

The effect of income distribution on life expectancy and under-5 mortality rate in Iran

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Abstract

Health is one of the most important factors affecting human ability and functions and accordingly has the key role in determination of human capital quality through manufacturing processes. During the past decades, many studies have been done to identify the various factors affecting human health. The aim of this study is to investigate the effect of income distribution on life expectancy and under-5 mortality rate during 1976-2007 in Iran. For this purpose Johansen- Juselius co-integration approach has been used.

Empirical results show that, there is a long-run convergent relationship between above-mentioned variables. Furthermore, results revealed that income inequality has negative effect on health indicators. Therefore, it could be argued that improvement in income distribution can lead to higher standards of health in Iran.

Keywords: Distribution, Life Expectancy, Mortality, Income

Introduction

The concept of health has been of high importance in all eras due to its direct effects on the function of body, mind and even life expectancy and death of human beings. This has prompted efforts to identify threats to health. The result of these efforts has been the identification of many factors detrimental to human beings' health, however, over the previous centuries, those factors have continuously changed from one form to another, thus posing new challenges to humans and researchers [1]. During the last decades, researchers have referred to the impact of socio-economic status (SES) on people's health [2,3,4,5]. The researchers have described

SES as the most important factor determining health disparities between individuals. Then a number of studies have been conducted on this issue in the past 30 years. The studies show us that in addition to the socio-economic status such as income, education, better jobs, etc., socio-economic inequalities have a crucial role in determining the levels of health in any society [6,7]. Some of these studies have even regarded the role of socio-economic inequalities as more important than that of absolute income [8]. The outcome of the reports has initiated a broad range of follow-up studies aimed at assessing the veracity of the new hypothesis.

Since public health and reduction of economic inequalities have always been a concern among policy-makers and a main objective of all development programs in Iran, knowledge on the relationship between the two concepts can undoubtedly affect the adoption of effective policies in line with those objectives. Meanwhile, absence of deep research on the issue in our country is another reason for necessity and importance of conducting the present study. Given the lack of studies on the relationship between health and socio-economic inequalities in Iran, the present research intends to assess the issue in the country. For this purpose this article aimed at evaluating the impact of distribution of income (income inequalities) as one of the most important indices for socio-economic inequality on determining the level of health in Iran.

Until this day, Researchers have recognized various mechanisms through which socio-economic inequalities affects health levels of people. For example, Segall and Chapel believe that the factors affecting SES can change health levels of people directly or indirectly. They mention cultural and material factors as direct factors and psychological factors and lifestyles as indirect ones. In their view, educated people may have better jobs and those with a better economic status have better chances of buying such goods like a house and enjoying better nutrition and healthcare (direct effect). In contrast, lower socioeconomic status by affecting the psychosocial variable and improper lifestyles, results in chronic stresses, lack of skillfulness, vanity, and unfavorable health behaviors (such as smoking, improper nutrition, alcohol abuse, insufficient physical activity and etc) [9].

Kravdal believes that in societies with high income inequalities, many people feel poor relative to others which may produce a psychological stress that affects their health. He further describes the unequal opportunities and lifestyles caused by income inequalities as one of the key factors undermining social cohesion, which can affect health indices and mortality rates in any society. Kravdal underlines that

social disintegration leads to a decrease in public trust and to risky health behaviors.

As a third way, income inequality affecting health, he refers to underprivileged people's demands that want more public investments in the healthcare sector. Kravdal believes that adopting a policy of increasing public investments by the government in a society confronted with well-off people's desires who want to pay less tax. He concludes that although policies are chosen by the ruling parties, but when socio-economic disparities are high enough result in more conflicts, the policies move towards allocating less public funds to the healthcare sector. Consequently, this will affect the health of both lower and higher income groups of people in that society [8].

Huijts et al. consider stress and unhealthy behaviors as the key factors through which people's unequal socio-economic status (e.g. income inequalities) can affect aggregate society's health levels [10]. Marmot & Wilkinson believe that more socio-economic inequalities in the US in comparison with Costa Rica are the reason why African-Americans have lower life expectancy than Costa Rican men despite the fact that per capita income in the United States is four times as much as that in the Costa Rica. They also refer to the same but a deeper gap between the US and Greece; where psychological variables influencing health as a result of socio-economic inequalities, are the reason for longer life expectancy in Greece, while Americans have a per capita income double as much as that of the Greeks [11]. Marmot underscores the crucial role of stress in a society where socioeconomic inequalities exist and believes that a rise in stress as a result of a decrease in people's control over their lives and jobs and feeling being disrespected in the society in unequal socio-economic opportunities and conditions lead to numerous health problems in a society [2].

In sum, we can say that social status and the quality of social environment have long been recognized as factors which affect people's health levels [3,4]. Recent studies

and empirical evidence have, however, shown that societies suffering from socioeconomic inequalities will not only face more problems relating to lower social status, but also erosion of social cohesion and social nets. The erosion will increase tensions, and decrease confidence and social capital in the societies [12,13]. Moreover, other studies indicate that numerous psychological factors relating to low social

status can indirectly affect health via chronic stress or directly through unhealthy behaviors [10,14]. For example, Charles Worth *et al.* believe that having a low social status breed stress because it causes feelings of baseness and being less valued and respected among people [14] Wilkinson and Gilligan believe that such feelings are the most important cause of social tension and stress [12,15].

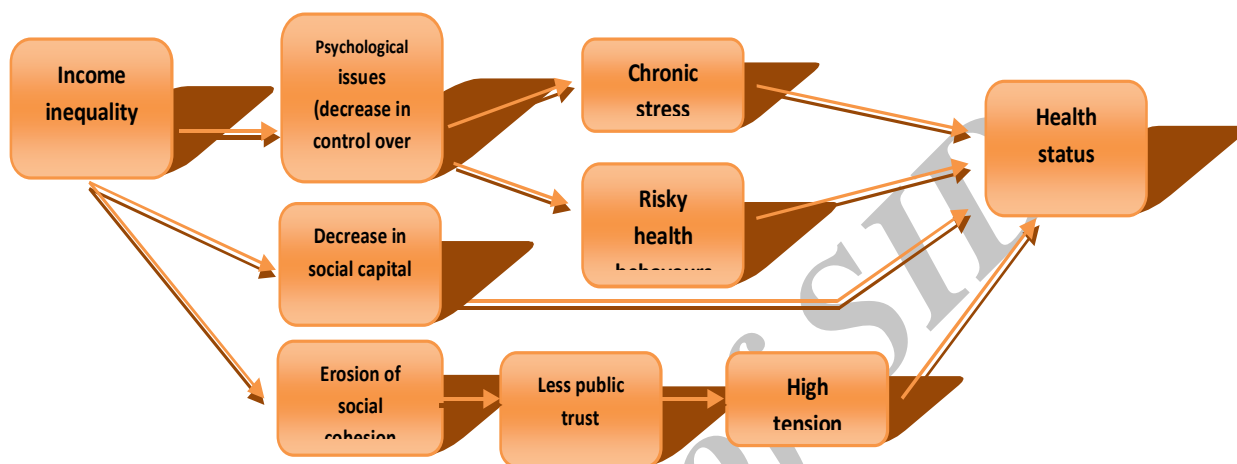


Chart1 Channels through which income inequality affects health status in a society

As shown in figure 1, income inequality in a society can affect people's health via different channels and mechanisms. Accordingly, the inequalities do not exclusively affect people in the lower-class and with lower incomes but indeed they impact the health of all people including those with high incomes and hence decrease the average health status in the society.

Method

This applied study used library sources and the time series data of the variables related to socioeconomic status and two health indices of life expectancy and under-5 mortality rate in Iran between 1976 and 2007. Furthermore, analytical-descriptive method was used for analysis. The study also employed a combination of regression, estimation and interpretation of related coefficients with appropriate statistical methods to assess the significance and severity of the impact of income inequality (as independent variable) on health indices.

Therefore, in the first step, model of the study

introduced and then the operational definition of variables of the model is outlined. Then, we refer to the statistical technique of estimating the regressive model and then we address the expected sign of the theory for each variable that enters the model. It should be noted that the study used version 6 of Eviews software program so that the authors can make all the calculations and have access to all needed tests for the purpose of implementing necessary statistical procedures (Johansen-Juselius Co-integration technique).The model which is used to investigating the relationship between income inequality and health indicators specified as:

$$\text{Log}(H_i) = \beta_0 + \beta_1 \text{Log}(ieq_i) + \beta_2 \log(pci_i) + \beta_3 \text{Durban}_i + \varepsilon_i [1]$$

That model is taken from flegg [16] and Mellor & Milyo, Waldman [17,18] models and the "Log" is indicating the logarithmic form of the variables that have been considered in the above model as follows:

H_i : The health levels of people in a given society, which are assessed in this study

using two indicators namely under-5 mortality rate in each 1000 live births (H1mort) and life expectancy at birth (H2expect).

ieq_t: Income inequality, which is measured using the most important and popular existing index, that's Gini coefficient.

pci_t: per capita income is based on fixed prices of 2007 and is attained by dividing the GDP of the year by the population of that year.

Durban_t: The variable pertaining to changes in the percentage of urban population in Iran each year, which has been inserted into the model to better explanation of health fluctuations.

For the above variables, the data pertaining to health were taken from Iran Statistical Center Database [19] and those of per capita income and Gini coefficient as well as urban population are from Central Bank's Time Series Database [20]. Meanwhile, as existing studies show, one of the advantages of the linear-logarithmic model is that it considers the concave relationship between absolute income and health indices more properly. Under this circumstance, the condition is better met for the assessing 'diminishing individual's health returns to increasing individual's income' hypothesis which has been emphasized by many previous studies. In statistical calculations, for meaningful understanding of the relationship between two or more variables using the regression technique, the time series need to satisfy some stationary properties. Therefore the variables in any economic model are required to be tested and while one or more variables couldn't fulfill the stationary requirement (called has unit root), using some techniques like Ordinary Least Squares (OLS) method in estimating coefficients provides misleading implication and result in spurious relationships. Hence, it is important that we carefully consider the existence or non-existence of unit root as an empirical reality. If there is unit root in the time series of model, we should consider co-integration techniques. To test for stationary, the present study used the Augmented Dickey-Fuller (ADF) and Philips-Perron (PP) as the most common methods of time series' stationary tests.

While there is a non-stationary variable(s)

among the variables of the model, if we can find a linear composition between them that be stationary, the variables will be called co-integrated and one can say that there is a long-term relationship between them that prevents the variables from divergence form one another in the long-run.

In other words, they pursue each other over time. The current study uses the Johansen-Juselius technique to test existence of co-integration between the variables based on the Vector Auto Regressive (VAR) model given the fact that the one or more variables have been proved to have a common root. The advantage of the Johansen- Juselius co-integration technique to other methods is that it considers more than one vector of co-integration between the variables of the model and in the event of using the method, estimators will be consistent [21].

About the expected signs of the coefficients in the model, according to the literature, it is expected that an increase in income inequalities in Iran, would have a negative impact on health indices.

It is also expected that the sign of per capita income be also in the same direction as health indices and would have a positive impact on them. About urbanization it should be noted that there exists Different views on how the percentage of urban living affects people's quality of life and health and in general there is no any consensus in this respect. In fact, one can say that finding out the way urban living affects health index in Iran is a minor goal of the present study and the findings of the research can clarify the fact.

Results

As we said in the previous section, inference about the stationary properties of the variables is carried out by ADF and PP tests. The results are shown in Table 1.

As Table 1 shows, the result of ADF and PP tests show that all the variables are non-stationary and have a unit root at the 5 percent level. Based on results, all variables became stationary after 1 St differentiating.

Table 1 Augmented Dickey-Fuller and Philips-Perron stationary tests for the model's variables

Variable	ADF Test probability		PP test probability	
	In level with trend and intercept	1 St difference with intercept	In level with trend and intercept	1 St difference with intercept
Log (H1mort)	0.722	<0.001	0.134	<0.001
Log (H2expect)	0.945	<0.001	0.947	<0.001
Log (Ieq)	0.08	<0.001	0.069	<0.001
Log (pci)	0.653	<0.001	0.639	0.001
Durban	0.475	0.002	0.422	0.002

In other words, all the variables of the study are integrated-1 from the statistical stationary viewpoint. Since the present study uses two indices to assess the health of people in the society, it will have two different models; in both of them the right-side variables (explanatory variables) are identical. However, the dependent variable in the first model is the log of under-5 mortality rate in each 1000 live births and in the second model it is the log of life expectancy at birth. Each model will be estimated and discussed separately. The first step in carrying

out the co-integration approach in Johansen is to determine the optimal lag length for each model. We have used the Schwartz- Bayesian criterion in selecting optimal lag length in models because it delivers the minimum optimal length needed. In order to summarize the discussion, the results of our work to determine the optimal lag length in each model come as following Table.

As Table 2 shows, the number of optimal lags for the first model is two and for the second model is one. In the next step, the number of co-

Table 2 The number of optimal lags for first and second models of our study

Model/ Number of lags	Number of Optimum lag(s)	Schwartz- Bayesian Statistic
First Model of Research	2	-9.42
Second Model of Research	1	-15.33

integration vectors between the variables in each model regarding its optimal lag length has been decided by using trace and maximum Eigen value tests.

The brief results have been shown in the following Table.

As shown in Table 3, the existence of a vector for the first model of the study is confirmed by

Table 3 The results of the trace and maximum Eigen value tests for the first and second models of the study

Model/Test	Matrix Trace	Maximum Eigen value Max	Result
First Model of Research	One vector at 5% level	One vector at 5% level	One vector confirmed
Second Model of Research	Two vector at 5% level	One vector at 5% level	One vector confirmed

both tests. Meanwhile, for the second model, given the accuracy of maximum Eigen value test against the trace test, we accept the one co-integration vector for this model too. The next stage is to establish co-integration relationship between model variables. Accordingly the

results of the estimation are as follows. (The figures in the parentheses show the standard deviation of the coefficients).

Considering the results of the first model, we can say that income inequality has a meaningful positive effect on the mortality

Table 4 co-integration vector estimation results for the first and second models

Dependent var.	Intercept	Independent variables (estimated coefficients)		
		Log(ieq)	Log(pci)	Durban
Log(h1mort)	-	1.26 (0.05)	-0.65 (0.09)	0.25 (0.23)
Log(h2expect)	5.49	-0.4 (0.11)	0.022 (0.015)	0.09 (0.024)

rate of children under 5 in Iran. In other words, a rise in the income inequality index in a society, by increasing the mortality rate of children under 5, adversely affects health levels. Meanwhile, the log of the per capita income has a negative and meaningful impact on the log of under-5 mortality rate. Thus, to this result, we can confirm the concave relationship between the per capita income and health levels of people and the performance of the absolute income theory in Iran. Moreover, a look at the estimated coefficient sign for the variable of changes in the percentage of urban population will enable us to conclude that the variable works in line with increase in the child mortality rate, and a decline in health levels. However, the coefficient lacks the statistical significance. Given the results of the estimation of the second model, we can state that income inequality has the expected meaningful impact on health levels of people in the society. In other words, as we expected, a rise in income inequality resulted in a decrease in life expectancy. The estimated sign of the per capita income coefficient is completely compatible with the theoretical basis of the study. The linear-logarithmic relationship between the two concepts shows that more and more increases in

the per capita income of people have less and less of an effect on their health levels, which again confirms the absolute income theory. Although, it seems that the coefficient of that variable of the model lacks the statistical meaningfulness.

Also, the results indicate that unlike the first model, the coefficient of the changes in the percentage of urban population has a positive and meaningful impact on the index of life expectancy. In other words, given the bi-directional effect for the changes in urbanization, we can to some extent refer to the different performance of the variable with regard to health indices in Iran. We will discuss the matter in detail in the next section. Prerequisite for the meaningfulness of derived co-integration vectors in the models is that error correction term's coefficient must be between 0 and -1 and it shows the speed at which dependent variable moves to its long-run equilibrium after a change in independent variable.

The results from the Vector Error Correction Model (VECM) for both models are shown in the following Table.

With regard to the results of VECM model, we can say that the speed of internal correction

Table 5 Results from the Vector Error Correction Model (VECM) for first and second models

	variable	Coefficient	(SD)	t-student statistics
First model	ECM(-1)	13/0-	10/0	-1/38
Second model	ECM(-1)	11/0-	04/0	-2/48

towards the long-run equilibrium in the first model is 0.13 and for the second model is 0.11. These values indicate a relatively low speed of balancing towards the long-term equilibrium. This can be more or less justified regarding the nature of the dependent variable of the model; health.

Discussion

The results of the Johansen-Juselius co-integration approach show that there is a long-run co-integration vector between the health indices, income inequality index and the per capita income of people along with urbanization in Iran. However, the coefficient of income inequality (Gini coefficient) is meaningful in

both models and has the expected sign of the theory². The present study's findings indicate that the most famous and important index of income inequality, that is, Gini coefficient, has had a meaningful adverse impacts on health indicators in Iran. In other words, a rise in income inequality worsened the health indices between the years 1976-2007. The other result from the estimation of models was that both the indices of health had a meaningful, logarithmic relationship with the per capita income. In other words, the fact that the logarithmic relationship was meaningful indicated a non-linear link between income and health indices. This means that more

and more increases in the absolute income of individuals leads to less and less improvement in health levels among them. The results are not worth comparison. This is because there are no domestic equivalent studies that have been used a regressive relationship and an estimation of relevant coefficients for the severity of income inequality's effects on health variables. Nevertheless, among domestic researchers, Babakhani [22] has referred to a simple bilateral correlation between income inequality's variables and health indices. In his study, Hedayat Shoushtari [23] puts emphasis on the significant role of the household's socio-economic status in affecting the under 5 mortality rate in the city of Shoushtar. The results of the present study are in line with the results of the above mentioned researches. As for the non-linear relationship between absolute income and health indices and confirmation of income inequality's effectiveness on health indices among foreign studies, we can refer to Hongbin-Li [24]. Their study was conducted on 7,300 people on an observatory basis in China. The other research was conducted by Babones who has shown the relationships for 134 world countries between 1970 and 1995. Carlson et al [7] verified the relationships in their observations of 21,000 people in 21 countries. The results of the present study for Iran are compatible with the findings of the above researchers, though there are others studies by Judge et al [5], Gravelle et al [25] and Deaton [26] which have verified the relationship between absolute income and health indices, but they have failed to detect a meaningful link between the variables of income inequality and health indicators in their studies. As for the effect of changes in percentage of urban population, the results of the models indicated different directions; in a way that positive change in the percentage of urban population raised life expectancy whereas they also increase the mortality rate of children under 5 in Iran. Perhaps, a look at the cause of under5 mortality rate in Iran can justify the bi-directional impact of the variable. In the World Health Organization's view about

the causes of mortality [27], it is showed that infectious diseases like malaria, pox and contagious infections have a very small share in the mortality rate of children under 5 in Iran. This is while nearly half of the causes of mortalities among the children are related to premature births and congenital deficiencies. It seems that the above factors stem from living in urban regions and pollutions in those areas. Regarding the positive effect of this variable on life expectancy at birth, we can say that immigration from rural areas to cities has always been associated with a rise in the number of opportunities and facilities in urban regions or access to good jobs and brings a sense of well-being in the long run. This can lead to a positive effect on the variable of life expectancy at birth in Iran. Although the results reported by the present study are based on using credible and official statistics and data from Iran's statistical sources, one of the main drawbacks to the study is confusion, ambiguity and incompatibility between the obtained data from these sources. Moreover, the absence of a single reference for the health data in Iran and even the existence of conflicting reports from a statistical center have doubled the ambiguity. This has cast doubts on the authenticity of the statistical sources, which is regarded as the basis of any scientific study. Another drawback of the study is the lack of access to some detailed data and complementary variables that would have an effect on health standards in the society such as accurate data about the age of the population throughout the years under study or separated data in urban and rural areas. It should be noted that addressing the relationships between the key indicators of health and income inequality at a macro level and in the long run across the nation and controlling for more variables compared to other similar domestic researches and aiming at achieving more decisive results are among advantages of the current study. The results are worth being paid attention by economic and health policy-makers of Iran and can be helpful in devising long-term developmental

plans. Meanwhile, the existence of such issues as incompatibility between individual studies and observations and nationwide macro-level studies as well as failure to use individual observations on a large scale across the country, which stem from lack of access to the relevant data, can be described as another weakness of the present study. However, it is hoped that in the future studies and with improvements in the structure of data gathering, these weaknesses could be handled.

Conclusion

Generally speaking, the results of the models in this research indicate the significance of the role of both variables of per capita income and income inequalities in affecting health indices in Iran. It even seems that after controlling for absolute income, the income inequality variable is still meaningful. One of the main reasons reported in foreign studies for the significant effect of income inequality on health status after controlling other factors is a change in nature of diseases; from epidemiological (infectious) to non-contagious illnesses like cancers and cardio-vascular diseases [7,28]. Thus, it seems that the results of the present study is compatible with the findings of domestic researches³, showing a change in pattern of diseases in Iran toward non-infectious ones [29]. Moreover, our study confirms the results of most foreign researches that have been able to prove the meaningful effect of income inequality on health status among other nations.

Based on the most important result of the present study that is the significance of the income inequality in explaining health levels of people in the long run, hence, we offer the following policy recommendations:

A- We recommend that authorities pay special attention to re-distribution of income in Iran and make the current re-distribution process more efficient. Since it's been proved by our study that absolute income plays a role in determining the health levels of people in Iran, too, we recommend that policy-makers have to match economic growth policies and improving the distribution of income through

re-distribution tools simultaneously for the better outcome for health in the society.

B- Considering the contradictions between health statistical references and sources in Iran and existence of conflicting data on different health indices, we recommend that officials form a single authority for the statistics and figures be responsible for, and take actions to consolidate all previous data and information.

1- According to the absolute income hypothesis, Income is one of the most important determinants of health and people with high absolute income, live longer and enjoys better physical and mental health.

2- It should be noted that similar results have been obtained while using the ratio of 10% expenditure share of the wealthiest people to 10% expenditure share of the poorest as an index for income inequality in the model.

3- For example, Amani (2009) concluded in his study on the process of changes in mortality rates between 1971 and 2007 that in recent years the share of deaths as a result of infectious, parasitological, renal, urinal and respiratory diseases has been shifted to disorders in the blood circulation system and blood pressure such as cardio-vascular diseases and heart attacks.

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Contributions

Study design: MaM, HA

Data collection and analysis: HA, SJ

Manuscript preparation: SJ, ShS

Conflict of interest

"The authors declare that they have no competing interests."

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