Age and Time in the Measurement of the Burden of Disease

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Forthcoming in Nir Eyal, Samia Hurst, Christopher J. L. Murray, S. Andrew Schroeder, and Daniel Wikler (eds.), *Measuring the Global Burden of Disease: Philosophical Dimensions.* Oxford University Press.

Abstract

A basic principle of the Global Burden of Disease (GBD) studies is that all units of health loss have the same value. However, in earlier iterations of the GBD studies this principle had some qualifications. One was that the value of the same health loss may differ between individuals of different ages; that is, DALYs were age-weighted. Age-weighting has now been removed for ethical reasons. A year of healthy life has the same value regardless of the age of the person living it. Contrary to this claim, however, I argue that a form of implicit age-weighting is still implied by the GBD methodology. But I also argue that this kind of age-weighting can be defended on moral grounds.

Keywords: age-weighting, years of life lost, ideal life expectancy, death rate, median age of death, modal age of death

1 Background

A basic principle of the Global Burden of Disease (GBD) studies is that all units of health loss have the same value. Each unit is equally important regardless of its cause and the characteristics of the individual whose health loss it is. At one point, this was, programmatically, expressed in a pair of propositions:

Proposition 1. The burden calculated for like health outcomes should be the same.

Proposition 2. The non-health characteristics of the individual affected by a health outcome that should be considered in calculating the associated burden of disease should be restricted to age and sex.[1]

In the GBD studies, the unit of health loss is the DALY (disability-adjusted life year). The DALYs associated with a health condition h are the sum of the *years of life lost* and the *years lived with disability* due to condition h:

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[1]Both propositions are quoted from Murray (1996, 6).

$$\text{DALY}^h = \text{YLL}^h + \text{YLD}^h.$$

If a health condition kills you at a given age, then it causes a specific number of years of life to be lost (YLL), determined by how much longer an individual at your age could have been expected to live. If the same condition also disables you for several years before it kills you, then each of those years is marked down with the disability weight (a number between 0 and 1) that is associated with the condition. These are added up (this is YLD), and the result is added to the years of life lost. The sum is the burden of this health condition for you. To calculate the overall burden of this condition in the population, your DALYs are added to the DALYs of other people who suffer from the same condition. And to calculate the overall disease burden, the DALYs from all conditions are added up. That, at least, is the basic idea; the details are of course more complicated.

So years of life lost are one kind of DALY, years lived with disability another. In this chapter, my focus is only on YLLs. I will have nothing to say about YLDs.

Proposition 1 states that if two health outcomes are similar in all relevant respects, then they are equally bad. If two conditions lead to the same health outcome (for instance, blindness or death), then they should have the same burden. Proposition 2 modifies this by adding two exceptions: the value of the same health loss may differ between men and women, and it may differ between individuals of different ages.

These modifications make a big difference when it comes to years of life lost. The DALY is a *gap measure*: it represents the shortfall, or loss, from some baseline level of health. In the case of the disability weights used in YLDs, the baseline level is full health. But in the case of YLLs, the question of baseline is more complicated. How many years of life do you lose when a disease kills you? The answer to this question may depend, for instance, on where you live. If you live in a developed country, your life expectancy considerably exceeds the life expectancy of people in poor countries. But surely your death is no worse just because you happened to be born in an affluent society. And this isn't just a matter of ethics. Attributing different numbers of years of life lost to people from different countries would massively violate the basic principle expressed in Proposition 1.

The baseline for years of life lost is determined by a life table that contains "ideal" life expectancies at each age, called the *standard life table*. The years of life lost due to death at a particular age equals the ideal life expectancy at that age. In the early iterations of the GBD studies, the standard life table had a life expectancy of 82.5 years at birth for women, and 80 years for men. Note that this doesn't mean that mortality does not matter once you have reached 80 or 82.5. Ideal life expectancies vary with age. At 20, it was originally 63.08 for women and 60.44 for men; at 60, it was 24.83 for women and 21.81 for men. Once you reached 20 or 60, the number of years of life that you would lose if you died at that point was greater, relatively speaking, than at birth. (This is due to the fact that some members of your birth cohort have already died.) Still, the death of a woman was considered worse at all ages than the death of a man.

In addition, up until the latest, 2010 update of the Global Burden of Disease studies (henceforth GBD 2010) DALYs were *age-weighted*. An additional year of life had different value depending on the age of the beneficiary. The age-weighting function started from a low value at birth, increased until young adulthood, and then gradually decreased in middle- and old age. As a consequence, an extra year added to a person's life counted for more when she was 20 compared to when she was 5 or 60.

Proposition 2 implies that it is permissible to consider an additional year of life more valuable at any age when it benefits a woman rather than a man. It also implies that it is permissible to attribute different value to additional years of life at different ages. These are not violations of the basic principle expressed in Proposition 1. But both of these modifications had become controversial, and they were given up in GBD 2010.

2 The Rejection of Age-Weighting

The 2010 update was a significant departure from the earlier methodology of the measurement of the burden of disease. It contained numerous revisions of the way DALYs are calculated.[2] Two of these are especially relevant to my discussion. They are the introduction of a new standard life table and the rejection of age-weighting.

Before the update, life expectancies for different ages in the standard life table were different for males and females. In particular, they were lower for men at each age. Two reasons were given. It was argued that there is a biological difference in survival potential between the sexes. In addition, it was argued that men tend to engage in more risky behavior, or at least tend to face greater health risks, than women. The difference of 2.5 years in life expectancy at birth (82.5 for women and 80 for men) was seen as a reasonable estimate of these two factors.

The life expectancies in the original standard life table were loosely based on life expectancies in Japan, which had the highest life expectancies in the world. The thought was that they can be interpreted as *aspirations*. Since one part of the world has managed to reach these life expectancies, it should be possible to reach them everywhere. Intuitively, the idea is that it is regrettable if you cannot live as long as some others, but it is not regrettable if you cannot live longer than everybody else.

But if this is how the numbers in the standard life table should be interpreted, then there is no reason to set male life expectancies lower. A man's premature death is just as bad as a woman's. In addition, the gap in life expectancies between men and women have narrowed since the earliest GBD studies, and they have been increasing for both sexes. To do justice to both the ethical arguments and the empirical trends, a new standard life table was introduced in the 2010 update, with life expectancy at birth set to just above 86 years (reflecting, once again, the situation in Japan), and with no difference between male and female life expectancies at any age.[3]

Figure 1 on page 7 presents an abridged version of the new standard life table.

Originally, DALYs were also age-weighted. Age-weighting was defended in the following way. People are more productive in their young adulthood. They are more likely

[2]For details, see Murray *et al.* (2012).

[3]See Murray (1996, 16–19), Murray *et al.* (2012, 13–14), and Wang *et al.* (2012).

to be employed. They also contribute to social productivity in other ways: they often take care of their children and elderly parents. Hence the welfare of children and the elderly depends, to a large extent, on their contributions. This sort of *welfare interdependence* has a crucial role in society. In particular, the illness of a young adult is likely to negatively affect the welfare of others. Therefore, it should have more weight when the burden of disease is calculated. Age-weighting was introduced to take welfare interdependence into account.[4]

But this argument is deeply problematic. When the DALYs of young adults are given more weight, considerations that should be irrelevant to measuring the burden of disease are introduced—namely, considerations about the *social value* of health. The premature death or the disability of a young adult is considered worse not because it is worse for her, but because it is worse for others. This sort of consideration should have no place in a measure of health.

What's more, even if the burden of disease should be interpreted as a measure of the social value of health, as the argument from welfare interdependence suggests, age-weighting leads to double counting, since the care that some people provide to others is already reflected in the measure of the burden of those who receive the care. Therefore, age-weighting is not justified in any case.[5]

In response, age-weighting was abandoned in GBD 2010. It was conceded that "viewed as a strict summary measure of population health, arguments for weighting years of healthy life lived at different ages are less compelling."[6] But it was also suggested that age-weighting may remain a matter of social concern. Even if a year of healthy life has the same value regardless of the age of the individual whose life it is, societies may implement policies that assign different weights to years of life at different ages. They might do this, for instance, in order to promote fairness, equality, or some other ethical objective. In general, the 2010 update placed greater emphasis than ever before on the distinction between *measurement* and *priority setting*. It explicitly acknowledged that certain moral considerations should not be reflected in the measurement of population health. Their place is in health policy.

These changes amount to abandoning Proposition 2. The revisions to the calculation of DALYs reaffirm the basic principle that all units of health loss have the same value. The exceptions have now been eliminated.

3 Implicit Age-Weighting

In the rest of this chapter, I want to examine whether it is truly the case that all units of time have the same value in the calculation of DALYs. I will show that they do not; a kind of implicit age-weighting is still present. I will explain why this occurs, and consider whether it is possible to defend this form of age-weighting.

[4] See Murray (1996, 54–61) and Murray and Acharya (2002).

[5] The last three paragraphs follow Bognar (2015, 53). For a more detailed argument, see Anand and Hanson (2004) and Bognar (2008).

[6] Murray *et al.* (2012, 16).

I will begin with some simple examples. Suppose you are a doctor and you have two patients with some fatal disease. You can save only one of them. The only difference between the patients is that one of them is 20 years old and the other is 60 years old. You know for certain that whomever you save would remain completely healthy for the rest of her life. You also know that these patients would live for the exact number of years that their life expectancy was at birth. So you must choose between

(A) saving a 20-year-old who would reach her life expectancy at birth, if saved;

(B) saving a 60-year-old who would reach her life expectancy at birth, if saved.

If you choose (A), the 60-year-old patient will die, and the 20-year-old patient will live until she reaches her life expectancy at birth, at which point she dies. If you choose (B), the 20-year-old patient will die, and the 60-year-old patient will live until she reaches her life expectancy at birth. One way to choose is to calculate the YLLs associated with these outcomes in order to determine which alternative would *minimize* DALYs. (Since DALYs represent burden, you want to have as few of them as you can.)

Suppose life expectancy at birth is 86 years. Since there are no years of life lived with disability, the calculation of DALYs if you choose (A) is straightforward. You can simply take the number of years of life lost:

$$\mathrm{DALY}_{(\mathrm{A})} = \mathrm{YLL}_{60} = 26. \tag{1}$$

Calculating the DALYs if you choose (B) is similar:

$$\mathrm{DALY}_{(\mathrm{B})} = \mathrm{YLL}_{20} = 66. \tag{2}$$

Evidently, what you must count are the years of life lost associated with the *other* patient's death: when you save the 20-year-old, the burden is determined by the years that the 60-year-old loses. (This is indicated by the subscript of YLL above.) Thus, if your aim is to minimize the burden of disease, saving the younger patient is clearly better: you avert 40 DALYs by choosing (A). But this is not because any unit of health loss has more value than any other. It is simply because there are more years of life lived when the younger patient is saved.

Consider now a variant on the example. You have to choose between

(C) saving a 20-year-old who would survive for another 10 years, if saved;

(D) saving a 60-year-old who would survive for another 10 years, if saved.

Even though these patients would not reach their life expectancy at birth, the years of life lost should still be calculated in terms of it. The calculation is slightly more complicated because now YLLs must be attributed also to the patient who is saved:

$$\mathrm{DALY}_{(\mathrm{C})} = \mathrm{YLL}_{30} + \mathrm{YLL}_{60} = 56 + 26 = 82; \tag{3}$$

$$\text{DALY}_{(\text{D})} = \text{YLL}_{20} + \text{YLL}_{70} = 66 + 16 = 82. \quad (4)$$

That is, in order to calculate the DALYs associated with the outcome of saving the younger patient, you add up the years of life lost associated with the death of the 60-year-old at this point, and the years of life lost associated with the death of the 20-year-old 10 years from now, when she is 30, as shown in (3). Calculating the DALYs in outcome (D) is similar.

The burden associated with the two outcomes is the same. No matter what you do, you can only gain 10 years of life. It makes no difference which patient gets those extra years. All additional years of life have the same value. This is exactly what you should expect if all units of health loss are equally important.

Some people might object that you ought to save the life of the younger patient in the choice between (C) and (D), just like you ought in the choice between (A) and (B). Now in that choice, one outcome had fewer DALYs, providing a strong reason for choosing it. However, by the same reasoning, you ought to be indifferent between (C) and (D), since they have the same number of DALYs. Nevertheless, the objection goes, there might be reasons for choosing (C), for instance having to do with equality or fairness. But the DALY count does not reflect these reasons. So something has gone wrong.

One way to respond to this objection is to invoke the distinction made above between *measurement* and *priority setting*. You can point out that when it comes to measurement, all units of time should have the same value: the age of the person who receives an additional year of life should make no difference. This reflects the basic principle that all units of health loss are equally important. But when it comes to priority setting, there are other moral factors that you might want to take into account. Perhaps the younger patient should be saved because this would make the outcome more equal or less unfair. Therefore, you don't have to give up the basic principle—you can account for certain moral considerations, like those of fairness or equality, separately from measurement.

There is, however, a problem with this response.

To explain it, let me first note that the simple method of calculation that I used in the choices between (A) and (B), and (C) and (D), is *not* the way DALYs are calculated in the GBD studies. For my examples, I simply took age (denote it by a) and stipulated that an individual's life expectancy at age a is simply $(86-a)$. So the YLL of any premature death is $(86 - a)$. But this is a gross oversimplification. Life expectancy changes throughout life. In particular, as more people in your birth cohort die, your overall life expectancy increases as you get older.

The GBD 2010 uses a standard life table, reproduced in part here as Figure 1, to calculate years of life lost at different ages. Consider again the choice between (A) and (B). Using now the life expectancies from Figure 1, the DALYs come out the following way:

$$\text{DALY}_{(\text{A})} = \text{YLL}_{60} = 27.81; \quad (5)$$

Age	Life expectancy
0	86.02
1	85.21
5	81.25
10	76.27
15	71.29
20	66.35
30	56.46
40	46.64
50	37.05
60	27.81
70	18.93
80	10.99
90	5.05
100	2.23

FIGURE 1. Abridged GBD 2010 standard life table. (Based on Murray *et al.* (2012), Figure 6.)

$$\mathrm{DALY}_{(\mathrm{B})} = \mathrm{YLL}_{20} = 66.35. \tag{6}$$

There is only a slight difference in the evaluation of (A) and (B) when it is based on the simple method that I have used above, and when it is based on the GBD 2010 life table: the number of DALYs averted are slightly smaller on the latter. But there are still fewer DALYs if the younger patient is saved.

Consider now the choice between (C) and (D). In this case, calculating on the basis of the GBD 2010 life table gives a surprising result:

$$\mathrm{DALY}_{(\mathrm{C})} = \mathrm{YLL}_{30} + \mathrm{YLL}_{60} = 56.46 + 27.81 = 84.27; \tag{7}$$

$$\mathrm{DALY}_{(\mathrm{D})} = \mathrm{YLL}_{20} + \mathrm{YLL}_{70} = 66.35 + 18.93 = 85.28. \tag{8}$$

Saving the 20-year-old averts *more* DALYs than saving the 60-year-old! Even though both of them can survive only for 10 more years, the burden of premature mortality is less in the outcome in which the younger patient survives. This is surprising because with age-weighting gone from the measurement of the burden of disease, years of life should have the same value at different ages. And it violates what I have called the basic principle—that all units all health loss are equally important. The result is *not* what you would expect if all units of health loss had the same value.

Note that this phenomenon occurs across the board. Consider, for instance, the choice between saving a 5-year-old who can survive for another 10 years and saving a 20-year-old who can survive until she is 30. If you save the 5-year-old, there will

Period	Decrease
0–10	9.75
10–20	9.92
20–30	9.89
30–40	9.82
40–50	9.59
50–60	9.24
60–70	8.88
70–80	7.94
80–90	5.94

FIGURE 2. Changes in life expectancy in each decade of life in the GBD 2010 standard life table.

be 137.64 years of life lost; if you save the 20-year-old, there will be 137.71 years lost. Thus, saving the 5-year-old results in fewer DALYs than saving the 20-year-old. The extra 10 years are slightly more valuable when they go to the 5-year-old, even though there is no explicit age-weighting. This is remarkable because the original age-weighting function gave greater value to years of life between 20 and 30 than at any other period. This was a particularly controversial aspect of age-weighting. It's not only that the weights are gone now, but, as an unintended side effect, the result is effectively reversed.

The way years of life lost are calculated in the GBD studies implicitly incorporates different weights for the burden of premature mortality at different ages. This was also the case with earlier iterations that used a different standard life table. But before GBD 2010, one might have considered it less problematic due to Proposition 2. Now with the exception for age gone, implicit age-weighting is more of a concern.

But what causes the implicit age-weighting? The explanation for this is found in the way life expectancies change. Figure 2 sets out the amount of change in life expectancies in the GBD 2010 standard life table for each decade of life. Setting aside the first decade, life expectancies decrease at a *decreasing* rate at higher ages. Consider an individual who is 20 years old now. Her life expectancy is 66.35 years. By the time she becomes 30, her life expectancy is 56.46 years, decreasing by 9.89 years. Between 30 and 40, it decreases by 9.82 years, and between 40 and 50 by 9.59 years. It decreases by less and less for each decade of life.

The implicit age-weighting is a consequence of this. If the decrease in life expectancy in the life table was constant, an additional year of life would have the same value at every age. But this just leads to the next question: why do life expectancies decrease at a decreasing rate? What is the reason for this pattern in the life table?

x	n_x	d_x	e_x	n_x	d_x	e_x	n_x	d_x	e_x
0	100	20	2.5	100	10	3	100	30	2
1	80	20	2	90	15	2.277	70	25	1.642
2	60	20	1.5	75	20	1.633	45	20	1.277
3	40	20	1	55	25	1.045	25	15	0.9
4	20	20	0.5	30	30	0.5	10	10	0.5
5	0	0	—	0	0	—	0	0	—
	(a) *Leibniz*			(b) *Halley*			(c) *Huygens*		

FIGURE 3. Three possible worlds. (x = unit of time ("age"); n_x = number of individuals alive at the beginning of x; d_x = number of individuals who die during x; e_x = life expectancy at the beginning of x.)

4 Possible Worlds

The original life table in the GBD studies was based on Japanese life expectancy data and a model life table based on data from selected developed countries. For the updated life table in GBD 2010, age-specific life expectancies were derived from data from those countries that had the lowest death rates for each age. This reflects the idea that ideal life expectancies are aspirations: at each age, the burden of premature mortality should be calculated from the baseline determined by the greatest life expectancy that has been observed for that age.[7]

In other words, the standard life table is based on empirical data. At each age, life expectancy is based on the lowest observed death rate in the world. Thus, the *pattern* of the change in life expectancies in the standard life table is contingent. It would be different if the pattern of mortality was different in the world. The implicit age-weighting that we discovered is a consequence of the pattern in the life table. It would disappear if the pattern of the change in life expectancies was different.

Since implicit age-weighting is a threat to the basic principle that all units of health loss have the same value, it is worth examining the conditions that give rise to it. In order to do that, I am going to use some very simple examples. I am going to consider three "worlds" which are similar in some respects and different in others. In each of these worlds, there is only one birth cohort with a hundred people. (If that's unintuitively small, multiply it by a thousand.) There are also only five units of time—I will simply call them "years," but they could represent any time unit (for example, two decades of life). Thus, each individual is born at the beginning of "year" 0, and no individual is alive by year 5. Finally, people die at different ages, but they never suffer any disability. Hence only YLLs are relevant for calculating their burden of disease.

This is how the three worlds differ:

Leibniz's world. In each time period, the same number of people die. The death rate is constant.

[7] See again Murray (1996, 16), Murray *et al.* (2012, 14), and Wang *et al.* (2012).

Halley's world. In each time period, more and more people die. The death rate is increasing.

Huygens's world. In each time period, fewer people die. The death rate is decreasing.[8]

Figure 3 provides an example of one way these worlds might be. In *Leibniz's world*, the same number of people die each period, and the size of the population decreases evenly. The pattern of the change in life expectancy is constant. In *Halley's world*, few people die young, but more and more people die at later times. Life expectancy at each age, except for the very end of life, is greater than in Leibniz. In *Huygens's world*, a lot of people die young, and the number of deaths decreases later. Life expectancy is lowest in this world at each age save for the very last.

Let us examine whether there is implicit age-weighting in any of these worlds. Consider a simple example, not unlike the others above, in which you have to choose between

(E) saving an individual at $x = 1$ who would survive for 1 more unit of time;

(F) saving another individual at $x = 3$ who would survive for 1 more unit of time.

(Since everyone is the same age, you do (E) or (F) at different times, but you can't do both. If you choose (E), the individual in (F) dies, if you choose (F), the individual in (E) dies.) Let us calculate the burden of disease for (E) and (F) in these different worlds:

Leibniz's world:

$$\mathrm{DALY}_{(\mathrm{E})} = \mathrm{YLL}_2 + \mathrm{YLL}_3 = 1.5 + 1 = 2.5; \tag{9}$$

$$\mathrm{DALY}_{(\mathrm{F})} = \mathrm{YLL}_1 + \mathrm{YLL}_4 = 2 + 0.5 = 2.5. \tag{10}$$

Halley's world:

$$\mathrm{DALY}_{(\mathrm{E})} = \mathrm{YLL}_2 + \mathrm{YLL}_3 = 1.633 + 1.045 = 2.678; \tag{11}$$

$$\mathrm{DALY}_{(\mathrm{F})} = \mathrm{YLL}_1 + \mathrm{YLL}_4 = 2.277 + 0.5 = 2.777. \tag{12}$$

Huygens's world:

$$\mathrm{DALY}_{(\mathrm{E})} = \mathrm{YLL}_2 + \mathrm{YLL}_3 = 1.277 + 0.9 = 2.177; \tag{13}$$

$$\mathrm{DALY}_{(\mathrm{F})} = \mathrm{YLL}_1 + \mathrm{YLL}_4 = 1.642 + 0.5 = 2.142. \tag{14}$$

[8] The names of these worlds correspond to different early hypotheses about mortality. Gottfried Wilhelm Leibniz (1646–1716) thought that the number of deaths at each year of age remained constant from birth to death. Christiaan Huygens (1629–1695) seems to have believed that the number of deaths decline. And in the life table published by Edmond Halley (1656–1742), the death rate was increasing. For details, see Robine (2011).

Just as before, whether an additional unit of time has the same value in each time period depends on the pattern of the change in life expectancy through time. More specifically, it varies depending on how the death rate changes through time. In a world where the death rate is constant, additional units of time have the same value: the basic principle expressed in Proposition 1 is satisfied. But in a world where the death rate increases or decreases, Proposition 1 is violated. In particular, in a world in which the death rate increases with time—as in Halley—an additional unit of time has greater value the *younger* the beneficiary is; in a world in which the death rate decreases with time—as in Huygens—an additional unit of time has greater value the *older* the beneficiary is. In one, there is discrimination against the old; in another, there is discrimination against the young.

Our actual world resembles most closely Halley's world. (Infant and early childhood mortality complicates the picture, hence they are set aside here.) But this is not a metaphysical necessity; our world could be different. And remember that the life expectancies in the standard life table are aspirations. They express normative ideas about the harm of mortality. Surely, we should ask what sort of pattern they should exhibit—that is, what kind of world we would want to live in, regardless of the kind of world in which we actually live. To put it in more practical terms, we should ask the question: what sort of mortality pattern should be used for the purpose of measuring the harm of premature mortality?

One simple answer is to say that the best world is that in which everyone lives up to the greatest age. In terms of our possible worlds, that would be one in which everyone is alive until the end of period 4. Or, in terms of the simple method I used above, one in which everyone lives until 86. But it can immediately be seen that this simple answer is nonsensical. People will not die at the same time, no matter how much premature mortality is minimized. The standard life table should reflect this fact. (It goes without saying that it would be monstrous to force everyone to die at the same time.)

So this answer won't do. Let me, instead, construct a simple veil of ignorance argument, using the examples that I have already set up. Suppose you have to choose between the worlds of Leibniz, Halley, or Huygens, knowing that you will be one of the individuals in the world you choose once the veil is lifted; but you don't know who you will be. In particular, you don't know how long you are going to live. Which world would be rational to choose?

Consider Huygens first. There is not much to recommend this world. It has the lowest life expectancy at birth, and it has the lowest life expectancies at all times except for the last period. At each time after the first period, the population is smaller than in either of the other two worlds. The *median age at death* (the age when half of the population has already died) is less than 2. The *modal age at death* (the age when most deaths occur) is less than 1. On just about any summary measure of longevity, Huygens's world does worst of the three.

That leaves Leibniz and Halley to compare. Of these two, Halley has a greater life expectancy both at birth, and at any later time except for the very end of life. At each period, Halley has a bigger population. (In other words, it has the best *survivorship* *profile*.) In addition, the median age of death is before the third "year" in Leibniz, but after that in Halley. And while the death rate is constant in Leibniz, the modal age of death is at the latest possible time period in Halley. It has the highest modal age of death. Therefore, Halley's world is preferable on all of these measures.

The only drawback of Halley is that it has the sort of implicit age-weighting that we discovered in the life table used in the GBD studies. It violates Proposition 1. But perhaps the properties of Halley can help us provide the beginnings of the argument for defending implicit age-weighting in the measurement of the burden of disease. All things considered, the implication that additional years of life have different value at different ages should be acceptable as a consequence of the sort of mortality and life expectancy profile that we should aspire to. We should care about life expectancy at birth and at later ages. We should maximize survivorship and the median and modal ages of death. Just as life expectancies at different ages should reflect the greatest life expectancies that we can have, the standard life table should reflect these other features too. If, as a consequence, additional units of time will have different value, that is a cost that should be accepted.[9]

5 Conclusion

The revisions of the GBD 2010, and especially the rejection of age-weighting and different life expectancies for men and women, reaffirmed the idea that all units of health loss have the same value. But I have argued that a form of implicit age-weighting is still present in the calculation of years of life lost. It is a consequence of some of the features of the standard life table that is used to calculate YLLs. I have constructed some simple examples to explore the implications of these features. I have suggested that because the implicit age-weighting is the inevitable consequence of features that we should want in the standard life table, it can be defended.

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[9] I provide a more detailed and general version of this argument in Bognar (forthcoming).

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