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Original Article

Economic Value of Life in Iran: The Human Capital Approach

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Abstract

Background: The human life value is among the most important challenges of the health economic evaluation. This limitation has reduced the feasibility of applying the cost-benefit method in evaluations of health interventions and policies. Using the human capital approach and discounted value of future earnings, the present study calculated the human capital of different age groups.

Methods: The required data were obtained using "income and expenditures of Iranian households" data in 2015 from the Statistical Center of Iran, which included the information on 19380 urban households.

Results: According to the calculation of human capital, the maximum value of a statistical life year in the high-income group was related to the age group of 30-34 yr old (223,286 US$ equals to 9378 million Iranian Rials). The lowest value in all three groups of high, medium and low income is related to the age group of 85 and older. In addition, the economic value of statistical life year for men has been calculated as higher than that of women, however, in older age groups, the human capital of both genders have been converging.

Conclusion: The economic value of life for young people aged between 20 to 30 yr was higher than other demographic groups. The findings of the research help to provide a more accurate base for the cost-benefit analysis of health and social policies. Considering the economic value of the statistical life for different age groups may change policy priorities in areas related to health and life of human beings.

Keywords: Economic value; Statistical life year; Human capital; Cost-benefit analysis; Economic evaluation

Introduction

Among topics related to public policies, the risks associated with human health and safety are followed with more sensitivity. Monetary valuation of different years of human life is one of the most important factors required in the economic evaluation of health policies and interventions. The acceptance of this prevailing perspective that the value of human life cannot be calculated with money will make it impossible to make accurate analyses of the policies affecting the life of individuals. More than four decades have passed since the estimation of the economic value of statistical life year (EVSLY) of humans. This value has been used by researchers in various fields such as life insurance, education, law and health (1). The EVSLY, calculated in a few different

methods attempts to estimate an accurate value of individual productivity. These methods are used as a tool for measuring the social benefits of programs for the prevention or treatment of diseases (2). Calculating the EVSLY in economic texts is not a new concept. This method was adapted for valuing slaves labor force in ancient times (3). In general, there are two main approaches to calculate EVSLY.

In the Human Capital approach, each individual is considered as a stream of production that valued based on their income. The illness and death of the labor force eliminate a valuable economical source because it causes people to lose their time and effectiveness of work and other productive activities (1). In this approach, a discounted expected lifetime earnings are the most important determinant of the EVSLY (4). Using the human capital approach to value human life has first been addressed in the works of Petty and Farr (5, 6). This topic has been studied and developed, theoretically and experimentally, in later studies (7-10). In the human capital approach, the value of each person's life will depend on his potential earnings in the future (11). Usually, in this method, the expected income of individuals transformed into the present value, using the discount rate. A parameter that is very important for implementing the human capital approach is the choice of an appropriate social discount. This rate plays an essential role in converting the non-present earnings into the present value (12). The human capital approach has been criticized for under-estimating the EVSLY. This method valuates the human life with the use of market earnings, thus assign very low values for children and retired elderly individuals (1).

The second approach, known as the willingness to pay (WTP), focuses on lowering the risk of death. In this framework, all that affects people's well-being, such as passive income, risk aversion, the value of the free times and the value of avoiding pain, are taken into account (13, 14). For example, the willingness to pay for a drop of 0.2% in death risk is estimated around 76 US dollars. Based on this, he estimates the value of each person's life by 38,000 US dollars (15). In another study, the value of life and injuries was estimated to pedestrians using a willingness to pay and calculated that the EVSLY is 699,434 euros and the estimated economic value of injuries to pedestrians amounted to approximately 20,077 euros (16). The survey conducted by the Traffic Police Research Center of Iran in 2015 shows that the willingness to pay to prevent death by car crashes has been around 19.7 billion Iranian Rials (518,421 US dollars regarding the official exchange rate). People with more commutation, higher education and higher incomes have expressed a higher willingness to pay (17, 18).

Valuation of life can provide a framework for prioritizing social policy (19), but given the state of the macroeconomic variables in each society (such as per capita income, mortality risk, the social discount rate, etc.), the EVSLY in each country varies, and this value may even vary for a country over time. Regarding this issue, this study attempts to calculate the economic value of statistical life year for Iranian citizens in different age and gender groups. The results of this research can be used in future studies that try to analyze the cost-benefit of health interventions and policies.

Materials and Methods

Data

In this study, information needed for research calculations has been extracted from income and expenditure survey of Iranian households in 2015, carried out by distributing the questionnaire among 19830 urban households. The information used is related to the income of individuals after-tax and includes all forms of income (such as the wage and all non-labor related earnings, it will be a good source of human capital calculation. The value of housekeeping services and non-market activities of individuals that are not calculated in gross domestic product (GDP), were not considered in this study, too.

Methods

The current research applied a human capital approach to calculate the EVSLY. In this method, individuals' lifetime income takes into account as a proxy of human capital (20, 21). However, checking the income of community members over time is very time-consuming and costly. Therefore, in this study, households were classified according to the age of the head of household in the age groups categorized from 20 to over 85 years. Then, mean annual income for each age group has been calculated based on raw data. Therefore, the human capital of an individual is equal to the total income that a person earns or will earn during his or her life (22, 23). However, the economic values related to different periods cannot be combined easily. These incomes will be earned at different periods. The present value of these earnings must first be calculated and then are aggregated (24). To calculate the present value of revenues, the discounted cash flow method is used as follows:

$$DIF = \frac{IF_1}{(1+r)^1} + \frac{IF_2}{(1+r)^2} + \cdots + \frac{IF_n}{(1+r)^n}$$

In this formula, *DIF* is the discounted present value of the income of individuals at different periods, IF_1 is the nominal income of individuals in the first period and *r* is the discount rate. To calculate human capital, it is necessary to consider the appropriate discount rate for calculating the present value of the incomes. Theoretically, this rate reflects the opportunity cost of assets and represents the various risks of investments. Choosing an appropriate discount rate entails proposing the question of how much is the average return rate on assets in the economy. The social discount rate for Iran's economy is estimated at 7.2% using real per capita consumption growth rate, the elasticity of marginal utility of consumption and mortality related discount rate (25). Another research incorporated the social rate of time preference and calculated the social discount rate for Iran at 5.12 (26). The present study, based on the recentness of later study, has used the social discount rate of 5.12 in the calculation. In addition, given that the data reported by the Iranian Statistics Center were in the form of national currency, for converting figures into US dollars, the official exchange rate of the Central Bank of Iran has been used at a rate of $ 1 per 38,000 Rials.

Results

Along with age grouping, income and gender grouping was performed, and the EVSLY was calculated based on income and gender. All cases have been categorized into three groups as high incomes (three highest income deciles), middle income (four middle-income deciles) and low income (three lowest income deciles). In addition, the average income of each age group was calculated separately for males and females.

Human capital calculation of different age groups shows that in all income groups, the higher human capital was related to young and middle age groups (Table 1). The high social discount rate in the calculations (due to the characteristics of the Iran's economy), current years' earnings for each age group has a high weight in the human capital of that group. Thus, human capital decreased with age in all categories. In other words, the high discount rate will result in a drastic devaluation of the earnings of the past or future periods.

Calculation of the human capital for different income groups shows that the difference in this value in the young and middle age has been at its highest amount, and in older age groups, the gap between the income groups decreased gradually. Moreover, the comparison of EVSLY for three income groups shows that there is a significant difference between the high-income group and the other two groups.

The EVSLY of a person in the age group of 20-24 yr was 2341 million Iranian Rials (61,605 US$) and 4650 (122,368 US$) million Iranian Rials for the low-income group and the middle-income group respectively. However, this person's EVSLY in the high-income group estimated around 9201 million Iranian Rials (242,131 US$).

Table 1: The value of statistical life year of different age groups (million Iranian Rials)

Age group(yr)		*Gender*		*Income group*		
		Male	*Female*	*Low*	*Middle*	*High*
1	20-24	4,847	3,671	2,341	4,650	9,201
2	25-29	5,155	3,502	2,332	4,627	9,348
3	30-34	5,446	3,718	2,313	4,595	9,378
4	35-39	5,606	3,766	2,311	4,608	9,326
5	40-44	5,694	3,839	2,240	4,500	9,085
6	45-49	5,630	3,803	2,190	4,430	8,963
7	50-54	5,372	3,536	2,136	4,340	8,794
8	55-59	4,958	3,243	2,071	4,226	8,553
9	60-64	4,546	2,860	1,984	4,079	8,276
10	65-69	4,110	2,580	1,885	3,891	7,924
11	70-74	3,604	2,262	1,760	3,649	7,502
12	75-79	3,019	1,991	1,599	3,342	6,792
13	80-84	2,406	1,686	1,401	2,948	5,934
14	>85	839	548	891	1,898	3,751

In other words, the gap between the value of statistical life year among the high-income group and the other two groups is significant (Fig. 1).

The value of the human capital of different age groups has been calculated for both genders, separately. In all age groups, the human capital of men was higher than women. This gap has gradually diminished, and in older age groups, women's and men's EVSLY become almost equal (Fig. 2).

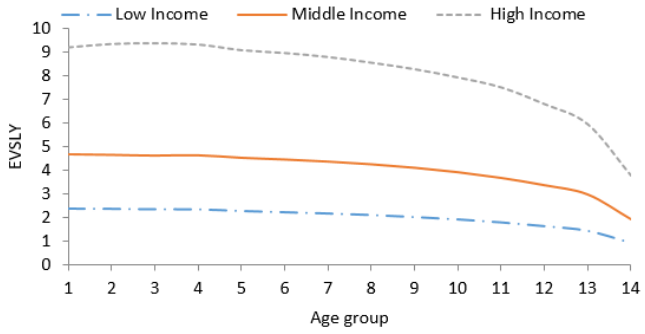

Fig. 1: The value of statistical life year of 14 age groups based on income group (billion Iranian Rials)

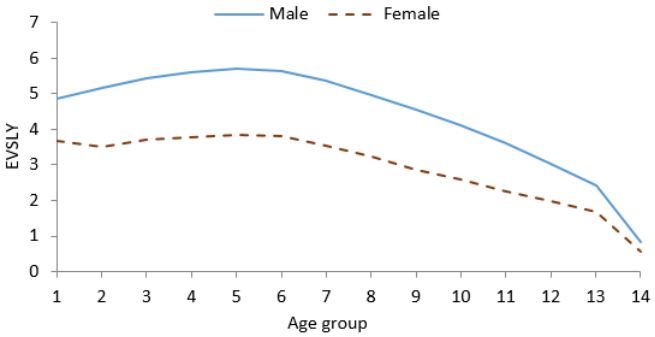

Fig. 2: The value of statistical life year of 14 age groups based on gender (billion Iranian Rials)

Discussion

Our results showed that in the different income groups, at the young and middle ages, in which people have a higher capacity of economic activity, the economic value of statistical life year is higher than the last years of life. A lower life expectancy at older ages and the fall of expected incomes for these groups is the main reason for this decline. As a second reason, we can mention the reduction of income levels in older age groups in comparison to the middle and young ages. Therefore, the two variables of reduction in the average income and a reduction in the remaining years of life have resulted in a reduction in human capital and the EVSLY in older age groups. This finding is consistent with the studies previously carried out (1, 4, 27).

The EVSLY has also varied among different income groups. This issue has been normal and predictable, since the criterion for calculating this value was the people's lifetime income. What is remarkable is the significant gap between the values of statistical life year of the high-income group with the other two groups.

Calculating human capital for gender groups also shows that the EVSLY for men was higher than that of women, but with the increase of age and in elderly ages, the calculated value for the two groups has had a high convergence. Previous studies calculated the EVSLY by gender have also reported similar differences (1, 11). The ingredients for calculating this research was income and some of the non-market activities of women (such as home-based activities) are not considered in calculations (28, 29). Therefore, the difference obtained here is due to the lower market income of women than men in society, and the consideration of non-market income (production) can completely change the calculations.

The results can be used in two different aspects for policy-making. The first aspect is related to quantify the resources of the benefits of many social policies (including health policies), the cost of diseases and social problems (such as tobacco use or environmental pollution) and intervention decisions. The cost of policies (stated as financial and budget costs) is often observable and tangible to decision-makers; but the social benefits of policies, especially in areas related to the health and life of humans, are very ambiguous and challenging. For example, how can one decide whether an allocation of 100,000 US dollars to prevent AIDS in schools is an economically efficient decision? Or implanting a 130,000 US dollars' worth artificial heart for a young 18-year-old person can have rational (not moral) justification? Therefore, the present findings can, to a certain extent, facilitate the answer to the above questions at least in from the economic point of view.

The second aspect, which happens to be much more important than the first aspect, is related to the comparison and selection of different policies with varying costs and benefits. If two policies with different costs have positive or negative effects on the health or life expectancy of different population groups, by using the results obtained in the present study, these effects can be converted into quantitative and measurable amounts. Comparing these effects with the costs of the respective policies will help the policy makers to choose the best policy. For example, the government intends to allocate subsidies of a specified amount to one of two policies, "installing the filter in the exhaust system of cars" or "Installing airbag in a car". The benefits of the first policy mainly include elderly and infants (30, 31) and the benefits of the second policy, mainly intends to cover young people and middle-aged people (32, 33). If both policies lead to save of the life of 1000 people per year, which policy will have benefits that are more social? Certainly, these questions cannot be answered, from an ethical point of view, since resource constraints make policy-makers to choose one of them. Therefore, there is not an alternative other than prioritizing the lives of different groups. However, choosing the second policy can also be considered socially as a moral policy, since choosing this policy is cost-effective, and society will gain more benefit from the second choice.

Although this study provides quantitative figures for the value of human life in the socioeconomic environment of Iran, some criticisms also can be

applied to this approach. One of the most important of these criticisms is that it calculates the value of life like a financial asset. In addition, this approach has a very low value for the lives of children and elderly people due to their lower productivity.

Conclusion

This study provides researchers and policymakers with information to achieve a comprehensive understanding of the effects and economic consequences and opportunity to choose the best among different policies. The approach of human capital in calculating the EVSLY of different ages helps to put programs and policies at the top of the agenda, in which society obtains the most benefit from them. The mere economic evaluation should not be considered as a conclusive criterion for decision making; because this approach has a purely economic look to human life. However, the use of accurate economic analysis can be an undeniable basis for optimal resource allocation, especially in the health sector, and this study can be considered a step to this direction.

Ethical considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

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Conflict of interest

The authors declare that there is no conflict of interest.

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