are born, where do most die and how have these measures changed since 1970? A map of birth rates would not help you much, unless you had the kind of memory that could associate several hundred areas with counts of their populations of young women, and had the ability to perform some quick mental arithmetic of rate reciprocals. Nor would maps of death rates help much in answering these questions. Seeing the world shaped by how many babies are born in a year is a more reliable and rapid way of communicating these numbers (Fig. 1).

This figure was created using software derived from that which is freely available online.[1] The software changes the sizes of countries to represent the proportion of all children worldwide who were born there. This is done by equalizing the densities of a measure such that a country that is physically quite small but with many births increases in size (e.g. Guatemala), while somewhere with a large area but few births shrinks (e.g. Australia). Each birth is allocated the same amount of space, and thus country borders are stretched and crumpled around these adjusted areas.[2,3]

Very few people can identify most countries of the world on an unlabelled conventional world map. Country identification can be even more difficult on the cartogram that is Fig. 1, given the distortion from the world shape that we are used to seeing. However, this particular cartogram does have the advantage of inviting the reader to focus on identifying those countries in which most of humanity is born. And as the topology of the planet is preserved and the shape often not too distorted, this is not too difficult a task,[4] and is far easier than imagining rates from colours. The shades in Fig. 1 are there to allow the matching of countries between the different maps in this paper. Compare Fig. 1 to Fig. 2 – countries that are larger in the former have lower rates of infant death, and vice versa.

Fig. 2 is shaded and made identically to Fig. 1, except now the countries are sized by the numbers of infants who died in each country in their first year of life in the year 2002. By comparing the two maps you gain an impression of not just where rates are higher or lower than the world average, but also of how many infants are affected by these inequalities. In both maps, the total areas of all countries are identical. Our ability to gauge and compare areas is not great; it is worse than our general visual aptitude for comparing lengths. But if, when comparing these two maps, you think you are benefiting from this despite almost certainly already being aware of these inequalities, then these maps should be useful for those less familiar with this subject.

There are of course limitations of the data, as well as of the technique. In only a minority of countries are all births and deaths registered, so these maps mostly show estimates. However, to varying degrees that is true of all such data. Because the quality of data varies between countries, there is a danger of these images inviting flawed comparisons to be made. It is not possible to show "missing data" on these maps; giving them zero area would imply no births or deaths. That would mean that countries experiencing some of the worst of times might be ignored, as they often are when missing from official tabulations. The disadvantage of estimating data is that the numbers for countries such as Afghanistan, Iraq and Somalia may not be quite as accurate as others. However, the degree of inaccuracy involved with these figures is probably less than the error in your visual estimation. Just how circle-shaped a country is can affect how large you think it is.

These maps use countries as their unit of analysis, thus obscuring subnational variations which themselves are sometimes greater than the international variations. To use cartograms at a smaller scale would require finer-grained data, which is subject to the same limitations as country-level data. Also, there are inevitable variations in data collection or estimation, definitions used and varying political motives behind particular numerical descriptions of health in different places. As is the case with national data, those areas that are the most disrupted are often where we know least about what is going on. Nevertheless, for policy and planning such maps could be an effective tool to draw attention to what is happening where, and to possibly guide resource allocation. An example of the political use of these maps was that they were used in the 2006 International Monetary Fund discussions about vote redistribution.[5]

Map area can be used to show something that requires urgent action, such as high infant deaths, but it can also show successes such as large decreases in those deaths. If we can map something that is happening, we can also map its inverse – where it happens less over time, it is also possible to show these changes. Fig. 3 illustrates the extent of improvement in infant mortality over the past three decades in terms of the number of infants who survived until their first

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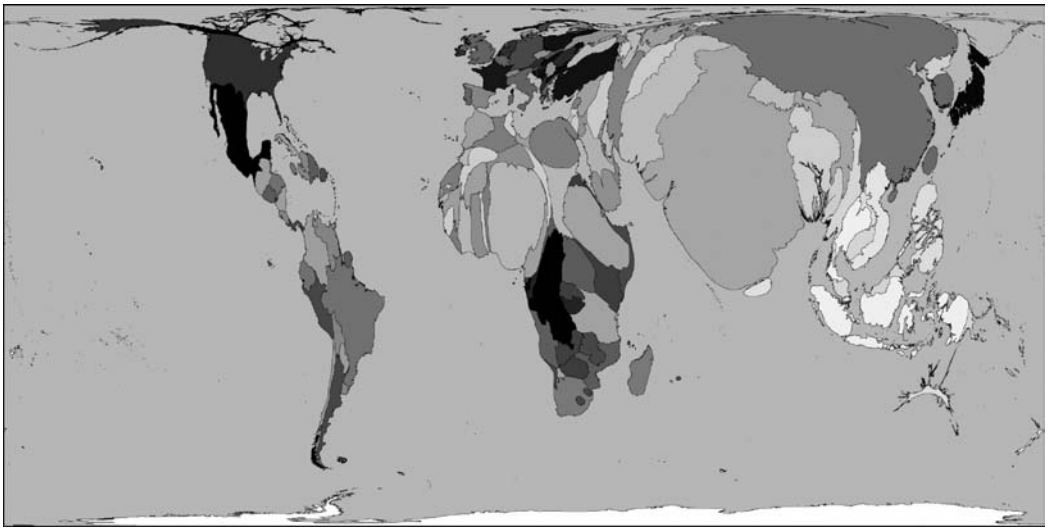
Fig. 1. **Worldmapper map 3: total births**[a]



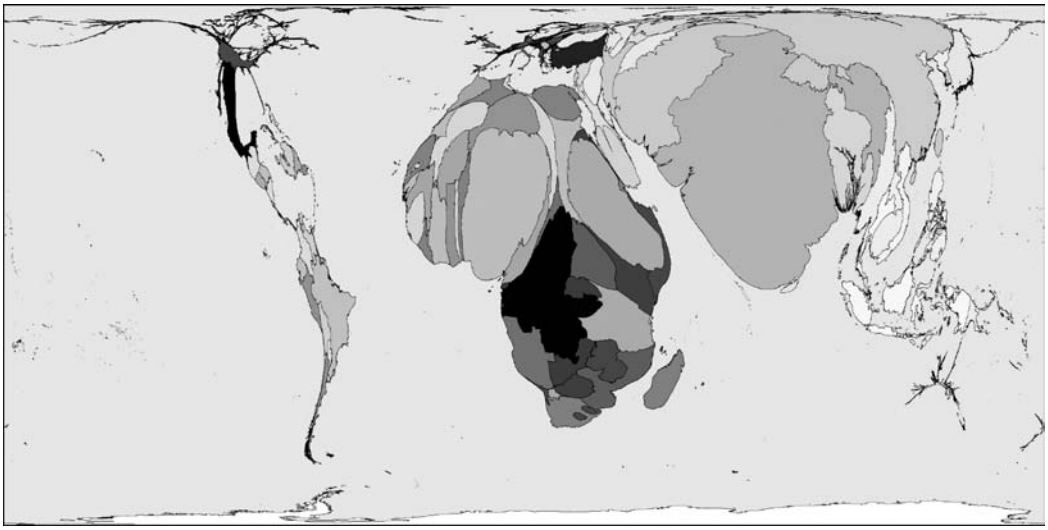
[a] This map shows the proportion of the world's total births for each territory in the year 2000.

birthdays in 2002 who would have died had the infant mortality rates of 1970 continued. Reading Fig. 3 in conjunction with Fig. 2, we can develop a sense of where improvements have occurred in the context of where most infant deaths still happen.

No country experienced an increased rate of infant mortality between 1970 and 2002, but if one had there would be no difference in its appearance on Fig. 3 from if the mortality rate had remained the same: it would still have zero area. Maps of change over time are limited because these two-dimensional images cannot be easily used to express negative area – so increases and decreases cannot be drawn on the same map. Comparing between maps showing the inverse of the same variable or showing different variables can help us to see certain patterns. Yet there are other patterns that are much more clearly expressed by different means. Fig. 4 shows the percentage change in infant mortality by region – it provides a clear depiction of how closely a region's position on the Human Development Index (by which the regions are ordered) relates to the extent of improvements to infant mortality. Read in conjunction with the other figures, we can see changes in the rates as well as where these improvements are happening, and get a sense of the distribution of how and where children are living longer.

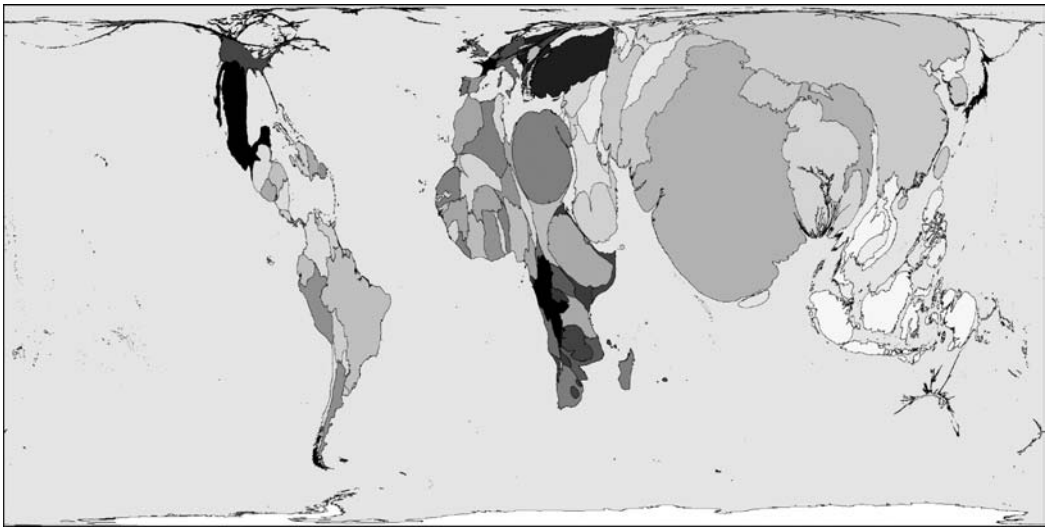
In reading these maps it is worth considering what is being shown and not shown, and what insights you are

Fig. 2. **Worldmapper map 261: infant mortality**[a]



[a] Territory size shows the proportion of infant deaths worldwide that occurred there in 2002. Infant deaths are deaths of babies during their first year of life.

Fig. 3. **Worldmapper map 262: infant mortality change**[a]

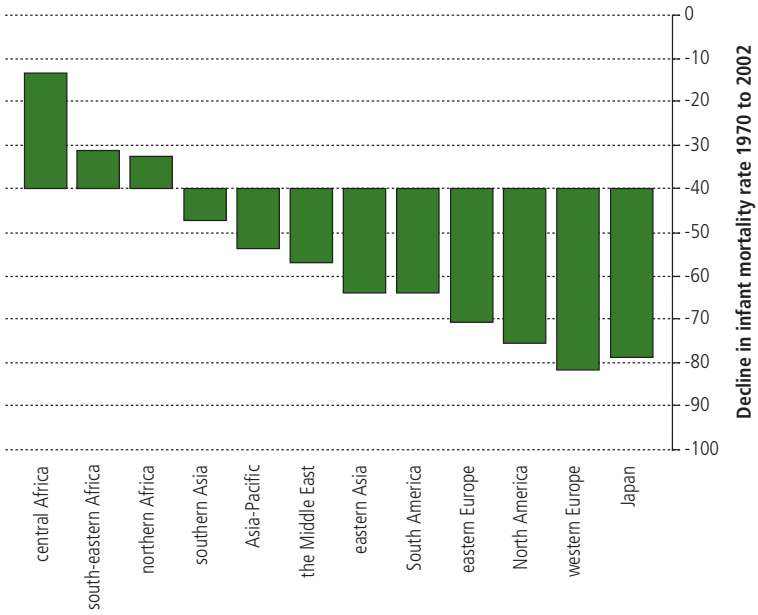


[a] Territory size shows the proportion of all reduction in infant mortality worldwide, between 1970 and 2002, which has occurred there. The map shows the number of children born in 2002 who will reach their first birthday, when their counterparts in 1970 did not.

gaining. Keeping in mind the international variability in data quality and availability, do you now have an improved sense of the worldwide distribution of births, of infant mortality and of the extent of improvements in infant mortality? In doing this, we can see that some of the poorest countries in the world, where there were the most infant deaths in 2002, have seen far fewer infants die than did at 1970s rates. However, the graph informs us that it is in the richer countries where the largest proportionate improvements in infant mortality rates have occurred; these are territories where there were relatively few deaths to begin with.

The three maps that are shown here form part of series that is freely available at www.worldmapper.org. Other maps in the series include health-care provision, distribution of disease, wealth, poverty, trade and pollution.[6] The web site is about to launch a series of maps of the distribution of different causes of death based on World Health Organization Global Burden of Disease data. Each map is accompanied by data sheets, technical notes and a downloadable poster. Hopefully this website allows viewers to not only see one country in its global context, but also to see one element of our lives in relation to another. ■

Fig. 4. **Decline in rate of infant mortality, 1970–2002**[a]



[a] The order of the regions is based on the average Human Development Index of people living there. 40% is the world average decline in infant mortality rates over this period.

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