Reproductive System & Sexual Disorders: Current Research

Jamison, Reprod Syst Sex Disord 2016, 5:4
DOI: 10.4172/2161-038X.1000195

Research Article OMICS International

Perceptions Regarding the Value of Life Before and After Birth

Julian C. Jamison*

Global INsights Initiative, The World Bank, Washington DC, USA

***Corresponding author:** Jamison JC, Global INsights Initiative, The World Bank, 1818 H St NW, Washington DC 20433, USA, **Tel:** 1-202-817-4942; **E-mail:** jjamison@worldbank.org

Rec date: November 7, 2016; **Acc date:** November 16, 2016; **Pub date:** November 23, 2016

Abstract

Objective: This paper aims to explain the practical importance of placing a numeric value on the relative values of lives (or deaths) at different ages, including just before and after birth, and to implement one feasible method for estimating concrete inputs into such values.

Methods: The study population consisted of an online convenience sample of 1628 unique individuals. They were each asked to fill out a short survey consisting of six demographic questions and one question requesting an explicit comparison of numbers of lives saved across groups of humans at different ages. Subjects were randomized into one of ten treatment conditions, where each condition involved a different comparison. The age groups which were asked about consisted of fetuses at 10 and 39 weeks gestation; pregnant women at 10 and 39 weeks gestation; infants in the first week of life; 1-year-old children; and adult women.

Results: On average respondents valued younger fetuses less than more developed ones; fetuses less than children; children less than adult women; and women less than pregnant women. However, there was no discernible difference in valuation between 39-week fetuses and early neonatal infants. Female subjects valued all fetuses and children (relative to adult women) more highly than did male subjects.

Conclusion: Meaningful data can be collected about sensitive topics using online experiments. In this case we find support for a continuously growing valuation of life with developmental age, starting early in gestation and without any sudden jump at birth.

Keywords: Stillbirth; Burden of disease; Health cost-effectiveness; Relative value of lives; Online experiment; Stated preferences

Introduction

The question of when life begins, especially human life, has long been a fraught one. It has been addressed in philosophy [1-4], global health [5-7], and cost-effectiveness analysis [8-9], amongst other disciplines. It could be defined at a single point in time, whether that be conception; the transition from embryo to fetus; the (ever-changing with technology) beginning of viability outside the womb; the onset of sentience and an ability to feel pain; birth; consciousness, which almost certainly comes after birth; or some other point altogether. Several of these, even if theoretically constituting a moment in time, vary greatly across individuals and are essentially unknowable to an outside observer, in which case they may have conceptual appeal but little in the way of practical implications.

On the other hand, one may also imagine that life begins not at a single point in time but rather over a gradual process of becoming a human being [1,5,10]. This may appear as a foreign idea to many people, but in multiple respects it reflects the non-binary nature of the world. Indeed, without perhaps consciously realizing it, the very fact that our legal, medical, and social institutions treat fetuses and infants of different ages in varying manners along a continuum suggests an implicit endorsement of this view. For some purposes, e.g., counting the population size of a given political district, a binary resolution is required: there must be an integer number of people. But for many other purposes this is not the case and such an approach may be overly restrictive.

The most salient application is to abortion, although that is not the focus of the present study. It is worth noting, however, that even there the legality does not shift abruptly in an all-or-nothing jump. Certain procedures are allowed in certain jurisdictions at certain ages, while others are not. Sometimes the origin of the pregnancy (e.g., rape or incest) is taken into account; sometimes not. The health of the mother often overrides the rights of the fetus (if any), even when abortion would otherwise be disallowed. Prosecutorial discretion further complicates the matter and probabilistically smoothens out some of the rough edges. There is no need to force a more constrained decision onto the immutable but not always unhelpful complexity of the environment.

The more consequential application of valuing life before birth is to global health policy. Limited health resources imply that tradeoffs must be made between interventions that save lives or avoid morbidities at different rates for different age groups [11]. This typically requires placing an explicit numerical value on disease outcomes and chronic conditions (such as bilateral blindness or schizophrenia) relative to death, but also placing a relative numerical value on deaths at any given age. Traditional approaches such as Disability Adjusted Life Years (DALYs) have placed zero weight on miscarriages (early fetal loss) or stillbirths (late fetal loss), although some modifications have allowed for a positive weight on loss before birth [5]. Conceptually, therefore, the traditional formulation implies that no social outlay should be incurred in order to avoid fetal loss at any age.

In practice, however, the medical establishment expends nontrivial resources to avoid stillbirths, with the full blessing not only of patients (at least the parents; one can only assume that the fetus also approves) but also without argument from the population more broadly. Given that there are an estimated 2.6 million stillbirths every year [12], with 1.2 million of those occurring during labor, this is not a minor matter. Compare these numbers with roughly 4.5 million infant deaths (i.e., before age 1) yearly. The query then naturally arises: whence the appropriate numerical values for fetal and neonatal loss by gestational age to use in policy making?

This paper cannot fully answer that question, much less the deeper question of when life begins. However, it can add to the remarkably sparse literature attempting to place a number on the relative values of losses before and soon after birth. In this case a simple but informative approach has been undertaken: asking people. Specifically, we use a carefully constructed online survey experiment with over 1600 individuals to estimate the perceived relative valuations of the following groups: 10-week-old fetuses; 39-week-old fetuses; 1-week-old infants; 1-year-old children; pregnant women with 10-week fetuses; and pregnant women with 39-week fetuses.

Although there is naturally much variation in responses, overall the patterns make sense and are not random noise or confusion, yielding confidence that the results are coherent and faithfully convey the typical perceptions of the (admittedly non-representative) survey sample. 10-week fetuses are valued less than 39-week fetuses on their own, but not substantially differently, and pregnant women are valued equally whatever the age of the fetus-although they are valued more than non-pregnant women. 39-week fetuses are valued essentially the same as 1-week-old infants, with no discontinuity at birth, but both are valued considerably less than 1-year-old children. There is no suggestion that policy-makers should simply import these numbers directly into their cost-effectiveness analyses, but they do provide input into the difficult quantitative choices, and perhaps at least as importantly they provide strong support for the qualitative conclusions that both fetal and neonatal loss should be given a partial positive value, increasing with age before and also after birth, with no discontinuous jump at the moment of birth.

Literature

In order to make health policy decisions, it is necessary to address and respond to tradeoffs between interventions that have different costs and different benefits for different groups of people [11]. This typically requires placing a numerical magnitude on the value of a life-year at various ages (which can of course be the same value), and on the value of a death averted at various ages. Potentially the values can also vary across genders, nationalities, or other characteristics. Given that some interventions such as antenatal syphilis screening [8] or magnesium sulphate to prevent eclampsia [9] affect the probability of stillbirth, what relative number or numbers should be used?

Existing empirical evidence points toward a positive value of life before birth. The sociobiology of grief suggests a higher social value on lives lost at certain ages [13], with particularly high values for reproductive females. Given that there exist extensive feelings of loss for stillbirths even in countries with high infant mortality rates [14], an analogous conclusion would entail positive (albeit lesser) valuation before birth. There are also studies regarding the indirect costs of stillbirths [15], although that in itself is neither necessary nor sufficient for a positive valuation in health-specific cost effectiveness analyses. In terms of neural development, sentience [1] and consciousness [10] increase continuously throughout gestation, and at least for consciousness is still incomplete at birth.

As mentioned previously, philosophers have considered the ethical and moral dimensions of this problem. One of the most consistent conclusions across multiple lines of reasoning [2-4,6] is that there is no fundamental distinction between late-term fetuses and early neonatal infants; hence if we place value on the latter then we ought to on the former as well.

It also implies in numerical terms that there is no need for (indeed perhaps actively argues against) a discontinuity at birth, i.e., any sudden acquisition of even partial personhood at that moment. Given no jump at birth, and given a positive value at some point after birth (but zero value before conception, if not later), this also implies a gradual non-binary increase over time.

This traces a consistent qualitative pattern but leaves the quantitative dimension untouched. Very few previous papers attempt to attach numbers to fetal loss at various gestational ages. One article gives a flexible functional form for a pre-multiplier in the context of Disability-Adjusted Life Years (DALYs), which can be adapted to the decision-maker's preferred numbers [5].

The authors suggest a default option with specific values, becoming nonzero at the beginning of the third trimester and equal to 0.3 at birth (i.e., incurring only 30% of the DALY loss that would accrue in the traditional formulation) before rising to 0.67 at age 1 and finally 1.0 at age 5. Although they do not attempt to justify these particular choices, others have defended origination in the third trimester more thoroughly [7].

Individual agents and households, of course, also have to make choices about how to trade off health interventions and implicit valuations at different ages. For instance, malaria is riskiest for young children and pregnant women, but bednets are not always used for these groups. Framing may unduly influence such decisions: one study found that bednets received for free were relatively more likely to be used by children under 5, whereas purchased bednets were used for income-earning adults [16].

Given that people face these choices in their daily lives, it's not unreasonable to imagine that they would be able to meaningfully respond to explicit questions regarding them, and this has been shown to be the case [17,18]. This paper adapts that methodology and applies it for the first time to fetuses and pregnant women, yielding specific relative values that can be used, even if only indirectly, to inform policy.

Methodology

Depending on the research question at hand, an increasing number of social scientists are using Amazon's mTurk (mechanical Turk) platform for online experimentation. Workers on the site typically do short tasks of various types for which computers are not well qualified, earning small amounts of money in return for their time.

The survey implemented in the present study involved seven brief questions, taking 1-2 min in total to complete, for which respondents were paid $0.12. This was a competitive enough rate that there was no problem eliciting hundreds of responses in 24-48 h. The distribution of (self-reported) demographic characteristics of this sample is given in Table 1 below.

Characteristic	Proportion
Female	43%
Age (years)	
18 to 24	15%
25 to 29	25%
30 to 34	23%
35 to 44	22%
45 to 54	9%
55+	6%
Married	48%
Has Children	41%
Household Income	
Less than $25,000	28%
$25,000 to $34,999	17%
$35,000 to$49,999	16%
$50,000 to $74,999	19%
$75,000 to $99,999	11%
$100,000 or more	9%
No tertiary degree	30%
N	1628

Table 1: Sample Characteristics

Although there can be no claim of statistical representativeness, it is equally clear that the sample covers a wide range of people in terms of age, income, education, and household structure. It is not simply a selection of poor and uneducated individuals seeking to earn small amounts of money, nor is it limited to the college population that instantiates many social science lab experiments.

In order to assess the relative value of fetal loss and/or death at various ages without directly triggering an attempt by respondents to give the 'right' answer, the survey was designed primarily for indirect comparisons, similar to the methodology of [18]. In particular, in each of the ten conditions to which participants were randomly assigned, they were asked a single additional question beyond the six demographic questions included in Table 1. For the eight primary conditions, this took the following form:

Appropriate life-saving programs can prevent many causes of death. Suppose that there are two different life-saving programs and that they target different age groups of the population.

Program A *saves 100 adult women.*

Program B *saves [X] infants in the first week after birth.*

How many infants (can be less than, equal to, or greater than 100) would Program B have to save in order for you to value both programs equally, in the sense of benefiting society as a whole by the same amount? Assume that both programs have the same cost, and please think carefully about your answer.

Respondents could choose either to specify an exact numeric value X or to state that no number X would be sufficient to make the programs equivalent in their mind. This latter option was included both to allow for the possibility that the value X might be essentially infinite for some people in some cases, and to allow for the possibility that some people would simply be uncomfortable making such comparisons about deaths and lives saved.

The variation in the first eight treatments was in the age saved in program B; program A always involved 100 adult women. The different versions were: fetuses at 10 weeks gestation; babies at 10 weeks gestation; fetuses at 39 weeks gestation; babies at 39 weeks gestation; infants in the first week of life; children at age one year; pregnant women at 10 weeks gestation; and pregnant women at 39 weeks gestation. The non-technical but valid term "babies" was substituted for "fetuses" in half the cases to see if the vocabulary used would impact responses.

In the final two treatments, the goal was to directly compare fetuses at 39 weeks against infants in the first week of life, i.e. roughly symmetric on either side of and in close proximity to birth. This comparison is one of the most fundamental aspects of any age-valuation mapping regarding early life choices, and in addition the direct tradeoff could be compared with the implicit indirect tradeoff derived from the initial questions in which each of those ages was evaluated against adult women. To implement the direct comparison, one or the other of these two ages replaced "adult women" in program A, while the remaining one took the corresponding role in program B. It was necessary to (separately) implement both variants due to the possibility of a default or status quo bias favoring either the first or second option simply due to the physical framing or ordering of the question.

Results

The proportion of respondents who refused to input an explicit number X (which would make program B equally valuable in their mind to saving 100 women in program A) ranged from 37% to 45% across all treatments, except for the two treatments involving 10-week fetuses or 10-week gestation babies, where it ranged from 56% to 60%. This is suggestive of a situation in which roughly 40-45% of individuals simply do not like to make such comparisons no matter the ages involved, and in which a further roughly 15% of individuals may be willing to make such comparisons in general but believe that an adult woman's life is worth an arbitrarily large number of 10-week fetal losses. However, this interpretation is not conclusive as it is impossible to verifiably ascertain what led to the various refusals, and throughout the rest of the paper the focus remains solely on those who were willing to input an explicit number X.

Of course even among those who entered a numerical value, some may have been confused by the question, or may have accidentally typed the wrong key, or may have deliberately attempted to give false or disruptive answers. For this reason the analysis drops all observations above the 95th percentile (i.e., drops the highest 5% of values) within each treatment condition. This still leaves a few entries above 500 or even 1000 (recall that the comparison is to 100 adult women, and that larger numbers imply a lower valuation of life at the alternative age in program B), which tend to skew the results. Of course those entries may truly be indicative of a perception that the alternate age should be valued much less, so there is no reason to necessarily drop them; instead we censor at 1000 and top-code everything above that level as 1000 exactly, in order to include them but not let them completely overpower the other data points. This is a fairly conservative approach, and the overall results are robust to other specifications.

A natural first question regards the potential difference between framing fetal loss as involving "babies" or "fetuses". At 10 weeks gestation, the average entry for "babies" is 194 while the average for "fetuses" is 210; at 39 weeks the numbers are 143 and 176 respectively. So in both cases the imputed valuation is lower for fetuses than for babies (despite the objective equivalence of the two descriptions), as expected. However, in neither case is the difference statistically significant, nor is it significant when they are combined. Hence from here on all results are reported with the combined data at each of these ages.

We now turn to the central results of the paper. Figure 1 below illustrates the average response for each of the six age categories considered. For instance, 100 adult women is perceived equally valuable as approximately 159 39-week-old fetuses, but only as valuable as approximately 74 women who are 39 weeks pregnant. The initial aspect to note is that almost all the relative values go in the expected direction. To start, 10-week fetuses are valued less than 39-week fetuses (marginally significant: $p=0.06$), and this is very likely understating the differential due to the larger number of individuals stating that no X was large enough in the case of 10-week fetuses. All the cases before and just after birth are valued less than one-year-old children ($p<0.01$), who are in turn valued less than adult women (not significant: $p=0.13$). Pregnant women (i.e., including a fetus) are valued more than non-pregnant women ($p<0.05$). This all suggests confidence in the methodology.

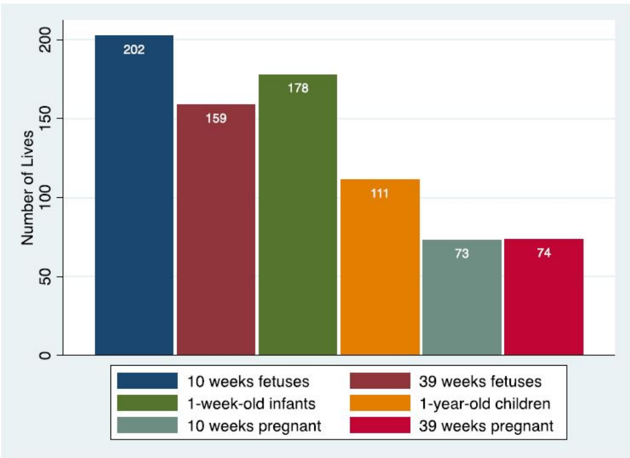

Figure 1: Average Stated Equivalence to 100 Adult Women.

The other aspect to note is that two of the comparisons are less expected. First, women who are 10 weeks pregnant are valued essentially identically to women who are 39 weeks pregnant, despite the fact that a 10-week fetus on its own is valued substantially less than a 39-week fetus. This outcome does not constitute a direct contradiction, because the two questions were asked of different respondents and all values are imputed via the equally matched comparison to adult women. But it does suggest that people think about this relative valuation differently depending on the context, which is not altogether surprising, and that therefore policy-makers will have to decide which interpretation is more relevant in a given setting or for a given purpose. The second surprising comparison is that 1-week-old infants are if anything valued less than fetuses at 39 weeks gestation; we shall return to this later.

In addition to the mean values, we can examine the distribution of responses in each case. In particular we observe a large number of individuals who enter a value of exactly 100, thereby valuing both groups of lives equally. The percentage so doing ranges from 46 to 51, quite a narrow band, except at the extremes: only 40% rate 10-week fetuses equally with adult women (within the roughly 40% who even give a value here) and only 39% rate 39-week pregnant women equally, with the remainder valuing the latter more highly than adult women. Finally we see smaller fractions (approximately 30% each) stating an equivalency value of 50 for the two groups of pregnant women, which is effectively giving the unborn fetus equal weight to both the pregnant mother and the comparison adult woman. Replicating the analysis without the responses equal to 100 yields Figure 2 below.

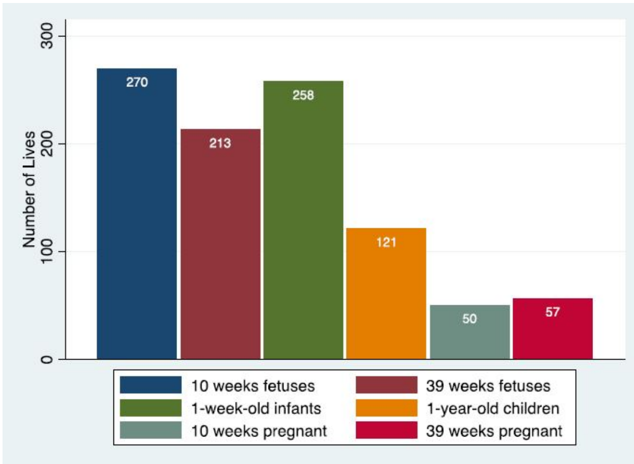

Figure 2: Average Equivalence to 100 Adult Women, dropping values = 100.

Of course, by construction, the numbers are all exaggerated relative to the base case, and they are not especially meaningful on their own. What is pertinent is that the relative comparisons and distribution have not changed substantially. This implies that the original conclusions are not being driven by varying numbers of subjects choosing 100 in each scenario (which we already saw was not the case) but instead that those who are inputting substantive responses are varying their choices in a well-patterned manner.

We can also compare the overall values for various subgroups of the population. The obvious splits are by gender and parental status, which was the rationale for including the latter question in the demographic profile. Figures 3a and 3b below display the results of these comparisons.

Each gender displays a similar patterns of valuation across ages, although women consistently value the potential recipients of program B more highly than men do, implied by the fact that they claim fewer beneficiaries are needed to be of equal value to program A. Note that this is despite the fact that the beneficiaries of program A consist entirely of women! Instead it seems to be driven by the fact that all the potential beneficiaries of program B involve fetuses or children in some form. The gender difference across all groups combined is statistically significant (p<0.01, controlling for multiple hypotheses), and it is even larger in magnitude and significance when limited to the first four groups, involving fetuses. Surprisingly, women appear to value one-week-old infants less than they do any other group in the study, including 10-week fetuses, and even one-year-olds are roughly on par with the two categories of fetus.

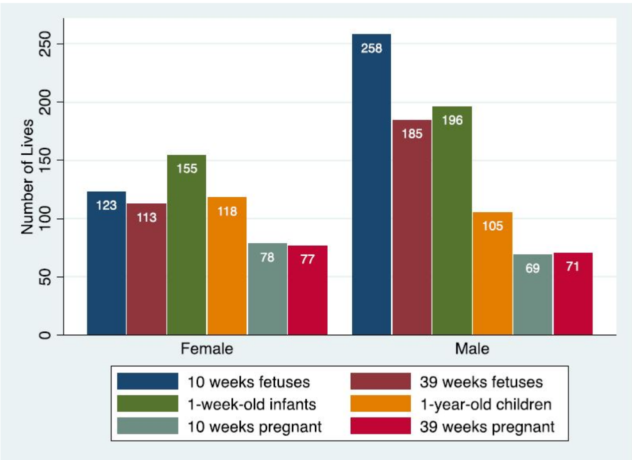

Figure 3a: Stated Equivalence to 100 Adult Women, by Gender.

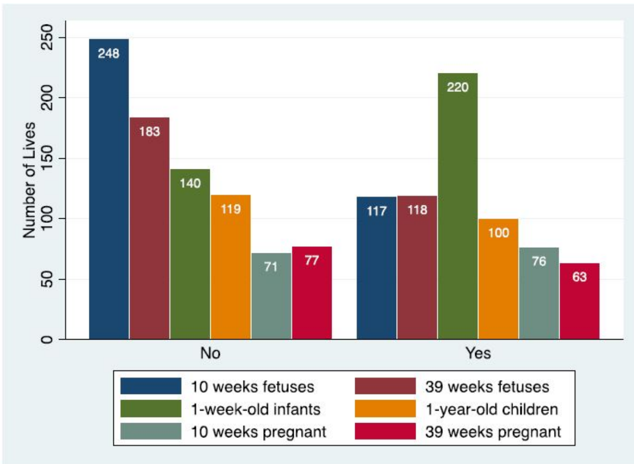

Figure 3b: Stated Equivalence to 100 Adult Women, by Parenthood.

The split by parental status does not show as strong a pattern as the split by gender. The overall difference between the two distributions is not statistically different, although the average number (required to be equivalent to 100 adult women) is lower for the four categories involving fetuses – on their own or along with the mother – among those who report having children (p<0.01, controlling for multiple hypotheses). This suggests that they place a higher implicit valuation on those categories, which is perhaps not surprising but is at the relative expense of infants, especially neonates, so it's not altogether obvious.

Turning to the final comparison, the difference between a 39-week fetus and an infant in the first week of life is a matter of days at most; indeed if the infant was born pre-term the fetus may well be more developmentally advanced. In essence we are asking whether there is a discontinuous jump in valuation due to birth, and Table 2 summarizes the results.

Denominator	Groups	Mean (numbers of lives)
100 adult women	Fetuses+babies at 39 weeks	159
	Infants at 1 week	178
	Ratio of fetuses to infants (=159/178)	0.89
100 infants/ 100 fetuses	Fetuses (against 100 infants)	96 (a)
	Infants (against 100 fetuses)	90
	→invert to fetuses (against 100 infants)	111 (b)
	Average of (a) and (b)	104
	Ratio of fetuses to infants (=104/100)	1.04

Table 2: Calculations for the Relative Value between Late-term Fetuses and Newborn Infants.

Using the initial treatment conditions where each group was compared with 100 adult women yields an indirect effective valuation of 0.89 39-week fetuses to each neonatal infant, implying that the fetuses are actually implicitly valued slightly more highly. In the last two treatments respondents were asked to directly compare these two groups against one another. In both cases there is a small preference for program B (which is why it was necessary to counter-balance the options), but in total we find an average valuation of 1.04 late-term fetuses for each newborn infant, implying that under this approach the fetuses are valued slightly less. Overall it seems that we do not observe a significant difference in valuation between the two groups.

Discussion

The first conclusion is that it is possible to collect meaningful data about a difficult topic from a non-expert and untrained population of subjects. It is desirable for both ethical and data-quality purposes to allow respondents not to answer, and in this case close to half of them partook of such an option. However, once that is allowed for, most respondents spent more than a few seconds thinking about their answers and eventually entered generally reasonable numbers. More convincingly, when averaged together these values exhibited the age-specific trends that one would expect to see, despite no single individual having been asked more than one question, and despite almost all direct comparisons having been made against a 'neutral' group of adult women. Given the relative paucity of quantitative primary data on topics related to the valuation of human life, and the practical policy importance of such explicit valuations, this suggests that there is room for extended and more sophisticated analyses in this area.

The second broad conclusion concerns the actual numeric trends observed in the data. We find that 10-week fetuses are valued less than

39-week fetuses (especially when taking into account the potential selection bias regarding which subjects gave explicit responses), but they are still valued at roughly half the level of adult women. Furthermore, there is no difference in the average valuation of pregnant women at the corresponding gestational stages, although both are higher than for non-pregnant women. This suggests overall that society places a distinctly positive value on fetuses, even quite early in pregnancy, but also that the imputed value increases over time, contradicting a purely binary perspective.

One-year-old children are valued almost (but not quite) as highly as adult women, especially by male respondents. However, one-week-old infants are valued much less. Indeed, we do not find a difference in valuation between these neonatal infants and full-term fetuses. Biologically this makes sense, but it is edifying that the birth event does not have a stronger impact on valuations. This is true even when we ask subjects to compare the two groups directly, which is a more stringent test of the hypothesis. Overall, then, the perceived value of life is weakly positive and increasing with gestational age; it does not exhibit a discontinuity at birth; around birth it is still substantially below that of an adult woman; but by age one it has narrowed most of the gap.

To be perfectly clear, there is no indication that the specific values derived from the experiment in this paper should be imported wholesale into policy analyses. However, the qualitative comparisons at the end of the previous paragraph provide strong support for one family of conceptual models that has been advanced in the literature, and against alternative models that violate one or more of the given properties. The magnitudes themselves may also be useful as one input among many when calibrating such models for cost-effectiveness and resource prioritization. Further more refined experiments on a targeted (but potentially broader) sample population, or subgroups thereof such as health professionals, could yield more robust empirical estimates regarding the valuation of life not just around the time of birth but at older ages and across geographic locales.

Acknowledgement

I wish to thank Dean Jamison, Peter Martinsson, Joseph Millum, and others for helpful and stimulating conversations regarding this topic over several years, as well as Tasmia Rahman for expert input and research assistance throughout the study. Remaining errors are my own, as are the interpretations and conclusions expressed herein. In particular they do not necessarily represent the views of the World Bank Group.

References

1. Sumner LW (1981) Abortion and moral theory. Princeton University Press.
2. Tooley M (1983) Abortion and infanticide. Oxford University Press.
3. Lindemann H (2009) "…but I could never have one": The abortion intuition and moral luck. Hypatia 24: 41-55.
4. Stoyles BJ (2015) The value of pregnancy and the meaning of pregnancy loss. J Soc Philos 46: 91-105.
5. Jamison DT, Shahid-Salles SA, Jamison J, Lawn JE, Zupan J (2006) Incorporating deaths near the time of birth into estimates of the global burden of disease. In Global burden of disease and risk factors. The World Bank pp: 427-463.
6. Phillips J, Millum J (2015) Valuing stillbirths. Bioethics 29: 413-423.
7. Qureshi, ZU, Millum J, Blencowe H, Kelley M, Fottrell E, et al. (2015) Stillbirth should be given greater priority on the global health agenda. British Medical Journal 351: h4620.
8. Terris-Prestholt F, Watson-Jones D, Mugeye K, Kumaranayake L, Ndeki L, et al. (2003) Is antenatal syphilis screening still cost effective in sub-Saharan Africa. Sex Transm Infect 79: 375-381.
9. Simon J, Petrou S, Gray A (2009) The valuation of prenatal life in economic evaluations of perinatal interventions. Health Econ 19: 487-494.
10. Lagercrantz H, Changeux JP (2009) The emergence of human consciousness: from fetal to neonatal life. Pediatr Res 65: 255-260.
11. Jamison DT, Breman JG, Measham AR, Alleyne G, Claeson M, et al. (2006) Disease control priorities in developing countries. Oxford University Press (2nd edn.)
12. Blencowe H, Cousens S, Jassir FB, Say L, Chou D, et al. (2016) National, regional, and worldwide estimates of stillbirth rates in 2015, with trends from 2000: A systematic analysis. Lancet Glob Health 4: e98-e108.
13. Crawford CB, Salter BE, Jang KL (1989) Human grief: Is its intensity related to the reproductive value of the deceased? Ethol Sociobiol 10: 297-307.
14. Kelley M (2011) Counting stillbirths: Women's health and reproductive rights. Lancet 377: 1636-1637.
15. Heazell AEP, Siassakos D, Blencowe H, Burden C, Bhutta ZA, et al. (2016) Stillbirths: economic and psychosocial consequences. Lancet 387: 604-616.
16. Hoffmann V (2009) Intrahousehold allocation of free and purchased mosquito nets. The American Economic Review 99: 236-241.
17. Cropper ML, Aydede SK, Portney PR (1994) Preferences for life saving programs: How the public discounts time and age. Journal of Risk and Uncertainty 8: 243-265.
18. Johansson-Stenman O, Mahmud M, Martinsson P (2011) Saving lives versus life-years in rural Bangladesh: An ethical preferences approach. Health Econ 20: 723-736.