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SAVING LIVES VERSUS LIFE-YEARS IN RURAL BANGLADESH: AN ETHICAL PREFERENCES APPROACH

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SUMMARY

Using a random sample of individuals in rural Bangladesh, this paper investigates people's ethical preferences regarding relative values of lives when it comes to saving lives of individuals of different ages. By assuming that an individual has preferences concerning different states of the world, and that these preferences can be described by an individual social welfare function, the individuals' preferences for life-saving programs are elicited using a pair-wise choice experiment involving different life-saving programs. In the analyses, we calculate the social marginal rates of substitution between saved lives of people of different ages. We also test whether people have preferences for saving more life-years rather than only saving lives. In particular, we test and compare the two hypotheses that only lives matter and that only life-years matter. The results indicate that the value of a saved life decreases rapidly with age and that people have strong preferences for saving life-years rather than lives *per se*. Overall, the results clearly show the importance of the number of life-years saved in the valuation of life. Copyright © 2010 John Wiley & Sons, Ltd.

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1. INTRODUCTION

Policy makers often work under specific budget constraints such that a specified amount of money should be used in the best way to improve health in a certain area. To make such priorities, they must clearly know the *relative* values of the various health improvements.[1] For example, they must be able to compare the values of saving lives of different ages, i.e. the task of the present paper. Although Sunstein (2004) used explicitly ethical arguments to conclude that it is appropriate to focus on saved *life-years* rather than saved *lives* when making life-saving priorities, the empirical evidence regarding people's ethical preferences on such issues is quite limited, in particular in developing countries. This paper contributes to this literature by estimating the relative value of saving lives belonging to different age groups in rural Bangladesh, based on people's ethical preferences.

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[1]Note that for in order to prioritize subject to a given budget, there is no need to quantify *absolute* values of statistical lives, for which large variations have been observed in the literature; see, e.g. Weinstein *et al.* (1980), Viscusi (1993), Hammitt and Graham (1999), and Viscusi and Aldy (2003). This is partly due to methodological differences, sample differences with respect to important explanatory variables such as average income, real underlying differences in values, and measurability problems related to cognitive difficulties in translating small risk reductions into monetary benefits (Hammitt and Graham, 1999).

Empirical studies quantifying the trade-offs between saving lives of people of different ages observe that people place more weight on saving younger people's lives than on saving the lives of older people; see Cropper *et al.* (1994), Johannesson and Johansson (1997), and Johansson-Stenman and Martinsson (2008), where the latter study obtained a less extreme age-dependency than the two former. Age-weighting has been discussed in other contexts as well. For example, the 1993 World Development Report endorses that life-saving benefits should be based on disability-adjusted life years (DALYs), implying that the value of a life decreases rapidly with age (e.g. Murray, 1994, 1996; Murray and Acharya, 1997). However, DALY age weights have been questioned for having unclear theoretical and empirical foundations (e.g. Anand and Hanson, 1997; Williams, 1997, 1999, 2000). As an alternative, yet qualitatively rather similar, approach, quality-adjusted life years (QALYs) can be used as the basis for the benefit measure; see, e.g. Weinstein and Stason (1997), Dolan (2000), Hammitt (2002, 2007), and Dolan *et al.* (2005). The main difference compared to the DALY approach when valuing saved lives of different ages is in the way the age-related weight for each life-year is calculated. In particular, the DALY (but not the QALY) approach implies that each gained life-year is weighted not only with respect to the health (or the disease) of the individual, but also with respect to age itself, following an inverted U-shape with a lower weight to children and old people. This age-dependency is intended to account for the fact that these age groups are dependent on others to a larger extent. The motivation is hence not that the time lived at different ages is more or less important.

People's more general attitudes toward health interventions at different ages have been investigated in several studies. Most available empirical evidence suggests that people on average prefer that the young should be given priority over the old when it comes to health care; see Tsuchiya (1999), Tsuchiya *et al.* (2003), and Dolan and Tsuchiya (2005). However, most of these findings are based on developed countries. Exceptions include Kapiriri and Norheim (2004) and Baltussen *et al.* (2006), who found, in Uganda and Ghana respectively, support for the idea that age should play a role for priorities in the health care system.

As far as we know, however, no previous study has, based on people's preferences with respect to public priorities, attempted to quantify the relative values of statistical lives of different ages in a developing country. In the present paper, we estimate people's ethical preferences for saving lives (while ignoring other health improvements)[2] of different ages in rural Bangladesh. Such estimates are first and foremost important as they may guide policy makers in their priorities. In addition, they may be valuable to policy makers for political economy reasons; for example, gaining better information about people's preferences may improve the odds of winning the next election. People's ethical preferences regarding saving people of different ages may also constitute important elements that can be used to understand different social phenomena, such as distribution of resources within a household and age-based discrimination.

Following an approach similar to Johansson-Stenman and Martinsson (2008), the individuals' preferences for relative values of lives are elicited using pair-wise choice experiments. We also test whether people have preferences for saving life-years rather than saving lives *per se*. The rest of the paper is organized as follows: Section 2 outlines the theoretical and empirical model, Section 3 presents the design of the choice experiment, Section 4 discusses the econometric results and the analysis of responses from the follow-up questions asked after the choice experiment, and Section 5 concludes the paper.

2. THE MODEL

Assume that an individual has ethical preferences concerning different states of the world that can be described by an individual social welfare function (ISWF), i.e. a continuous function that ranks all relevant states in a consistent way according to the individual's ethical preferences. Let us also assume

[2]There are two main reasons why we ignore other health improvements: firstly, including such effects on top of life-saving issues would increase the complexity for the respondents considerably. Secondly, it may be more difficult to communicate the various health improvements for different age groups in such a way that the respondents interpret the information reasonably similar. Still, we believe it is an important task for future research.

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that individuals maximize their own ISWF, by acting as social planners, with respect to choosing life-saving programs. Following Johansson-Stenman and Martinsson (2008), we consider a general ISWF (henceforth the general model) that includes the number of saved lives in different age groups. Based on the ISWF and the assumption of no discounting, one can calculate the individual social marginal rates of substitution (SMRS) between saved lives of people of different ages. We also test a more restrictive model (denoted the restricted model) where the ISWF depends only on the total number of saved lives (irrespective of age) and the total number of life-years saved. The restricted model allows us to test and compare the hypotheses that *only lives matter* and that *only life-years matter*.

Let us begin with the general model. Considering small changes in the number of saved lives of people of different ages, and a corresponding local linearization in these variables, we can write

$$W_i = \hat{W}_i + \alpha_i^1 s^1 + \cdots + \alpha_i^n s^n, \tag{1}$$

where $\hat{W}_i$ denotes i's social welfare, according to i's ISWF, at status quo, i.e. without any lives saved as a result of the programs; s^j is the number of people saved in age group j; and α_i^j is the coefficient associated with the saved number of people in age group j for individual i. The SMRS between age group j and age group k for individual i is expressed as

$$\text{SMRS}_i^{jk} = \frac{\partial W_i}{\partial s^j} \Big/ \frac{\partial W_i}{\partial s^k} = \frac{\alpha_i^j}{\alpha_i^k}. \tag{2}$$

Thus, $SMRS_i^{jk}$ measures, based on individual i's ethical preferences, the relative value of a saved life belonging to age group j in terms of saved lives belonging to age group k. An SMRS equal to 1 between all age groups then means that only the numbers of lives matters, i.e. equal relative values are assigned to all age groups. In other words, the more lives saved the better, irrespective of the ages of the saved individuals.

According to the random utility approach (McFadden, 1974), it is assumed that the true ISWF is not directly observable and hence consists of both an observable and a non-observable (stochastic) part. By introducing a random error term, ε_i, to reflect unobservable characteristics, equation (1) can be re-written as

$$W_i = \hat{W}_i + \alpha_i^1 s^1 + \cdots + \alpha_i^n s^n + \varepsilon_i. \tag{3}$$

An ISWF-maximizing individual prefers a project A over a project B if $W_i(A) > W_i(B)$. Based on the observable information, one can then model the probability that project A is chosen as

$$\Pr(A \text{ is chosen}) = \Pr(W_i(A) > W_i(B)) = \Pr(\alpha_i^1 \Delta s^1 + \cdots + \alpha_i^n \Delta s^n > \phi_i), \tag{4}$$

where $\Delta s^k = s^k(A) - s^k(B)$ and $\phi_i = \varepsilon_i(A) - \varepsilon_i(B)$. Given that ϕ_i is standard normal distributed, equation (4) can be estimated by a standard probit regression.

The alternative, restricted, model is when the ISWF depends on a linear combination of saved lives (irrespective of ages) and the total number of life-years saved, assuming in the latter case that the individuals have the information necessary to estimate this. We can then write individual i's ISWF as follows

$$W_i = \hat{W}_i + \beta_i l + \delta_i y + \varepsilon_i, \tag{5}$$

where l is the total number of lives saved, y is the total number of life-years saved, and where β_i and δ_i are the associated coefficients to be estimated. Although this model is of course very restrictive, in that it, for example, rules out quadratic terms and interaction effects, it facilitates a direct test between the 'only-lives-matter hypothesis' (the l-hypothesis) and the 'only-life-years-matter hypothesis' (the y-hypothesis). According to the l-hypothesis, one would expect that $\beta_i > 0$, and $\delta_i = 0$, whereas the y-hypothesis implies that $\beta_i = 0$, and $\delta_i > 0$. Some intermediate alternatives of course also exist, where then

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$\beta_i > 0$ and $\delta_i > 0$. The probability that individual i chooses project A can be estimated as

$$\Pr(A \text{ is chosen}) = \Pr(W_i(A) > W_i(B)) = \Pr(\beta_i \Delta l + \delta_i \Delta y > \phi_i), \tag{6}$$

where $\Delta l = l(A) - l(B)$, $\Delta y = y(A) - y(B)$ and $\phi_i = \varepsilon_i(A) - \varepsilon_i(B)$.

The relative value of saving a life in one age group rather than in another is then estimated as

$$\text{SMRS}_i^{jk} = \frac{\beta_i + \delta_i y^j}{\beta_i + \delta_i y^k}, \tag{7}$$

where y^j and y^k denote the total remaining expected life-years of the saved individual in age groups j and k, respectively.

3. THE CHOICE EXPERIMENT

In a choice experiment, respondents make repeated choices between different alternative goods or projects that are described by their attributes (see Louviere *et al.*, 2000; Alpizar *et al.*, 2003). The choice experiment approach is now increasingly applied in eliciting preferences for health and health care (see, e.g. Ryan and Gerard, 2003; Ryan *et al.*, 2006). Some of the advantages of using a choice experiment rather than a single question experiment are that it is easier to estimate the marginal impact of different attributes on the decision and that more information is provided per respondent. However, there are also negative aspects, e.g. it is cognitively more demanding for the respondents and the complexity of the task can affect the respondents' decision. The design of a choice experiment involves defining attributes and levels of attributes, experimental design, questionnaire development, and designing a sample and sampling strategy. In our case, the attributes of life-saving programs are the age of the life saved and the number of lives saved. The experimental design involves creating the choice sets in an efficient way by combining attribute levels into alternatives in the choice sets. One important issue here is to minimize task complexity and obtain a manageable number of choice sets. The choice sets were created by only considering the main effects, using the software SAS. Hence, we are only considering the direct of each attribute on utility, by using a D-optimal design approach.[3] Forty-two choice sets were created and then blocked into seven groups. The blocks were randomly distributed among the respondents. To facilitate the design (choice of attributes, attribute levels, and the choice scenario), focus groups and two pilot studies were conducted to test the choice experiment in the field. The attributes and the levels used in the final choice experiment are presented in Table I.

The choice experiment and a subsequent household survey were conducted among a random sample of 390 rural households in Bangladesh in November 2003;[4] descriptive statistics are provided in Table II. In the final analyses, we dropped four surveys as they were incomplete. In addition to the socioeconomic questions, the survey included questions on the respondents' health and risk perceptions, plus contingent valuation questions on risk reduction. The enumerators conducting the survey were trained on beforehand regarding the purpose of the experiment and how to conduct it practically, and on how to present the choice scenario and the choice sets. The choice scenario was translated back to English from Bengali to ensure the exact meaning of the original English version. Each choice set was presented by the enumerators using a small card to which they pointed while explaining the choice situation to the respondents.

[3]D-optimal design considers the importance of the levels of the attributes in the choice sets and ensures that the alternatives give more information about the trade-off between the different attributes; see Carlsson and Martinsson (2003).

[4]The survey was conducted in the selected villages and hence the sample is not representative of the Bangladesh population. Moreover, 33% of the respondents are of Hindu religion as opposed to the national average of 11%; the remaining 67% are of Muslim religion. The sample consists of 23% replacement households due to unavailability of the particular household heads during repeated visits by the enumerators.

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Table I. Attributes and levels used in the choice experiment

Attribute	Levels
Number of people saved	200, 400, 700, 1000, 1300, and 1700
Age group of people saved (years)	0–1, 1–10, 10–20, 20–30, 20–40, 40–60, and 60–80

Table II. Sample characteristics

Characteristics	Mean	Min	Max
Male	0.91	0	1
Married	0.95	0	1
Age (years)	44.28	19	87
Illiterate (cannot read and write)	0.32	0	1
Hindu religion[a] (base case Muslim)	0.33	0	1
Per capita household income[b] (TK)	1648	139	24071

[a]Hindu is overrepresented in our sample compared to the national average of 11%.
[b]Equivalent yearly household income per-capita, calculated as follows: total yearly household income is divided by (number of adults+0.5 × number of children)$^{0.75}$, where an individual is an adult if he or she is above age 16 years. 1 US $ = 59.4 TK, as of October 2004.

The scenario description used in the choice experiment (see Appendix A) explains that financial constraints often necessitate setting priorities in conducting life-saving programs, and people's preferences regarding such priorities are of essential importance for policy makers. Moreover, the respondents were told that it is possible to target people within certain age groups for these life-saving programs. To be more realistic, saved lives were presented in terms of age groups spanning a range of ages rather than in terms of specific ages, i.e. 0–1 year, 1–10 years, 10–20 years, 20–30 years, 20–40 years, 40–60 years, and 60–80 years. Henceforth, we refer to these groups as 1, 5, 15, 25, 30, 50, and 70-year olds to save space. Respondents were presented with six pairs of life-saving programs that differed with respect to the number of lives saved and the age group of the saved persons; however, the programs were similar in other aspects, including their costs. It was specifically mentioned that the life-saving programs would not change the total amount of suffering among the ill or injured people so that the respondents would not assume different diseases/injuries (and their associated sufferings) in the different age groups. This implies that the programs if implemented would save the life (lives) but not affect the quality of life of the saved person(s).[5] Finally, the respondents were asked to choose their preferred alternative in each of the six choice sets assuming that each choice set was the same in all aspects, including cost, except for the attributes included. The respondents were presented with two life-saving programs at a time, each containing information on the number of individuals saved and the ages of the saved persons.

After the choice experiment, the respondents were asked follow-up questions. They were explicitly asked if they wanted to prioritize saving the younger people over the older. Given that they expressed that the younger should be prioritized, the respondents were then asked qualitative questions about their preferences for prioritizing the younger. For example, it might be relevant to think that it is fair to save younger individuals so that they can live, all else going well, as many years as an old person has already lived. Moreover, as an older person has fewer expected life years left, by saving a considerably younger person, more life-years could be saved to achieve more societal welfare. Another important aspect is that young adults could contribute to society both in terms of production and child caring, and

[5]Here we assume that a saved person would expect to live his/her remaining expected years based on average life expectancy. As different ages are targeted, the quality of a saved life might well be different for persons saved from different causes of death. The respondents hence are not expected to make assumptions about, or focus on, the quality of life of the saved person when choosing between alternative programs.

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could also shoulder the responsibility of the older people. Appendix B presents the exact wordings of the follow-up questions and the responses.

4. ECONOMETRIC ANALYSIS AND RESULTS

As the choice experiment involves only two choice alternatives, a binary probit model is employed to estimate the choice parameters. Given that each respondent made six choices providing six observations for analysis, these observations may be correlated at the individual level. Hence, to account for a possible overestimation of the statistical significance of the attributes, clustering at the individual level is used, implying that observations are considered to be independent across individuals (clusters), but not between the responses for a specific individual.

Table III presents the estimated probit coefficients for the general model. A positive coefficient implies that if we increase the number of saved individuals in a specific alternative, say alternative A, in a given choice set, then the probability that alternative A will be chosen increases as well; a larger coefficient implies a larger probability increase. Let us start by interpreting the results for the full sample, i.e. the first column of Table III. As can be observed, the coefficients are positive and (typically) highly significant up to age 30, insignificant for age 50, and negative and significant for age 70. The latter thus implies that an alternative is less likely to be chosen if the number of 70-year olds saved in this alternative increases, *ceteris paribus*, implying a negative value of saving additional 70-year olds. If we then consider the different sub-samples, divided according to religion, literacy, age, and income,[6] we observe roughly the same pattern for each sub-sample.

The negative value of saving 70-year olds appears unintuitive. One possible interpretation is that some respondents adopted a simplified choice strategy of always choosing the alternative where more people younger than 70 years were saved irrespective of the number of saved 70-year olds. The design of the choice sets may also be a potential issue. However, we obtained basically the same result in two pilot studies, after which we adjusted the choice sets in order to avoid what we initially believed were flawed results due to an inappropriate design.[7] Yet, we regret that we did not include a choice set where the number of younger people was the same in both alternatives and the number of 70-year olds was different, as this would have enabled a more clear test of whether people really put a negative value on saving additional old people. Nevertheless, a possible explanation behind the negative coefficient is that many respondents believe that the current number of 70-year olds in society is not sustainable. It is also possible that some respondents simply do not want to prolong an older life considering their apparent old-age related sufferings due to economic hardship, socio-economic insecurity, and poor healthcare facilities. Moreover, it appears unlikely that one would have obtained a similar age pattern when focusing on health rather than on life saving. This may also reflect an expression of attitude, which is not related to trade-offs in the choice experiment or preferences of the individual (Kahneman *et al.*, 1999). However, given the results of the previous pilot studies, it can certainly not be ruled out that the responses reflect true preferences, related to, e.g. a perceived society sustainability concern or the suffering of old people.[8]

However, we are not primarily interested in the probit coefficients, but in the implied relative values of lives of different ages. As was demonstrated theoretically in Section 3, these relative values are basically obtained from the random utility model by the ratios of the estimated probit coefficients; the standard errors are calculated based on the delta method.

[6]As the fraction of female respondents is only 9%, percent, we do not investigate gender effects.
[7]We also tested a large number of econometric specifications and functional forms, but the negative weight of the oldest age group is very robust.
[8]For example, Johri *et al.* (2005) found in a study conducted in Canada that the intervention type seems to matter for age preference; responses for a life-saving scenario favored younger age groups while those for palliative care scenarios showed no age preference.

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Table III. Probit coefficients (standard errors) for the total sample and different sub-samples, based on the general model

	All [$n = 386$]	Muslim [$n = 257$]	Hindu [$n = 129$]	Literate [$n = 262$]	Illiterate [$n = 124$]	Age below 40 [$n = 196$]	Age 40 and above [$n = 190$]	Income below median [$n = 166$]	Income above median [$n = 220$]
1-year old saved	0.907*	1.305*	0.677*	0.808*	1.113*	0.919*	0.909*	0.940*	0.871*
	(0.116)	(0.140)	(0.209)	(0.136)	(0.217)	(0.171)	(0.158)	(0.174)	(0.156)
5-year old saved	0.715*	0.764*	0.639	0.638*	0.870*	0.653*	0.807*	0.755*	0.670*
	(0.152)	(0.182)	(0.278)	(0.176)	(0.298)	(0.222)	(0.210)	(0.227)	(0.207)
15-year old saved	0.515*	0.636*	0.283	0.346	0.846*	0.487	0.570	0.529	0.490
	(0.169)	(0.201)	(0.312)	(0.198)	(0.320)	(0.244)	(0.237)	(0.252)	(0.230)
25-year old saved	0.437	0.498	0.336	0.415	0.474	0.411	0.480	0.383	0.456
	(0.178)	(0.213)	(0.326)	(0.208)	(0.342)	(0.254)	(0.255)	(0.270)	(0.240)
30-year old saved	0.425*	0.521*	0.241	0.337	0.600*	0.261	0.598*	0.467*	0.381
	(0.116)	(0.141)	(0.205)	(0.140)	(0.211)	(0.168)	(0.159)	(0.167)	(0.163)
50-year old saved	−0.006	0.114	−0.249	−0.060	0.108	−0.144	0.116	0.000	−0.017
	(0.077)	(0.093)	(0.137)	(0.092)	(0.143)	(0.110)	(0.110)	(0.107)	(0.108)
70-year old saved	−0.361*	−0.250*	−0.605*	−0.380*	−0.319*	−0.479*	−0.244	−0.281*	−0.432*
	(0.069)	(0.082)	(0.129)	(0.084)	(0.122)	(0.098)	(0.099)	(0.100)	(0.096)
Number of observations	2316	1542	774	1572	744	1176	1140	996	1320

Note: In the estimations, we divided all variables by 1000. Superscript *denotes significantly different from zero at the 1% level.

The results indicate that the relative value of life decreases rapidly with age. For example, based on the full data set, saving one 1-year old is judged equivalent to saving 2.14 (1/0.468) 30-year olds. Table IV also presents the ratios of life expectancy for the relevant ages; the ratios are calculated by dividing the average remaining life expectancy for a person of the given age by the average remaining life expectancy for a 1-year old (Column 2). From the second and third columns of Table IV, it follows that both the life expectancy ratio and the relative value, as expressed in terms of the SMRS, decrease strongly with age. The decrease in relative value is particularly sharp at higher ages.

By comparing the pattern of the second and the third columns, we are able to analyze whether or not the preference for saving the lives of younger people over older people is solely due to their different remaining life expectancies. If yes, then the life expectancy ratios and the SMRS patterns with respect to age should coincide, given that people have a good perception of life expectancies at different ages and use zero time preference. Alternatively, if the SMRS decline faster than the life expectancy ratios, then this would mean that, in addition to the number of life years expected by saving a life at different ages, it is possible that diminishing weighting of life-years by age is taking place. Similarly, if the life expectancy ratios decline faster than the SMRS, then this may mean increasing weighting of life-years by age, or that people attach ethical values both to saving lives and life-years.

Starting by comparing the 1-year and 5-year age groups, we see that the SMRS differ substantially, whereas the life expectancy ratio between them is close to 1, implying that the life-years of small children between the age groups of 1 and 5 years are valued higher than later ones, which is the opposite of the implications of the DALY approach, as mentioned in the introduction. Continuing with comparing the 5-year and 15-year age groups, we see that again the SMRS decreases faster than the life expectancy ratio between them, implying that the life-years of children between 5 and 15 are valued higher than later ones. When we compare the age groups of 15 and 25 years, as well as 25 and 30 years, respectively, we do not obtain the same pattern. Here, there is instead a slight tendency for the life expectancy ratios to decline faster than the SMRS. When moving to the oldest age groups of 50 and 70 years, we see again that the SMRS decreases rapidly with age. While it is consistent with the DALY approach that the SMRS of the oldest group decreases faster than the life expectancy ratios, it is not consistent that the SMRS turns negative.

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Table IV. Social marginal rates of substitution (standard errors in parentheses) in the total sample and different sub-samples, based on the general model

	Actual life expectancy (expected age of death)	Life expectancy ratio	All [$n = 386$]	Muslim [$n = 257$]	Hindu [$n = 129$]	Literate [$n = 262$]	Illiterate [$n = 124$]	Age below 40 [$n = 196$]	Age 40 and above [$n = 190$]	Income below median [$n = 166$]	Income above median [$n = 220$]
			SMRS (standard error)								
1-year old saved	63.95	1	1	1	1	1	1	1	1	1	1
	(64.95)										
5-year old saved	62.70	0.977	0.788	0.738*	0.944	0.790	0.774	0.710	0.887	0.803	0.796
	(67.70)		(0.091)	(0.101)	(0.187)	(0.118)	(0.147)	(0.133)	(0.124)	(0.130)	(0.131)
15-year old saved	53.75	0.840	0.567*	0.615*	0.418	0.428*	0.753	0.529	0.627	0.563	0.562
	(68.75)		(0.135)	(0.139)	(0.364)	(0.194)	(0.181)	(0.193)	(0.190)	(0.192)	(0.195)
25-year old saved	44.65	0.698	0.481*	0.481*	0.497	0.514	0.422	0.448	0.528	0.408	0.524
	(69.65)		(0.154)	(0.162)	(0.375)	(0.201)	(0.244)	(0.216)	(0.222)	(0.237)	(0.210)
30-year old saved	40.20	0.628	0.468*	0.503*	0.356*	0.417*	0.534*	0.284*	0.658*	0.496*	0.437*
	(70.20)		(0.086)	(0.089)	(0.223)	(0.124)	(0.112)	(0.142)	(0.104)	(0.113)	(0.131)
50-year old saved	23.25	0.363	−0.007*	0.110*	−0.367*	−0.074*	0.096*	−0.157*	0.128*	0.001*	−0.019*
	(73.25)		(0.085)	(0.082)	(0.273)	(0.121)	(0.118)	(0.138)	(0.110)	(0.114)	(0.126)
70-year old saved	10.15	0.158	−0.398*	−0.241*	−0.894*	−0.470*	−0.284*	−0.521*	−0.268*	−0.299*	−0.496*
	(80.15)		(0.112)	(0.101)	(0.408)	(0.163)	(0.145)	(0.179)	(0.140)	(0.143)	(0.177)

Note: Life expectancy is defined as the average number of years left to be lived by a cohort, if mortality at each age remains constant in the future. Life expectancy figures are adapted from the Bangladesh Bureau of Statistics (BBS, 2001). Life expectancy ratios are calculated by dividing the average remaining life expectancy for a person of the given age by the average remaining life expectancy for a 1-year old. Superscript *denotes significantly different from 1 at the 1% level.Number of saved 1-year olds constitutes the base case.

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Table V. Probit coefficients (standard errors in parentheses) for the total sample and different sub-samples, based on the restricted model

	All [$n = 386$]	Muslim [$n = 257$]	Hindu [$n = 129$]	Literate [$n = 262$]	Illiterate [$n = 124$]	Age below 40 [$n = 196$]	Age 40 and above [$n = 190$]	Income below median [$n = 166$]	Income above median [$n = 220$]
Life saved	−0.487*	−0.361*	−0.763*	0.808*	−0.503*	−0.661*	−0.333*	−0.424*	−0.537*
	(0.068)	(0.080)	(0.127)	(0.081)	(0.122)	(0.095)	(0.095)	(0.101)	(0.091)
Life year saved	0.222*	0.023*	0.022*	0.638*	0.021*	0.025*	0.020*	0.022*	0.022*
	(0.002)	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)	(0.002)
Number of observations	2316	1542	774	1572	1572	1176	1140	996	1320

Note: In the estimations, we divided all variables by 1000. Superscript *denotes significantly different from zero at the 1% level.

Regarding observed preference heterogeneity, we can observe that respondents of the Hindu religion, i.e. the minority, on average assigned relatively lower (i.e. more negative) values to 70-year olds. We have no clear explanation for this result and feel that such heterogeneity warrants further investigation. Perhaps, Hindus experience a higher degree of stress, making older people appear more burdensome. Yet, perhaps surprisingly, we do not find the corresponding result that people with less than median income value old people less, but rather the opposite. Moreover, by comparing the literate and the illiterate sub-samples, we can rule out that the results are largely driven by the large fraction of illiterate responses, since the age pattern is fairly similar in the two groups. It is also interesting to note that the older half of the respondents also indicate a negative value for saving a 70-year old, although this effect is somewhat smaller than for the younger sub-sample. This is consistent with the findings of Johansson-Stenman and Martinsson (2008), who found that older respondents tend to value older saved lives somewhat higher (in relative terms) than younger respondents do, while Cropper *et al*. (1994) and Johannesson and Johansson (1997) found no preference effects of age.

Regarding the parameters of the restricted model (Equation (5)), we consistently for all sub-samples obtain a negative coefficient for the number of lives saved and a positive coefficient for the number of life-years saved; both being significant at the 1% level (see Table V). In other words, an alternative is more likely to be chosen the more life-years saved and the lower the number of lives saved, *ceteris paribus*. This result is not fully consistent with any of our hypotheses, but does indicate, again, that the relative value of life decreases rapidly with age.

The resulting SMRS patterns, i.e. patterns of relative value of life, following equation 7 (with a 1-year old saved as the base case) are reported in Table VI, for the full samples and different sub-samples. As can be observed, we again consistently find quite similar patterns as for the estimations based on the general model, reported in Table IV, including negative values for the oldest age group in the choice experiment.

On the whole, the results here clearly show the importance of the number of life-years saved when valuing life, i.e. they support the *y*-hypothesis rather than the *l*-hypothesis.

4.1. Follow-up questions

We asked verbal follow-up questions about whether the respondents agreed with a number of statements concerning priorities in life saving. Almost everybody agreed with the statement that society should give higher priority to saving younger people. Out of these, about 80% supported the view that society could save more life-years by saving a younger individual rather than an older, and 66% thought that younger individuals should be given priority as they have not lived as many years as older individuals have. Almost all respondents supported the view that society should give higher priority to saving younger people primarily because they can be expected to contribute more to society in terms of production and raising children. Although one cannot rule out the possibility of 'yea saying' in these

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Table VI. Social marginal rates of substitution (standard errors in parentheses) in the total sample and different sub-samples, based on the restricted model

	Actual life expectancy (expected age of death)	Life expectancy ratio	All [$n=386$]	Muslim [$n=257$]	Hindu [$n=129$]	Literate [$n=262$]	Illiterate [$n=124$]	Age below 40 [$n=196$]	Age 40 and above [$n=190$]	Income below median [$n=166$]	Income above median [$n=220$]
			SMRS (standard error)								
1-year old saved	63.95	1	1	1	1	1	1	1	1	1	1
	(64.95)										
5-year old saved	62.70	0.977	0.953*	0.959*	0.934*	0.951*	0.957*	0.948*	0.958*	0.956*	0.951*
	(67.70)		(0.003)	(0.003)	(0.011)	(0.004)	(0.004)	(0.005)	(0.004)	(0.004)	(0.005)
15-year old saved	53.75	0.840	0.748*	0.778*	0.645*	0.735*	0.770*	0.718*	0.775*	0.764*	0.735*
	(68.75)		(0.016)	(0.015)	(0.062)	(0.024)	(0.020)	(0.027)	(0.020)	(0.021)	(0.025)
25-year old saved	44.65	0.698	0.535*	0.591*	0.345*	0.510*	0.575*	0.479*	0.585*	0.564*	0.510*
	(69.65)		(0.030)	(0.027)	(0.114)	(0.044)	(0.038)	(0.049)	(0.037)	(0.038)	(0.046)
30-year old saved	40.20	0.628	0.431*	0.499*	0.198*	0.400*	0.480*	0.362*	0.492*	0.466*	0.400*
	(70.20)		(0.037)	(0.034)	(0.139)	(0.053)	(0.046)	(0.060)	(0.045)	(0.047)	(0.056)
50-year old saved	23.25	0.363	0.034*	0.149*	−0.362*	−0.018*	0.118*	−0.083*	0.138*	0.093*	−0.019*
	(73.25)		(0.062)	(0.057)	(0.236)	(0.091)	(0.078)	(0.102)	(0.077)	(0.079)	(0.096)
70-year old saved	10.15	0.158	−0.273*	−0.121*	−0.794*	−0. 342*	−0.163*	−0.426*	−0.135*	−0.194*	−0.342*
	(80.15)		(0.082)	(0.075)	(0.311)	(0.119)	(0.102)	(0.134)	(0.101)	(0.104	(0.126)

Note: Life expectancy is defined as the average number of years to be lived by a cohort, if mortality at each age remains constant in the future. Life expectancy figures are adapted from the Bangladesh Bureau of Statistics (BBS, 2001). Superscript *denotes significantly different from 1 at the 1% level.Number of saved 1-year olds constitutes the base case.

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responses, i.e. that some respondents may have answered yes because they believed either that this answer would please the enumerator or that they themselves would be seen in a better light by the enumerator, the findings are consistent with the estimated choice experiment results.

5. CONCLUSIONS

The choice experiment results strongly indicate that the respondents have preferences for life-saving projects that save younger people, and a model where people simply value the total number of saved life-years appears to explain the choice data reasonably well. The rather surprising results regarding the negative relative value of saved older people may be related to measurement problems due to the choice experiment design. The respondents may also have expressed a view that is not related to the trade-offs in the choice experiment presented to them. However, it cannot be ruled out that the responses do reflect true preferences, related to, e.g. a perceived society sustainability concern or the suffering of old people. The responses to follow-up questions after the choice experiments are also broadly consistent with the choice experiment results, indicating again that society should prioritize saving younger people. On the whole, the results here clearly show the importance of the number of life-years saved in the valuation of life. The main findings are also remarkably robust for the different sub-samples analyzed in terms of age, literacy, religion, and income. The main results are also broadly consistent with the recent empirical finding by Johansson-Stenman and Martinsson (2008) as well as with the normative claim by Sunstein (2004) that it is appropriate to focus on the value of statistical life-years rather than the value of statistical lives when making life-saving priorities.

The findings in this paper further contribute to the more general debate about whether relative values of lives should be used in public decision making. As the current practice is mixed, such that the value per statistical life tends to be used in some policy areas such as in road and infrastructure investments, and the value per statistical life-year (quality-adjusted or not) is often used in others such as in the health sector, incorporating the relative values of life obtained here would clearly imply a substantially changed practice in some policy areas, whereas it would offer support for the current practice in others. Overall, disregarding any methodological issues, the results convey important information for policies concerning public health, particularly infant and child health, in developing countries. Finally, a word of caution is warranted: priorities regarding life saving clearly involve fundamental ethical principles, and one cannot readily suggest what should be done based on how people act, whether in real life or when answering hypothetical questions; i.e. one cannot derive an 'ought' from an 'is.' What is needed therefore is also some kind of fundamental ethical principle that would guide what is considered 'good' and 'bad.' Although normative economic analysis is typically based on some kind of consequentialist ethical principle, such as utilitarianism, there are also prominent right-based alternatives. Some moral philosophers and politicians would thus disagree with the consequentialist ethics underlying the analysis here in the first place. It is therefore not our intention to directly influence priority setting in practice. In particular, we want to be perfectly clear that we do not recommend any negative weights to be used in practice.

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APPENDIX A: THE CHOICE SCENARIO

Governmental policy makers can prevent or postpone many deaths by increasing the financial resources for different kinds of life-saving programs. However, since the government's budget is limited, it has to choose which programs to prioritize. The purpose of this part of the survey is to gather information about people's preferences regarding such priorities.

Appropriate life-saving programs can prevent many causes of death. Many people die each year due to contaminated water, contaminated food, polluted air, smoking, and road accidents. More and better life-saving programs could reduce the number of deaths from each of these causes.

Suppose that there are two different life-saving programs and that they target different age groups of the population. Both programs save a different number of lives in different age groups. Both programs cost the same.

[Enumerator: Show Figure EXAMPLE and POINT to the attribute levels when they are mentioned]

As an example, assume that you were to choose between two available life-saving programs, A and B. The effects of the programs differ with respect to the number of lives saved and the ages of those saved. The cost of both life-saving programs is the same. Program A saves 200 lives of people who are 20–40 years old, and program B saves 250 lives of people who are 40–60 years old. The programs do not change the total amount of suffering experienced by ill or injured people.

	Program A	Program B
Age-group of lives saved	20–40 years	40–60 years
Number of lives saved	200	250
Your choice		

QUESTION: If both programs cost the same, which life-saving program would you choose?

[Enumerator: Let the respondent mark (X) the blank box for the chosen program]

We will now present you with six different pairs of life-saving programs and each time we will ask you to choose the one you think would be the best for society. The effects of the programs differ with respect to the number of lives saved and their age group, but they are similar in all other respects. The programs do not change the total amount of suffering experienced by ill or injured people.

APPENDIX B: FOLLOW-UP QUESTIONS ON PRIORITY SETTING IN SAVING LIVES

Question/statement

1. Society should give higher priority to saving younger people
   Agree (go to question 2[a])
   Disagree
2. Why do you think that society should give higher priority to saving younger people?
   (a) A younger individual has a longer time left to live; hence, society saves more life-years by saving a younger individual compared with an older
   (b) It is fairer that younger individuals are saved since they have not lived as many years as older individuals have
   (c) It is better from a social point of view to save younger individuals as they will contribute more to society in terms of production and raising children

[a]The respondents could choose more than one response.

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