

Economic Inequality in Visual Impairment: A Study in Deprived Rural Population of Iran

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Abstract

Purpose: To determine economic inequality in visual impairment (VI) and its determinants in the rural population of Iran.

Methods: In this population-based, cross-sectional study, 3850 individuals, aged 3–93 years were selected from the north and southwest regions of Iran using multi-staged stratified cluster random sampling. The outcome was VI, measured in 20 feet. Economic status was constructed using principal component analysis on home assets. The concentration index (C) was used to determine inequality, and the gap between low and high economic groups was decomposed to explained and unexplained portions using the Oaxaca–Blinder decomposition method.

Results: Of the 3850 individuals that were invited, 3314 participated in the study. The data of 3095 participants were finally analyzed. The C was -0.248 (95% confidence interval [CI]: $-0.347 - -0.148$), indicating a pro-poor inequality (concentration of VI in low economic group). The prevalence (95% CI) of VI was 1.72% (0.92–2.52) in the high economic group and 10.66% (8.84–12.48) in the low economic group with a gap of 8.94% (6.95–10.93) between the two groups. The explained and unexplained portions comprised 67.22% and 32.77% of the gap, respectively. Among the study variables, age (13.98%) and economic status (80.70%) were significant determinants of inequality in the explained portion. The variables of education (coefficient: -4.41 ; $P < 0.001$), age (coefficient: 14.09; $P < 0.001$), living place (coefficient: 6.96; $P: 0.006$), and economic status (coefficient: -7.37 ; $P < 0.001$) had significant effects on inequality in the unexplained portion.

Conclusions: The result showed that VI had a higher concentration in the low economic group, and the major contributor of this inequality was economic status. Therefore, policymakers should formulate appropriate interventions to improve the economic status and alleviate economic inequality.

Keywords: Economic factors, Economic inequality, Iran, Visual impairment

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INTRODUCTION

Visual impairment (VI) is a public health problem, affecting a relatively large percentage of people. Estimates indicate that 43.2 million people are blind, 295.3 million have moderate-to-severe VI, 257.3 million have mild VI, and, in general, 1.1 billion people live with vision loss in 2020.¹ This is while studies suggest an increasing trend in the prevalence

of VI,^{1,2} indicating that the number of blind people, individuals with moderate-to-severe VI, subjects with mild VI, and total people with vision loss will increase to 60.2 million, 473.6 million, 360.1 million, and 1.7 billion, respectively, in 2050.¹ Population growth and the proportion of the aged population underline the importance of VI increasing trend. Global estimates suggest that the costs of VI will increase from \$3 trillion in 2010 to \$3.6 trillion in 2020.³

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The prevalence of VI differs in various populations, and several factors such as age distribution,⁴ sex,⁵ economic status, and living place⁶ markedly contribute to this inequality. However, it should be noted that the importance of VI lies in its consequences such as decreased educational–economic opportunities⁷ and quality of life.⁸ Although different causes have been reported for VI, refractive errors, cataracts, and age-related macular degeneration are the three leading causes of VI.²

Due to the importance of VI, several efforts have been made to eliminate avoidable blindness by 2020 under a global initiative entitled “Vision 2020: The right to sight.”²³ Accordingly, different studies investigated the factors affecting VI.^{2,8-12} The results of these studies indicate an inequality in the prevalence of VI such that most VI cases occur in less developed countries.^{2,3} In other words, there is a marked economic inequality in the prevalence of VI in the world. Hence, several studies investigated economic inequality in VI and its determinants,¹³⁻¹⁷ which provided health policymakers and stakeholders with valuable information in this regard. However, inequality in VI was only addressed in few studies in Iran,^{9,15,18} indicating a lack of sufficient evidence in this regard. Our extensive search showed no information about economic inequality in VI in the Iranian rural population, while economic inequality is more prominent in the rural population.^{19,20} Lack of evidence on the one hand and the need for information for health planning in underserved areas on the other hand encouraged us to conduct a study to investigate economic inequality in VI in the rural population of Iran and its determinants using the Oaxaca–Blinder decomposition method.

METHODS

This retrospective study was conducted on the data of a cross-sectional study performed in 2015. The methodological and sampling details of the present study have already been

published.^{21,22} This cross-sectional, population-based study was performed in the rural parts of two underserved regions of Iran in 2015. Assuming a prevalence of 6.4% for VI (as the main objective of the study), alpha of 0.05, precision of 1%, design effect of 1.5, and loss to follow-up of 10%, 3850 individuals were selected using multistage stratified cluster random sampling. First, two underserved districts in the north (Kojur District, Mazandaran Province; 15 villages) and southwest regions of Iran (Shahyun District, Khuzestan Province; 5 villages) were selected using national data as strata. The map of Iran is presented in Figure 1 to show the distribution of the selected rural areas.

All people aged over 1 year who lived in these villages were invited to join the study. Informed consent was obtained from all participants.

Examinations included refraction and visual acuity measurement. In each village, two optometrists that had a high agreement in detection of refractive errors (myopia, hyperopia, and astigmatism) conducted the examinations in a place with standard illumination using retinoscopy and a Snellen chart. The subjects were interviewed before optometric and ophthalmic examinations to collect demographic and economic data in a researcher-made form. Finally, according to the World Health Organization definition, VI was defined as a presenting visual acuity of worse than 20/60.

Statistical analysis

To determine the economic status, the data of seven household assets (car, motorcycle, microwave oven, computer, telephone, vacuum cleaner, and washing machine) were collected and an asset index was generated using principal component analysis according to the weighting of the first component (initial Eigenvalues: 2.34; %variance: 30.01; Kaiser–Meyer–Olkin measure of sampling adequacy: 0.699).²³ Then, a concentration index (*C*) was used as a measure of economic inequality in VI.

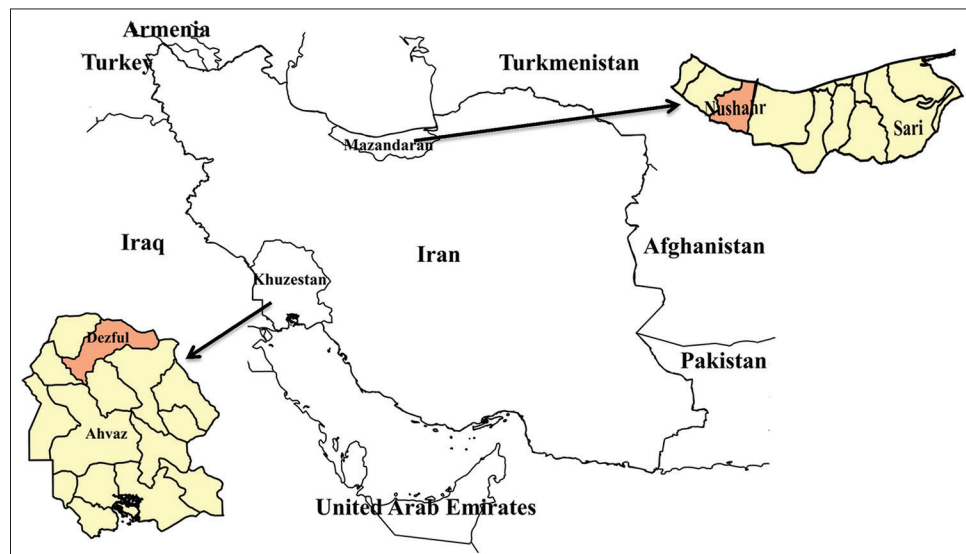


Figure 1: The location of two villages selected in this study in the map of Iran

C is defined based on the concentration curve (CC).^{24,25} The C was calculated using the convenient covariance method with the following formula:

$$\frac{2}{\mu} \text{cov}(y_i, R_i)$$

where y_i is a variable for which the inequality is to be measured, μ is the average of this variable, R_i is the fractional rank of the i^{th} person in the distribution of economic status, and cov is the covariance.^{24,25} In CC , the y axis shows the cumulative percentage of the health variable and the x axis presents the cumulative percentage of the population ranked by the economic status from the lowest to the highest. If every person, irrespective of his or her economic status, has exactly the same value of the health variable, the CC will be a 45° line, known as the line of equality. If, by contrast, the health variable takes a higher (or lower) value among the low economic group, the CC will lie above (or below) the line of equality. The farther the curve is from the line of equality, the more inequality exists in the distribution of the health variable between the high and low economic groups. C is defined as twice the area between the CC and the line of equality.^{24,25} Therefore, if CC falls on the line of equality, C will be equal to 0, and if CC is above or below the line of equality, it will have a negative or positive value, respectively. CC ranges from -1 to $+1$.²⁵ Then, based on the asset index, the participants were divided into two groups of below the 50th percentile (the low economic group) and above the 50th percentile (the high economic group), and the Oaxaca–Blinder decomposition method was used to decompose the gap between the two groups to its determinants. In this method, the gap in outcome between two economic groups (here the high/low economic groups) is decomposed based on determinants. In other words, this method determines that how much of the gap in outcome between two groups is 1: due to differences in the mean values of the determinants between the two groups (explained portion) and 2: due to differences in the coefficients of these determinants or determinants' effects (unexplained portion).^{26,27} Therefore, the participants were divided into two economic groups, and then a linear regression analysis was done between the outcome and determinants (gender, age, education level, living place, and economic status) to calculate the beta coefficient of each variable. Then, the mean values of the determinants were calculated in two economic groups, and finally, the mean values and beta coefficients were used to decompose the gap. Hence, in this decomposition approach, the explained portion is the differences in the mean values of the determinants between the two economic groups, and the unexplained portion is the differences in beta coefficients between the two economic groups. Because the study outcome was a binary variable, the method developed by Yun for nonlinear outcomes was used.²⁸ It should be emphasized that economic status was also included in the decomposition model to investigate its direct effects on economic inequality besides its indirect effects.¹⁵ The Oaxaca command in the Stata software version 11 (StataCorp LP, College Station,

Texas) was used to analyze inequality.²⁹ It should be noted that the “omega” command was used for decomposition. Moreover, the association between VI and the study variables was evaluated using multiple logistic regression, and the cluster sampling effect was considered for calculating the confidence intervals (CIs) in all analyses. $P < 0.05$ was considered statistically significant.

Ethical issues

The Ethics Committee of Shahid Beheshti University of Medical Sciences approved the study protocol, which was conducted in accordance with the tenets of the Declaration of Helsinki. All participants signed a written informed consent. For individuals below 18 years, informed consent was taken from the household head (Ethics Number: IR.SBMU.PHNS.REC.1397.060).

RESULTS

Of the 3851 samples, 3314 participated in the study (response rate = 86.5%). Because visual acuity was not measured in 220 participants, the data of 3095 participants were analyzed, 1747 (56.5%) of whom were women and the rest were men. The mean age of the participants was 37.6 ± 20.7 years (range, 3–93 years), and 57.4% of them ($n = 1776$) were from southeast villages.

The prevalence (95% CI) of VI was 6.42% (5.36–7.50) in all participants. Table 1 presents the prevalence of VI according to demographic variables. The prevalence of VI was 6.54% (4.96–8.13) in men. According to age group, the highest prevalence of VI was seen in participants ≥ 65 years old (33.33%, 95% CI: 27.39–39.28). The prevalence of VI was 1.72% (0.90–2.54) in the high economic group and 10.66% (8.82–12.50) in the low economic group. The prevalence of VI according to other variables is shown in Table 1. According to the results, the odds of VI were lower in participants with secondary (odds ratio [OR]: 0.32, 95% CI: 0.11–0.93) and high school education (OR: 0.18, 95% CI: 0.06–0.57) compared to illiterate participants. According to the economic status, the odds of VI were significantly lower in the high economic group (OR: 0.14, 95% CI: $-0.347 - -0.148$).

Economic inequality in visual impairment and decomposition results

Figure 2 presents the CC for economic inequality in VI. CC was above the line of equity, indicating a pro-poor inequality. In other words, VI was concentrated in the low economic group. The value of C was -0.248 (95% CI: $-0.347 - -0.148$).

The Oaxaca–Blinder decomposition method was applied to determine the factors affecting economic inequality in VI and their share in developing inequality. The decomposition results are presented in Table 2. The prevalence of VI was 1.72% (95% CI: 0.92–2.52) in the high economic group and 10.66% (95% CI: 8.84–12.48) in the low economic group with a statistically significant gap (8.94%) between the two groups ($P < 0.001$). The share of explained and unexplained

Table 1: Percentage of visual impairment and its association with different independent variables based on multiple logistic regression

Variable	Percent (95% CI)	Multiple logistic regression	
		OR (95% CI)	P
Gender			
Female	6.33 (4.95-7.71)	1	-
Male	6.54 (4.96-8.13)	1.07 (0.7-1.63)	0.769
Age group			
<15	0.52 (0.12-1.64)	1	-
15-24	1.63 (0.22-3.05)	6.61 (1.15-38.04)	0.034
25-34	1.82 (0.38-3.27)	6.87 (1.37-34.61)	0.019
35-44	1.71 (0.35-3.08)	3.94 (0.77-20.11)	0.100
45-54	4.58 (2.40-6.77)	9.02 (2.05-39.67)	0.004
55-64	9.84 (5.99-13.68)	14.62 (3.59-59.57)	<0.001
≥65	33.33 (27.39-39.28)	67.88 (16.48-79.66)	<0.001
Education			
Illiterate	15.84 (13.03-18.65)	1	-
Primary	3.49 (2.13-4.85)	0.57 (0.33-1.01)	0.051
Secondary	1.62 (0.03-3.21)	0.32 (0.11-0.93)	0.037
High school	1.15 (0.14-2.16)	0.18 (0.06-0.57)	0.004
College	1.72 (0.01-3.64)	0.30 (0.09-1.01)	0.052
Economic group			
Low economic group	10.66 (8.84-12.48)	1	-
High economic group	1.72 (0.92-2.52)	0.14 (0.08-0.23)	<0.001
Living place			
Southwest	4.73 (3.52-5.94)	1	-
North	8.71 (6.84-10.57)	1.07 (0.72-1.58)	0.744
Total	6.42 (5.36-7.50)	-	-

OR: Odds ratio, CI: Confidence interval, Low economic group: Lower than 50th percentile, High economic group: Upper than 50th percentile

portions was 6.01% (95% CI: 4.25–7.78) and 2.93% (95% CI: 1.63–4.23), respectively; age (b : 0.84; P : 0.019) and economic status (b : 4.85; P : < 0.001) in the explained portion and education level (b : -4.41; P : < 0.001), age (b : 14.09; P : < 0.001), living place (b : 6.96; P : 0.006), and economic status (b : -7.37; P : < 0.001) in the unexplained portion.

DISCUSSION

The results of this study showed a significant pro-poor inequality in VI in people living in underserved regions of Iran. In other words, VI was seen in about 6.42% of the study population. However, according to the economic group, the prevalence of VI was about 8.94% higher in the low economic group, that is, the low economic group suffered from VI 6.2 (10.66/1.72) times more than the high economic group. Emamian *et al.*⁹ and Gilbert *et al.*³⁰ showed inequality in VI in Shahroud (Iran) and Pakistan, respectively. Moreover, the Vision 2020 initiative report showed that VI and blindness were more common in less developed societies.³¹

Comparison of inequality between that of our research and similar studies indicates a gap of 8.94% between the high and

Table 2: Decomposition result of visual impairment gap between economic groups by Oaxaca-Blinder decomposition

Visual impairment	Coefficient (95% CI)	P
Economic group		
Low economic group	10.66 (8.84-12.48)	<0.001*
High economic group	1.72 (0.92-2.52)	<0.001*
Differences (total gap)	8.94 (6.95-10.93)	<0.001*
Explained portion		
Variables		
Education	0.13 (-0.09-0.35)	0.254
Age	0.84 (0.14-1.53)	0.019*
Living place	0.21 (-0.16-0.57)	0.261
Gender	-0.01 (-0.04-0.03)	0.628
Economic status	4.85 (3.37-6.33)	<0.001*
Total	6.01 (4.25-7.78)	<0.001*
Unexplained portion		
Variables		
Education	-4.41 (-5.96--2.86)	<0.001*
Age	14.09 (9.86-18.32)	<0.001*
Living place	6.96 (2.01-11.9)	0.006*
Gender	0.74 (-0.87-2.35)	0.370
Economic status	-7.37 (-10.28--4.46)	<0.001*
Constant	-7.08 (-13.86--0.30)	0.041*
Total	2.93 (1.63-4.23)	<0.001*

*Significance. CI: Confidence interval

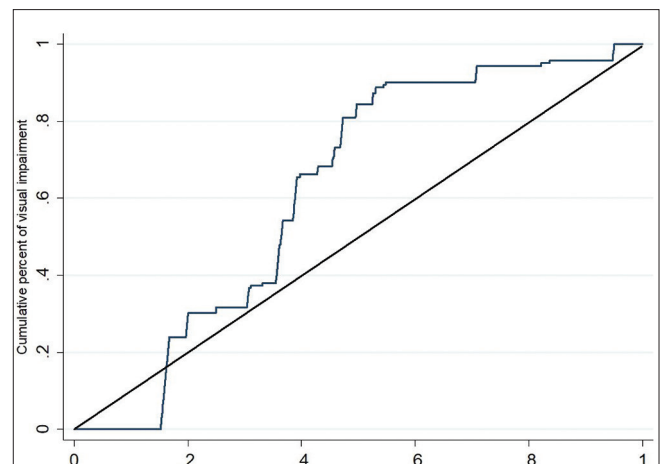


Figure 2: Concentration curve (CC) of visual impairment and economic status; the CC is above the line of equity, showing pro-poor inequality

low economic groups that was higher than similar domestic studies. For example, Emamian *et al.*⁹ and Mansouri *et al.*¹⁵ reported a gap of 7.49% and 7.05%, respectively, suggesting that the gap is more prominent in rural areas. Several studies have shown the unfavorable condition of the rural population and a high prevalence of VI in this population,³⁰ indicating their need for more attention.

Decomposition of the gap between the two groups demonstrated that about 67% of the gap was related to the explained portion. In other words, if the two groups became similar, a marked portion of the economic inequality would be eliminated.²⁹ In

the explained portion, age had a significant effect, accounting for 14% of inequality in the explained portion, which was lower than the results of the studies by Emamian *et al.*⁹ (19%) and Mansouri *et al.*¹⁵ (15%). Aging increased the difference in the prevalence of VI between the low and high economic groups (gap). On an average, the mean age of the low economic group was 2 years more than that of the high economic group, and younger people had a better visual status in the low economic group. Therefore, supportive programs for low economic group should especially focus on older age groups.^{9,16} The fact that older people do not usually have a job or income underlines the importance of attention to this age group. In line with our results, Emamian *et al.*⁹ and Mansouri *et al.*¹⁵ also found that age was effective in generating economic inequality in VI and presenting vision. Several studies have shown the effect of age on inequality in other diseases such as diabetes¹⁴ and the high prevalence of VI.^{11,15,17,32,33}

An important finding of the present study was the effect of economic status in generating economic inequality in the prevalence of VI. In other words, 54% of the gap between the high and low economic groups was caused by the direct effect of economic status, and if the economic status of the two groups became similar, more than half of the inequality would be eliminated. It seems that people with a better economic status utilize more eye care services and follow preventive programs more seriously, resulting in the decreased prevalence of different diseases in this population. Although Emamian *et al.*⁹ rejected the role of economic status in their study, Mansouri *et al.*¹⁵ found that the economic variable was an effective contributor to economic inequality in presenting vision, accounting for 19% of inequality. It should be noted that the percent contribution of economic status in this study was much lower than that of our results, indicating a worse status in the rural population. Therefore, priority should be given to improving low economic people's access to eye care services.³⁴

The unexplained portion comprised 23% of the gap in VI prevalence between the low and high economic groups, indicating that 23% of the gap was caused by factors that were not included in the model or due to the different effects of the study variables on the low and high economic groups, making the low economic group more vulnerable to inequality determinants.²⁹

Several studies have investigated the roles of other variables such as education level and sex in inequality. Some studies found a higher percentage of VI in people with lower education^{10,35} and in females,³⁶ whereas our results showed that sex and education level had no effects on the explained and unexplained portions.

One of the variables that could be evaluated in the model used in this study was insurance because the coverage of rural insurance (as a governmental insurance) is very high in rural areas (about 100%), and the coverage of private insurance is very low (about 1% of the total population) due to its high costs. Therefore, because there was no variation in

this variable, it was not possible to evaluate its contribution in this study. Studies have shown the effect of insurance on inequality;^{10,20} in other words, lack of insurance coverage is associated with decreased utilization of eye care services and increased prevalence of VI³⁴ because eye care services are usually expensive³⁷ and low-income people cannot afford the out-of-pocket costs of ophthalmic services.³⁸

It should be noted that one of the major limitations of the present study is that it was conducted in a deprived area, so it does not reflect all areas of the country, even other deprived areas. Moreover, measuring a few asset variables may increase sampling bias and may not be sufficient to generate a valid socioeconomic status variable.

Despite several limitations, the results of the present study can be used to address economic inequality in VI to achieve the objectives of "Vision 2020: The right to sight," including decreased avoidable blindness. Our study benefited from a large sample size, a high participation rate, a methodologically correct population-based design, and quality control to decrease any errors during data collection and analysis, which were the strong points of this research. However, it should be noted that the observed inequality and the decomposition results do not indicate a causal direction between the relationships. On the other hand, the Oaxaca–Blinder decomposition approach is a deterministic method that decomposes a gap according to the variables included in the model and is unable to determine the role of other variables.

In general, the results showed a significant pro-poor (VI concentration in the low economic group) inequality in VI in the Iranian rural population. A major part of this inequality was due to differences in the economic status and age between the two groups. Economic status had direct and indirect effects on inequality. It also had a significant effect on the explained and unexplained portions. To eliminate the gap, health policymakers should direct their efforts on improving the economic status.

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Conflicts of interest

There are no conflicts of interest.

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