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Original Research

A paradigm shift for socioeconomic justice and health: from focusing on inequalities to aiming at sustainable equity

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ABSTRACT

Objectives: To measure the 'best possible health for all', incorporating sustainability, and to establish the magnitude of global health inequity.
Study design: Observational, retrospective.
Methods: We identified countries with three criteria: (1) a healthy population—life expectancy above world average; (2) living conditions feasible to replicate worldwide—per-capita gross domestic product (GDP-pc) below the world average; and (3) sustainability—per-capita carbon dioxide emissions lower than the planetary pollution boundary. Using these healthy, feasible, and sustainable (HFS) countries as the gold standard, we estimated the burden of global health inequity (BGHiE) in terms of excess deaths, analyzing time-trends (1950–2012) by age, sex, and geographic location. Finally, we defined a global income 'equity zone' and quantified the economic gap needed to achieve global sustainable health equity.
Results: A total of 14 countries worldwide met the HFS criteria. Since 1970, there has been a BGHiE of ~17 million avoidable deaths per year (~40% of all deaths), with 36 life-years-lost per excess death. Young children and women bore a higher BGHiE, and, in recent years, the highest proportion of avoidable deaths occurred in Africa, India, and the Russian Federation. By 2012, the most efficient HFS countries had a GDP-pc/year of USD$2,165, which we proposed as the lower equity zone threshold. The estimated USD$2.58 trillion economic gap represents 3.6% of the world's GDP—twenty times larger than current total global foreign aid.
Conclusions: Sustainable health equity metrics provide a benchmark tool to guide efforts toward transforming overall living conditions, as a means to achieve the 'best possible health for all.'

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Introduction

Although the focus of the World Health Organization (WHO) on health inequalities[1] and on the measurement of the social determinants of health[2] has been a step forward in recognizing the central role that socioeconomic conditions play in the health status of individuals and populations, it has also contributed to further fragmentation in global health standards and interventions.[3] This fragmentation limits the transition from random mitigating interventions to universal transformational policies needed to provide the living conditions that allow all people to lead a healthy, feasible and sustainable life. Inequalities,[4] or 'any mathematical differences or ratios', are not synonymous with inequities, which are 'unfair differences'[5,6] (Table 1). Equity also includes the concept of ecological sustainability, or intergenerational fairness in the use of resources, i.e., the responsibility to manage planetary resources for generations to come as others have analyzed in greater depth.[7]

The WHO's lofty, yet nonspecific, constitutional objective of 'the attainment by all peoples of the highest possible level of health',[8] the only common global health objective of all nations,[9] remains unmeasured, rendering the goal unenforceable. We propose a method to identify those standards while adding the dimension of sustainability to the WHO's constitutional goal,[10] to determine health equity standards that are feasible to achieve with the economic means available, are sustainable in the use of natural resources over time, and are applicable to all human beings. These feasible and sustainable global health equity standards allow quantification of the burden of health inequity between and within countries and provide estimates of the economic resources needed to close current gaps in inequity.

Methods

Data sources

To identify feasible and sustainable global health standards, we utilized average national data from the World Bank database from all years available: 1960–2012.[11] These data sets include worldwide country-level health, socioeconomic, and development indicators. After running correlations among commonly used indicators, we decided to include in our study life expectancy at birth (LE), as a proxy for overall health; constant-value per-capita gross domestic product (GDP-pc[c]), to identify living standards that can be scaled globally (feasibility) and fossil-fuel consumption carbon dioxide equivalent emissions per capita (COe_2-pc) as a surrogate measure of ecological sustainability,[d] acknowledging that it is only one of the planetary boundaries of sustainability.[12]

Analysis

Subsequently, we identified countries that fulfilled three criteria, as compared with world weighted-averages: (1) higher LE (healthier); (2) lower GDP-pc (feasible to replicate); and (3) CO_2e-pc equivalent emissions below the planetary recycling boundary (sustainable). We designated these countries as having healthy, feasible, and sustainable (HFS) global health equity standards. The correlation with underlying socioeconomic factors, however, remains to be studied. Subsequently, we utilized age (5-year age groups up to 80 years of age) and sex-specific all-cause mortality rates of the HFS-model countries, from the United Nations Demographic Statistics Division,[13] as global mortality-rate standards. By applying these global health equity standards to population figures of each country, we compared the observed and expected number of deaths in each country, estimating the excess mortality if socioeconomic conditions were at least those of the countries in the HFS model. We defined this excess mortality as the burden of global health inequity (BGHiE). We examined the distribution of the BGHiE by country, sex, and age group. We also examined temporal trends in BGHiE using 5-year annual averages from 1950 to 2010. These analyses were repeated estimating the proportion of excess mortality (hereafter defined as 'avoidable deaths') from all deaths below 80 years of age,[14] number of life-years-lost, and survival pyramids.[15]

Subsequently, based on the GDP-pc of the HFS countries, we calculated the economic threshold necessary to be able to achieve the proposed global health equity standards. Under the feasible and sustainable global health equity principle, we assigned the weighted-average of the countries that during the study period had the lowest GDP-pc among the HFS countries as the lower income threshold to enable HFS standards. Knowing the weighted-average world GDP-pc, and assuming a theoretical normal distribution, we then estimated the symmetric upper limits of GDP-pc to define an 'equity zone', namely the area of the GDP-pc distribution contained between the lower and upper thresholds. We then estimated the threshold level of GDP-pc above which, the cumulative excess GDP, if redistributed, would suffice to fill the deficit of those counties under the equity zone lower thresholds. We call that limit the 'excess accumulation threshold.'

Finally, for every year from 1960 to 2012, we determined the distribution of countries and total population in each of the following categories: below, within, and above the equity zone, the latter divided into two subcategories, above and below an 'excess accumulation' threshold. By applying the global health equity standards, we then calculated the redistribution of GDP-pc, the number of avoidable deaths, and the proportion of all deaths that would be avoided in every country according to equity zone categories.

[c] GDP-pc constant value GDP at purchaser's prices as the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. Data are in current U.S. dollars and are converted from domestic currencies using single year official exchange rates. The data on GDP-pc at purchasing power parity were not available for all countries during the study period, and there is significant controversy on the methodology and interpretation: see: www.oecd.org/std/na/1960906.doc.

[d] CO_2 emissions per capita are estimated from the production source and underestimate the effect (by demand) and responsibility of the consumption end.

Table 1 – Differences between inequality and inequity.

Domain	Inequality	Inequity
Concept	Differences	Unfair differences
Measurement	Differences or ratios between subpopulations	Gap from best feasible and sustainable standards: burden of inequity
Conclusions	Arbitrary conclusions	Measurable objective, inter and intra national, intra and intergenerational
Strategy	Approach to disadvantaged groups: poverty alleviation	Approach to minimum threshold: social cohesion (address both extremes), levels of dignity, and universal rights
Effect	Mitigation	Transformation

Results

Throughout the period assessed (1960–2012), 14 countries worldwide, listed in Table 2, consistently achieved the three HFS criteria: LE above the world weighted-average (70.7 years in 2012), while having a GDP-pc below the world average (USD $10,256 in 2012) and CO_2 emissions below the planetary recycling boundary of 2.5MT (yearly average for the 2000–2010 decade). In 2012, the weighted-average LE for the 14-HFS countries was 75.1 years (range 72.2–79.7 years), weighted-average GDP-pc was USD $3894 (range $1755 to $9733), whereas the average CO_2e-pc (average 2000–2010) were 1.52 MT (range 0.59–2.48MT), for the period 2000–2010 (Table 2). The weighted-average figures for the 14 HFS countries were 6% higher LE, 61% lower GDP-pc, and 70% lower CO_2e-pc, as compared with world weighted-averages for that year and period, respectively.

Based on the 14-HFS global health standards, we calculated a burden of global health inequity of approximately 22 million avoidable deaths per year in the 1960s; this estimate decreased to 17 million by the 1970s, mostly because of decreased mortality among young children. However, the number of annual avoidable deaths has remained stagnant ever since the 1970s. Despite secular demographic trends, as a proportion of all deaths, these avoidable deaths have represented roughly 40% of all annual deaths below the age of 80 years, worldwide, since 1970 to the present day (Table 3). Each avoidable death was associated with an average of 36 life-years lost (LYL) during the 2005–2010 period, a figure that increased from 23 LYL in the 1950s to 40 LYL in the 1970s and decreased thereafter. The countries in which the proportion of avoidable deaths, represented more than 40% of all deaths were China, India, Central and South America, and Africa during the 1960s; more recently they were concentrated in sub-Saharan Africa, India, Pakistan, Central Asia, and the Russian Federation (Fig. 1). Most avoidable deaths occurred in children less than 5 years of age, and among women (Table 3). Avoidable deaths among women were, on average, 40% higher than among men, a difference that persisted, though to a lesser degree, beyond the reproductive age.

The economic threshold needed to attain global health equity was derived from the average GDP-pc among the most 'efficient' of the 14 HFS countries (Vietnam and Sri Lanka), at USD $2165 in 2012. Utilizing the world's GDP-pc–weighted-average of USD $10,256 in 2012, we then estimated a symmetric upper economic threshold, so that the economic equity zone was defined as countries with GDP-pc between USD $2165 and USD $18,345 (Fig. 2). In 1960, the proportion of people living in countries within the economic equity zone

Table 2 – Selecting criteria of the 14 HFS countries.

Country name	LE in years 2012	GDP-pc in USD 2012	CO_2e–pc in Metric Tons, Yearly Average 2000–2010
Costa Rica	79.71	$9733	1.65
Cuba	79.71	$6448	2.48
Albania	77.35	$4256	1.31
Vietnam	75.61	$1755	1.19
St. Lucia	74.67	$7201	2.21
Armenia	74.44	$3343	1.36
Sri Lanka	74.07	$2922	0.59
Georgia	73.94	$3529	1.16
Colombia	73.78	$7885	1.43
Belize	73.70	$4674	1.69
Grenada	72.61	$7585	2.18
Tonga	72.49	$4364	1.56
St. Vincent	72.40	$6352	1.78
Paraguay	72.19	$3856	0.7
14 HFS weighted-average/total	75.14	$4067	1.27
World average/total	70.71	$10,444	4.22
World range	45.3–83.5	$673 -$135,798	0.01–53

Abbreviations: LE, life expectancy; GDP-pc, gross domestic product per capita; CO_2e-pc, carbon dioxide equivalent emissions per capita; HFS countries, healthy, feasible, and sustainable countries.

Table 3 – Global burden of health inequity total avoidable deaths 1950–2010.

Period	Global avoidable deaths per year	Percent from all global deaths <80 years	Percent avoidable deaths from all deaths in children aged <5 years	Percent avoidable deaths from deaths <80 years in women	Percent avoidable deaths from deaths <80 years in men	Percent avoidable deaths in countries below equity zone
1950–1955	22,378,571	46.9%	53.3%	43.4%	50.1%	84.0%
1955–1960	22,359,125	47.6%	56.1%	45.2%	49.8%	83.4%
1960–1965	23,681,287	49.3%	60.8%	48.5%	49.9%	78.7%
1965–1970	17,540,402	42.4%	58.4%	44.3%	40.7%	77.7%
1970–1975	15,953,937	39.3%	58.6%	38.8%	39.8%	81.7%
1975–1980	16,333,040	40.9%	62.8%	42.1%	39.8%	86.7%
1980–1985	16,360,286	40.6%	65.3%	45.2%	36.9%	88.5%
1985–1990	16,561,451	40.7%	68.1%	47.6%	35.0%	91.6%
1990–1995	17,603,116	42.1%	70.3%	48.9%	36.7%	95.3%
1995–2000	18,591,914	43.5%	73.4%	51.3%	37.3%	85.8%
2000–2005	17,428,328	40.6%	71.0%	52.8%	31.1%	84.0%
2005–2010	16,821,851	39.4%	70.8%	51.7%	29.9%	83.4%

was 17%, which increased nearly three-fold to 47% by 2012. The population living in countries under the equity zone decreased from 70% in 1960 to less than 40% in 2012, whereas the population living in countries above the equity zone has remained stable between 15% and 20% during that period, with half of that population (8–10%) residing in countries in the excess accumulation zone (Fig. 3). In the period 2005–2010, there were 2.6 billion people (36% of the world's population) in the 54 countries with a GDP-pc below the equity zone and as a group they shared 4.2% of world's GDP (Table 4). Almost three-quarters (73%) of avoidable deaths occurred in these countries. In the late 1980s, however, there were abrupt changes, which were likely influenced by the economic reform[16] and sharp decrease in the estimate of Vietnam's GDP-pc,[17] and China entering the equity zone (Fig. 4).

On the other hand, the proportion of the world population living in countries with a GDP-pc above the equity zone in 2005–2010 was around 20%, possessing 63% of the world's GDP (Table 4). Approximately 10% of the world's population lived in countries with average national GDP-pc above the excess accumulation threshold, which we calculated at $48,025 USD, and as a whole held almost half of the world's income (Table 4). In 2012, countries with GDP-pc above the excess accumulation threshold included the United States and Canada, most of Western Europe, Japan, and Australia (Fig. 5). It is important to note that, a GDP-pc above the equity zone (USD $18,345) has negligible correlation with increased LE (r^2: 0.06) as the curve of LE flattens around that level of GDP-pc; while, at the same time, no country with a GDP-pc above the equity zone had CO_2e-pc levels below the planetary boundary (Figs. 6 and 7).

We estimated that, in 2012, the economic resources required to bring all countries with a GDP-pc from under, to within, the equity zone at $2.58 trillion USD. This amount translates into approximately 3.6% of the world's GDP. If these financial resources were ethically redistributed, close to 12 million deaths would be prevented annually, while enabling living conditions necessary for people to lead healthy and productive lives (Table 4). As a reference, if using the average

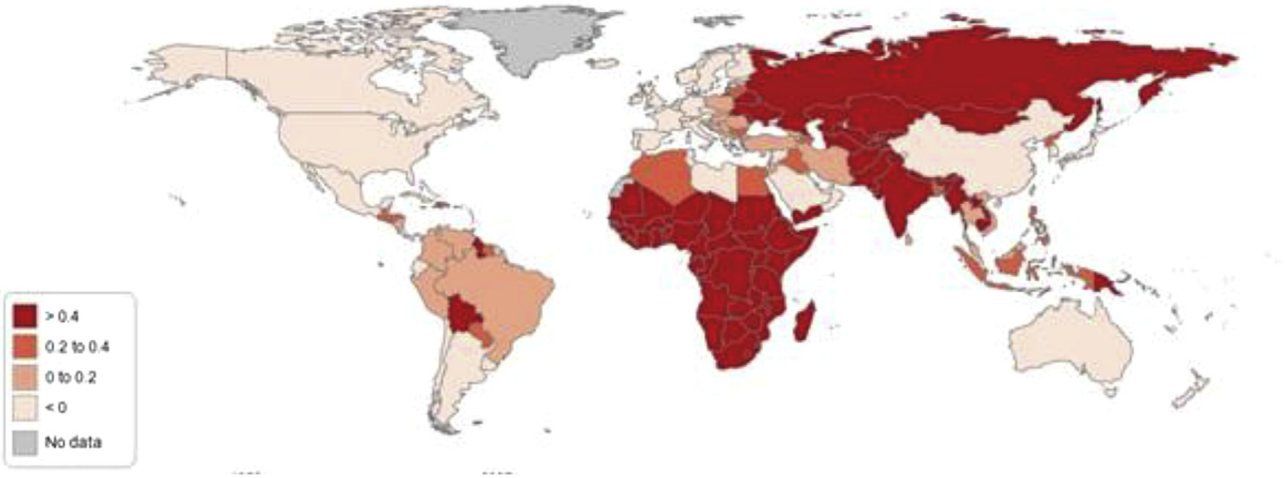

Fig. 1 – Proportion of all deaths below 80 years that are avoidable by global sustainable health equity in 2005–2010. Color scale refers to avoidable deaths by sustainable health equity as a proportion of all deaths among people below 80 years, in each country, yearly average 2005–2015. Map created using StatSilk (2016). StatPlanet: Interactive Data Visualization and Mapping Software. http://www.statsilk.com.

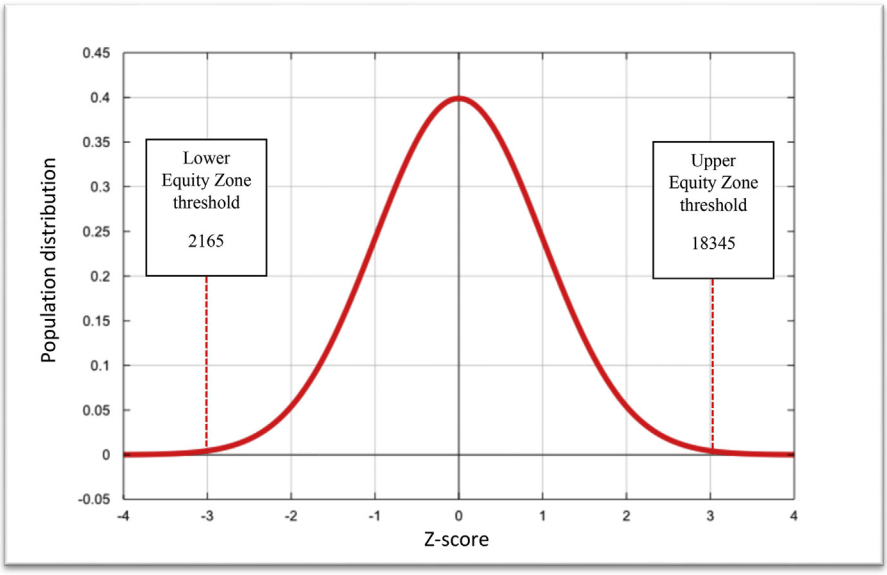

Fig. 2 – Equity zone using the most efficient HFS countries as the lower threshold.

GDP-pc of the 14 HFS countries (USD $4067), as the lower threshold for the equity zone, the economic gap would be $7.16 trillion, representing 9.9% of the world GDP.[15]

Discussion

Over the past 40 years, despite significant improvements in sanitation and healthcare services, still 40% of deaths worldwide are avoidable and have occurred because of socioeconomic injustice.

Despite the limitations of setting feasibility and sustainability criteria through just economic and carbon emissions, our study attempts for the first time to estimate the burden of health inequity. The tragedy of a burden of global health inequity of 17 million avoidable deaths every year, affecting mostly the poor and among them primarily children and women, is ethically intolerable and highlights the need to position health as a transformational force in societies.

The Health Millennium Development Goals, if met, would have prevented 8.4 million deaths annually or approximately one half of the world's avoidable deaths estimated by global

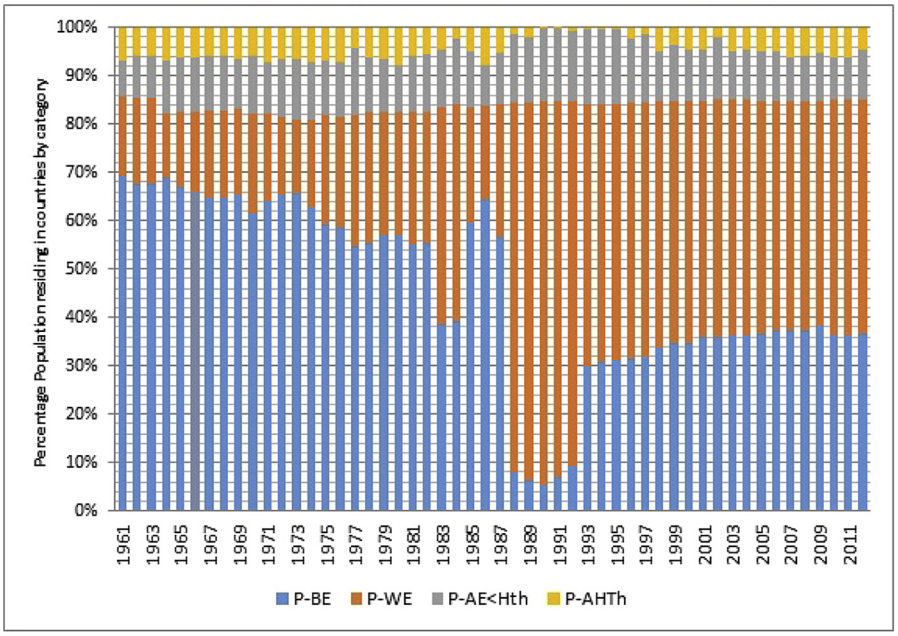

Fig. 3 – World's population by global health equity economic thresholds. P-BE = Population in countries with GDPpc below equity zone; P-WE = Population in countries with GDPpc within equity zone; P-AE < HTh: population in countries with GDPpc above equity zone but below hoarding threshold; P-AHTh: population in countries with GDPpc above hoarding threshold.

Table 4 – Equity zone per most efficient HFS model—summary data for 2012.

Indicators	Equity zone per HFS—most efficient countries. Year 2012
Total number of avoidable deaths yearly average 2005–2010 (percent of total avoidable deaths)	11.91 million (73.2%)
Number of avoidable deaths yearly average 2005–2010, in countries below equity zone (percent of total avoidable deaths)	9.60 million (59.1%)
Equity zone lower threshold—GDP-pc in USD	$2165
Equity zone upper threshold—GDP-pc in USD (assuming a normal distribution)	$18,345
Excess accumulation threshold in USD	$48.025
Ratio equity zone upper to lower thresholds	8.5
Ratio excess accumulation to equity zone lower threshold	22.2
Population below equity zone (%)	2.59 billion (36.7%)
Population within equity zone (%)	3.43 billion (43.7%)
Population above equity zone (%)	1.39 billion (19.7%)
Population above equity zone & below excess accumulation threshold (%)	720.83 million (10.2%)
Population above excess accumulation threshold (%)	672.20 million (9.5%)
GDP below equity zone in USD (%)	$3.03 trillion (4.2%)
GDP within equity zone in USD (%)	$23.26 trillion (32.1%)
GDP above equity zone and below excess accumulation threshold in USD (%)	$12.14 trillion (16.7%)
GDP above excess accumulation threshold in USD (%)	$34.11 trillion (47.0%)
GDP gap to achieve sustainable health equity in USD	$2.58 trillion
GDP gap to achieve sustainable health equity as percent of all GDP	3.6%
GDP gap to achieve sustainable health equity as percent of GDP above equity zone	5.6%
GDP gap to achieve sustainable health equity as percent of GDP above excess accumulation threshold	7.6%

Abbreviation: GDP, gross domestic product; GDP-pc, per-capita gross domestic product; HFS countries, healthy, feasible, and sustainable countries.

health equity. While some 2030 Sustainable Development Goals (SDGs)[18] are progressive, though without an effective date, most appear aspirational and not amenable to concrete measurement, and none are based on existing human-rights frameworks. These approaches (Millennium Development Goals and SDGs), based on inequalities, involve two arbitrary choices: which variables to select, disaggregate, and correlate (called by some 'relative equity'[5]) and the degree of reduction in each variable. However, discussing development without regards to human rights may lead to fragmented decisions subject to lobbying pressures and political volatility. If they are to lead to progressive elimination of health inequities, SDGs require targeting specific, equitable, feasible, and sustainable standards for all.

In 1970, the Organization for Economic Co-operation and Development (OECD), representing high-income countries, agreed to provide 0.7% of their combined GDP as the target for official development assistance (ODA). This has been an arbitrary, controversial,[19] and never-accomplished goal,[20] which is based on macroeconomic growth assumptions, not on quantification of a gap. Development aid from OECD, for the year 2012 represented 0.29% of the GDP of member countries,[21] approximately USD $120 billion, which corresponds to a minute fraction of the estimated deficits using the HFS models (Table 5). Moreover, the process followed by ODA since its inception has implemented interventions directed to various countries and diverse population subgroups, utilizing a 'special-interests' approach. Thus, dependent on severely underfunded and mostly subjective mechanisms, ODA resources could not have done more than 'take the edge off' of random inequalities rather than to systematically address the root causes of such disparities.

Furthermore, limited analysis of available data suggests that international cooperation has not followed an equitable distribution of higher support for those in greater need;[22] highlighted by a lack of correlation between ODA received per capita and several indicators of development and health. On the other hand, the approach of targeting inequalities by reaching the most vulnerable reflects 'policies for the poor', which, as opposed to universal equitable policies, have the effect of further fragmenting interventions. In addition, the influence of corruption on the resources that reach the beneficiaries may hinder even further the mitigation effect.[23]

One of the conditions required to achieve health equity is a distribution of resources within the 'equity zone', a zone compatible with the universal right to health. Estimating the level of fair distribution of market-generated inequalities requires the establishment of boundaries within which the magnitude of inequalities is considered ethical. We propose that such limits be determined by the conditions required for a dignified human life and by limits to excess wealth accumulation. We have estimated that the economic threshold to attain health equity is approximately $5.8 USD/person/day, an estimate that is substantially higher than the current World Bank poverty threshold of $1.90 USD/per-capita/day.[24] The equity zone also identifies an upper-limit at roughly $50 USD/per-capita/day, and the threshold of excessive income (and wealth) accumulation at $131.6 USD/per-capita/day.

The estimated economic gap to achieve global health equity of $2.58 trillion USD would be met by the GDP-pc above the excess accumulation threshold, consequently, excessive wealth accumulation prevents ethical redistribution.[25] Moreover, excess accumulation is correlated with unsustainable socioeconomic dynamics,[26] and it is not correlated with increases in LE. In addition, excess accumulation of income and wealth is one of the main contributors to socioeconomic inequality. Analyses including quality adjusted life-years might further clarify these observations, although studies have failed to find meaningful associations between human and social well-being indicators and GDP-pc above that level.[27]

The equity zone approach integrates the imperative of moderation in the use of resources and stewardship of the planet for future generations. It requires redistributive mechanisms geared to eradicate extreme poverty and excess

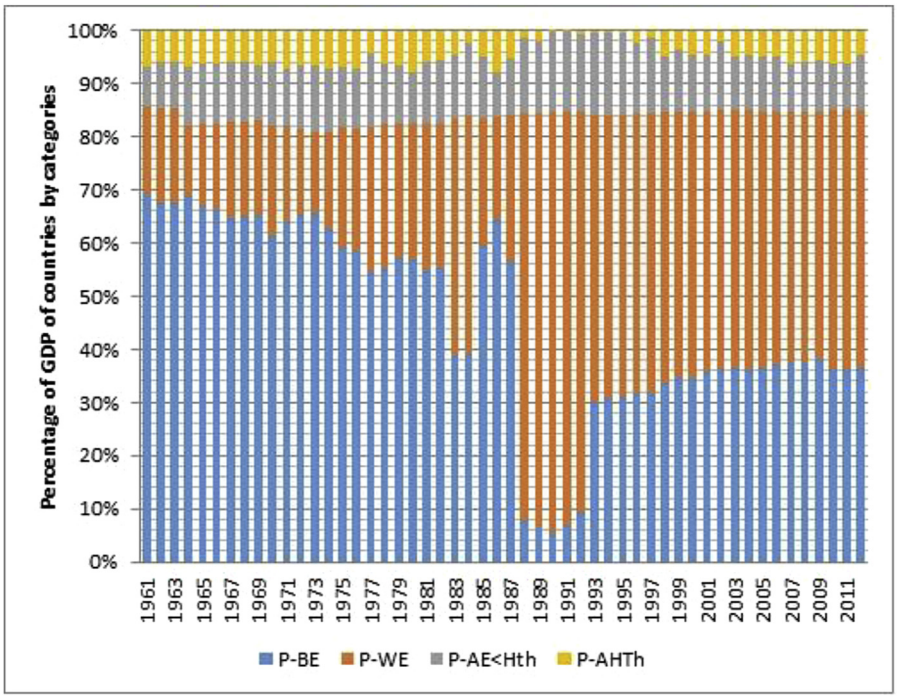

Fig. 4 – World's gross domestic product (GDP) by global health equity economic thresholds. P-BE = GDP in countries with GDP-pc below equity zone; P-WE = GDP in countries with GDPpc within equity zone; P-AE < HTh: GDP in countries with GDPpc above equity zone but below hoarding threshold; P-AHTh: GDP in countries with GDPpc above hoarding threshold.

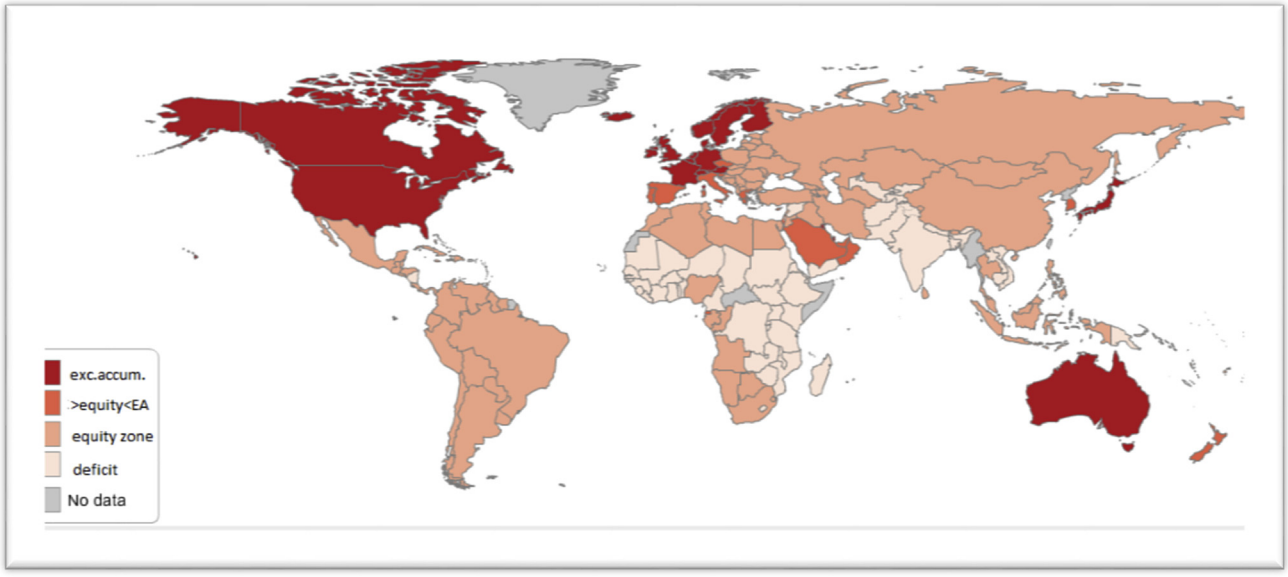

Fig. 5 – Distribution of countries by economic equity zone and excess accumulation threshold—2012. Exc. accum: Countries with GDPpc above the excess accumulation threshold. >equity<EA: Countries with GDPpc above the equity zone but below the excess accumulation threshold. equity zone: Countries with GDPpc within the equity zone. Deficit: Countries with GDPpc below the equity zone. Map created using StatSilk (2016). StatPlanet: Interactive Data Visualization and Mapping Software. http://www.statsilk.com. EA = Excess accumulation; >equity<EA = greater that equity zone, but lower than excess accumulation; Equity zone = within equity zone; Deficit = below equity zone.

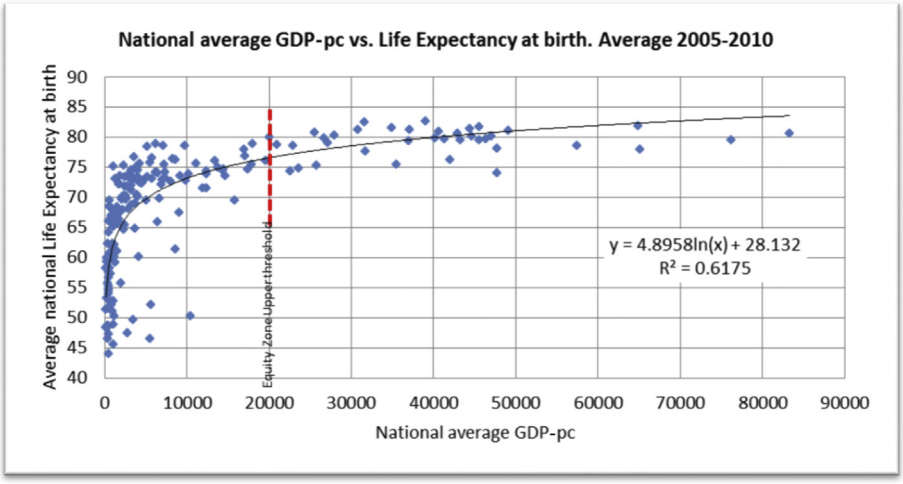

Fig. 6 – Correlation between average life expectancy and per-capita gross domestic product (GDP-pc) 2012.

accumulation, as well as superfluous and unsustainable use of resources, and pollution beyond the planetary recycling capacity.

The analyses presented in this paper constitute a first step toward the metrics of sustainable health equity between countries, which may hide major sub-national inequities. Further research is required to determine the level of within-nation health inequities, to identify geopolitical units that fulfill the HFS criteria and to unmask within-country health inequities that are lost in the national averages. Within- and between-country components of health inequity would provide a more accurate analyses of the burden of health inequity and the associated economic gap, than our current estimates, which probably represent an underestimation, since most countries do have significant income inequalities within themselves.

The equity zone analyses show that there are enough economic resources in the world to enable the universal right to health for all peoples—as a necessary, yet not sufficient condition— even allowing for a wide distribution of resources, with income ratios between extremes of around 9 (income equity zone lower to upper thresholds) and 22 times (income equity zone lower threshold to excess accumulation threshold). The monetary resources to confront this shameful conundrum amount to 3.6% of the world's GDP and can conceivably be obtained through a fair and ethical global redistributive mechanism. These findings challenge the present foreign aid model of OECD-ODA in its magnitude,

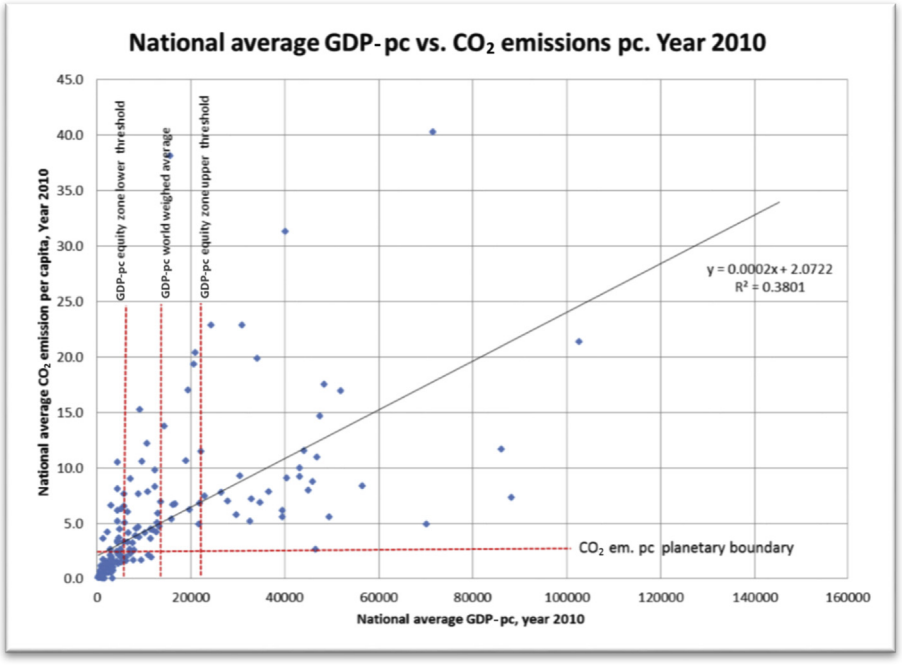

Fig. 7 – Correlation between per-capita gross domestic product (GDP-pc) vs carbon dioxide (CO_2) emissions.

Table 5 – Comparison of ODA and redistribution required for global health equity (GHE).

Feature	ODA	Redistribution × GHE (2012)
Donors	OECD/DAC	Equity zone upper threshold (USD >$18345 pc) Excess accumulation threshold (USD >$48025 pc)
Recipients	Developing countries (World Bank income regions and OECD/DAC)	Equity zone lower threshold (USD <$2165)
Magnitude	0.29% of GDP (2013) (Target 0.7%)	3.56% of global GDP. = 5.58% of GDP above the equity zone = 7.57% of GDP above the excess accumulation threshold
Distribution	Not correlated with GDP deficit	Correlated with GDP deficit for equity zone lower threshold
Predictability	Low (1–2 years)	Stable and adjusted to GDP evolution
Binding nature	Voluntary (volatile)	Requires global binding mechanism
Ownership	Weak	Strong + global monitoring system

Abbreviations: ODA, official development assistance; GDP, gross domestic product; OCED, Organization for Economic Co-operation and Development; pc, per capita.

distribution, volatility, and non-binding nature; while they also reveal the fact that constant growth without addressing inequity is not a suitable model for universality or sustainability.

We put forward the notion that it is feasible to estimate the best possible (and sustainable) levels of health for all, based on equity and human rights. The objective of WHO should read: 'attaining the best possible and sustainable health by all peoples.' Sustainable health equity, a comprehensive measurement of how society guarantees the living conditions for people to enjoy the universal right to health, is the best barometer of inclusive and sustainable development, and as such can support the development of a human rights–based international legal framework. There is an opportunity for WHO to take this qualitative leap by positioning sustainable global health equity standards as a compass for social justice, taking a prominent role in the post-2015 development and SDGs agendas.

Author statements

Ethical approval

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Competing interests

None declared.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.puhe.2017.04.015.