The burden of disease in Europe: West to East

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Abstract

Aim: The burden of disease among populations is not spread evenly across Europe. Some nations in Europe have the lowest disease burden in the world, while some lag far behind among industrialized nations. These differences make real-world impacts in the lives of the residents of Europe, and are thus important to investigate. The objective of this paper was, firstly, to examine the correlation between the geographic locations of nations in Europe and the amount of burden of disease accumulated by their populations. Looking further, to correlate the burden of disease with the amount spent on healthcare per capita in these nations. Finally, to investigate the question of how health system efficiency is affected by healthcare spending.
Methods: Using data concerning burden of disease, healthcare spending and health system efficiency, correlations were made both visually and numerically in order to show the results.
Results: There is a strong correlation between the high number of DALY's accumulated by a population and living in Eastern Europe. This is related to low healthcare spending and lack of efficiency in the health systems of these nations.
Conclusion: In order to reduce the burden of disease in Eastern Europe when compared to Western Europe, healthcare spending per capita must be increased to reach a minimum level where efficient practices can take place and DALY's can be reduced.

Keywords: burden of disease, Eastern Europe, healthcare spending, health systems, Western Europe.

Introduction

Since the breakup of the Soviet Union and the fall of socialism in eastern and central Europe, nations whose socioeconomic and political institutions were formerly state-controlled and centralized have been transitioning to a market-based system which has more in common with Western Europe (1). Despite improvements in the economies of these nations since the early 1990's, the health of their populations still lags far behind that of western and northern Europe (2). In this study, we will explore the link between the political geography of Europe and the distribution of the burden of disease across the continent. Further, we will investigate healthcare spending and health system efficiency as possible reasons for such large gaps in population health among neighboring nations. For convenience, the formerly socialist states in central and eastern Europe will be abbreviated CEE.

Burden of disease

The concept of burden of disease in combination with the DALY (disability-adjusted life year) unit of measurement has, since 1994, provided a tool with which to compare the relative health of differing populations (3). These populations differ not only in geographic location, but also in economic productivity and in health system effectiveness. The DALY serves as a unit of measurement for the burden of disease. The concept of burden of disease is important because it provides a comparable (across differing populations) measurement of health with which to allocate service and research (4). One DALY is, in essence, one year of healthy life lost. In order to calculate the DALYs for a population or an individual, the years of life lost (YLL) and the years lived with a disability (YLD) are added together (3). The time spent with a disability or disease is counted as portions of a year, based on the severity and duration of the disorder. In this way, communicable diseases, non-communicable diseases, mental and physical disorders, and premature deaths are all taken into account when calculating the health of a population or an individual.

Previous studies

No previous studies could be found which specifically examined the correlation between political geography and burden of disease in Europe. Haomiao and Lubetkin (5) do use geographic patterns in their assessment of burden of disease from smoking in the United States. However, they do not attempt to describe correlations in geographically directional terms, perhaps because geographically diverse states have similar trends which do not correlate in a linear fashion. Valent et al. (6) use three World Health Organization subregions for Europe in their study of burden of disease in adolescents. In this case, nations in the European region are divided into EurA, EurB, and EurC based on adult and child mortality.

Methods

As a first step in data analysis, a map of the study area was created which assigned a magnitude of eastness to each European country. The choice was made to only include those countries with a population of more than 1,000,000 residents for the sake of clarity and in order to exclude Iceland, which would have been an outlier in the geography of Europe. The longitude of 10°W of the Prime Meridian was assigned a value of '0'; the longitude 40°E therefore has a value of '50'. Beginning with Ireland and Portugal in the west, the magnitude of eastness gradually increases, cumulating with Russia which has the maximum magnitude of 50. In order to assign the longitude, publicly available maps of Europe with the coordinate system included were used (7).

The data for the number of DALY's accrued per 100k people was sourced from the World Health Organization global burden of disease update for 2004 (8). Due to the fact that older populations tend to have a higher prevalence of disease, countries with older demographics accrue more DALY's. For this reason, age-standardized DALY's were used in order to more accurately compare nations with differing age distributions. The source used for "per capita total expenditure on health" was the World Health Organization's World Health Statistics for 2013 (9). The measure of per capita expenditure was used because it provides data which is more reflective of the actual money spent per person than a ratio measurement such as "total expenditure on health" as a % of GDP. Purchase power parity

Figure 1. The relative geographic location of nations in Europe with >1,000,000 residents
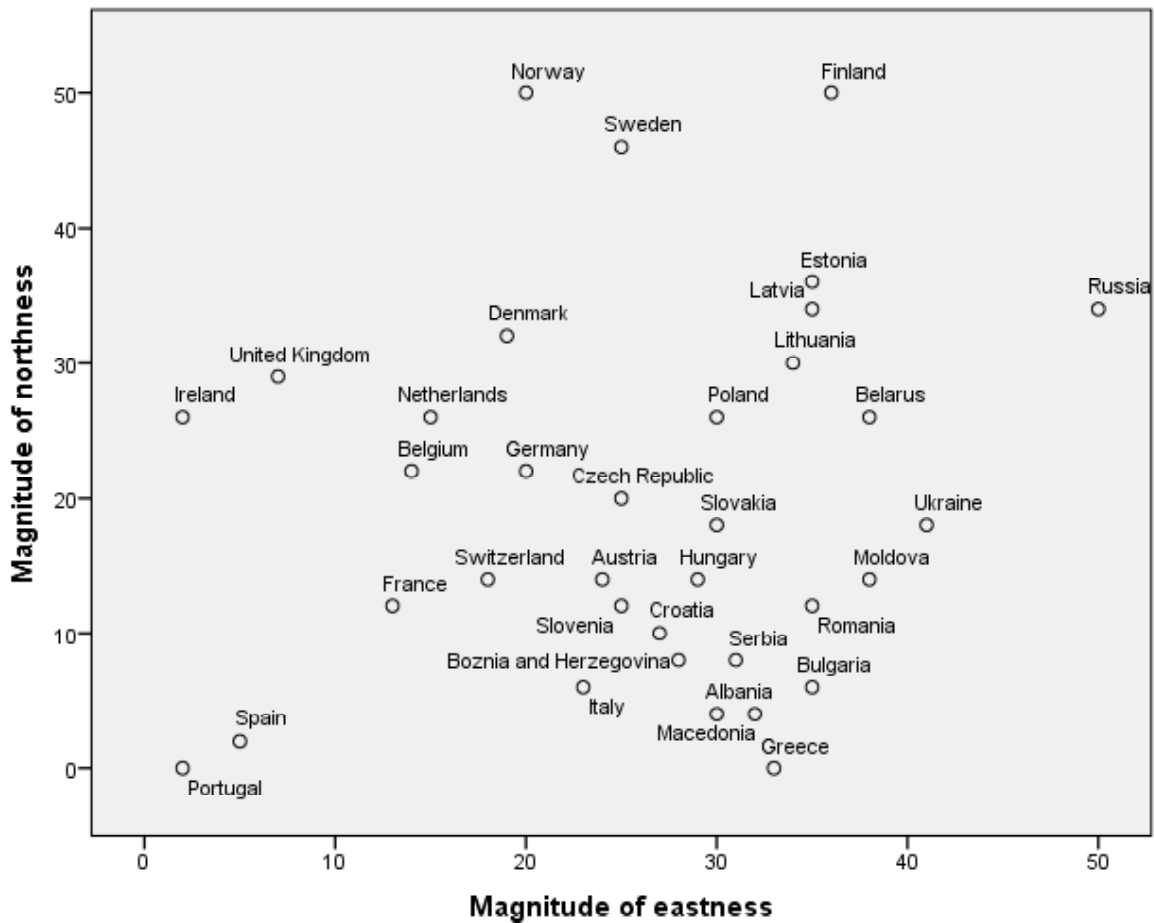
(PPP) was also used as opposed to average exchange rate because this further gives a more accurate comparison of the money spent on healthcare in countries with differing currencies and economic performance (10). Thus, the monetary value of the health expenditures are expressed in terms in international PPP dollars. The data was compiled, and IBM's SPSS statistical software was used as a display and analysis tool.

Results

The result from a comparison of the magnitude of eastness to the number of age-standardized DALY's accumulated per 100k people in a population shows a strong trend in increasing number of DALY's as one travels from west to east through Europe. This increase, however, only occurs after travelling past central Europe, using the German-Polish border as a dividing line. Finland and Greece are two notable nations who go against the trend by having low DALY's but who lie in the eastern part of Europe. From the scatterplot below, it is shown that there is a slight dip (an improvement in health) in the region between France and Germany, traditionally considered to be the most economically productive region of the continent. The correlation calculated between high DALY's and eastness is 0.754 using the Pearson method of linear correlation. This is on a scale of -1 (perfect negative correlation) through 0 (no correlation) to 1 (perfect positive correlation). The result shows that there is a high and statistically significant correlation between eastern European nations and a high accrual of DALY's by their populations.

Table 1. The correlation and significance of DALY distribution west to east

	Magnitude of eastness	
Age-Standardized DALY's per 100k people	Pearson Correlation	0.754*
	Sig. (2-tailed)	<0.001
	N	35

* Correlation is significant at the 0.01 level (2-tailed).

Figure 2. Distribution of units of DALY's per 100k residents when compared to the magnitude of eastness
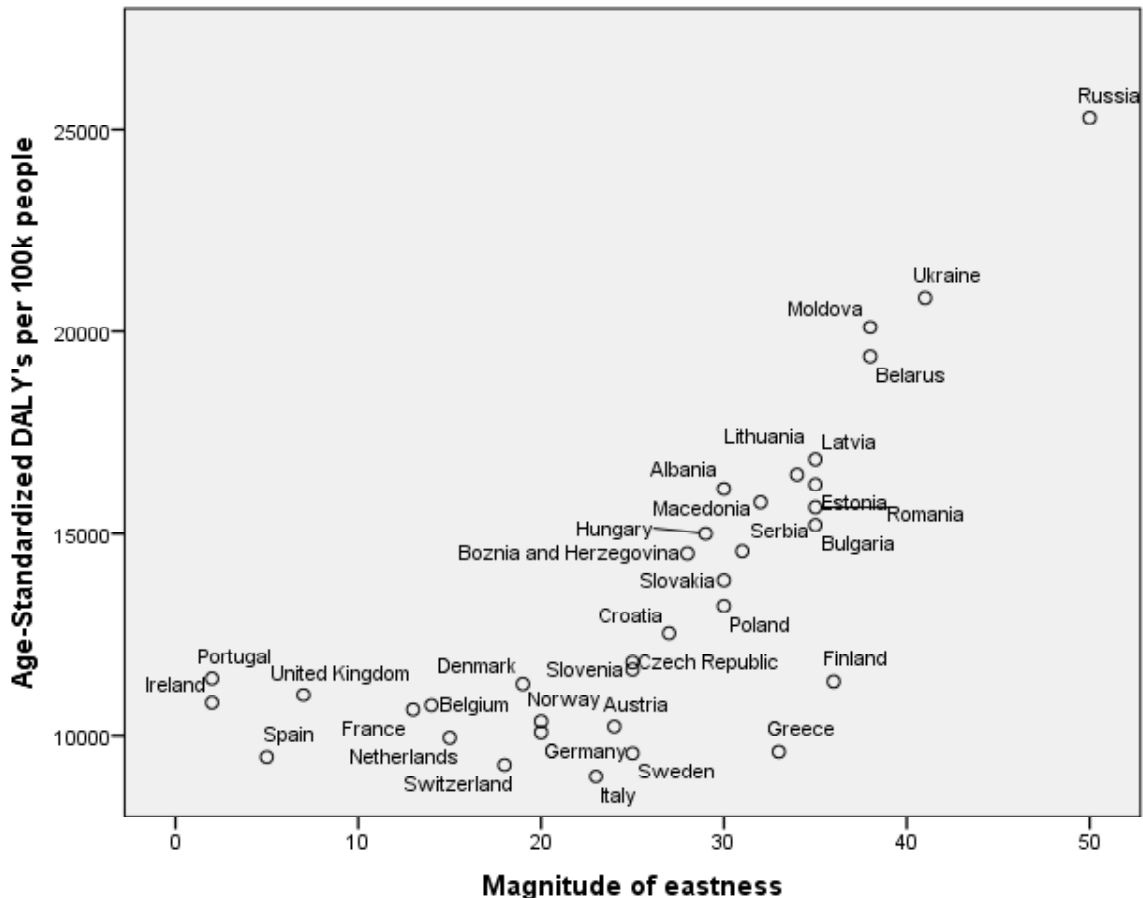
Healthcare spending

Having established the fact that nations in Eastern Europe have a higher overall DALY accrual rate than nations in Western Europe, it was important to establish what factors might be influencing this discrepancy. Because economic factors were suspected to be at work, an examination of the relationship between healthcare expenditures per capita (in PPP international $'s) and the DALY's accumulated by that population was performed. A graphical representation of the results is displayed below.

It is evident from this graphical summary that the less money is spent per person on healthcare, the more DALY's a population will accrue. The correlation coefficient is - 0.777, meaning that there is a strong correlation between low per capita healthcare spending and poor health. Due to the weak economic performance of eastern European

Figure 3. The relationship between sending on health and accumulation of DALY's
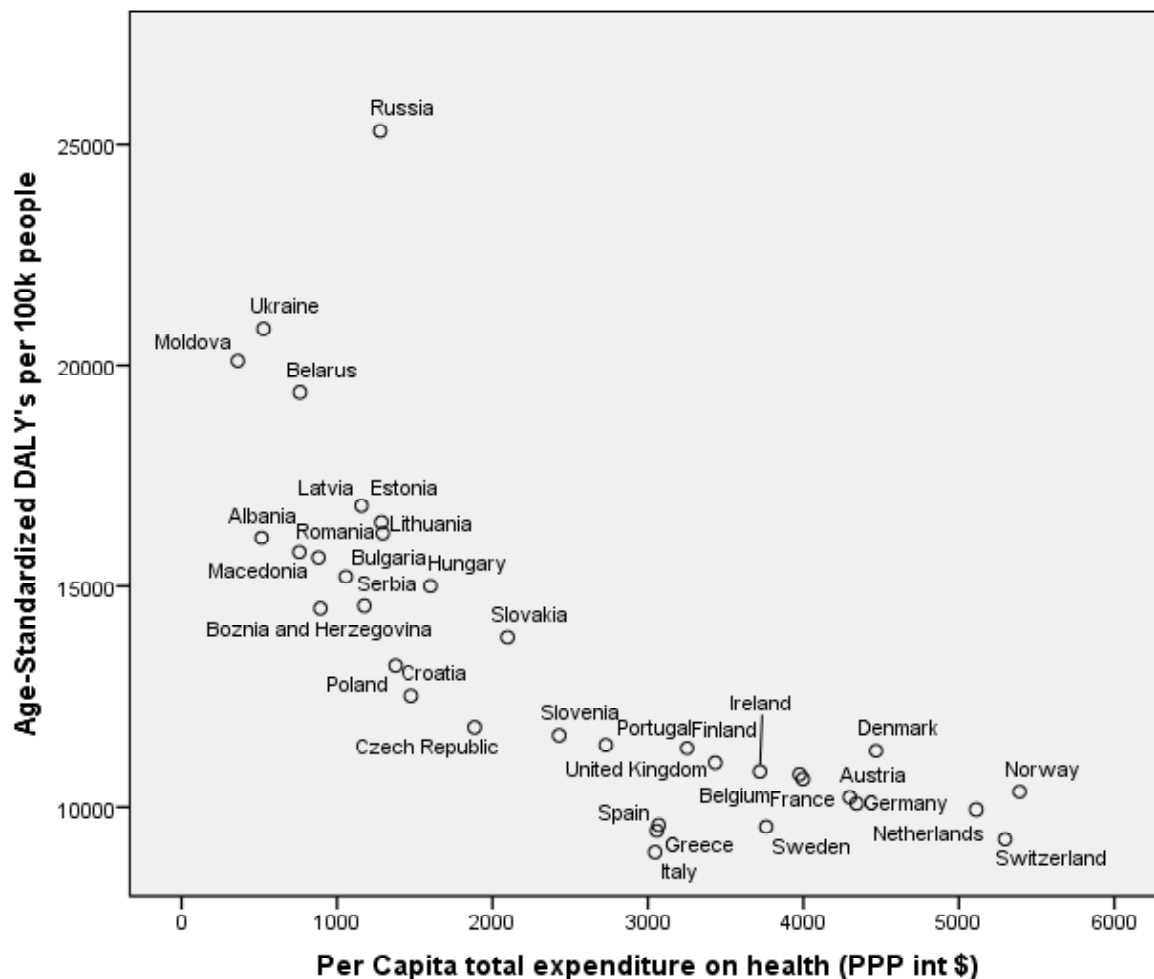
nations compared with their western neighbors, the amount of money necessary in order to reduce the number of DALY's accumulated by eastern populations is not forthcoming. One further note on this data: using the previous chart as an indication, there is little overall improvement in population health between int$3000 and int$5500 spent per capital on healthcare. It seems probable from this data that at some point additional healthcare expenditures do little to improve overall population health in wealthier nations.
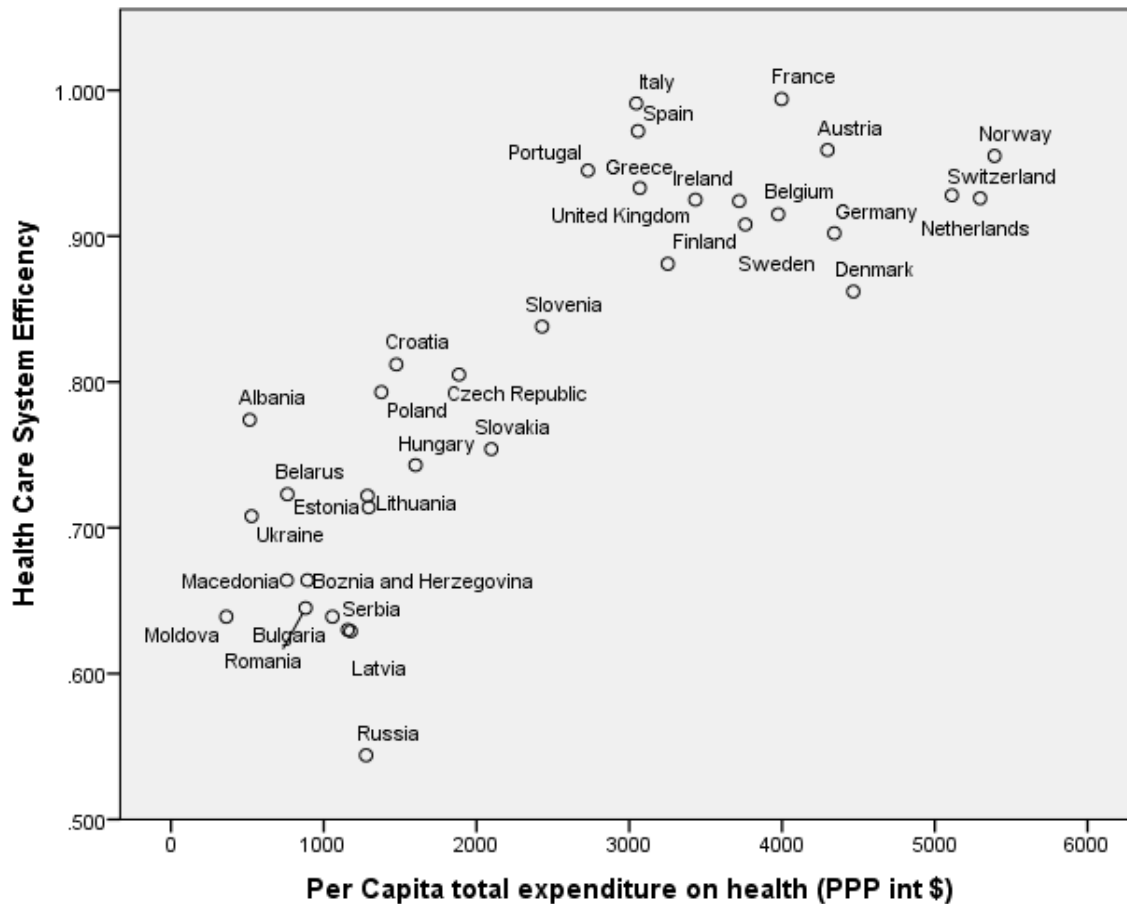
Efficiency

Although it was now clear that a lack of spending on healthcare leads to poor health in Eastern Europe, the efficiency of the CEE nations with the money they did possess for healthcare was the next area of investigation. Using data from the WHO Health System Performance survey (11), a search was conducted for correlations between total healthcare expenditures per capita and healthcare efficiency. The Health System Performance survey calculated efficiency based on many factors and ranked WHO-affiliated nations on a scale of 0 (no efficiency) to 1 (exemplary efficiency). It was found that there is a 0.835 correlation (very strongly positive), which means that nations who spend more on healthcare also have more efficient healthcare systems.

The reader will notice that two distinct groups have formed, those whose healthcare spending is below about $2,500 per capita and those whose healthcare spending is above this level. This "boundary" seems to create a clear division between those nations with efficient systems and those nations who are less efficient.

Figure 4. Positive correlation between health system efficiency and health spending

Discussion

It is apparent from this data that there is a health gradient across the breadth of Europe in several regards. Healthcare spending and efficiency decreases, and the burden of disease increases. The real question is: what can be done about it? Must we wait for economic growth in the CEE nations and hope that with it comes an increase in healthcare spending and an improvement in population health? An increase in healthcare spending is the general trend at this time, with Ukraine increasing their expenditures per capita from int\$184 in 2000 to int\$527 in 2010 (9). However, this trend needs to be combined with an efficient use of the limited budgets available in these nations in order to provide quality healthcare.

Inefficiency

Because of inefficient healthcare systems, Eastern Europe is ill-prepared to take a holistic approach to healthcare (12). Tandon et al. (11) found in their study that "efficiency on health appears to increase with health expenditure per capita and then to decline slightly." From the data at hand, a minimum spending level of about \$2,500 per capita is needed in order to keep the efficiency coefficient of health care above 0.850. Chisholm and Evans (13) identify 9 leading sources of health system inefficiency. These are: inappropriate or costly staff mix, under-use and over-pricing of generic drugs, irrational drug use, sub-standard or counterfeit drugs, over-use of procedures, investigations and equipment, sub-optimal quality of care and medical error, inappropriate hospital size, inappropriate hospital admissions of length of stay, and corruption and fraud. By focusing on these topics and examining best practices put into place in other instances, CEE nations can make significant improvements to population health with minimal extra expenditure.

One useful exercise may be to look at nations with similar economic circumstances but who have accomplished higher-quality health and efficiency outcomes.

Case in point

One interesting case is the Czech Republic and Slovakia. These two nations share a common history and culture as the two halves of the former Czechoslovakia. The Czech Republic manages a DALY rate of 11,812 per 100K people spending $1,885 per capita, while Slovakia accumulates 13,844 DALY's while spending $2,097. Consequently, their respective levels of efficiency are 0.805 and 0.754. Why the difference? According t zo Potůček (14), after the splitting of Czechoslovakia the Slovak system developed into a government driven, inflexible system while the Czech health system developed into a more liberal "corporatist" structure which allowed for innovation. While this is only one example, and government oversight in medical care is certainly necessary and desirable, a balance must be found in which innovation based on reward can take place.

The burden of out of pocket expenses

Atanasova et al. (15) take Bulgaria as an example of the problems faced by the populations of CEE nations. They state that "low-income groups more often refrained from using inpatient and outpatient services because of the level of out-patient payments". These payments consist both of formal and informal payments for services. Informal (under the table) payments to physicians have a long history in CEE nations, and can mean the difference between a long waiting list and immediate treatment, or between a low-quality treatment and the latest techniques and technology. This practice is widespread in some CEE nations because of the low pay of doctors (1.3-2 times average professional earnings compared to 3-4 times in Western Europe) (2). The fact that patients and their relatives need to either borrow money or forego medical treatment because of the expense goes against the principle of universal coverage theoretically in place in most CEE nations.

Other factors which can increase the burden of disease in these nations are environmental exposures (6), a large population of poor older residents (16), lack of education (17) and poor diet (18). These are all problems, to varying degrees, that the nations of Eastern Europe have been dealing with for the past 20 years or longer. In looking to improve the health of their populations, Eastern Europe, in addition to strengthening their economic robustness, will need to examine their past while looking outward in order to create health systems which fits their needs.

Limitations

Since its introduction, there has been debate over the appropriateness and usefulness of the DALY unit of measurement. Anand and Hanson (19) state that "the DALY framework, through age-weighting and discounting, values life years lived by people of different ages and generations differently… we see no reason why a life year lived by a young or old person should be valued less than that lived by a person in the middle-age groups…". In terms of resource allocation, the use of the DALY is also under debate because it implies that "fewer resources should be allocated to a disabled person compared to an able-bodied one" (19) Finally, the manner in which the burden of disease for specific conditions are calculated is highly contentious, because they assume that diseases affect the lives of "similar" people identically. However, the similarity of these people does not take into account wealth, culture, health system effectiveness, or social support system. These factors can affect disease burden dramatically. As a final note, the data used for this analysis was taken from diverse sources which use the latest information available. However, this means that direct comparison of data is sometimes suspect because they come from different times. During the intervening years, change in the data may have occurred which is not reflected. For example, the study of Tandon et al. on the overall efficiency of health systems dates from 1997, while it is being compared to economic data from WHO health statistics from 2013. Also, the global BOD study from 2004 is compared to healthcare spending data from 2013. Using data collected during the same time period would strengthen the conclusions reached in this paper.

Conflicts of interest: None declared.

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