Using choice experiments to measure relative values of statistical lives: evidence from Bangladesh

By

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Abstract
By assuming that an individual has preferences concerning different states of the world and these preferences can be described by an individual social welfare function, this paper explores the relative values of (statistical) lives related to age using a pair-wise choice experiment on life-saving programs. The results indicate that relative value decreases strongly with age and that people have strong preferences for saving more life-years rather than lives per se.

Key words: social preferences; life-saving programs; choice experiment; relative values of lives; Bangladesh

JEL Code: D63, I18, J17

1. Introduction

The value of a statistical life (VSL), in monetary terms, has been studied for a long time using both revealed and stated preference approaches (see e.g. Weinstein et al., 1980; Viscusi 1993; Hammitt and Graham 1999; Viscusi and Aldy, 2003). The idea of using varying values of statistical lives in decision making is more recent, and has been frequently discussed since the publication of the 1993 World Development Report (World Bank, 1993). The report states on page 213 that "Most societies attach more importance to a year of life lived by a young or middle-aged adult than to a year of life lived by a child or an elderly person." Murray and Lopez (1994) argued that "In all societies social role varies with age. The young, and often the elderly, depend on the rest of society for physical, emotional and financial support. Given different roles and changing levels of dependency with age, it may be appropriate to consider valuing time lived at a particular age unequally." The disability

adjusted life year (DALY)[1] age weights, proposed by Murray (1994; 1996) and used by the World Bank (1993) in measuring the global burden of diseases, imply that the value for each year of life lost rises steeply from zero for newborns until a peak at the age of 25 and then declines gradually with increasing age, while remaining positive.[2] The DALY age weights also imply that the value of a statistical life, commencing from infanthood, strongly decreases with age (see Figure 1 and Appendix 1). Such age weights are defended on the ground that they seem to be appealing to most people and the discriminatory effect is ethically quite different from setting un-equal age-weights regarding sex, ethnicity, education, or income, since everybody is supposed to experience each age (Murray, 1996). Priority setting in health care on the basis of the burden of disease calculations (thus on the basis of the DALY age weights) is still a matter of debate (see e.g. Williams 1999, 2000; Murray and Lopez, 2000; Mooney and Wiseman, 2000), however, some critics (e.g. Williams, 1997; 1999; 2000) suggest that such age weights may be relevant for developing countries. This paper uses a choice experiment approach to investigate people's preferences, in the context of developing countries, regarding relative values of life when it comes to different ages of individual being saved. In particular, individuals' preferences for life-saving programs is elicited using a pair-wise choice experiment between different life-saving programs. This approach also allows to test if people have preferences for saving more life-years rather than only saving lives.

There now exists a large theoretical literature in economics and in philosophy that discusses the issue of age related preferences (or ageism) in the context of health care and life-saving (for review see Hausman and McPherson, 1996; Broome, 1999; Tsuchiya, 1999, 2000; Cookson and Dolan, 2000; Williams and Cookson, 2000; Tsuchiya et al., 2003). For example, Tsuchiya (1999) discusses two different rationales for age weighting health benefits as "efficiency based age weighting" and "equity based age weighting," The three main forms of ageism discussed are: (i) "health maximization ageism"- giving priority to younger versus older since younger will experience an analogous health gain for a longer period; (ii) "productivity ageism"- giving priority to young adults as they are more productive in the family and in the society; and (iii) "fair innings ageism"- relates to quality adjusted life years[3]

[1] DALY measures health outcome in terms of losses. The sum of DALYs lost across all ages, conditions, and regions are referred to as the global burden of disease, which reflects both the number of "years of life lost due to premature death," as well as the number of "years of life lived with disabilities," due to each disease (see World Bank 1993; Murray, 1994, 1996; Murray and Acharya, 1997).

[2] The World Health Organisation regularly publishes burden of disease results in the World Health Reports, and hence endorses its application and development (see e.g. World Health Report, 2004).

[3] QALYs measure health outcomes in terms of gains in health, as opposed to DALYs (see Weinstein and Stason, 1997; Dolan, 2000; Hammit, 2002).

(QALYs) and gives priority to a younger person over an older because the former has a smaller number of expected lifetime QALYs than the older.[4] "Fair innings weights" reflect aversion to inequality in lifetime QALYs and are supposed to decrease with age to reflect that the expected lifetime QALY increases with survival (Tsuchiya, 2000, p. 58). The first two forms of ageism are related to "efficiency based age weighting," while the last form of ageism is related to "equity based age weighting." The DALY age weighting has been referred to as" efficiency based age weighting," which relates to "productivity ageism" (Tsuchiya, 1999).

There are also some empirical studies that elicit peoples' preferences regarding the question of age related priority setting, mostly conducted in developed countries. For example, in the case of health care many people prefer that young should be given priority over the old (for reviews see Tsuchiya, 1999; Williams and Cookson, 2000). Studies quantifying trade-offs between saving lives at different ages also observe that people place more weight on saving younger people's lives than on saving the lives of older people (Cropper et al., 1994; Johannesson and Johansson, 1997). Both these seminal studies, conducted in the USA and Sweden respectively, estimated trade-offs between lives saved at different ages. Cropper et al. (1994) found that saving eleven 60 year olds was judged equivalent to saving one 30 year old. Johannesson and Johansson (1997) found that saving five 50 year olds or saving thirty-four 70 year olds was judged equivalent to saving one 30 year old. The result from these two studies also predicts that the value of saving lives decreases promptly with advancing age. More recently, Johansson-Stenman and Martinsson (2004), using an ethical preference approach and a choice experiment about safety enhancing road investment in Sweden, also found that the relative value of a saved life decreases by age but at a much slower rate; e.g. saving two 70 year old pedestrians was judged equivalent to saving one 30 year old pedestrian.

Following an approach similar to Johansson-Stenman and Martinsson's (2004) (henceforth J-SM), this study elicits individuals' preferences for life-saving programs using a random sample of households in rural Bangladesh. As a developing country, Bangladesh has a much less developed social security system, reflecting almost non-existence of child-care as well as elderly-care systems. The social institutions that these vulnerable groups rely on are the family or the extended family. Unlike developed countries, the income in a developing

[4] This is based on Williams (1997) fair innings argument: "It reflects the feeling that everyone is entitled to some normal span of health (usually expressed in life years, e.g. 'three score years and ten'). The implication is that anyone failing to achieve this has in some sense been cheated, whilst anyone getting more than this is living on a borrowed time" (p. 119).

country like Bangladesh, peaks in the 20-40 age range since the productivity of workers, which often is of manual nature, peaks in the same age range. These prime age adults simultaneously bear the responsibility of supporting their children as well as their elderly parents. Given such socio-economic and cultural setting, one might expect that people in a developing country like Bangladesh would have fairly different perceptions of valuing lives of different ages, i.e. perceive smaller differences in the relative values of life, compared to people in most developed countries such as the USA or Sweden. The results, however, indicate that relative value decreases strongly with age of the individuals saved and people have stronger preferences for saving more life-years, rather than lives.

The rest of the paper is organized as follows: Section 2 discusses the theoretical and empirical model, Section 3 presents the design of the choice experiment, Section 4 discusses the econometric results, and Section 5 discusses the responses from follow-up questions asked after the choice experiment. Finally, Section 6 concludes the paper.

2. The model

Let us assume that an individual has social preferences concerning different states of the world that can be described by an individual social welfare function (ISWF). Let us also assume that individuals maximize their own ISWF, by acting as social planners, with regards to choosing life-saving programs. Let us, following J-SM, start with a general ISWF (henceforth 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. In this paper, a more restrictive model, denoted restricted model, is also tested where the ISWF depends on the total number of saved lives (irrespective of age) and the total amount of life-years saved. The restricted model allows testing and comparing the hypotheses *only lives matter* and *only life-years matter*.

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

$$W_i = \hat{W}_i + \alpha_i^1 s^1 + ... + \alpha_i^n s^n , \qquad (1)$$

where $\hat{W}_i$ denotes *i*'s social welfare at status quo, i.e. without any saved lives from the programs, s^j is the number of saved people in the group *j* (e.g. corresponding to a certain

age), and α_i is the vector of coefficients for individual *i*. The SMRS between group *j* and group *k* for individual *i* is expressed as follows:

$$SMRS_i^{jk} = \frac{\partial W_i}{\partial s^j} \Big/ \frac{\partial W_i}{\partial s^k} = \frac{\alpha_i^{\ j}}{\alpha_i^{\ k}} \quad . \tag{2}$$

The $SMRS_i^{jk}$ thus gives the ratio of saved lives of age group *j* to age group *k*, for which the individual remains indifferent.

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, the above equation can be re-written as

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

An ISWF-maximizing respondent 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 *A* is chosen as follows:

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

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) and all individual-specific coefficients can then in principle be estimated by a standard probit regression for each individual separately.

A more restricted way of modelling observable heterogeneity is to use segmentation, which is used in equation (5) by interacting the individuals' observable personal characteristics with the saved number of people of a certain age such as

$$W_i = \hat{W} + \alpha^1 s^1 + ... + \alpha^n s^n + \sum_{j=1}^{n} \gamma^j x_i s^j + \varepsilon_i \ , \tag{5}$$

where γ is a vector of coefficients to be estimated and x_i denotes the observable characteristics of individual *i*, or people in subpopulation *i*, which may for example reflect age, level of education and whether the individual has any children or not. Thus we can then estimate the probability that an individual *i*, or people of the sub-population *i*, will choose *A* as follows:

$$\Pr(A \text{ is chosen}) = \Pr(W_i(A) > W_i(B)) = \Pr\left(\alpha^{\ 1}\Delta s^1 + ... + \alpha^{\ n}\Delta s^n + \sum_{j=1}^{n} \gamma^j x_i \Delta s^j > \phi_i\right). \tag{6}$$

The relative value of saving a life belonging to group *j* compared to group *k* can then be calculated as:

$$SMRS_i^{jk} = \frac{\alpha^j + \gamma^j x_i}{\alpha^k + \gamma^k x_i} \quad . \tag{7}$$

Now, disregarding the observable characteristics of the respondents, an SMRS equal to 1 would for example mean that only the number of lives matter. That is, the more lives saved the better, irrespective of the ages of the saved individuals.

An alternative and somewhat more restricted model is when the ISWF depends on saved lives (irrespective of ages) and the total amount of life-years saved, assuming that a saved person will attain the average life expectancy of her/his age. Compared to the model in equation (1), in this case a specific functional form for ISWF is imposed assuming that all individuals have the same preferences as measured in the deterministic part, and heterogeneity in preferences is captured by the error term:

$$W_i = \hat{W} + \beta l + \delta y + \varepsilon_i \ , \tag{8}$$

where *l* is the total number of lives saved and *y* is the total number of life-years saved. This model facilitates a direct test between the "only-lives-matter-hypothesis," *l*-hypothesis for short, and the "only-life-years-matter-hypothesis," *y*-hypothesis for short. According to the *l*-hypothesis, one would expect that $\beta > 0,\ \delta = 0$, whereas the *y*-hypothesis implies that $\beta = 0, \delta > 0$. Some intermediate alternatives, of course, also exist, where $\beta > 0$ and $\delta > 0$. The probability that individual *i,* or people of sub-population *i,* will choose program A can be estimated as follows

$$\Pr(A \text{ is chosen}) = \Pr(W_i(A) > W_i(B)) = \Pr\left(\beta \Delta l + \delta \Delta y > \phi_i\right) \ , \tag{9}$$

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

The estimated relative value of saving a life belonging to a certain age group, compared to another, is then given as follows:

$$SMRS_i^{jk} = \frac{\beta + \delta y^j}{\beta + \delta y^k} \ , \tag{10}$$

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

3. The choice experiment

In a choice experiment framework, respondents make repeated choices between different alternative goods or projects described by their attributes (see Louviere et al., 2000; Alpizar et al., 2003). 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 negative aspects such as being cognitively more demanding for the respondents, and that the complexity of task can affect the decision of the respondents (Adamwicz et al., 1998). The complexity of the task is determined by the following factors: the number of choice sets, the number of alternatives in the choice sets, the number of attributes describing the alternatives, and the correlation between attributes (Swait and Adamwicz, 1996).

The design of a choice experiment necessarily involves defining attributes and levels of attributes, experimental design, questionnaire development, and designing a sample and sampling strategy. Here, the attributes of life-saving programs are the age of the life saved individuals 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 in SAS, only considering main effects (i.e. considering the effects of each attribute on utility, by using a D-optimal design approach). 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). Forty-two choice sets were created, and blocked into 7 groups so that respondents answered different sub-sets of the main design. These 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 in order to test the choice experiment in the field. The attributes and the levels used in the final choice experiment are presented in Table 1.

>>> TABLE 1

The choice experiment was conducted among a random sample of rural households in the following five districts of Bangladesh: Netrokona, Mymensingh, Manikganj, Gazipur, and Narayanganj. The sample is therefore not representative of the Bangladesh population, which consists of 64 districts. Moreover, the villages were chosen so that the respondents of the Hindu religion are over-represented (34% compared to the national average of 11 %) in order

to facilitate religious comparisons. The enumerators, used to conduct the survey, were allocated to different parts of the selected villages and were then asked to perform a survey and the choice experiment.[5] Table 2 presents the sample characteristics. The survey included questions on respondent health and risk perceptions, in addition to the socioeconomic questions, plus contingent valuation questions on risk reduction. The enumerators were trained beforehand regarding the choice experiment, i.e. the purpose of the experiment and how to conduct it practically, the presentation of 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 using a small card on which enumerators pointed each time they explained a new choice situation to the respondents.

>>> TABLE 2

The scenario used in the choice experiment (see Appendix 2) explains that the 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 are 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 as groups spanning a range of ages rather than as specific ages. The age intervals used are: 0-1 year, 1-10 years, 10-20 years, 20-30 years, 20-40 years, 40-60 years and 60-80 years. Respondents were presented with six different pairs of life-saving programs differing 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 the costs. It was specifically mentioned that the life-saving programs do not change the total amount of suffering of ill or injured people, so that the respondents would not assume different diseases/injuries (and their associated sufferings) for different age-groups. 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, follow-up questions were asked regarding priority setting on saving lives.

[5] The interviews were conducted with the household heads as the decisions made within households are normally made, or at least approved of, by the household heads. If the household head was not around, the enumerators were instructed to go back later. If the respondent was not at home at the second visit, the enumerator moved to the next household. However, in the villages, people from the same family-chain normally live in a cluster of 4-5 households. Thus, a replacement from the next household or next to the next household (in some cases) should not bias the results. There were 22 % replacement households in our sample.

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 allowed to be independent across individuals (clusters), but, not necessarily independent between responses for an specific individual.

Table 3 presents the results i.e. the SMRS or relative value. SMRS between age groups in the experiments is calculated using the probit estimates (not reported here) and equation 7 (disregarding the respondent characteristics), taking saved 1-year olds as the base case (column 3). Table 3 also presents the ratios of life expectancy for the relevant ages; the ratio is calculated by dividing the average remaining life expectancy for a certain age by the average remaining life expectancy for a 1-year old (column 2). The results indicate that the relative value strongly decreases with age. For example, saving one 1-year old is judged equivalent to saving 2.09 (1/0.478) 30-year olds. As shown in Table 3, except for the 50-year old saved, the *SMRSs* are significantly different from one at 1% level. The relative values of life obtained here are roughly similar to the ratios of life expectancy, up to a certain age. However, the results also indicate that relative value is negative and significant for the oldest group (70-years old) in the choice sets. While such a negative value is very surprising and theoretically un-intuitive, this might result from the fact that respondents have a very strong preference for saving more life- years by saving younger lives; therefore in a pair wise choice of life-saving programs they might be always choosing the alternative which saves relatively younger lives. Thus, this might result in negative coefficients even if their true preferences entail assigning very small weight on saving the old.

>>> TABLE 3

With regards to observed preference heterogeneity, given the results discussed above, the focus is made in the preference heterogeneity of saving the lives of older people by using the equation 6 and by interacting 70-year olds saved with the following characteristics of the respondents: age, education, religion, income, and whether a respondent's parent is alive or not.[6] From the estimated probit coefficients (not reported here), the relative value for all saved lives as well as an additional value for the 70-year olds saved in the choice experiment

[6] As the sample consists of only 9 percent female respondents, gender difference is not focused here.

is calculated as before using the equation 7(column 4 of Table 3). The results do not indicate any significant differences in values towards older saved lives with regards to respondent age and income. It may be mentioned that both Cropper et al. (1994) and Johannesson and Johansson (1997) found that respondent preferences are unaffected by own age, while J-S M found that older respondents value older saved lives higher than younger respondents do. However, unlike J-SM, age is used here as a continuous variable. The results also indicate that a respondent values older saved lives relatively higher if his/her parent is alive. This seems quite reasonable given that people may care more for their own elderly parents than for the elderly in general.[7] On the other hand, the respondents with a higher level of education and the respondents of the Hindu religion on average assigned relatively lower values to 70-year olds. While no good explanation can be provided for this result, such heterogeneity warrants further investigation.

With regards to the parameters of the restricted model(equation 9), contrary to the hypotheses mentioned earlier, a negative coefficient is obtained for the number of lives saved and a positive coefficient is obtained for the amount of life- year saved; both being significant at the 0.1 % level. The resulting SMRS (column 5 of Table 3), following the equation (10) (with 1-year olds saved as the base case) imply a negative value for the oldest group in the choice experiment, almost similar to the results reported in the third column of Table 3.

Figure 1 shows the relative value of a life obtained from the restricted model, from the general model, and from the DALY age weights, as a function of age, along with the ratio of life expectancy.

>>> FIGURE 1

As depicted in Figure 1, the relative value of life becomes negative around the age of 53 with both models presented here. It is interesting to note the results are quite closely related to the age pattern of the relative value of life obtained using the DALY age weighting function, up to a certain age. However, the negative values for the oldest age group in both models may seem unreasonable and one can speculate about the reason. One possibility is that there are methodological reasons related to the choice experiment design, and that the results simply reflect that the respondents have very strong preferences for saving younger individuals, i.e. almost lexicographic preferences. 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). It may also be mentioned that a similar negative value

[7] There is a negative and significant (at the 1% level) correlation between the age of respondents and whether their parents are alive (r=-0.14).

was obtained using a slightly different design in two pilot studies preceding the final choice experiment. On the other hand, it might be that respondents simply do not want to prolong an older life considering their apparent old age related sufferings out of economic hardship, socio-economic insecurity and poor health care facilities. It appears unlikely, however, one would have obtained a similar age pattern when focusing on health rather than on life-saving.[8]

In this paper, a further restricted model is estimated assuming that the value of life is a function of the number of saved life-years up to a certain age, and that saving life-years beyond this cut-off point yields no further value; in other words, saving lives above this age level yields zero value. Such model is estimated using a grid search procedure (Greene, 2000), which resulted in an estimated cut-off point of about 66 years. That is, beyond the age of 66 additional saved life-years have a social value of zero. Otherwise, the age-pattern was quite similar to the previously estimated models without any cut-off point. On the whole, the results here clearly show the importance of the number of life-years saved in the valuation of life, i.e. they support the *y*-hypothesis rather than the *l*-hypothesis, which is also consistent with the ratio of life expectancy and with the results implied by the DALY age weighting function used in World Bank (1993).

5. Follow-up questions

After the choice experiment, the respondents were asked follow-up questions regarding priority setting on saving lives. As noted earlier, World Bank (1993) observes that most societies in practice seem to attach higher values to a year of life of young and middle aged adults than to a year of life of a child or an elderly person. Following this, the respondents were explicitly asked if they wanted to prioritize saving the younger people over the older. Then the respondents were asked about their preferences on prioritizing the younger, given that they agreed to prioritize the younger. 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 the society both in terms of production and child rearing, and could also shoulder the responsibility of the older

[8] For example, Johri et al. (2005) found in a study 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.

people. This aspect is related to productivity ageism. The exact wordings of follow-up questions and responses are presented in Table 4.

>>> TABLE 4

As elicited in the follow-up questions, almost all respondents agree with the statement that society should give higher priority to saving younger people. Out of these, about 80% support the view that society could save more life-years by saving a younger individual compared to an older, and 66% think that younger individuals should be given priority as they have not lived as many years as older individuals have (supporting "fair-innings ageism"). Almost all respondents support the view that society should give a higher priority to saving younger people primarily because they will contribute to the society in terms of production and raising children (supporting "productivity ageism"). Although one cannot rule out the possibility of "yea saying" in these responses, the findings are nevertheless consistent with the estimated choice experiment results.

6. Conclusion

The 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 data quite well. Interestingly, the results here are quite closely related to the age pattern of relative values, up to a certain age, implied by the disability adjusted life year (DALY) age weights used by the World Bank. While the DALY age weights relate to "productivity ageism," the relative values here, obtained as a reflection of peoples' preferences, appear also to be related to other kinds of ageism. One may argue that decisions on priority setting should be informed by people's preferences on such priorities and the results here are informative for priority setting in public health projects in the context of developing countries. The rather surprising results regarding the relative value of "old years" may partly be linked to measurement problems related to the choice experimental design and that respondents are expressing a view not related to the trade-offs in the choice experiment presented to them. It is essential for more research to be done on eliciting preference for relative value of life using the choice experiment method. In any case, any negative weights cannot be recommended to be used in practice. Moreover, the choice experiment approach on life-saving programs may seem rather demanding in the context of a developing country, where a substantial proportion of the population has no formal education. Future research should also address such methodological issues when eliciting peoples' preference for using relative value of life in public decision making.

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Table 1. 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	0 - 1, 1 - 10, 10 - 20, 20 - 30, 20 - 40, 40 - 60 and 60 - 80

Table 2. Sample Characteristics

Variable/Characteristics	Mean	Minimum	Maximum
Male	0.91	0	1
Age	44.28	19	87
Illiterate (Cannot read and write)	0.32	0	1
Low education (Not illiterate and/or educated up to high school level)	0.54	0	1
High education (Educated above High school level)	0.14	0	1
Hindu religion [a]	0.33	0	1
Muslim religion	0.67	0	1
Per capita household income [a] (Taka)	22552	947	288848
Children in the household (up to age 16 years old)	0.87	0	1
Parent alive (either father or mother is alive)	0.09	0	1

[a] Yearly household income is adjusted with household equivalent and economies of scale, by dividing total yearly income by [Number of adults+0.5*number of children] $^{0.75}$. USD $ = 57.8 Taka, at the time of survey (October, 2003).

Table 3. Relative value of (statistical) life [a] (SMRS)

Saved life	Life expectancy ratio [b]	SMRS [c]	SMRS [d]	SMRS [e]
1- year old saved	1	1	1	1
5- year olds saved	0.977	0.790*** (0.594 – 0.986)	0.819*** (0.634 – 1.1)	0.966*** (0.962 – 0.969)
15 -year olds saved	0.84	0.569*** (0.303 – 0.836)	0.602*** (0.349 – 0.856)	0.761*** (0.737 – 0.785)
25- year olds saved	0.698	0.490*** (0.194 – 0.786)	0.515*** (0.236 – 0.799)	0.548*** (0.502 – 0.593)
30- year olds saved	0.628	0.478*** (0.332 – 0.624)	0.494*** (0.355 – 0.634)	0.444*** (0.388 – 0.50)
50- year olds saved	0.363	0.003 (-0.154 – 0.160)	0.035 (-0.114 – 0.184)	0.047 (-0.048 – 0.143)
70- year olds saved	0.158	-0.397*** (-0.587 – -0.188)	-0.481** (-0.895 – -0.066)	-0.259*** (-0.385 – -0.132)
Observed heterogeneity				
70- year olds saved × respondent's age			0.004 (-0.003 – 0.012)	
70- year olds saved × respondent has high education			-0.374** (-0.717 – -0.074)	
70- year olds × Per-capita household income			0.0003 (-0.0009 – 0.002)	
70- year olds saved × respondent is of Hindu religion			-0.261** (-0.498 – -0.054)	
70- year olds saved × respondent's parent alive			0.229** (0.009 – 0.449)	

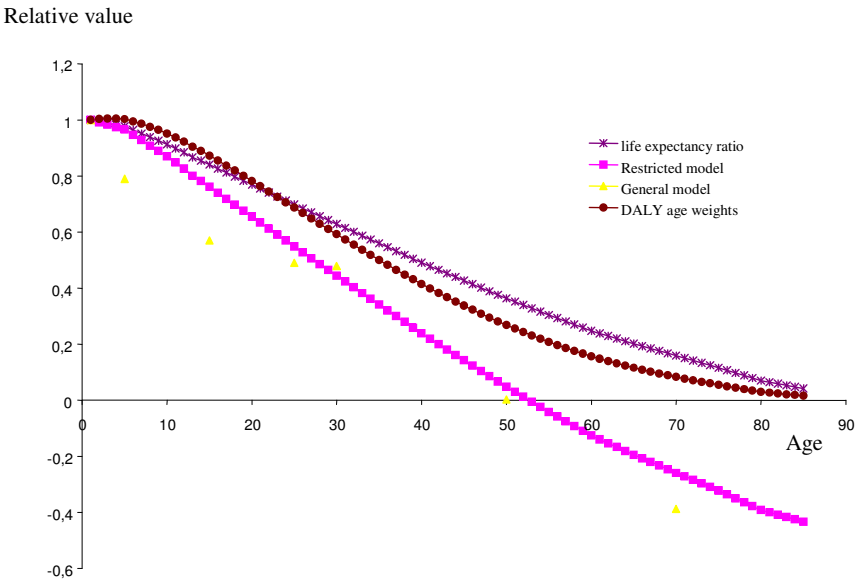
[a] 1- year old saved is the base case. 95% confidence intervals in the parentheses and the superscripts *** and ** denote statistical significance at 1% and 5% level, respectively.
[b] Life expectancy figures are adapted from the BBS (2001).
[c] Calculated using the estimated coefficients of the general model.
[d] Calculated using the estimated coefficients of the general model accounting for heterogeneity.
[e] Calculated using the estimated coefficients of the restricted model.

Table 4. Preferences for priority setting in saving lives

Question/Statement	% of respondents agree
1. Society should give a higher priority to saving younger people. [a]	98
2. Why do you think that society should give a higher priority to saving younger people?	
a) A younger individual has a longer time left to live. Hence the society saves more life-years by saving a younger individual compared to an older.	80
b) It is fairer that younger individuals are saved since they have not lived as many years as older individuals have.	66
c) It is better from a social point of view to save younger individuals since they will contribute more to the society in terms of production and of raising children.	98

[a] Given an agreement to this statement, question 2 is asked; the respondents could choose more than one response.

Figure 1. Relative value of life



Appendix 1: Relative value of life using the DALY age weighting function

The relative value of a year of life at each age has been modelled using the following formula:

Age-weighting function = $Kxe^{-x\beta}$, (1)

where $K = \text{constant} = 1$

$\beta = \text{constant} = 0.04$

$x = \text{Age}$

This function rises quickly from zero at birth to a peak at age 25 and then declines asymptotically toward zero (World Development Report, 1993, p 213).

We calculate the value of life at each age, x, by integrating equation (1) as follows:

$$\int_x^{T(x)} Kxe^{-x\beta}\,dx, \quad (2)$$

$$= \left[-\frac{k}{\beta^2}\{x\beta + 1\}e^{-\beta x} \right]_x^{T(x)}$$, where $T(x)$ denotes life expectancy at age x.

The relative value of life at each age is obtained as a ratio by taking the value for 1- year old as the base case.

Appendix 2: 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 for such priorities.

Appropriate life-saving programs can prevent many causes of death. Many people die each year because of contaminated water, contaminated food, polluted air, smoking, or as a result of 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 it is possible to target different age groups of the population within each of these programs. 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 age 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 put cross mark (X) in the blank box under the chosen program]

We will now present you with 6 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.