Preferences of urban Zimbabweans for health and life lived at different ages

Jennifer Jelsma,[1] Darlies Shumba,[2] Kristian Hansen,[3] Willy De Weerdt,[4] & Paul De Cock[5]

Objective To determine the age-weighting preferences of urban Zimbabweans in relation to health care priorities.
Method A total of 67 randomly selected residents of a high-density area of Harare participated in the study. Participants were asked ''person trade-off ''questions to determine their preferences in terms of the numbers of people of various ages who would be saved from death and from suffering a year of ill-health relative to the number of 30-year-olds who would be saved from these eventualities.
Findings The responses indicate that the value of averting a year of ill-health was judged greatest for 15-year-olds and was equal for people aged 1, 30, and 45 years. The value of averting a death primarily reflected the expected years of life lost, but the influence of age-weighting was evident in that 15 years was the most highly valued age.
Conclusion Although the age-weighting curves did not correspond exactly with the Global Burden of Disease (GBD) age-weights, Zimbabweans showed a preference for saving the lives of young adults. The GBD age-weights should be used to determine the disability-adjusted life years lost in the Zimbabwean population.

Keywords Cost of illness; Life expectancy; Quality-adjusted life years; Age factors; Value of life; Choice behavior; Zimbabwe (*source: MeSH, NLM*).

Mots clés Coût maladie; Espérance vie; Rapport qualité vie-survie; Facteur âge; Comportement choix; Zimbabwe (*source: MeSH, INSERM*).

Palabras clave Costo de la enfermedad; Esperanza de vida; Calidad de acuerdo a los años de vida; Valor de la vida; Conducta de selección; Zimbabwe (*source: DeCS, BIREME*).

Bulletin of the World Health Organization 2002;80:204-209.

Voir page 208 le résumé en français. En la página 209 figura un resumen en español.

Introduction

Resources for reducing the risks of mortality and morbidity are finite and choices have to be made between different health strategies (*1*). There is increasing interest in the development of resource-conserving strategies that include the implementation of formalized and standardized decision-making processes (*2*). Cost-utility analysis is frequently used to develop a priority list for the funding of health care interventions so as to maximize benefits under a given budget (*3*). However, there is an absence of broad agreement on the criteria that should influence the rationing of services (*4*). The measurability of utility has been a subject of intense debate for many years (*3*).

Composite indicators of utility have been developed which incorporate morbidity and mortality attributable to different health conditions into a single comparable unit (*5*). The most widely used unidimensional indicator of health outcomes is the quality-adjusted life year (QALY) (*6*). Typically, a utility or QALY-weight (u (Q)) of value 0–1 is assigned for each health state and is multiplied by the time t spent in this state (*6*).

The disability-adjusted life year (DALY), a variant of the QALY, was developed as a measure of the Global Burden of Disease (GBD) (*7*, *8*). It combines information about the number of years of life lost (YLL) because of premature death and the number of years lived with disability (YLD). An indicator based on the number of years of life lost gives unduly great weight to the death of a child in comparison with that of an adult (*5*). Moreover, the utility of health has been reported to vary with age (*4*, *9–11*). Consequently, the notion implicit in the QALY model that each healthy year of life gained is equal, irrespective of the age of the individual, may not reflect real preferences in society (*9*, *10*).

The DALY incorporates values for age-weighting and time-discounting. Age-weighting is included in the DALY calculation through functions of the form $Cx\exp[-\beta x]$, where C and β are constants equal to 0.1658 and 0.04, respectively, and x is the age of the subject. This weighting function is claimed to offer a credible approach to capturing the dependence of the young and the older generation on adults (*12*). Murray (*11*) used a modified Delphi method with a group of health experts to establish this continuous mathematical

[1] Doctoral candidate, Department of Rehabilitation, Institute of Physical Education and Physiotherapy, Catholic University of Louvain, Louvain, Belgium; and Senior Lecturer, Division of Physiotherapy, School of Rehabilitation and Health Sciences, Faculty of Health Sciences, Anzio Road, Observatory, Cape Town, South Africa (email:jjelsma@uctgsh1.uct.ac.za). Correspondence should be addressed to this author at the latter address.

[2] Physiotherapist, Mpilo General Hospital, Bulawayo, Zimbabwe.

[3] Health Economist, Department of Community Medicine, University of Zimbabwe Harare, Zimbabwe.

[4] Professor of Physiotherapy, Department of Rehabilitation, Institute of Physical Education and Physiotherapy, Catholic University of Louvain, Louvain, Belgium.

[5] Professor of Paediatrics, Centre for Developmental Disorders, Faculty of Medicine, Catholic University of Louvain, Louvain, Belgium.

Ref. No. **00-0994**

function for the weights at each age. The incorporation of an age-weighting function is controversial and some authors feel that lower age-weights for the young and old are not uniformly supported by the international literature. They have therefore recommended that it be left out of the calculation of DALYs (*13*, *14*).

In 1997 the Zimbabwe National Burden of Disease Committee was established to provide information in the form of DALYs on the burden of disease attributable to various health conditions. The question arose as to whether age-weighting should be incorporated into the calculation of DALYs and, if so, whether the "standard" DALY age/weight curve was an adequate reflection of the values of the local Zimbabwean people. Weighting by productivity of healthy days of life lost has been applied to an evaluation of health projects in Ghana (*15*). However, no literature was found on the societal valuation of health at different ages in sub-Saharan Africa.

The overall aims of the study were therefore to assess whether the age-weighting function used in the calculation of DALYs reflected the values that Zimbabweans attached to a life saved and to a year lived in full health or less than full health at different ages. In addition an investigation was conducted into whether the age, sex, and educational level of respondents were determining factors in the valuation of life lived at different ages.

Materials and methods

Theoretical framework

It can be postulated that the responses to questions on the value of life lost at different ages are determined in part by the following: the appreciation of the number of years of life that would be forfeited by a death at each age, i.e. the expected years of life lost (EYLL); the value attached to the life lived at that age (age weight); and the individual's personal preferences, as influenced by his/her life experiences.

EYLL are already incorporated into the QALY and DALY formulae and should not be counted twice. In order to extract the age-weighting preference for averting a death at each age from the value of the EYLL it would be necessary to ask a nonsensical question such as "Assuming that a 1-year-old had as many years of life to live as a 30-year-old, whose life would you save?" However, if the age-weighting preferences for saving lives do not follow the EYLL curve exactly it may be assumed that age preference overrides the EYLL component. If the two curves are identical, age-weighting should not be used as this would violate the mutual-utility-independence condition for QALYs, meaning that quality of life and life years were not independent of each other (*16*). The values of averting the loss of a year of healthy life are more likely to reflect a true age-weighting function because the period of loss is the same for each age.

It was therefore hypothesized that the effect of EYLL would override the impact of an age-weighting function in exercises relating to years of life lost, that an age-weighting function would be detected in exercises related to averting a year of ill-health at different ages, and that the age, sex, and marital status of respondents would influence their valuations.

Methodology

All residents of a high-density suburb of Harare who were over 15 years of age and who had at least seven years of schooling were eligible for the study. Those living in eight randomly chosen street blocks who met the inclusion criteria and were present on the day of interview were included. Interviews were conducted during weekends in order to ensure that working family members were represented. A total of 84 people were approached for interview: six refused to participate and the responses of 11 were incomplete or inconsistent and were therefore not analysed. The final sample therefore consisted of 67 persons. Their mean age was 27.69 years (standard deviation 11.46). The demographic characteristics of the subjects are given in Table 1.

A structured interview based on a questionnaire was developed and translated into the vernacular, Shona. It was piloted on a sample of convenience of 20 younger and 28 older people. The original phrasing of the ranking question was altered and after a second pilot study a final version was adopted in which the first question was: *"Assume that you are the only doctor in a hospital. An ambulance brings in five accident victims who all need to be operated on as soon as possible so that their lives can be saved. The casualties all have the same chances of survival. The only difference between the casualties is age. Please rank the casualties, starting with the patient you would operate on first and ending with the patient you would operate on last"*. The ages were presented in the following order: 15, 70, 1, 30 and 45 years.

In order to determine the value of a life saved at different ages and the value of a year of healthy life lived at different ages a "person trade-off" approach (*17*) was used. The second question involved a binary choice: *"I would like to ask you about different programmes for preventing death at various ages. You probably know that some accidents and diseases mainly affect younger persons and some mainly affect older persons. Assume that a choice has to be made between two equally costly programmes, A and B, that prevent death in different age groups. Which programme would you choose if programme A saves 10 lives of 30-year-olds and programme B saves 10 lives among persons aged 1, 15, 45 or 75 years?"*

After the respondent had chosen a programme, the number of lives in the programme not chosen was increased by ten, a figure selected because it was easy to conceptualize. The process was continued to the point of indifference. Subjects were asked to give reasons for their choices.

The third question was formulated with a view to examining the relative value of one year of healthy life. *"Assume that disease is causing a person to be bed-bound. If the patient is given medication the disease resolves as soon as the medication is administered. On the other hand, if the patient does not obtain the medication he or she will remain bed-bound for a year, after which the disease resolves.*

Table 1. **Demographic details of study subjects**

Variable	*n*
Age	
Young (⩽34 years)	50 (74.6)[a]
Old (⩾35 years)	17 (25.4)
Sex	
Male	33 (50.7)
Female	34 (49.3)
Marital status	
Single	40 (59.7)
Married	27 (40.3)

[a] Figures in parentheses are percentages.

Programme A will cure 30-year-olds. Programme B will cure people aged 1, 15, 45, or 75 years. The two programmes cost the same. Which would you choose if programme A cures ten 30-year-olds and programme B cures ten people aged 1, 15, 45 or 75 years?"

Again, increments of ten patients were used until the point of indifference was reached. The reference point of 30 years was chosen because it was expected that this age would be awarded the greatest value on the basis of two previously reported age-weighting curves (*7*, *15*).

Approval for the study was given by the Medical Research Council of Zimbabwe. The aim of the study was explained to the respondents, who were advised that the information collected would remain confidential and would be used exclusively for the purposes of the study. The respondents were free to refuse participation.

SPSS version 8.0.0. (*18*) was used to analyse the data. A descriptive analysis of the demographic data was conducted. The number of 30-year-olds who would preferentially receive treatment was the reference point in the person trade-off exercises and all results were expressed as the ratio of each value or rank to the value or rank given to a 30-year-old. As the data were not normally distributed, and to counter the effect of outliers, 5% trimmed means were used as a measure of central tendency, i.e. the arithmetic means calculated after the largest 5% and smallest 5% of the cases were eliminated (*18*). This reduced the effective sample size to 61. The final values were obtained by dividing all the mean scores by the largest score in order to obtain values between 0 and 1. In order to allow comparability with other age-weighting functions, the values of all three exercises were inverted so as to award the highest value to the preferred age. Plots of the means and 95% confidence intervals (CIs) were drawn.

The linear interpolation of values allowed the development of a curve against which the GBD curves of the age-weighting function and of the years of life lost attributable to deaths at each age could be compared. Both GBD curves were reduced to values between 0 and 1. As the numbers were relatively small, non-parametric statistics were applied. The Mann–Whitney U test was used to determine whether there was a difference in the rank ordering of the preferences for saving one individual between males and females, between persons aged <35 years and those aged >35 years, and between single and married persons. The 5% level of significance was chosen for the tests.

Results

The distribution of responses to the ranking exercise is indicated in Table 2. There is a clear linear preference for saving the lives of younger people.

The 5% trimmed mean and 95% CIs for each age in the person trade-off exercises are given in Table 3. Since the confidence intervals did not overlap there was a statistically significant difference between the means of the two younger ages and the three older ages for the question on lives saved. For the question on the year of ill-health averted there is a statistically significant difference between the means for 15-year-olds and the three older age groups. In both cases the mean number of 70-year-olds is significantly smaller than the numbers for the other ages. Preference in both exercises was given to 15-year-olds. In the case of lives saved, this was followed by 1-, 30-, 45- and 70-year-olds in that order.

Table 2. **Distribution of rank order assigned by study subjects for casualty patients, according to patient's age group**

	Patient's age				
	1 year	15 years	30 years	45 years	75 years
Rank	Count	Count	Count	Count	Count
1	**48[a] (71.6)[b]**	8 (11.9)	10 (14.9)	–	1 (1.5)
2	0 (0)	**44 (65.7)**	9 (13.4)	7 (10.4)	7 (10.4)
3	10 (14.9)	10 (14.9)	**37 (55.2)**	8 (11.9)	2 (3)
4	8 (11.9)	3 (4.5)	3 (4.5)	**51 (76.1)**	1 (1.5)
5	1 (1.5)	2 (3)	8 (11.9)	1 (1.5)	**56 (83.6)**
Total	67 (100)	67 (100)	67 (100)	67 (100)	67 (100)

[a] Figures in bold are the maximum count.
[b] Figures in parentheses are percentages.

However, the value of averting a year of ill-health was practically equal for the 1-, 30- and 45-year-olds. Fig. 1 plots EYLL at each age on the basis of the life table of Zimbabwean women (*19*) with age-weighting and time-discounting incorporated, plotted against the value of life lost, relative to the largest value. Both curves peak between 10 years and 15 years, but the value attributed to 30-year-olds is less in the Zimbabwe data. In Fig. 2 the value of averting a year of ill-health is plotted against the GBD age-weighting curve (ß = 0.04). The GBD value peaks at about 25 years, whereas the peak indicated by the Zimbabwe data is at 15 years and 30-year-olds are valued less in the present study. The value of life at 70 years is relatively greater in the GBD curve. If a ß value of 0.06 is used the GBD curve approximates to the values of the present study.

There were no statistically significant differences in the ranking of the responses to the first question between male and female respondents, between respondents aged <35 years and those aged >35 years, or between married and unmarried respondents.

Reasons given for choices

It was considered by 62.8% of the subjects that the young should be given first priority in life-saving interventions because old people had lived long enough and should give the young a chance to live into old age. The remaining 37.1% of interviewees considered that 30- and 45-year-olds should receive preferential treatment as they were economically productive and the other age groups were dependent on them.

As far as a year of healthy life saved was concerned, 70.5% said that the economically productive, i.e. the 30- and 45-year-olds, should be given first priority because they had dependants to care for; 18.5% considered that the 15-year-olds should receive priority so as to avoid interruption of their education; 11% said that the young should be given priority because the old had lived long enough.

Discussion

As expected, the EYLL had a major impact on the values given to lives saved at younger ages. The ranking question clearly showed that when the respondents could choose only one person to save, the younger person was given preference. However, when the exercise required more deliberation, the

Table 3. **Descriptive statistics for the replies received to question 2 (person trade-off exercise) relative to the value of one 30-year-old (n = 61)**[a]

	Age				
	1 year	**15 years**	**30 years**	**45 years**	**75 years**
No. individuals saved relative to one 30-year-old					
5% trimmed mean	1.76	2.19	1	0.76	0.33
95% confidence interval	1.43–2.09	1.84–2.54		0.60–0 .92	0.21–0.45
No. individuals spared one year of ill-health relative to one 30-year-old					
5% trimmed mean	0.95	1.67	1	0.97	0.43
95% confidence interval	0.69–1.21	1.34–2.01		0.76–1.19	0.27–0.59

[a] Since 5% trimmed means are used the sample size is decreased from 67 to 61.

Fig. 1. **Relative value of life lost at each age compared to relative expected years of life lost for Zimbabwean women attributable to a death at each age, using the Global Burden of Disease (GBD) age-weighting function and 3% time-discounting rate.** (Note: The ratio of each value to the largest value is depicted in all cases)

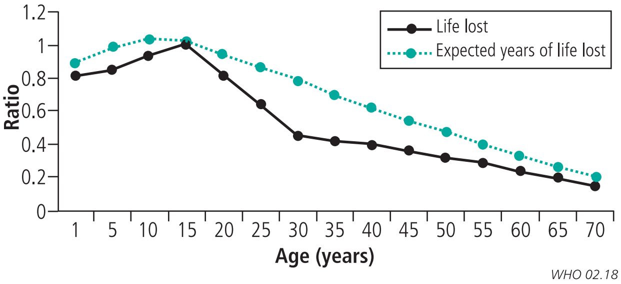
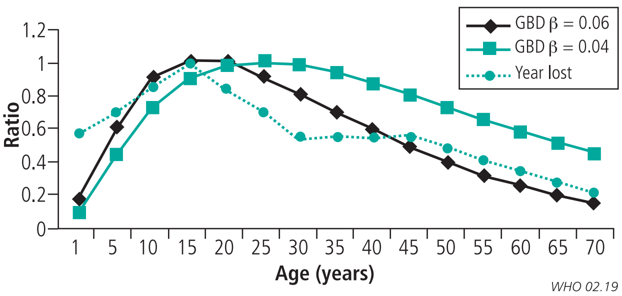


Fig. 2. **Value attached to averting a year of ill health at each age plotted against Global Burden of Disease (GBD) age-weighting function ($Cx\exp[-\beta x]$ with β = 0.04, the standard value used, and β = 0.06 (C = 0.16243 and x is the age).** (Note: The ratio of each value to the largest value is depicted in all cases)



utility of saving the life of a 15-year-old was found to be equal to or greater than that of saving the life of a 1-year-old. An age-weighting preference was also demonstrated in respect of the year of ill-health averted, in that young adults were weighted most highly, whereas the value of a 1-year-old was found to be equivalent to that of people in middle age. In both exercises the age preferences overrode the EYLL component and a linear preference for saving the young over the old was not demonstrated.

Comparable age preferences to those revealed by the present study, peaking at the age of about 15 years and then falling steadily to the lowest utility of life at 70 years, have been reported elsewhere. For example, in the Netherlands, 30 students and 35 elderly people were asked to compare the quality of life of imaginary patients of different ages suffering from end-stage renal failure (*9*). The utility of good health at 10 years of age was valued twice as highly as that at 60 years of age. Both the elderly group and the students valued life at 5 years of age less than at 10 years of age. A study in the United Kingdom reported that over 60% of 721 randomly selected individuals considered that an imaginary 8-year-old with leukaemia should be treated in preference to a 2-year-old (*1*). In Sweden the choices of 780 people indicated that saving 34 persons aged 70 years or five persons aged 50 years was considered equivalent to saving one 30-year-old (*20*). A study on the priority ranking of 12 health services in the United Kingdom by about 2000 respondents produced a similar result (*4*). Treatment for children with life-threatening illnesses was ranked as the first priority and treatment for people aged >75 years with such illnesses was ranked last. Intensive care for premature babies with only a slight chance of survival was ranked tenth. It seems that the age preferences revealed by the present study were consistent with the findings of most other studies and that the awarding of optimal value to those in middle-to-older childhood years is a common finding. However, it has been suggested that 23 years is the optimal age for treatment (*1*), and the productivity profile used by Barnum (*15*) peaks at approximately 30 years.

The age-weighting function (ß = 0.04) used in connection with the DALY (*21*) peaks at about 25 years of age However if a ß = 0.06 is used, the GBD age-weighting curve and the empirical results of the present study are very similar (Fig. 2). The plot of the value of life lost resembles the GBD curve representing the EYLL attributable to deaths at each age, which incorporates a time discount rate of 3% (Fig. 1). In this case the age range that becomes accentuated by weighting is 0–27 years (*13*), the ages valued the most by the high-density community It has been suggested that since age-weighting is controversial and its influence on the ranking of conditions is not very great, it should be excluded from the calculation of DALYs (*13*, *14*). However, it has been pointed out that the incremental effect of age-weighting is more marked in the calculation of disability of short-to-medium duration (*12*). The importance of years of life lived with disability is enhanced for the age group 7–52 years, maximum enhancement occurring at 23 years of age. This effect is important for conditions of short duration that are concentrated in the young adult age groups, e.g. neuropsychiatric conditions. For example, the number of years of life lived with disability because of major depressive episodes in Victoria, Australia, was reported to be 6657 when calculated without age-weighting (*14*). However, the inclusion of the GBD age-weighting factor increased this by about 30% to 8500. The inclusion of age-weighting in the calculation of years of life lived with disability seems to be justified and necessary, particularly if, as in present study the construct valued is not EYLL.

It is apparent that the utility of life is different at different ages. Two conceptual frameworks have been suggested as justifying age-weighting: it can be an indicator of productivity (the human capital approach) or a reflection of social roles at different ages (*7*). The effects of both frameworks were evident in the reasons given for the expressed preferences in our study. However, the importance of education was stressed. It may be that in a developing country, where access to secondary schooling is not universal, the interruption of study is a severe setback to the employment prospects of the individual. It is worth noting that, in 1999, a total of 30% of Zimbabwean primary school pupils did not progress to secondary school (*22*).

As can be expected from a study eliciting preferences from any group of people, there was a large spread of responses. In a previous investigation, outliers or absolute responses were reported that were attributed to either a lack of understanding or the application of a very simple allocation model in which the younger patient always had priority over the older, or vice versa (*9*). The use of the 5% trimmed mean as the measure of central tendency was used to circumvent these problems.

Since universal primary education began in Zimbabwe only in 1980, many older people did not meet the education criterion. Consequently, the sample overrepresented younger, unmarried, and childless respondents. However, there was no difference between the valuations of the different groups. The sample was relatively small and the non-parametric tests possibly lacked adequate power to detect differences between the two groups. Nevertheless, the results of the present investigation were similar to those of several other studies that reported no influence of the age of the respondent on age-weighting (*9*, *20*). This might indicate that the values assigned represented an underlying cultural or social consensus and that the respondents did not focus on personal risk reduction when answering this type of question (*10*).

The number of subjects was limited by the nature of the questions (*9*). A preference is more than a want or a desire, and should be the expression of an act of serious deliberation, in that values are assigned to different outcomes after a sincere attempt is made to weigh and consider alternative courses of action (*2*). The process was time-consuming and reduced the number of subjects who could be interviewed within the time frame of the study.

Conclusion

Although it is useful to have internationally comparable data sets, the calculation of a composite measure such as the DALY incorporates numerous value choices, many of which may not be valid in all the intended contexts of application. It has been argued that DALYs should be developed locally on the basis of judgements and priorities of local communities (*23*). The present GBD age-weighting curve does not exactly represent that of the Highfield community, which showed clear preferences for the age of 15 years. As mentioned earlier, age-weighting is included in the DALY calculation through functions of the form $Cx\exp[-\beta x]$, where C and β are constants equal to 0.1658 and 0.04, respectively, and x is the age of the subject. The use of a ß value of 0.06 in the formula, results in a peak value at about 15 years. Since several other studies reflect a preference for older children, this ß value should be considered. When time-discounting has been factored in, the age-specific life expectancies approximate to the life-saving preferences of the respondents. Zimbabweans show clear age preferences, and as the important issue is not the exact form of an age-weighting function but the presence of non-uniform age weights (*12*), we suggest that the GBD age-weighting factor be used to calculate the burden of disease in Zimbabwe. ■

Acknowledgements

This study was made possible by the Zimbabwe National Burden of Disease Study, funded by the Danish International Development Agency (DANIDA) and the United Kingdom Department for International Development (DFID). We thank Dr Theo Vos and Dr Philip Setel for their comments.

Conflicts of interest: none declared.

Résumé

Préférences accordées par des Zimbabwéens vivant en zone urbaine à la valeur de la santé et de la vie à différents âges

Objectif Déterminer chez des Zimbabwéens vivant en zone urbaine les préférences pondérées en fonction de l'âge au regard des priorités de santé publique.

Méthodes L'étude a été réalisée sur un échantillon de 67 résidents d'un quartier fortement peuplé de Harare choisis par tirage au sort. Il leur a été posé des questions sur la valeur accordée à la vie ou à la santé d'une personne afin de déterminer leurs préférences, exprimées en nombre de personnes de différents âges qui devraient être sauvées de la mort ou d'une année de vie en mauvaise santé par rapport au nombre de personnes de 30 ans qui devraient être préservées des mêmes risques.

Résultats Les réponses indiquent que le fait d'éviter une année de vie en mauvaise santé a la valeur jugée la plus élevée lorsqu'il s'agit de personnes de 15 ans et une valeur égale pour les personnes de 1 an, 30 ans et 45 ans. La valeur accordée au fait d'éviter un décès reflétait principalement le nombre d'années de vie prévues qui seraient perdues, mais l'influence de la pondération en fonction de l'âge ressortait clairement du fait que l'âge de 15 ans était celui pour lequel cette valeur était jugée la plus élevée.

Conclusion Bien que les courbes de pondération en fonction de l'âge ne correspondent pas exactement aux pondérations de la charge mondiale de morbidité, les Zimbabwéens ont montré qu'ils préféraient sauver la vie des jeunes adultes. Les pondérations de la charge mondiale de morbidité en fonction de l'âge devront être utilisées pour déterminer les années de vie ajustées sur l'incapacité (DALY) perdues dans la population du Zimbabwe.

Resumen

Preferencias de los zimbabwenses urbanos por la salud y la vida de personas de distintas edades

Objetivo Determinar las preferencias ponderadas por la edad de los zimbabwenses en relación con las prioridades asistenciales.

Métodos Participaron en el estudio 67 residentes de una zona de alta densidad de Harare elegidos al azar. Se les hicieron preguntas de «equivalencias de personas» para determinar sus preferencias en cuanto al número de individuos de diversas edades a los que salvarían de la muerte o de un año de mala salud en comparación con el número de individuos de 30 años a los que salvarían de esas mismas contingencias.

Resultados Las respuestas muestran que el valor de evitar un año de mala salud es máximo para los jóvenes de 15 años, y similar para las personas de 1, 30 y 45 años. El valor de evitar una muerte se correspondía sobre todo con los años de esperanza de vida perdidos, pero la influencia de la ponderación por la edad se advierte claramente en el dato de que la edad de 15 años fue la más valorada.

Conclusión Aunque las curvas de ponderación por la edad no coincidían exactamente con los pesos atribuidos a las edades en la Carga Mundial de Morbilidad (GBD), los zimbabwenses demostraron un interés preferente por salvar la vida de adultos jóvenes. Se deberían usar los pesos de la GBD para determinar los AVAD (años de vida ajustados en función de la discapacidad) perdidos en la población de Zimbabwe.

References

1. Lewis PA, Charny M. Which of two individuals do you treat when only their ages are different and you can't treat them both? *Journal of Medical Ethics* 1989; 15:28-32.
2. Sutherland H. Assessing patients' preferences. *Medical Decision Making* 1995; 15:286-7.
3. Cohen BJ. Utility measurement and the allocation of health care resources. *Medical Decision Making* 1995;15:287-8.
4. Bowling A. Health care rationing: the public's debate. *BMJ* 1996;312:670-4.
5. Hyder A, Rotlant G, Morrow R. Measuring the burden of disease: healthy life years. *American Journal of Public Health* 1998;88:196-202.
6. Bala MV, Wood LL, Zarkin GA, Norton EC, Gafni A, O'Brien B.Valuing outcomes in health care: a comparison of willingness to pay and quality adjusted life years. *Journal of Clinical Epidemiology* 1998;51:667-76.
7. Murray CJL. Quantifying the burden of disease: the technical basis for disability-adjusted life years. *Bulletin of the World Health Organization* 1994;72:429-45.
8. World Bank. *World development report 1993: Investing in health.* New York: Oxford University Press: 1993.
9. Busschbach JJV, Hessing DJ, de Charro FT. The utility of health at different stages in life: a quantitative approach. *Social Science and Medicine* 1993; 37:153-8.
10. Johannesson M. On the discounting of gained life-years in cost-effectiveness analysis. *International Journal of Technology Assessment in Health Care* 1992;8:359-64.
11. Murray CJL. Rethinking DALYs. In: Murray CJL, Lopez AD, editors. *The global burden of disease* (first edition). Cambridge (MA): Harvard School of Public Health on behalf of WHO and the World Bank;1996. pp.1-89.
12. Murray CL, Lopez AD. The incremental effect of age weighting on YLL, YLD and DALYs: a response. *Bulletin of the World Health Organization* 1996; 74:445-6.
13. Barendregt JJ, Bonneux L, Van der Maas PJ. DALYs: the age weights on balance. *Bulletin of the World Health Organization* 1996;74:439-43.
14. *The Victorian burden of disease study: morbidity.* Melbourne: Public Health and Development Division, Department of Human Services; 1999.
15. Barnum H. Evaluating healthy days of life gained from health projects. *Social Science and Medicine* 1987;24:833-41.
16. Johannesson M, Pliskin JS, Weinstein MC. A note on QALYs, time trade-off and discounting. *Medical Decision Making* 1994;14:188-93.
17. Cropper ML, Adede Sk, Portney PR. Rates of time preference for saving lives. *American Economic Review Papers and Proceedings* 1992;82:469-72.
18. *Statistical package for the social sciences. Release 8.0.0 ed.* Chicago (IL): SPSS Inc; 1997.
19. Zimbabwe National Burden of Disease Steering Committee. *The national burden of disease and cost effectiveness of services in Zimbabwe — 1997. Volume I – Burden of disease* (second draft). Harare: University of Zimbabwe; 1997. Ministry of Health and Child Welfare, Blair Research Institute, 2001 (to be published).
20. Johannesson M, Johansson P-O. Is the valuation of a QALY gained independent of age? Some empirical evidence. *Journal of Health Economics* 1997; 6:589-99.
21. Murray CJL, Lopez AD. Quantifying disability: data, methods and results. *Bulletin of the World Health Organization* 1994;72:481-94.
22. Tandon Y. *Human development report 1999 — Zimbabwe.* Harare: United Nations Development Programme; Poverty Reduction Forum, Institute of Development Studies, University of Zimbabwe; 2000.
23. Barker C, Green A. Opening the debate on DALYS. *Health Policy and Planning* 1996;11:179-83.