Original Article

Socioeconomic Inequalities in Gastroesophageal Reflux Disorder: Results from an Iranian Cohort Study

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ABSTRACT

BACKGROUND
Despite progress in the health indexes in recent years, health inequalities remain as a global challenge within and between regions and countries. This study is the first to quantify the socioeconomic inequity in gastroesophageal reflux disease (GERD) using the concentration index.

METHODS
In this cross-sectional study, we used baseline data (7012 subjects) from the Fasa Cohort Study (the Southern Iran). The principal component analysis was used to construct socioeconomic status of the participants. The concentration index and concentration curve were used to measure socioeconomic-related inequality in GERD. Decomposition of concentration index was also done to identify the contribution of each explanatory variable to the wealth-related inequality in GERD prevalence.

RESULTS
The prevalence of GERD was 16.9% (95% CI: 15.9-17.7%). The overall concentration index for GERD was 0.093 (95% CI: 0.062-0.166]. Correspondingly, this figure for men and women were 0.116 (95% CI: 0.062-0.171%) and 0.091 (95% CI: 0.044-0.137%), respectively. The main contributors of socioeconomic-related inequality in GERD prevalence were socioeconomic status (64.4%), alcohol drinking (29%), and age (8.4%).

CONCLUSION
GERD is significantly more concentrated among richest people. There was significant socioeconomic inequality in GERD according to some individual factors. These inequalities need to be addressed by policy makers to identify the vulnerable subgroups and to reduce the disease burden in the community.

KEYWORDS:
Gastroesophageal reflux, Concentration index, Inequality, PERSIAN Cohort, Iran

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INTRODUCTION

Gastroesophageal reflux disease (GERD) is a common gastrointestinal (GI) disorder with a high prevalence rate worldwide. It was described by the pioneering Iranian traditional physicians more than 10 centuries ago,[1-3] and its clinical symptoms were defined in detail and recorded precisely.[4] In modern medicine, consensus to determine the definitions of GERD has been regularly updating the data regarding the disease definition and epidemiological issues.[5] GERD affects 10-25% of the western population [6-8] and represents an

increasing incidence trend in both developed and developing countries.[9,10] Studies from Iran also report the same prevalence of GERD as western societies.[11-13] In Iran, a high prevalence of the disease has been reported following an increasing incidence pattern.[9,14]

GERD has a considerable economic burden on the society [15] and decreases the quality of life resulting in social burdens.[16] Many population-based studies have also reported various factors associated with GERD including age, sex,[17] smoking,[18] physical activity,[18] educational level,[19] obesity,[10] neuropsychiatric disorders,[20] residency place,[21] and nutritional and dietary factors.[18]

Despite progress in the health indexes in recent years, health inequalities within and between regions and countries remain as a global challenge. In health economics, it is essential to determine inequalities in diseases and their risk factors to help policy makers to make policies and design better interventions to control morbidity and mortality. To our knowledge, no study has been conducted to determine the socioeconomic inequalities in GERD. Therefore, this study is the first to quantify the socioeconomic inequity in GERD using the concentration index.

MATERIALS AND METHODS

In this cross-sectional study, which was conducted in 2015, we used baseline data from the Fasa Cohort Study (the Southern Iran).

This cohort study, which is a part of the Prospective Epidemiological Research Studies in IrAN (PERSIAN),[22] is a prospective population-based cohort to investigate risk factors of non-communicable diseases (NCDs) among individuals aged 35 to 70 years in the southern Iran. These individuals were invited by the rural health care workers (Behvarz) to participate in the cohort study and are followed up every six months.

There is a computer-based registration process for the cohort. Before registration, an informed consent is obtained from every participant. Data were collected through face-to-face interviews using electronic questionnaires on socio-demographic characteristics, health and disease status, lifestyle, physical activities, and behavioral factors. In addition, clinical examination and anthropometric measurements were done during the 15-year study period. All the electronic questionnaires were designed to be smart, which can detect the inaccurate

data. This issue can increase the accuracy and validity of the entered data. More details of the cohort study have been published before.[23,24]

In this inequality study, we used the baseline data of the cohort including age, sex, educational level, marital status, occupation status, smoking (no, yes), and alcohol consumption (no, yes) as independent variables.

The main outcome was GERD symptoms. GERD was defined based on the Montreal definition and classification of GERD.[25] Patients were diagnosed as having GERD if they had the history of regurgitation over the last year and/or prior to the past year. The frequency of GERD symptoms was recorded as never, daily, 1-2 times/week, 3-6 times/week, and 1-3 times/month. The frequencies were considered as dichotomous variable (no, yes) for analysis.

We used the household asset data to measure the socioeconomic status (SES) of the individuals. The asset data are commonly used in the developing countries such as Iran where there are difficulties to obtain the comprehensive information of household income and expenditure instead of using traditional money metric measures. In this study, the asset data included ownership or renting of residential home, the area of house, number of rooms, bathroom, refrigerator, microwave, freezer, washing machine, dishwasher, vacuum cleaner, computer, laptop, television (black and white, color, LED, or LCD), mobile phone, motorcycle, car or truck, and internet access at home.

The principal component analysis (PCA) was used to generate asset index as a measure of SES in the study. The asset index was categorized into five quintiles and each quintile included one fifth of the subjects. The first quintile consisted of the poorest people, while the fifth quintile included the richest ones.

The concentration index (CI) is commonly used to assess the socioeconomic-related inequalities in health and epidemiology. The CI is based on the concentration curves, which lies between −1 and +1. A negative index reflects a higher distribution of outcome among poor people (the concentration line is above equality line) and a positive index reflects a higher distribution among rich ones (the concentration line is under equality line). The zero value considered as perfect equality. In this study, the CI was used based on Wagstaff approach.[26]

Table 1: Descriptive characteristics and the prevalence of GERD in Fasa city, Southern Iran, 2015

Variables		N (%)	Prevalence of GERD	
			Crude (95% CI)	Age-adjusted (95% CI)
Age group	≤ 50 years	4000 (57.1)	17.9 (16.8 to 19.2)	17.1 (15.9 to 18.2)
	> 50 years	3012 (42.9)	15.4 (14.1 to 16.7)	14.5 (11.3 to 18.4)
Sex	Male	3109 (44.3)	15.9 (14.7 to 17.2)	15.9 (13.6 to 18.6)
	Female	3903 (55.7)	17.6 (16.4 to 18.8)	14.5 (12.6 to 16.7)
Marital status	Married	6245 (89.1)	16.7 (15.8 to 17.7)	15.1 (12.7 to 17.9)
	Single	233 (3.3)	14.2 (10.2 to 19.3)	17 (14.4 to 19.9)
	Other	534 (7.6)	19.7 (16.5 to 23.3)	19.2 (16.5 to 22.2)
Employment status	Unemployment	3596 (51.30	17.3 (16.1 to 18.6)	15.8 (13.3 to 18.7)
	Employment	3416 (48.7)	16.4 (15.2 to 17.7)	16.4 (14.3 to 18.6)
Obesity	No	5610 (80)	16.7 (15.7 to 17.7)	14.7 (12.6 to 17.1)
	Yes	1402 (20)	17.7 (15.7 to 19.7)	16.1 (13.4 to 19.1)
Smoking status	No	5180 (73.9)	16.7 (15.7 to 17.7)	12.6 (11.1 to 14.3)
	Yes	1832 (26.1)	17.4 (15.7 to 19.2)	21.2 (18.5 to 24.3)
Alcohol drinking	No	6574 (93.7)	16.6 (15.7 to 17.6)	15.2 (12.9 to 17.80
	Yes	438 (6.3)	20 (16.6 to 24.1)	16.7 (13.4 to 20.1)
Socioeconomic status	Poorest	1403 (20)	14.6 (12.8 to 16.6)	13.6 (11.6 to 15.8)
	Poorer	1403 (20)	14.8 (13.1 to 16.8)	14.9 (12.9 to 17.1)
	Middle	1403 (20)	16.2 (14.3 to 18.2)	16.3 (14.4 to 18.3)
	Richer	1403 (20)	16.9 (15.1 to 19.10	17.7 (15.2 to 20.4)
	Richest	1403 (20)	21.2 (19.6 to 23.9)	21.1 (18.6 to 23.8)

95% CI: 95% Confidence interval, GERD: Gastroesophageal reflux disease

In addition, the decomposition of the CI was done to identify the contribution of each explanatory variable to the wealth-related inequality in GERD.[27] A negative (positive) contribution reveals the wealth-related distribution of the factor. In other words, this means the relationship between the relevant factor and GERD contributes to a lower (higher) likelihood of GERD prevalence among the poor (rich) people. As stated, since dichotomous status (no, yes) of GERD was used in the analysis, the marginal effects obtained from a logit model was used in the decomposition analysis. All statistical analyses were performed by Stata software version 11 (StataCorp, College Station, TX, USA).

RESULTS

Data were available for 7012 subjects. The prevalence of GERD symptoms was reported among 16.9% (95% CI: 15.9 - 17.7%) of the subjects. The mean age of the participants was 49.4 years (SD = 9.6) and 55.7% were women. About 26.1% of the participants were smoker, 6.3% had reported alcohol drinking, and 48.7% of them were illiterate. The age-adjusted prevalence of GERD was 15.3% (95% CI: 12.9 - 17.9%). More details of demographic characteristics of respondents according to the variables by the GERD prevalence are shown in table 1.

The results of normalized CI and concentration curve for men, women, and total samples are presented in table 2 and figure 1. The normalized CI for whole sample was 0.093. This index for men and women were estimated to be 0.116 and 0.091, respectively. These results illustrated that GERD is more concentrated among better-off people ($p < 0.001$). In addition, the concentration curve for men, women, and whole samples lie under the line of perfect equality showing that GERD was more prevalent among advantaged people.

Table 3 shows the contribution of each explanatory variable to the wealth-related inequality in the GERD prevalence.

Table 2: Normalized concentration index in the prevalence of GERD

	Concentration index	*P* value	95% Confidence interval	
			Lower	Upper
Male	0.116	< 0.001	0.062	0.171
Female	0.091	< 0.001	0.044	0.137
Total	0.093	< 0.001	0.062	0.166

GERD: Gastroesophageal reflux disease

Table 3: Decomposition results for socioeconomic inequality to the prevalence of gastroesophageal reflux disease

		Concentration index	Marginal effects	Mean	Elasticity	Concentration index	Contribution	%Contribution	Total%
Age group	≤ 50 years	Ref	Ref	0.57	Ref	Ref	Ref	Ref	8.4
	> 50 years	-0.020		0.43	-0.051	-0.153	0.008	8.4	
Sex	Male	Ref	Ref	0.44	Ref	Ref	Ref	Ref	[c]-13.7
	Female	[a]0.037		0.56	0.123	[b]-0.104	-0.013	-13.7	
Marital status	Married	Ref	Ref	0.89	Ref	Ref	Ref	Ref	-5.9
	Single	-0.026		0.03	-0.005	-0.216	0.001	1.1	
	Other	0.041		0.08	0.019	-0.335	-0.007	-7	
Employment status	Unemployment	Ref	Ref	0.51	Ref	Ref	Ref	Ref	-0.2
	Employment	-0.001		0.49	-0.003	0.074	0.000	-0.2	
Obesity	No	Ref	Ref	0.80	Ref	Ref	Ref	Ref	-0.2
	Yes	-0.004		0.20	-0.005	0.047	0.000	-0.2	
Smoking status	No	Ref	Ref	0.74	Ref	Ref	Ref	Ref	1.6
	Yes	0.026		0.26	0.040	0.038	0.002	1.6	
Alcohol drinking	No	Ref	Ref	0.94	Ref	Ref	Ref	Ref	29
	Yes	0.026		0.60	0.097	0.278	0.027	29	
Socioeconomic status	Poorest	Ref	Ref	0.20	Ref	Ref	Ref	Ref	64.4
	Poorer	0.004		0.20	0.005	-0.399	-0.002	-2	
	Middle	0.021		0.20	0.025	0.000	0.000	0	
	Richer	0.028		0.20	0.033	0.401	0.013	14.3	
	Richest	0.051		0.20	0.061	0.801	0.048	52.1	
Total observed							0.077		83.3
Residual							0.016		16.7
Total							0.093		100

[a] Compared with men, women have 3.7 percentage point higher probability of GERD prevalence. [b] The concentration index reveals that the proportion of women are more concentrated among the poor. [c] The total contribution percentage of socioeconomic-related inequality in GERD for each variable.
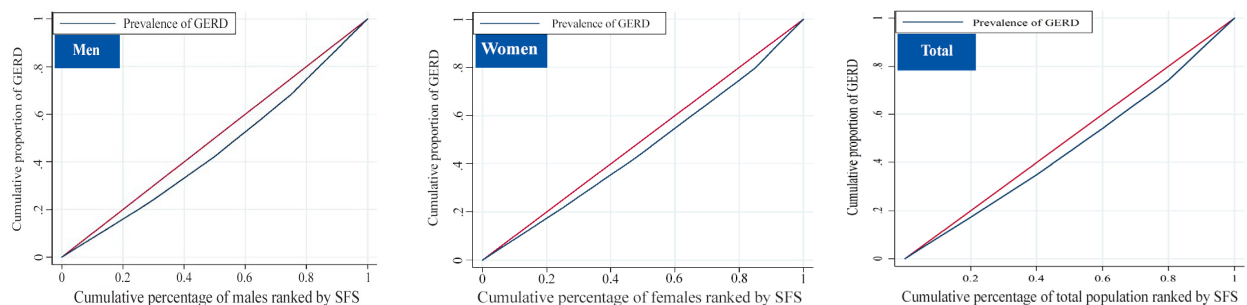

Fig.1: Concentration curve in the prevalence of gastroesophageal reflux disease among men, women, and total population based on their socioeconomic status

Older age, being single, employment, and obesity were associated with lower probability of GERD prevalence (the negative and significant sign of marginal effects). Higher SES (household wealth), smoking, alcohol drinking, and female sex were associated with higher probability of GERD prevalence among the participants (the positive and significant sign of marginal effects).

Results of the CI for explanatory variables indicate that employment, obesity, smoking, alcohol drinking, and female sex were more concentrated among the rich, whereas older age and being single were concentrated among the poor (see table 3).

The total contribution percentage for each explanatory variable was also demonstrated in the last column of the table 3. The main contributors of socioeconomic-related inequality in GERD were socioeconomic status (64.4%), alcohol drinking (29%), and age (8.4%). The results suggested that approximately 83.3% of socioeconomic-related inequality in GERD prevalence were explained by explanatory variables included in the study. The remaining 16.7% of inequality were not included in the analysis and other variables were responsible for this inequality.

DISCUSSION

The results of this study revealed the determinants of socioeconomic inequalities in GERD based on an Iranian cohort study. Although, there are several studies on the determinants of GERD symptoms worldwide,[13,21,28,29] to our knowledge, this is the first study conducted regarding the evaluation of GERD inequalities.

Getting information about the prevalence of non-communicable diseases is the first basic step to assess the effectiveness of preventive measures in all levels of disease prevention and modification.[30] So our first focus was on obtaining epidemiological data. We found that 16.9% of the participants had GERD symptoms. Prevalence of GERD is estimated to be 10-20% in the Western countries but less than 6% in south and east Asia.[31] Several epidemiological studies have been conducted in Iran and other countries to determine the prevalence of GERD, but with a remarkable diversity among the reports. This diversity is the result of difference in definitions, variability in genetics and moreover, diverse environmental factors including nutrition and diet. For example, the prevalence of GERD in Iranian general population is reported from a minimum of 2.8%,[32] to a maximum of 58.5%.[33] Based on the better methodology, in a large cohort study with 50,000 participants in the North of Iran a representative prevalence rate of 20% has been estimated.[13] A systematic review has also reported the prevalence rate of 21.2% in Iran.[15]

The main finding of our study was quantifying the size of inequality in GERD in a general population. We found a significant inequality in the disease with normalized CI of 0.093. In other words, our results showed that GERD in the Iranian population was not only prevalent, but also concentrated in the richest population and of course was associated with some factors. As found in previous studies, the high prevalence of GERD is associated with overweight/obesity,[13,34,35] dietary factors (fast food),[36] lower educational level,[37] and behavioral factors such as alcohol drinking,[13,36] and smoking.[13,35,38] On the other hand, there were more proportions of obesity, smoking status, and alcohol consumption in the higher SES.

We found inequality in GERD with regard to obesity, sex, age, job, marital status, smoking, and alcohol consumption. In addition, the decomposition analysis showed that wealth (64.4%), alcohol drinking (29%), and age (8.4%) were the main contributors to the observed inequality in the GERD prevalence. Based on the studies conducted on income-related inequality in health, SES has been reported as the most important contribution of pro-rich inequality in health.[39,40] We found no similar study for comparison. But one, by Emamian and colleagues,[41] reported that the concentration of the prevalence of risk factors of non-communicable diseases such as higher body mass index (BMI) was in the higher percentiles of economic rank of people. A meta-analysis,[42] showed that obesity was clearly associated with low educational levels, being married, and female sex, which may explain this fact. Another study conducted in Thailand to examine the SES and emerging obesity revealed that improvement in SES was positively associated with obesity for men and inversely for women aged younger than 40 years.[43] So obesity might be an important factor in the rich groups who suffer from GERD. However, it is reported that symptoms of GERD may occur regardless of BMI among Asian population.[44]

Another factor that might intervene in interpretation of the results of our study is Helicobacter pylori (*H. pylori*)

infection. In Iranian population, the prevalence of *H. pylori* infection in healthy people is reported to be 30.6% to 82%.[45] *H. pylori* infection in stomach can decrease acid production and subsequently reflux.[46] On the other hand, *H. pylori* infection is reported to be more frequently seen in low socioeconomic state.[47] As a consequent, low socioeconomic people might have more prevalence of *H. pylori* infection, which in turn, this infection might have protected them from GERD. So a further step in this study would be the evaluation of *H. pylori* infection in the GERD population of both high and low socioeconomic statuses in a comparative manner.

We had some limitations in this study. The baseline data from the cohort was cross-sectionally used, which only involved the people older than 35 years. Hence, our results need to be repeated on other age subgroups. In addition, the poor people may have the lower rate of referral to the physicians, which could have led to lower diagnosis rate of GERD. This issue may raise the information bias. In this regard, Mohammadbeigi and colleagues[48] showed the inequality in health care utilization. They reported that the referral rate of general physicians and specialists are more concentrated in the richest people. Despite its limitations, this study is the first to quantify the size of inequality in GERD by using the largest data from a cohort study.

CONCLUSION

GERD is significantly more concentrated among richest people. There was significant socioeconomic inequality in GERD according to some individual factors. These inequalities need to be addressed by policy makers to identify the vulnerable subgroups and to reduce the disease burden in the community.

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ETHICAL APPROVAL

There is nothing to be declared.

CONFLICT OF INTEREST

The authors declare no conflict of interest related to this work.

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