Years of Good Life (YoGL): A wellbeing indicator designed to serve as sustainability criterion

Wolfgang Lutz[a], Erich Striessnig[a] ,Anna Dimitrova[a,b], Anastasia Lijadi[a,b], Claudia Reiter[a,b], Sonja Spitzer[a,b], Dilek Yildiz[a,b]

[a]Wittgenstein Centre for Demography and Global Human Capital (IIASA, VID/OeAW, WU), IIASA, Schlossplatz 1, 2361 Laxenburg, Austria

[b]Listed in alphabetical order with equal contributions.

Abstract

Sustainable development (SD) as popularized by the Brundtland Commission and politically enshrined in the Sustainable Development Goals (SDGs) has been the explicit focus of sustainability science. While there is broad agreement that the trend of human wellbeing (W) over time should serve as sustainability criterion, the literature so far has mostly addressed this in terms of its determinants and the change over time in the different capitals contributing to "inclusive wealth" rather than focusing on the trends in W itself. There is broad agreement that an indicator for W should have multiple constituents, clearly going beyond GDP. Thus, we propose a tailor-made indicator to serve precisely this purpose following the specification of six explicit criteria that should be met. The indicator, Years of Good Life (YoGL), is based on the evident fact that in order to be able to enjoy any quality of life, one has to be alive. But since mere survival is not considered as good enough, life years are counted conditional on meeting minimum standards in three objective dimensions (being out of absolute poverty and enjoying physical and cognitive health) and in the subjective dimension of life satisfaction. By focusing directly on W, we avoid some of the still unresolved problems with measuring inclusive wealth, such as discounting the future. We discuss data requirements, inter-temporal dynamics, and provide illustrations for (sub-) populations at different stages of development.

Keywords: Sustainability Science, Human Wellbeing Indicator, Survival, Good Life

Introduction

Sustainability science refers to the most comprehensive scholarly effort to understand the interactions between natural and social systems in order to assess whether certain developmental pathways can be considered sustainable. In fact, most scholars in this field agree on a general definition of what is "sustainable". In the words of Matson et al., "Development is sustainable if inclusive social wellbeing does not decline over multiple generations" (1). Since this goal can be achieved in several different ways – assuming substitutability between different human wellbeing determinants (or capitals in economic terminology) – this approach is sometimes labelled "weak sustainability" (2). "Strong sustainability", on the other hand, postulates maintenance of all natural capitals irrespective of human wellbeing. In this paper, we focus on long-term human wellbeing as the ultimate end of sustainable development.

When assessing changes over time in the wellbeing of certain human populations (or sub-populations, as defined e.g. by gender, ethnicity, urban/rural place of residence, or other social groupings), the following "wellbeing production function" has gained prominence(3, 4). Wellbeing of population p at time t is described as a function of the stocks of different 'Capital Assets' C_i from which services flow, in particular manufactured capital, human capital and natural capital. In addition, I stands for institutions (laws, rules, norms, expectations, etc.) and K for knowledge.

$$W(p,t) = f\left(C_{i,p,t}, I_{p,t}, K_{p,t}\right) \quad (1)$$

Thus far, empirical and theoretical research has placed more emphasis on studying the right-hand-side of this equation, i.e. the production factors or determinants of wellbeing including environmental services (3), whereas specifying the constituents of wellbeing on the left-hand-side has received less systematic attention and often only refers to the unspecific notion of utility. This focus on determinants has led to the concept of "inclusive wealth" which can be used to assess whether a society is on a sustainable development trajectory in terms of the productive base necessary to maintain a high standard of living in the future (5). However, empirically measuring the values and relative effects of the different capitals determining human wellbeing remains extremely challenging and "no current attempt to date can be said to be fully inclusive", as stated recently by Polasky et al. (6).

Despite of its appeal – due to its foundation in a well-developed body of economic theory –, the inclusive wealth approach has hit several roadblocks. In particular, the following problems arise for which our demographic approach, focusing directly on the constituents of wellbeing rather than its determinants, offers solutions: (a) It remains unclear, how the relative contributions of the different capitals to W can be assessed quantitatively without estimating them in a model that includes specific empirical values of W. The economic approach of using prices as the weights placed on various capitals is highly contested, particularly because of the difficulties in pricing ecosystem services and the fact that nonmarket values can be strongly distorted, e.g. due to irrationality in human decision making (6). By providing numerical values of W, our approach allows for the relative contributions of different determinants to be estimated statistically. (b) As has been hotly debated around the Stern report (7), the choice of an appropriate rate to discount future wellbeing seems to be an unsolvable problem in economics. Depending on whether a high or low rate is chosen, the future challenges either become negligible or overwhelming. The demographic approach brought forward here relinquishes economic discounting, since the average number of Years of Good Life (YoGL) has a time-independent meaning in its absolute value. It applies equally across all sub-populations and generations and thus avoids the need for economic discounting. (c)

All estimates of the capital needs to assure future human wellbeing are highly sensitive to population growth. As Dasgupta points out, "the poorest countries of the world have 'developed' by depleting natural capital relative to their high population growth rates" (8). Thus maintaining per capita inclusive wealth under conditions of population growth requires increasing investment. Simply assuming one specific future population trajectory (as e.g. in 6) is unsatisfactory because long term population trends are highly uncertain. In fact, meeting the education and health SDGs by 2030 will have a high impact on future population trends (9). Again, focusing on YoGL makes the analysis independent from population growth assumptions because it refers to wellbeing per person. Finally, (d) as stressed also by Dasgupta (8)the nature of determinants can change over time and across places depending on different commodities and technological regimes, whereas the constituents of wellbeing – as used in YoGL – can be assumed to be universal across space and time.

The purpose of this paper – which reports first findings from a project on the "demography of sustainable human wellbeing" (FN) – is to propose a way to operationalize and measure W. We present a tailor-made indicator of the ultimate end of sustainable development that can be assessed across countries, different sub-populations and over time. This indicator can be modelled as the interplay of different production factors, including feedbacks from environmental change on future human wellbeing. But here we do not yet address the empirics of estimating the "wellbeing production function" which will be subject of subsequent research.

In the following we will first specify and discuss the criteria for such a universally applicable wellbeing indicator according to the literature, before offering examples of how it can be calculated and compared across populations and over time.

Six criteria for a fit-for-purpose wellbeing indicator

The field of wellbeing indicators is currently mushrooming. On the one hand, this reflects a deep dissatisfaction with conventional indicators of wellbeing that fail at "Measuring Tomorrow" (10) in the sense that they do not account for sustainability and resilience within social and natural systems. On the other hand, there is an evident need for quantitative indicators to help us assess whether developments go into desired directions and for comparing and benchmarking such developments across populations (a comprehensive overview and comparison of prominent wellbeing is provided in an additional appendix, which can be sent in a separate e-mail upon request). The official UN-lead statistical process assessing and evaluating the implementation of the SDGs, for example, has identified 230 indicators covering the 169 targets and 17 broader goals that should be estimated and compared across all national populations. But among such a flood of indicators it is difficult to see the big picture, in particular when their relative importance remains disputed.

An alternative strategy is to aim at one composite metric which incorporates a number of key constituents of wellbeing. Here, at least three possible strategies can be distinguished: (1) One can leave the weighting of different aspects of the aggregate wellbeing indicator to the users as is done e.g. by the OECD Better Life Index. While being seemingly rather user-friendly, this approach leads to non-comparable values depending on individual tastes and preferences. (2) One can give fixed weights to the different dimensions, thus already implicitly making a choice about the trade-offs among components as exemplified by the UNDP Human Development Index (HDI). This approach suffers from problematic trade-

offs between sub-indices (11). (3) Finally, one can develop a fully integrated indicator that has substantive meaning in its own right and does not require additional weighting assumptions because it results from a unique combination of its constituents, i.e. being above a minimum threshold in all constituents considered. This is the approach we are pursuing here.

As a first step towards operationalizing the above discussed formula (1), which lies at the heart of sustainability science, we specify the following six criteria W should meet, as based on the literature. The definition of sustainability would then be operationalized as W not declining in the long run for any sub-population of interest:

*(1) It needs to embody **universally shared values** in terms of specific ultimate ends*

The use of W as a wellbeing indicator only makes sense as far as there is near to universal consensus that it corresponds to a highly desirable target. While extremist views may contradict, the aspiration here is to capture the single most important ultimate end that broader groups of people with very different orientations, values and cultural backgrounds would be ready to subscribe to. Whilst the actual acceptance of the indicator as an ultimate end in different settings will be empirically tested later in this project, we can also base it on theoretical *ex ante* considerations. Survival and the avoidance of unnecessary premature mortality, either of ourselves or people we care about, is one prime candidate for such a universally shared goal. Moreover, it can be assumed that mere survival will not be considered enough by most people, but that minimum standards in terms of quality of life (QOL) need to be met. In YoGL such minimum standards are assessed through three objective dimensions (being out of extreme poverty, having minimal physical and cognitive health) and through subjective life satisfaction, which measures people's wellbeing according to their own standards and expectations. This reference to subjective assessment is necessary in order to capture the undeniable differences in people's individual hopes and expectations that could never be captured by a catalog of specific aspirations. In YoGL, we measure how people fare according to their own assessments in terms of overall life satisfaction based on their own and possibly differing aspirations without having to specify them in any detail.

*(2) It needs to be based on **characteristics of individuals** that can be flexibly aggregated to **sub-populations**.*

Since the focus of sustainability science is not on the wellbeing of nations but rather on groups of people, it should be possible to specify W "bottom-up", i.e. based on individually measurable (or at least possible to estimate quantitatively) characteristics that can be aggregated to sub-populations. Such a focus on sub-populations is essential for answering many of the important questions in sustainability science, in particular those of distribution and inequality: how does wellbeing differ by gender or by various ethnic or socio-economic groups in a population; how does it differ by urban/rural place of residence or other geographic units? Focusing on sub-populations rules out indicators that only exist at the national level, such as conventional GDP estimates. However, the same criterion also renders the widely used HDI unfit as a candidate for W. The use of national level indicators is also problematic under the long-term perspective of sustainable development because nations come and go and may change their boundaries.

(3) *It needs to be **comparable over time and across sub-populations**.*

For the purpose of comparing the wellbeing of certain populations at two different points in time and to see whether there has been improvement or deterioration, the indicator must have a meaning in its

absolute value and not be defined on a relative scale. As an example, the life expectancy component of the HDI is defined as a fraction of the maximum national life expectancy observed in any given year. Hence, when comparing this fraction for a given population at two different points in time, it is impossible to see whether survival conditions in this population actually improved and by how much. In its relative form the index can only show whether the given population improved its relative standing to the country with the highest life expectancy. This is why W should have meaning in its absolute level.

*(4) It should be theory based and not include **implicit trade-off assumptions or arbitrary weighting schemes.***

There seems to be broad consensus in the literature (12) that any one dimension alone would not be sufficient for adequately measuring human wellbeing or capturing the ultimate end of human development. Any one-dimensional indicator is exposed to similar criticism as GDP per person in terms of mis-measuring our lives (13). Even life expectancy, which has been suggested as a good and stable indicator covering and reflecting many key dimensions of wellbeing (11), would not suffice because mere survival is not good enough and what should be measured is the number of years with good QOL. On the other hand, one should be parsimonious in the number of constituents considered theoretical and choose only key dimensions with strong theoretical grounding. As discussed above, these different dimensions should not be combined based on arbitrary weighting or implicitly assumed trade-offs but through a substantively justified combined measure.

*(5) There needs to be sufficient empirical information for different sub-populations and time points to be **fit for serving as the dependent variable** in panel regressions*

Since the purpose of this indicator is to be estimated for many populations at different points in time, its constituents need to be based on empirical information from survey items or other sources that are readily available. Ideally, all pieces of information necessary for the calculation of the indicator are available for the same individuals participating in a survey. However, since this will not always be the case reasonable data integration methods could be applied to obtain missing dimensions.

*(6) If possible, it should have a substantive interpretation in terms of some **real life analogy** rather than just being an abstract index.*

An additional strength of a good indicator is its interpretability in terms of a real life analogy. GDP per person, for example, is suggestive of the amount of money a person has at his/her disposal while life expectancy gives the number of years one can expect to live on average. The HDI, on the other hand, gives us an abstract number that can hardly be associated with anything tangible. Unlike the previous ones, this criterion is desirable but not absolutely necessary.

As we will see in the remainder of this paper YoGL meets all six criteria.

Quality of Life conditional on survival

When designing YoGL based on the above-described criteria, a clear hierarchy among the constituent dimensions to be covered was established. First and foremost, we consider survival as the most essential prerequisite for enjoying any QOL. When a person dies, there is no QOL left (at least not in this world). But since mere survival is typically not considered the same as QOL, in a next step we go on to define

"good" years of life as those years when people are above a minimum level both in terms of objectively observable conditions, as well as subjective life satisfaction. Following Desai et al. (14) the objective conditions measuring "capable longevity" are further broken down into three dimensions: being out of poverty, being cognitively enabled and having no serious physical disabilities. Only if people are above critical levels in all three objective dimensions and in their reports about overall life satisfaction, the life years are considered as good years in the calculation of YoGL.

Figure 1 summarizes this structure and basic logic of YoGL. The big grey circle corresponds to the overall years of life a person can expect to live given the currently observed survival conditions. YoGL is a subset of these overall years of life depicted by the green area indicating the intersection of capable years of life (blue circle, defined by three objective criteria) and years with life satisfaction above a minimal level (yellow area).

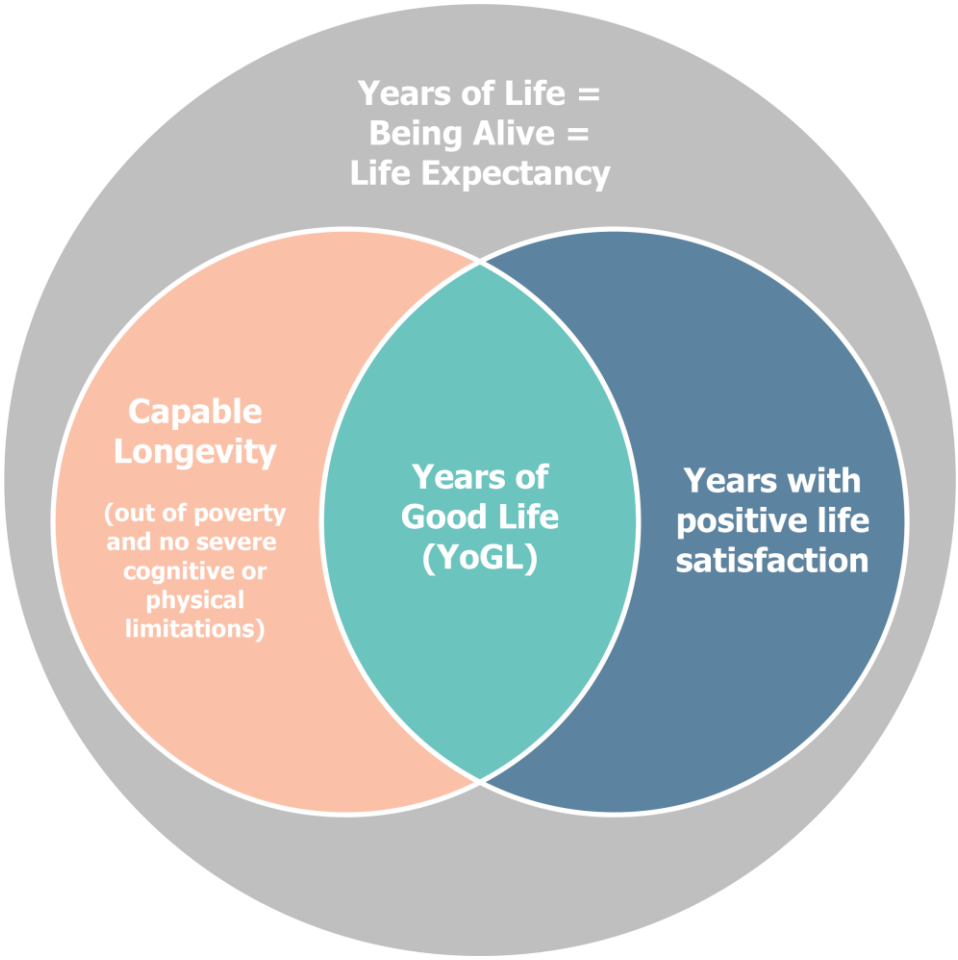

Figure 1: Dimensions of Years of Good Life - a human well-being indicator

Many of the most common indicators of QOL (see list in Appendix) do not reflect that being alive is a necessary precondition for enjoying any such QOL. Measuring quality indicators only for people who are still alive at any point in time without considering the length of life can lead to absurd conclusions, particularly in case of discontinuities in mortality conditions. A famous example for this is the relationship between GDP/person and AIDs mortality in Botswana. A simulation model by Sanderson (12) shows that an increase in AIDS mortality lead to an increase in GDP/person since GDP was largely based on diamonds and population size does not affect sales thereof while being the denominator in GDP/person. But increases in premature mortality due to AIDS could hardly be interpreted as an increase in human wellbeing. More generally, the same problem arises with any wellbeing indicator in which people differentially contribute to the numerator but are equally weighted in the denominator. Killing those who contribute least results in an increase in the average wellbeing for those surviving. It would indeed be absurd to interpret such a selection process as a real increase in average wellbeing over time. Instead the length of life and the incidence of premature mortality must be directly factored into the wellbeing indicator to avoid this problem.

Capable longevity and overall life satisfaction

The vast literature on human wellbeing shows a clear bifurcation into considering either objective or subjective criteria for what is considered a good life. Objective measures have a longer tradition and are more numerous, whereas representative studies of subjective wellbeing have only become available more recently (15). For reasons discussed below, YoGL combines both aspects and does not allow for trade-offs between them. Being highly above the minimum on the objective indicators does not compensate for insufficient life satisfaction and vice versa.

Even though tradition and a giant share of the literature tend to favor objective indicators, the subjective criterion is essential for capturing some of the “softer” value-related dimensions of what is considered a good life, such as living in a more egalitarian society, experiencing freedom and trust or valuing a clean environment. While intersubjective agreement over such values will never be accomplished, by including life satisfaction, in agreement with one of the major goals of subjective wellbeing research, we let people themselves assess whether they are satisfied and this way “to advance their idea of the good life” (16). Simultaneously, this makes the indicator comparable across cultures despite existing value differences.

Independently from subjective life satisfaction, there are objectively assessable criteria for what constitutes a good life. Desai, Sen, and Boltvinik (14) identify (1) basic health, (2) basic material subsistence, as well as (3) cognitive functioning as the three “basic capabilities” that jointly determine a person’s “freedom” to achieve wellbeing. This general approach has later been translated prominently into the HDI whose three components (health, income and education) directly reflect the three aspects of capability. The authors also suggest to combine these three dimensions with longevity to produce an indicator called “capable longevity”. To our knowledge, YoGL is the first indicator that operationalizes this general idea.

Ideally capable longevity should be measured through objectively assessed characteristics. In reality, though, many of the surveys collecting information about such objective indicators – due to resource constraints – prefer to simply ask people e.g. whether they can read or raise from a chair, instead of actually testing these capabilities. But wherever possible we use actually tested or objectively assessed

characteristics. A full account of the data and indicators used to derive the estimates presented here is given in the Appendix. In the following, we introduce the indicators that should ideally be used to derive YoGL and that should guide future survey taking:

(1) **Being out of absolute poverty** in low and middle-income countries is assessed through the presence of certain facilities such as a flush toilet or a solid floor in the living room. In high-income countries, household consumption data can be used instead.
(2) **Having no severe activity limitation** is assessed with respect to difficulties in "Activities of Daily Living" (ADLs) and specifically through testing the difficulty in rising from a chair (17), which can be objectively verified.
(3) **Being cognitively able in terms of basic numeracy and literacy** is assessed through a standardized test of basic literacy (18).

The field of subjective wellbeing (SWB) research is rapidly expanding, with an average of 14,000 publications a year (19), and attracts more and more attention – even among quantitative social scientists as SWB measures have long been accepted as "proxies for 'utility'" (20). A review of this extensive literature relevant for the development of YoGL as wellbeing indicator is given by Lijadi (21). The most universally recognized scales to measure SWB were introduced by Diener under the name of "Life Satisfaction" (22, 23), as well as the widely used "Happiness Scale" going back to Bradburn (24). Both of them are used in reputable international surveys. But the literature suggests somewhat less stability of "happiness", which refers to a more emotional assessment of one's life, whereas life satisfaction yields a more cognitive, and subsequently less volatile evaluation (19, 25). For this reason, we rely on overall life satisfaction rather than happiness to cover the subjective dimension in YoGL. Implicitly, life satisfaction contains a subjective weighting of different life domains by the responded him/herself that ought to be included in the derivation of an aggregate measure of QOL.

Application and Results

YoGL has been designed to be potentially applicable to any sub-population in any country and at different points in time. While age- and sex-specific survival rates, which are needed for calculating a life table and thus total life expectancy, typically come from vital registration systems covering entire populations, the indicators used to assess the proportions of years considered as good years of life have to be derived from sample surveys. While there is a huge empirical basis of such surveys for most countries, few of them so far cover all four dimensions considered here. An extensive discussion of potential data sources, their respective strengths and limitations, as well as estimation methods applied to obtain YoGL dimensions missing from the original surveys, is provided in the Appendix. Here we only present trends and differentials in YoGL for selected sub-populations to illustrate its potential.

The calculation of YoGL is based on demographic life table methods (26) in which age-specific person years lived at each age are multiplied by age-specific proportions considered to be above a critical threshold in all four YoGL dimensions. Thus, a year is only counted as a good year for individuals that are above the critical thresholds in all four dimensions. Following criterion (4) above, no trade-offs or compensatory mechanisms are assumed between dimensions. Summing up the age-specific person years of good life for all remaining age groups above the age at which remaining life expectancy shall be assessed results in

expected total years of good life. As with total life expectancy, YoGL can be assessed at birth, as well as at any other age considered appropriate. Since it is problematic to assess life satisfaction for children, in most applications we focus on remaining life expectancy at age 20, though we will also illustrate it for age 50.

Table 1: YoGL at age 20 for all 38 countries. 4 columns: female YoGL, female LE at age 20, male YoGL, male LE ordered by female YoGL

	Female		Male	
Country	**YoGL**	**LE**	**YoGL**	**LE**
Sweden	58	64	55	60
Netherlands	57	64	56	60
Germany	54	63	51	58
Chile	52	62	50	57
China	52	59	50	56
Spain	52	66	51	60
South Korea	51	65	51	58
Cyprus	50	63	50	58
Estonia	49	62	44	52
Uruguay	49	62	47	55
Ecuador	48	61	47	56
Brazil	47	60	45	53
Thailand	47	60	47	53
Colombia	46	59	44	53
Lebanon	45	62	46	58
Malaysia	43	58	44	54
Romania	43	59	42	53
Peru	42	59	46	55
Mexico	40	61	44	57
Armenia	39	58	39	52
Georgia	39	58	36	50
Turkey	39	60	45	54
Kazakhstan	38	55	36	46
Russia	35	57	33	46
Jordan	34	57	36	54
Algeria	29	59	36	57
Iraq	29	55	34	51
Ghana	28	49	31	47
South Africa	25	47	25	40
Pakistan	24	54	35	52
Haiti	23	51	23	48
India	23	54	31	51
Tunisia	23	59	32	55
Zimbabwe	22	44	25	42
Egypt	19	55	26	51
Morocco	14	59	12	57
Rwanda	11	52	12	50
Yemen	10	51	21	48

Table 1 shows results for 38 countries at very different stages of development and for women and men separately. As expected, the cross-country differences in YoGL at age 20 (left column) are much bigger than the differences in life expectancy (LE, right column). While in the most developed countries, women at age 20 can expect to have more than 50 years of good life left (with a record 58 years in Sweden), women in the least developed countries can expect less than 15 years (with a record low of 10 years for women in Yemen). While life expectancy is higher for women than for men in every single country, female YoGLs turn out to be lower than male in most developing countries. This reveals a significant gender inequality in objective living conditions and subjective life satisfaction in most of these countries.

These stunning differences naturally trigger the question of which YoGL dimensions drive them and whether there has been at least an improving trend over time. Figure 2 shows the time trends in the individual components of YoGL for women and three selected countries. In India women at age 20 in 1995-2000 had a total remaining life expectancy of 51 years, but only 15 of these years were assessed as being years of good life. 15 years later in 2010-15 remaining life expectancy had increased by 3 years but YoGL increased more strongly by 8 years. The decomposition into individual components traces back this increase mostly to reductions in absolute poverty and to a lesser extent improving life satisfaction and health. Cognition has not improved over time. South Africa displays an interesting different pattern with total life expectancy even declining by one year over the same period – presumably due to HIV/AIDS – while YoGL increased by 5 years, due to improvements in all components except for health. In Mexico, finally, life expectancy and YoGL increased almost in parallel with all components showing moderate increases except being out of poverty, which showed a steep increase. For men the improvements in YoGL have been much steeper than for women in India and Mexico, with little difference in South Africa. More countries are shown in the Appendix.

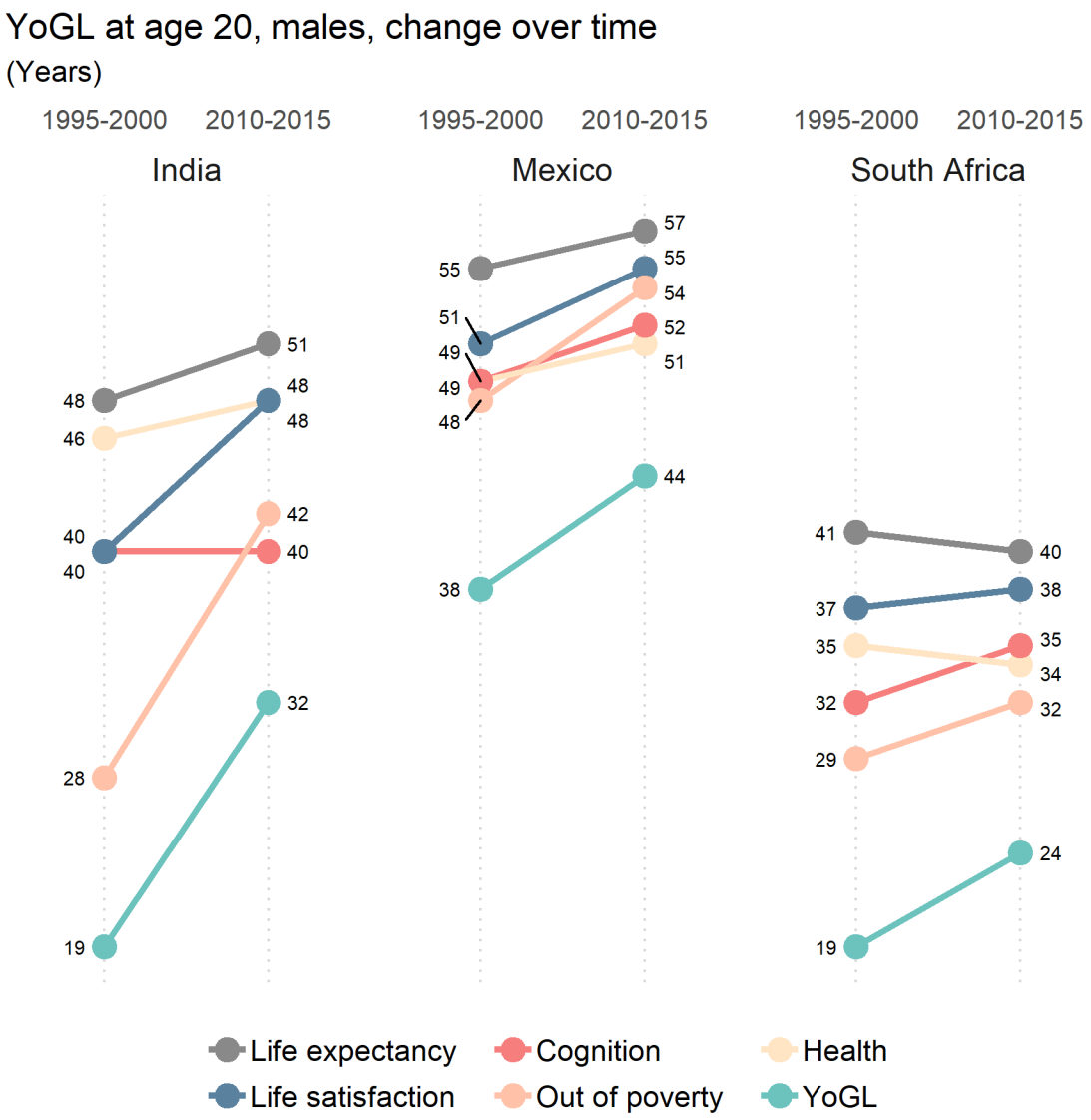

Figure 2: Trends in YoGL 20 for men, South Africa, India Mexico

Figure 3 finally illustrates the application of YoGL to sub-populations above age 50 and differentiated by highest level of educational attainment in five European countries for which SHARE surveys provide reliable data. Focussing on men, the figure shows that while remaining total life expectancy at age 50 is highest for better educated men in Italy, the remaining years of good life are highest for highly educated men in Denmark and Sweden. It is also interesting to see that both in terms of total life expectancy and in terms of YoGLs, the differences between the different sub-populations as defined by level of education are least pronounced in Scandinavia and strongest in Eastern Europe. In Estonia 50 year old men with lower education have less than half the expected number of remaining good years of life compared to men of the same age with high education.

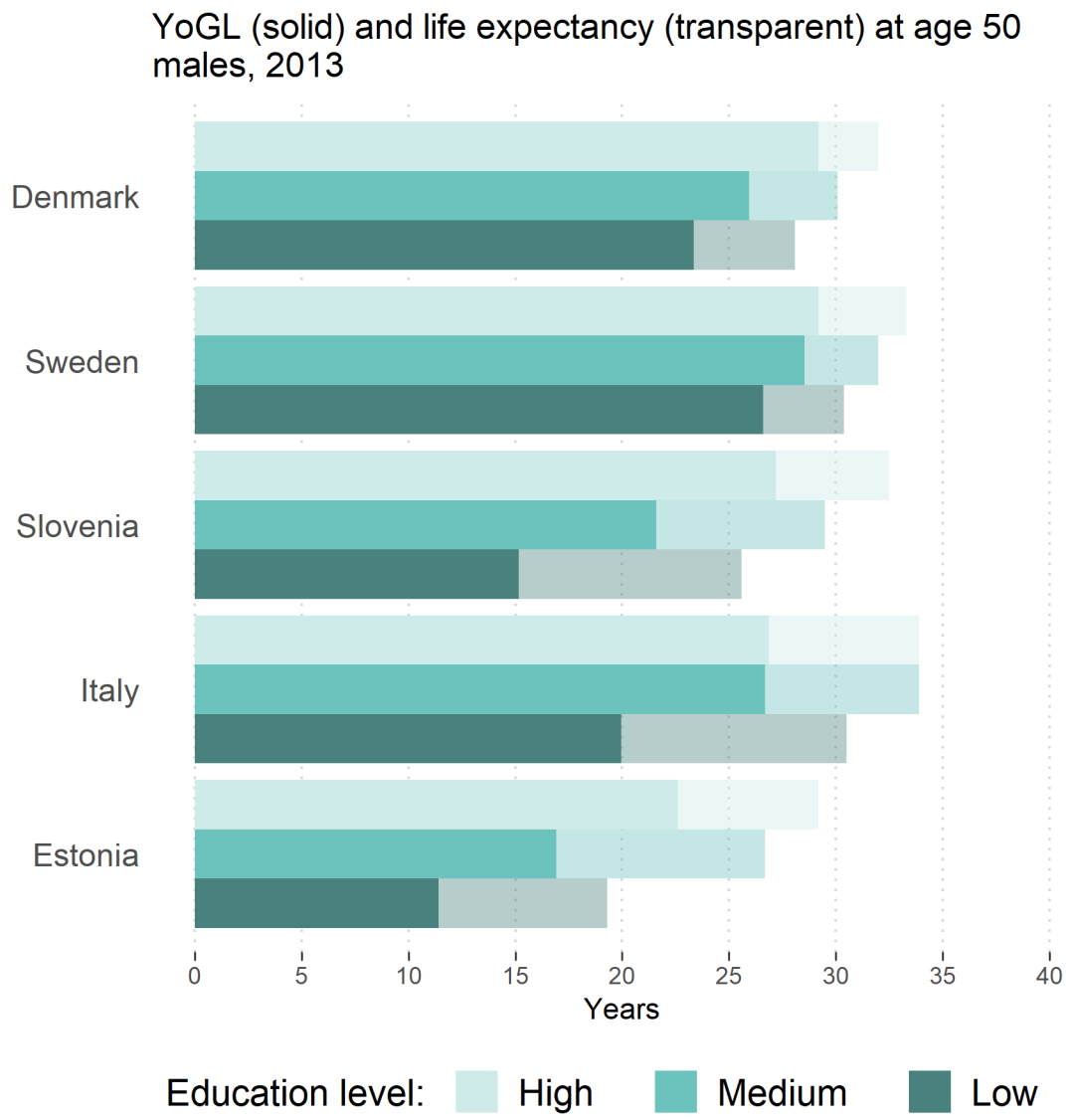

Figure 3: YoGL 50 by education – 5 European countries. Only YoGl 50 and LE 50 by education

Discussion and Outlook

The inclusive wealth approach is clearly the most advanced operationalisation of sustainability so far and it rests on a solid body of economic theory. But it has reached its limits due to the difficulties involved with its empirical application. There is simply not enough empirical information on the current stocks of the different capitals, their future values and limits of depletion, and in particular the desirable mix of capitals in producing human wellbeing.

In this article, we propose an alternative, demography-based approach measuring wellbeing directly. The Years of Good Life (YoGL) indicator focuses on the changing composition of human populations by individual characteristics that jointly constitute their wellbeing and its change over time. The indicator has been designed to serve as a criterion variable for judging long-term development trajectories with respect

to their sustainability. YoGL is being defined at the level of (sub-)populations whose wellbeing should not decline over time – even when factoring in feedbacks from environmental changes – if development is to be called sustainable. Unlike many other wellbeing indicators (which are being discussed in the Appendix), the newly proposed indicator meets six important criteria specified above.

The most ambitious of these criteria is the indicator's near universal acceptability as an ultimate end of human development. Some scholars claim that due to the evident multitude of world views and values, there can never be universal agreement on ultimate ends (27). But YoGL avoids the need to explicitly specify certain potentially contested values by letting people judge by themselves about what is their overall life satisfaction according to their own values and their own weighting of satisfaction in different domains of life. Only if overall life satisfaction is above a minimum level, life years are counted as good years.

Survival and the avoidance of premature death likely comes as close to a universally shared goal as one can possibly get. From an evolutionary perspective, survival is the ultimate criterion for success, which is why people across virtually all cultures and times used methods to avoid or postpone death wherever they became available. Because the value of survival is so self-evident, empirical value studies have hardly ever assessed it explicitly. In the context of the Global Burden of Disease Study large empirical investigations were carried out on different continents confirming interculturally shared values in assessing health outcomes (28). Similarly, at later stages of this project we will assess the universal acceptability of YoGL across different cultures.

An important advantage of YoGL over indicators that can be assessed only at the national level is its applicability to flexibly defined populations and sub-populations. At the same time, since a life table is only defined for groups of people, even though YoGL is suggestive of the average years of good life an individual can expect, it needs to be assessed at the level of groups of people. Moreover, the objective dimensions of YoGL do not intend to judge whether individual lives are good or bad. Similar to mortality rates, the prevalence of being below certain thresholds can only be assessed at the level of sub-populations.

Great challenges remain to comprehensively estimate the "wellbeing production functions" of sustainability science, quantify the feedbacks from environmental changes onto long-term human wellbeing and define scenarios about possible future trajectories. But constructing and empirically estimating a tailor-made wellbeing indicator W as the dependent variable in the analysis is a decisive first step. If the definitions proposed here are accepted by a broader research community, this can also lead to more and better data collection through including the specified items in major ongoing international surveys. YoGL has the potential to become a broadly used currency in which the costs and benefits of certain developments and actions can be expressed, competing with the still ubiquitous purely monetary units. For example, the social costs of carbon could potentially be assessed in terms of years of good life lost among future generations, rather than some dollar terms (29, 30).

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