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| Complete List of Authors: | Baigi, Vali; Tehran University of Medical Sciences, School of Public Health, Department of Epidemiology and Biostatistics<br>Nedjat, Saharnaz; Tehran University of Medical Sciences, School of Public Health; Knowledge Utilization Research Center,<br>Hosseinpoor, Ahmad Reza; World Health Organization, Technical Officer, Department of Information, Evidence and Research<br>Sartipi, Majid; Zahedan University of Medical Sciences, School of Public Health, Department of Epidemiology and Biostatistics<br>Salimi, Yahya; Kermanshah University of Medical Sciences, School of Public Health, Department of Epidemiology and Biostatistics<br>Fotouhi, Akbar; Tehran University of Medical Sciences, School of Public Health, Department of Epidemiology and Biostatistics |
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# Socio-economic inequality in health domains in Tehran

Vali Baigi[1], Saharnaz Nedjat[2]*, Ahmad Reza Hosseinpoor[3], Majid Sartipi[4], Yahya Salimi[5], Akbar Fotouhi[6]

**ValiBaigi**

PhD Student in Epidemiology, Department of Epidemiology and Biostatistics, School of Public Health, Student's Scientific Research Center (SSRC), Tehran University of Medical Sciences, Tehran, Iran

**SaharnazNedjat**

Professor of Epidemiology, Department of Epidemiology and Biostatistics, School of Public Health, Knowledge Utilization Research Center, Tehran University of Medical Sciences, Tehran, Iran

**Ahmad Reza Hosseinpoor**

MD PhD, Technical Officer, Department of Information, Evidence and Research, World Health Organization Geneva, Switzerland

**MajidSartipi**

Assistant Professorin Epidemiology, Department of Epidemiology and Biostatistics, School of Public Health, Zahedan University of Medical Sciences, Zahedan, Iran

**YahyaSalimi**

PhD inEpidemiology, Department of Epidemiology and Biostatistics, School of Public Health, Kermanshah University of Medical Sciences, Kermanshah, Iran

**Akbar Fotouhi**

Professor of Epidemiology, Department of Epidemiology and Biostatistics, School of Public Health, Tehran University of Medical Sciences, Tehran, Iran

*** Corresponding Author**: SaharnazNedjat (MD, PhD), Department of Epidemiology and Biostatistics, School of Public Health, Tehran University of Medical Sciences, Tehran, Iran

Email: nejatsan@tums.ac.ir

Tel: 0098 21 88992969

Fax: 0098 21 88889123

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**Authors' contribution:**

Vail Baigi[1,2,3,4,5], Saharnaz Nedjat[1,2,3,4,5], Ahmad Reza Hosseinpoor[3,4,5], Majid Sartipi[1,2,5], Yahya Salimi3[3,4,5], Akbar Fotouhi[1,2,4,5]

1- study design
2- data collection
3- statistical analysis
4- interpretation of data
5- Drafting the paper or revising it

## Abstract

**Objective:** Reduction of socio-economic inequality in health requires appropriate evidence on health and its distribution based on socio-economic indicators. The objective of this study was to assess socio-economic inequality in various health domains and self-rated health (SRH).

**Methods:** This study was conducted using the data collected in a survey in 2014 on a random sample of individuals aged 18 and above in the city of Tehran. The standardized World Health Survey (WHS) Individual Questionnaire was used to assess different health domains. The prevalence of poor health was calculated for each health domain and self-rated health based on levels of education and wealth quintiles. Furthermore, the Relative Index of Inequality (RII) was applied to assess socio-economic inequality in each of the health domains and self-rated health.

**Results**: The prevalence of poor health was observed in descending order from the lowest to the highest wealth quintile, and from the lowest level of education to the highest. RII also showed varying values of inequality among different domains favoring rich subgroups. The highest wealth-related relative index of inequality was observed in the 'mobility' domain with the value of 4.16 (95% CI 2.12 to 8.17) and the highest education-related relative index of inequality with the value of 6.14 (95% CI 1.87 to 21.93) was observed in the 'interpersonal activities' domain.

**Conclusions**: Substantial socio-economic inequalities were observed in different health domains in favor of groups of better socio-economic status. Based on these results, policymaking aimed at tackling inequalities should pay attention to different health domains as well as to overall health.

**Keywords: Inequality; Inequity; social status; Iran; Relative Index of Inequality**

**Strengths and limitations of this study**

**Limitations:**

- The study design is cross sectional, hence can only describe associations between socioeconomic indicators and health domains.
- The health domains have been measured with self-rated information and clinical examinations have not been performed to evaluate them.

**Strengths:**

- Inequality in health is multidimensional and magnitude of inequalities may change depending on the socio-economic indicators used. The present study measured socio-economic inequality by various socio-economic indicators.
- To the best of our knowledge, this is the first study in Iran to investigate socio-economic inequality in various health domains.

## Introduction

Based on the World Health Organization's (WHO) recommendations, one of the main parts of assessing health systems' performance is to measure health inequalities(1). Many of these inequalities which are a result of socio-economic differences between different groups of people are unfair(2). Socio-economic inequality in health is a major challenge in public health(3) and is seriously under consideration by policy-makers and researchers(4). All over the world, evidence suggests that people of poorer socio-economic status suffer from lower levels of health(5).

Based on the definition given by WHO, health is a multi-dimensional concept(6). Hence, to determine the status of health and to assess the impact of health interventions we must first evaluate the health status of individuals from all its aspects. Self-rated health (SRH) is a health indicator that is usually employed in research on socio-economic inequalities(7). Studies indicate that SRH may predict outcomes such as disability, morbidity and morbidity, and cardiovascular diseases(8-9). Although SRH has shown good reliability for indicating a society's health, but its utilization as a public health measure for inequality studies has led to under-estimation of inequality among different socio-economic groups(10). The WHO has outlined eight main health domains for individuals in its World Health Survey Individual Questionnaire, irrespective of their socio-economic status: mobility, self-care, cognition, interpersonal activities, vision, sleep and energy, pain and discomfort, and affect(11).

In the World Health Surveys conducted between 2002 and 2004, different health domains were measured in different countries(12), and, using the same data, socio-economic inequality was investigated as well(11).

In Iran too, studies have been conducted in the field ofsocio-economic inequality on different health outcomes including SRH(13). However, to our knowledge, no study has been conducted on socio-economic inequality of different health domains. The current study therefore, attempts to investigate the latter using the standardized WHO tool, and to compare it with SRH socio-economic inequality.

## Methods

This study used the data of the survey conducted in 2014 on Tehran's residents aged 18 and above. The individuals were selected using multi-stage sampling. The city of Tehran was divided into 22 municipal districts as strata. Proportional to the population size of each district a number of blocks randomly were chosen. From each block, 10 households were systematically selected and only one person was interviewed from each household. The respondent was selected from all eligible individuals of the household through quota sampling for age and gender. Face to face interviews were held with the respondents at their doorsteps at times when all members of the household would most likely be at home, to maximize the possibility of including all age and gender groups. Overall, 2987 households were visited to collect data, of which, eventually, 1995 households (individuals) were

interviewed (response rate=66.9%). Data were collected by 10 questioner teams, each consisting of 4 trained questioners. All the questioners had a bachelors or higher academic degree. For quality control purposes, the execution of the project was monitored by 4 teams. This study has been ethically approved by the Ethics Committee of Tehran University of Medical Sciences with code number of IR.TUMS.REC.1394.532.

***Data collection tool***

To assess the different domains of health we used the World Health Survey (WHS) Individual Questionnaire which has been translated and standardized in Iran(14). The intra-class correlation (ICC) of the questionnaire was 0.89(14). This questionnaire assesses an individual's health status in eight domains, namely, mobility, self-care, cognition, interpersonal activities, vision, sleep and energy, pain and discomfort, and affect.

The respondents were asked to report the extent of their problems in each domain by selecting one of the five options of none, mild, moderate, severe, extreme/cannot do. The individuals fell into one of the groups of good health (if either option of none, mild and moderate was chosen) and/or poor health (if either severe or extreme was chosen)(11).

The individuals' SRH was measured with the standard question of "In general, how would you rate your health today?". Those who rated their health as 'bad' or 'very bad' were assigned to the 'poor health' group, and those who rated their health as 'very good', 'good' or 'moderate' were classified as the 'good health' group(13, 15).

To assess the economic status of individuals, the principal components analysis (PCA) method(16-17) was applied to the net assets of each household, and the household wealth index was created. The PCA analysis conducted on variables of assets and household data included: owning a car (not for money-making purposes), motorcycle (not for money-making purposes), cellphone, freezer, dishwashing machine, microwave oven, personal computer, vacuum cleaner, washing machine, having a bath in the house, color TV, any type of video player (VHS, VCD or DVD etc.), and per capita number of bedrooms and per capita area of residence. In PCA, the first component justifies the greatest share of total variance among the variables, hence is considered as the wealth index of each household(18).

In this study, the first component justified 25.2% of the total variance. Based on the PCA result, individuals were classified into 5 groups of lowest to highest economic status.

From the standpoint of years of education received, the participants were grouped into no formal education, primary (1-5 years), intermediate (6-8 years), high school (9-12 years) and tertiary (13 years or more).

Moreover, the data related to age, sex, marital status (single, married, separated, widow) were also collected.

***Statistical analysis***

The prevalence of poor health was calculated for each of the health domains and SRH –based on educational level and economic status. Moreover, the relative index of inequality (RII) was used to assess socio-economic inequality in each of the 8 health domains and SRH.RII is a regression-based measure of socio-economic inequality(19).

To calculate RII on grounds of socio-economic status (SES) the individuals were ranked (from the highest to the lowest wealth index or educational status); the highest and lowest values ranked zero and one, respectively(20). RII represents the ratio of poor health among individuals at the highest relative inequality related to assets rank (i.e. the lowest level of education or wealth) to those who are ranked at zero (the highest level of education or wealth) taking into account the whole entire distribution of socioeconomic status(11). An RII greater than 1 indicates that the prevalence of poor health among people of low SES is greater.

In model 1, age-adjusted RII was calculated. In model 2, in addition to age, the effects of sex, marital status and wealth index or education were also controlled. Since the design effect of health outcomes were close to 1, sampling weights were not taken into account in the analysis(21).

Statistical analysis was done with STATA V12 (STATA Corp., Texas, USA).

## Results

The mean age of the participants was 41.8 years (range=18-90; SD=15.45). Thirty-six percent of the participants had received tertiary education. Table 1 shows the prevalence of poor health in different health domains and SRH. The lowest prevalence of poor health was observed in the 'self-care' domain (2.4%) and the highest prevalence was seen in the 'affect' domain (14.7%). Moreover, overall, the prevalence of poor health was higher in people with no formal education and the poorest wealth quintile (table 1).

Table 2 illustrates the wealth-related relative index of inequality in poor health for different health domains and SRH. In model 1, age-adjusted RII is greater than 1 and statistically significant in all domains but 'vision'. The range of statistically significant RIIs was 2.35 for the sleep and energy domain to 6.4 for the mobility domain. According to the results of this model, the prevalence of poor health of the 'mobility' domain in the lowest wealth quintile was 6.4 times the prevalence of poor health in the highest wealth quintile ($p<0.001$). In addition SRH's RII was 6.83 that show poor SRH was 6.83 as prevalent in the poorest, compared with the richest people. Controlling for age, sex, marital status and educational status in model 2 led to the weakening of inequality. Furthermore, in

model 2, RII was statistically significant only for SRH and the domains of mobility, pain and discomfort, affect, and sleep and energy. Based on the results of this model, the prevalence of poor SRH in the lowest wealth quintile was 3.8 times that of the highest wealth quintile.

Table 3 shows the education-related relative index of inequality in poor health for different health domains and SRH. In model 1, age-adjusted RII for all domains except for vision and sleep & energy were greater than one and statistically significant. The range of statistically significant RIIs was 1.81 for the affect domain to 8.09 for the pain and discomfort domain. Based on these results, the prevalence of poor health of the pain and discomfort domain in individuals with no formal education was 8.09 times that in those with tertiary education level. Also, SRH's RII was 5.49 that show poor SRH was 5.49 as prevalent in individuals with no formal education, compared with those in tertiary education level. In model 2, in addition to the effect of age, the effects of sex, marital status and wealth quintile were also adjusted. RII was greater than one and statistically significant for SRH and the domains of mobility, pain & discomfort, interpersonal activities and cognition. Based on the results of this model, the prevalence of poor health in the Interpersonal activities domain in people with no formal education was 6.41 as high in people with tertiary education level (0.003).

Table1: Prevalence of poor health across health domains and self -rated health among adults aged 18+, by wealth and education

| | Self-Rated health | | mobility | | Self-Care | | Pain and discomfort | | cognition | | Interpersonal activities | | Vision | | Sleep and Energy | | Affect | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | % | SE | % | SE | % | SE | % | SE | % | SE | % | SE | % | SE | % | SE | % | SE |
| average | **9.7** | 0.6 | **10.7** | 0.7 | **2.4** | 0.3 | **12.8** | 0.7 | **7.3** | 0.5 | **3.5** | 0.4 | **2.6** | 0.3 | **11.8** | 0.7 | **14.7** | 0.8 |
| Wealth Quintile 1 | **21.4** | 2.0 | **21.8** | 2.1 | **4.9** | 1.1 | **24.3** | 2.1 | **12.1** | 1.6 | **5.8** | 1.2 | **3.1** | 0.9 | **16.7** | 1.9 | **18.9** | 2.0 |
| Wealth Quintile 2 | **12.8** | 1.0 | **14.7** | 1.8 | **3.9** | 0.9 | **15.7** | 1.8 | **10.6** | 1.5 | **4.1** | 1.0 | **3.4** | 0.9 | **14.5** | 1.8 | **21.5** | 2.1 |
| Wealth Quintile 3 | **6.7** | 1.0 | **7.8** | 1.3 | **0.7** | 0.4 | **11.7** | 1.6 | **4.9** | 1.1 | **2.8** | 0.8 | **1.5** | 0.6 | **10.7** | 1.5 | **12.5** | 1.7 |
| Wealth Quintile 4 | **4.4** | 1.0 | **5.2** | 1.1 | **0.7** | 0.4 | **7.1** | 1.3 | **3.7** | 0.9 | **2.1** | 0.7 | **2.9** | 0.8 | **11.0** | 1.6 | **11.5** | 1.6 |
| Wealth Quintile 5 | **3.6** | 0.9 | **4.4** | 1.0 | **1.3** | 0.5 | **4.7** | 1.0 | **4.9** | 1.1 | **2.8** | 0.8 | **1.5** | 0.6 | **7.1** | 1.3 | **9.6** | 1.5 |
| No formal education | **46.7** | 4.8 | **42.8** | 4.8 | **15.2** | 3.5 | **45.7** | 4.8 | **22.1** | 4.0 | **10.5** | 3.0 | **6.6** | 2.1 | **27.9** | 4.4 | **26.7** | 4.3 |
| Primary | **19.8** | 3.0 | **16.4** | 2.8 | **3.5** | 1.4 | **30.4** | 3.5 | **11.2** | 2.4 | **4.7** | 1.6 | **3.5** | 1.4 | **11.8** | 2.4 | **19.2** | 3.0 |
| intermediate | **16.4** | 2.5 | **15.5** | 2.4 | **4.3** | 1.3 | **21.6** | 2.8 | **13.4** | 2.3 | **4.8** | 1.4 | **1.9** | 0.9 | **14.6** | 2.4 | **23.1** | 2.9 |
| High school | **5.3** | 0.8 | **8.8** | 1.0 | **1.5** | 0.4 | **8.3** | 1.0 | **5.1** | 0.8 | **3.9** | 0.7 | **2.0** | 0.5 | **9.7** | 1.0 | **12.0** | 1.1 |
| Tertiary | **4.7** | 0.7 | **5.2** | 0.8 | **1.0** | 0.3 | **5.9** | 0.8 | **4.6** | 0.7 | **1.5** | 0.4 | **2.5** | 0.6 | **10.5** | 1.1 | **12.4** | 1.2 |

Table 2: Wealth-related inequality in poor health by health domains and self –rated health

| Health domains | **Model 1**[a] | **Model 2**[b] |
|---|---|---|
| | **RII (95% CI)** | **RII (95% CI)** |
| Self-Rated health | **6. 83 (3.69 – 12.65)** | **3.86 (1.87-7.99)** |
| Mobility | **6.40 (3.59 – 11.40)** | **4.16 (2.12-8.17)** |
| Self-Care | **5.17 (1.45 -18.40)** | 3.30 (0.73-14.96) |
| Pain and discomfort | **5.36 (3.15- 9.01)** | **2.37 (1.29-4.36)** |
| Cognition | **3.84 (1.98 – 7.45)** | 2.01 (0.92 -4.40) |
| Interpersonal activities | **2.56 (1.02 – 6.44)** | 1.08 (0.37-3.17) |
| Vision | 1.06 (0.93- 1.21) | 1.01 (0.86- 1.17) |
| Sleep and Energy | **2.35 (1.42- 3.87)** | **2.20 (1.22-3.96)** |
| Affect | **2.44 (1.56- 3.82)** | **2.22 (1.31-3.76)** |

a Model 1 adjusted for age
b Model 2 adjusted for age, sex, education, marital status
Bold indicates $P< 0.05$

Table 3: Education -related inequality in poor health by health domains and self –rated health

| Health domains | **Model 1[a]** | **Model 2[b]** |
|---|---|---|
| | **RII (95% CI)** | **RII (95% CI)** |
| Self-Rated health | **5.49 (2.91-10.34)** | **2.98 (1.39- 6.35)** |
| Mobility | **4.45( 2.46- 8.04)** | **2.01 (1.01 -4.05)** |
| Self-Care | **3.94 (1.13-13.75)** | 1.67(0.37 -7.53) |
| Pain and discomfort | **8.09 (4.59-14.25)** | **4.57 (2.33- 8.93)** |
| cognition | **4.64(2.28-9.44)** | **2.84(1.22-6.59)** |
| Interpersonal activities | **5.61 (1.99- 15.75)** | **6.41 (1.87-21.93)** |
| Vision | 0.63 (0.21- 1.86) | 1.14 (0.96-1.36) |
| Sleep and Energy | 1.50 (0.88- 2.56) | 0.90(0.47-1.67) |
| Affect | **1.81 (1.12-2.91)** | 1.12 (0.64 -1.96) |

a Model 1 adjusted for age

bModel 2 adjusted for age, sex, wealth, marital status

Bold indicates $P< 0.05$

## Discussion

To our best knowledge, this is the first study in Iran to examine and compare socio-economic inequality in various health domains with that of overall self-rated health.

Based on our findings, the prevalence of poor health in the domains of mobility, pain and discomfort, cognition, sleep and energy and affect were relatively higher in comparison to those in lower-income countries(11). However, the prevalence of poor SRH was lower in comparison to lower-income countries(11). When compared to high-income countries, there was seen higher prevalence of poor health in the all domains and SRH(11).

Based on our results, different health domains have been unequally distributed among the residents of Tehran. For all health domains and SRH, the prevalence of poor health fell in descending order moving from the poorest to the richest wealth quintile and from the lowest to the highest level of education. The RII for SRH and all health domains (except for vision) were greater than 1 according to both wealth and education. For wealth-related RII, after controlling for the effect of age, sex, marital status and education, it remained greater than 1 and statistically significant for SRH and the sleep and energy, affect, pain and discomfort and mobility domains only. Education-related RII was greater than one and statistically significant for SRH, interpersonal activities, cognition, pain and discomfort and mobility.

Although it is difficult to compare our results with those of other studies because of the lack of similar such studies, but they are consistent with the few that are available.

In a similar study, Hosseinpoor et al used the World Health Survey of 2002-2004 to investigate socio-economic inequality of different health domains. Upon analysis, they too observed similar inequality results among low-income countries for most health domains(11). Inverse associations between poor SRH and education and wealth have been observed in other studies conducted in the City of Tehran as well(13, 22). Furthermore, our results are consistent with those of studies conducted elsewhere in the world between SRH and SES(23-24). The association between SES and the cognitive aspect of health has been examined in a couple of studies, which indicate a better cognitive performance among individuals of higher educational levels(25-26). Although the results of the latter studies are consistent with ours, we must keep in mind that most of these studies have been conducted on specific population, such as the elderly. Research on individuals' functional capacity indicate that people of lower educational level have lower functional capacity too, another finding similar to ours(27-28).

Like other similar studies conducted in the past, our findings indicate that sleep disorders are more common among poorer individuals (wealth-wise)(29-30). However, unlike other studies, we found no

association between sleep disorders and educational level. The reason behind this conflicting finding may be attributed to the method with which sleep disorders have been evaluated in previous studies compared to ours.

Unlike the current study which indicated that socio-economic inequality does not significantly exist in the vision domain, earlier studies show that visual disorders are less prevalent among groups of higher SES(11, 31). A possible explanation behind this difference may be the difference with measurement for this variable (objective vs. self-reported assessments)(31).

One of the principles recommended by the WHO *Social Determinants of Health Commission* to reduce inequalities is to understand and measure the problems and to assess the impact of the measures taken(32). The prerequisite of this task is to have appropriate evidence on different aspects of health and its distribution(32). SRH integrates many health-related factors, so it may not show the differences in various health domains(33). Therefore, understanding the key components of health can provide policymakers with more in-depth information to improve the different aspects of health and health as a whole.

The results of this study show that although inequality is seen in overall SRH, but the inequality seen in some health domains is different from the inequality seen in overall SRH, and that inequality does not exist in some domains. For example, although the prevalence of poor SRH in illiterate individuals is almost three times that in individuals with academic education, the prevalence of interpersonal activities in illiterate individuals is 6.4 times those with academic learning.

As one of the limitations the health domains have been measured with self-rated data and clinical examinations have not been performed to evaluate them. The data come from a cross-sectional study, hence a causal interpretation of associations between socio-economic factors and health should be done with caution. The distribution of households that refrained from responding was not equal across the different districts of Tehran. Nevertheless, the age and sex distribution of the participants did not significantly differ from those participating in the survey (p=0.30). Since it is difficult to assess the income and costs of households in developing countries(34), their assets were used as a proxy of economic status.

## Conclusions

The considerable socio-economic inequality was observed in different health domains in favor of groups of better socio-economic status. This inequality differed in different domains. Subsequently, the results suggest that policymaking aimed attacking inequalities should pay attention to different health domains as

well as to overall health. Since magnitude of inequalities may change depending on the socio-economic indicators used, it is essential that both education-related and wealth-related indices be measured to reflect socioeconomic inequality to planning effective interventions, for this purpose it is necessary to conduct further quantitative and qualitative studies.

## Competing of interest

The authors declare that they have no conflict of interest.

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## Ethics approval

This study has been ethically approved by the Ethics Committee of Tehran University of Medical Sciences with code number of IR.TUMS.REC.1394.532.

## Data sharing statement

Additional unpublished data are available by request to the corresponding author.

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STROBE Statement—checklist of items that should be included in reports of observational studies

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# Socio-economic inequality in health domains in Tehran: a population-based cross-sectional study

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# Socio-economic inequality in health domains in Tehran: a population-based cross-sectional study

Vali Baigi[1], Saharnaz Nedjat[2]*, Ahmad Reza Hosseinpoor[3], Majid Sartipi[4], Yahya Salimi[5], Akbar Fotouhi[6]

**Vali Baigi**

PhD Student in Epidemiology, Department of Epidemiology and Biostatistics, School of Public Health, Student's Scientific Research Center (SSRC), Tehran University of Medical Sciences, Tehran, Iran

**Saharnaz Nedjat**

Professor of Epidemiology, Department of Epidemiology and Biostatistics, School of Public Health, Knowledge Utilization Research Center, Tehran University of Medical Sciences, Tehran, Iran

**Ahmad Reza Hosseinpoor**

MD PhD, Technical Officer, Department of Information, Evidence and Research, World Health Organization Geneva, Switzerland

**Majid Sartipi**

Assistant Professor in Epidemiology, Department of Epidemiology and Biostatistics, School of Public Health, Zahedan University of Medical Sciences, Zahedan, Iran

**Yahya Salimi**

PhD in Epidemiology, Department of Epidemiology, School of Public Health, Kermanshah University of Medical Sciences, Kermanshah, Iran

**Akbar Fotouhi**

Professor of Epidemiology, Department of Epidemiology and Biostatistics, School of Public Health, Tehran University of Medical Sciences, Tehran, Iran

*** Corresponding Author**: Saharnaz Nedjat (MD, PhD), Department of Epidemiology and Biostatistics, School of Public Health, Tehran University of Medical Sciences, Tehran, Iran

Email: nejatsan@tums.ac.ir

Tel: 0098 21 88992969

Fax: 0098 21 88889123

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**Authors' contribution:**

Vail Baigi[1,2,3,4,5], Saharnaz Nedjat[1,2,3,4,5], Ahmad Reza Hosseinpoor[3,4,5], Majid Sartipi[1,2,5], Yahya Salimi3[3,4,5], Akbar Fotouhi[1,2,4,5]

1- study design
2- data collection
3- statistical analysis
4- interpretation of data
5- Drafting the paper or revising it

## Abstract

**Objective:** Reduction of socio-economic inequality in health requires appropriate evidence on health and its distribution based on socio-economic indicators. The objective of this study was to assess socio-economic inequality in various health domains and self-rated health (SRH).

**Methods:** This study was conducted using the data collected in a survey in 2014 on a random sample of individuals aged 18 and above in the city of Tehran. The standardized World Health Survey (WHS) Individual Questionnaire was used to assess different health domains. The age-adjusted prevalence of poor health was calculated for each health domain and self-rated health based on levels of education and wealth quintiles. Furthermore, the Slop Index of Inequality (SII) and Relative Index of Inequality (RII) were applied to assess socio-economic inequality in each of the health domains and self-rated health.

**Results**: The prevalence of poor health was observed in descending order from the lowest to the highest wealth quintile, and from the lowest level of education to the highest. RII also showed varying values of inequality among different domains favoring rich subgroups. The highest wealth-related relative index of inequality was observed in the 'mobility' domain with the value of 4.16 (95% CI 2.01 to 8.62) and the highest education-related relative index of inequality with the value of 6.40 (95% CI 1.91 to 21.36) was observed in the 'interpersonal activities' domain.

**Conclusions**: Substantial socio-economic inequalities were observed in different health domains in favor of groups of better socio-economic status. Based on these results, policymaking aimed at tackling inequalities should pay attention to different health domains as well as to overall health.

**Keywords: Inequality; Inequity; social status; Iran; Relative Index of Inequality**

**Strengths and limitations of this study**

**Limitation:**

- The study design is cross sectional, hence can only describe associations between socioeconomic indicators and health domains.
- The health domains have been measured with self-rated information and clinical examinations have not been performed to evaluate them.

**Strengths:**

- Inequality in health is multidimensional and magnitude of inequalities may change depending on the socio-economic indicators used. The present study measured socio-economic inequality by various indicators.
- To the best of our knowledge, this is the first study in Iran to investigate socio-economic inequality in various health domains.

## Introduction

Based on the World Health Organization's (WHO) recommendations, one of the main parts of assessing health systems' performance is to measure health inequalities (1). Many of these inequalities which are a result of socio-economic differences between different groups of people are unfair (2). Socio-economic inequality in health is a major challenge in public health (3) and is seriously under consideration by policy-makers and researchers (4). All over the world, evidence suggests that people of poorer socio-economic status suffer from lower levels of health (5).

Based on the definition given by WHO; health is a multi-dimensional concept (6). Hence, to determine the status of health and to assess the impact of health interventions we must first evaluate the health status of individuals from all its aspects. Self-rated health (SRH) is a health indicator that is usually employed in research on socio-economic inequalities (7). Studies indicate that SRH may predict outcomes such as disability, morbidity and morbidity, and cardiovascular diseases (8-9). Although SRH has shown good reliability for indicating a society's health, but its utilization as a public health measure for inequality studies has led to under-estimation of inequality among different socio-economic groups(10). The WHO has outlined eight main health domains for individuals in its World Health Survey Individual Questionnaire, irrespective of their socio-economic status: mobility, self-care, cognition, interpersonal activities, vision, sleep and energy, pain and discomfort, and affect (11).

In the World Health Surveys conducted between 2002 and 2004, different health domains were measured in different countries (12), and, using the same data, socio-economic inequality was investigated as well (11).

In Iran too, studies have been conducted in the field of socio-economic inequality on different health outcomes including SRH (13). However, to our knowledge, no study has been conducted on socio-economic inequality of different health domains. The current study therefore, attempts to investigate the latter using the standardized WHO tool, and to compare it with SRH socio-economic inequality.

## Methods

This study used the data of the survey conducted in 2014 on Tehran's residents aged 18 and above. The individuals were selected using multi-stage sampling. The city of Tehran was divided into 22 municipal districts as strata. Proportional to the population size of each district a number of blocks randomly were chosen. From each block, 10 households were systematically selected and only one person was interviewed from each household. The respondent was selected from all eligible individuals of the household through quota sampling for age and gender. Face to face interviews were held with the respondents at their doorsteps at times when all members of the household would most likely be at home, to maximize the possibility of including all age and gender groups. Overall, 2987

households were visited to collect data, of which, eventually, 1995 households (individuals) were interviewed (response rate=66.9%). Data were collected by 10 questioner teams, each consisting of 4 trained questioners. All the questioners had a bachelors or higher academic degree. For quality control purposes, the execution of the project was monitored by 4 teams. This study has been ethically approved by the Ethics Committee of Tehran University of Medical Sciences with code number of IR.TUMS.REC.1394.532.

***Data collection tool***

To assess the different domains of health we used the World Health Survey (WHS) Individual Questionnaire which has been translated and standardized in Iran (14). The intra-class correlation (ICC) of the questionnaire was 0.89(14). This questionnaire assesses an individual's health status in eight domains, namely, mobility, self-care, cognition, interpersonal activities, vision, sleep and energy, pain and discomfort, and affect.

The respondents were asked to report the extent of their problems in each domain by selecting one of the five options of none, mild, moderate, severe, extreme/cannot do. The individuals fell into one of the groups of good health (if either option of none, mild and moderate was chosen) and/or poor health (if either severe or extreme was chosen) (11).

The individuals' SRH was measured with the standard question of "In general, how would you rate your health today?". Those who rated their health as 'bad' or 'very bad' were assigned to the 'poor health' group, and those who rated their health as 'very good', 'good' or 'moderate' were classified as the 'good health' group (13, 15).

To assess the economic status of individuals, the principal components analysis (PCA) method (16-17) was applied to the net assets of each household, and the household wealth index was created. The PCA analysis conducted on variables of assets and household data included: owning a car (not for money-making purposes), motorcycle (not for money-making purposes), cellphone, freezer, dishwashing machine, microwave oven, personal computer, vacuum cleaner, washing machine, having a bath in the house, color TV, any type of video player (VHS, VCD or DVD etc.), and per capita number of bedrooms and per capita area of residence. In PCA, the first component justifies the greatest share of total variance among the variables, hence is considered as the wealth index of each household (18).

In this study, the first component justified 25.2% of the total variance. Based on the PCA result, individuals were classified into 5 groups of lowest to highest economic status.

From the standpoint of years of education received, the participants were grouped into no formal education, primary (1-5 years), intermediate (6-8 years), high school (9-12 years) and tertiary (13 years or more).

Moreover, the data related to age, sex, marital status (single, married, separated, widow) were also collected.

***Statistical analysis***

The prevalence of poor health was calculated for each of the health domains and SRH –based on educational level and economic status. Moreover, the slope index of inequality (SII) and relative index of inequality (RII) were used to assess absolute and relative socio-economic inequality, respectively in each of the 8 health domains and SRH. RII and SII are regression-based measures of socio-economic inequality (19).

To calculate RII and SII on grounds of socio-economic status (SES) the individuals were ranked (from the highest to the lowest wealth index or educational status); the highest and lowest values ranked zero and one, respectively (20). RII represents the ratio of poor health among individuals at the highest relative inequality related to assets rank (i.e. the lowest level of education or wealth) to those who are ranked at zero (the highest level of education or wealth) taking into account the whole entire distribution of socioeconomic status (11). An RII greater than 1 indicates that the prevalence of poor health among people of low SES is greater. SII is a measure of the difference in health among individuals at the highest relative inequality related to assets rank to those who are ranked at zero taking into account the whole entire distribution of socioeconomic status.

In model 1, age-adjusted SII and RII were calculated. In model 2 we just calculate RII and in this model in addition to age, to estimate pure effect of each of wealth index or education variables the sex, marital status and wealth index or education were also adjusted. To adjust for the population distribution, post-stratification corrections were made to sampling weights. However, the design effect of health outcomes were close to one (21) were not taken into account in the analysis.

Statistical analysis was done with STATA V12 (STATA Corp., Texas, USA).

## Results

The mean age of the participants was 41.8 years (range=18-90; SD=15.45). Thirty-six percent of the participants had received tertiary education. Table 1 shows the age-adjusted prevalence of poor health in different health domains and SRH. The lowest age-adjusted prevalence of poor health was observed in the 'vision' domain (4.3%) and the highest prevalence was seen in the 'pain and discomfort' domain (17.7%). Moreover, overall, the prevalence of poor health was higher in people with no formal education and the poorest wealth quintile (table 1).

Table 2 illustrate the wealth-related slop index of inequality and relative index of inequality in poor health for different health domains and SRH. In model 1, age adjusted SII for most domains are statistically significant. Accordingly, difference in the prevalence of poor health of the 'mobility' domain between the lowest wealth quintile and the highest wealth quintile is 12 percent. In model 1, age-adjusted RII is greater than 1 and statistically significant in all domains but 'vision'. The range of statistically significant RIIs was 2.35 for the sleep and energy domain to 6.4 for the mobility domain. According to the results of this model, the prevalence of poor health of the 'mobility' domain in the lowest wealth quintile was 6.4 times the prevalence of poor health in the highest wealth quintile ($p<0.001$). In addition SRH's RII was 6.83 that show poor SRH was 6.83 as prevalent in the poorest, compared with the richest people. Controlling for age, sex, marital status and educational status in model 2 led to the weakening of inequality. Furthermore, in model 2, RII was statistically significant only for SRH and the domains of mobility, pain and discomfort, affect, and sleep and energy. Based on the results of this model, the prevalence of poor SRH in the lowest wealth quintile was 3.8 times that of the highest wealth quintile.

Table 3 show the education-related slop index of inequality and relative index of inequality in poor health for different health domains and SRH. In model 1, age-adjusted SII is statistically significant in all domains but 'Self-Care' and 'Sleep and Energy'. According to the results of this model, difference in the prevalence of poor health of the 'pain and discomfort' domain between individuals with no formal education and those in tertiary education level is 17 percent. In model 1, age-adjusted RII for all domains except for vision and sleep & energy were greater than one and statistically significant. The range of statistically significant RIIs was 1.80 for the affect domain to 8.08 for the pain and discomfort domain. Based on these results, the prevalence of poor health of the pain and discomfort domain in individuals with no formal education was 8.08 times that in those with tertiary education level. Also, SRH's RII was 5.49 that show poor SRH was 5.48 as prevalent in individuals with no formal education, compared with those in tertiary education level. In model 2, in addition to the effect of age, the effects of sex, marital status and wealth quintile were also adjusted. RII was greater than one and statistically significant for SRH and the domains of mobility, pain & discomfort, interpersonal activities and cognition. Based on the results of this model, the prevalence of poor health in the Interpersonal activities domain in people with no formal education was 6.40 as high in people with tertiary education level (0.003). There were no significant differences in sex distribution on association between wealth index or education variable across all health domains and SRH ($P>0.05$).

Table1: Age-adjusted prevalence of poor health across health domains and self -rated health among adults aged 18+, by wealth and education

| | **Self-Rated health** | | **mobility** | | **Self-Care** | | **Pain and discomfort** | | **cognition** | | **Interpersonal activities** | | **Vision** | | **Sleep and Energy** | | **Affect** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **%** | **SE** | **%** | **SE** | **%** | **SE** | **%** | **SE** | **%** | **SE** | **%** | **SE** | **%** | **SE** | **%** | **SE** | **%** | **SE** |
| average | **15.1** | 0.1 | **17.5** | 1.1 | **8.8** | 0.8 | **17.7** | 1.1 | **9.1** | 0.9 | **4.4** | 0.7 | **4.3** | 0.4 | **14.1** | 1.0 | **16.5** | 0.1 |
| Wealth Quintile 1 | **24.4** | 1.0 | **26.1** | 1.7 | **9.6** | 0.09 | **28.8** | 1.7 | **13.7** | 1.7 | **6.3** | 1.3 | **4.1** | 0.8 | **20.3** | 1.8 | **21.6** | 1.9 |
| Wealth Quintile 2 | **15.4** | 1.0 | **18.3** | 1.9 | **6.3** | 1.1 | **17.3** | 1.9 | **12.5** | 1.6 | **6.5** | 1.4 | **4.2** | 1.1 | **14.5** | 1.8 | **22.8** | 2.0 |
| Wealth Quintile 3 | **9.7** | 2.0 | **11.2** | 1.5 | **3.0** | 0.7 | **16.0** | 1.9 | **4.1** | 0.8 | **2.4** | 0.8 | **1.6** | 0.6 | **8.9** | 1.4 | **10.9** | 1.5 |
| Wealth Quintile 4 | **6.1** | 1.0 | **5.2** | 1.1 | **0.6** | 0.3 | **8.9** | 1.3 | **5.2** | 0.9 | **2.1** | 0.8 | **3.7** | 1.6 | **10.2** | 1.5 | **11.7** | 1.6 |
| Wealth Quintile 5 | **7.6** | 0.8 | **7.5** | 1.1 | **4.1** | 0.5 | **7.9** | 1.1 | **6.9** | 0.8 | **3.6** | 0.6 | **2.0** | 0.8 | **8.9** | 1.1 | **13.4** | 1.4 |
| No formal education | **40.3** | 2.4 | **39.2** | 2.5 | **16** | 1.4 | **45.4** | 2.3 | **22.6** | 2.1 | **10.9** | 1.8 | **5.9** | 0.6 | **30.3** | 2.4 | **31.1** | 2.6 |
| Primary | **17.2** | 1.8 | **15.0** | 1.8 | **7.1** | 0.7 | **28.0** | 2.3 | **11.6** | 1.6 | **3.5** | 1.1 | **3.0** | 1.1 | **7.6** | 1.5 | **17.8** | 1.8 |
| intermediate | **15.4** | 2.0 | **16.8** | 1.8 | **5.6** | 1.0 | **21.3** | 2.0 | **12.4** | 1.8 | **4.1** | 1.2 | **1.7** | 0.6 | **14.8** | 1.8 | **26.3** | 2.1 |
| High school | **8.7** | 0.9 | **11.6** | 1.1 | **3.0** | 0.5 | **10.0** | 1.2 | **5.6** | 0.6 | **4.7** | 1.0 | **1.8** | 0.5 | **9.3** | 1.2 | **11.6** | 1.1 |
| Tertiary | **9.4** | 1.1 | **7.5** | 1.0 | **3.5** | 0.7 | **8.1** | 1.2 | **5.8** | 0.9 | **1.6** | 0.6 | **2.7** | 0.7 | **10.9** | 1.2 | **16.3** | 1.6 |

**Table 2: Wealth-related inequality in poor health by health domains and self –rated health**

| Health domains | Model 1[a] SII (95% CI) | Model 1[a] RII (95% CI) | Model 2[b] RII (95% CI) |
|---|---|---|---|
| **Self-Rated health** | **0.05 (0.01 to 0.10)** | **6. 83 (3.83 to 12.17)** | **3.86 (1.83 to 8.15)** |
| **Mobility** | **0.12 (0.08 to 0.17)** | **6.40 (3.50 to 11.66)** | **4.16 (2.01 to 8.63)** |
| **Self-Care** | 0.01 (-0.01 to 0.02) | **5.17 (1.25 to 21.32)** | 3.30 (0.55 to 19.79) |
| **Pain and discomfort** | **0.15 (0.10 to 0.21)** | **5.36 (3.29 to 8.70)** | **2.37 (1.32 to 4.26)** |
| **Cognition** | **0.07 (0.03 to 0.11)** | **3.84 (2.01 to 7.33)** | 2.01 (0.96 to 4.23) |
| **Interpersonal activities** | 0.02 (-0.01 to 0.05) | **2.56 (1.10 to 5.96)** | 1.08 (0.38 to 3.06) |
| **Vision** | -0.001 (-0.03 to 0.03) | 1.06 (0.54 to 3.57) | 1.01 (0.48 to 3.80) |
| **Sleep and Energy** | **0.09 (0.03 to 0.15)** | **2.35 (1.52 to 3.64)** | **2.20 (1.28 to 3.77)** |
| **Affect** | **0.13 (0.07 to 0.19)** | **2.44 (1.62 to 3.61)** | **2.22 (1.37 to 3.59)** |

**a Model 1 adjusted for age**
**b Model 2 adjusted for age, sex, education, marital status**
**Bold indicates *P*< 0.05**

**Table 3: Education -related inequality in poor health by health domains and self –rated health**

| Health domains | Model 1[a] SII (95% CI) | Model 1[a] RII (95% CI) | Model 2[b] RII (95% CI) |
|---|---|---|---|
| **Self-Rated health** | **0.07 (0.02 to 0.13)** | **5.48 (2.89 to 10.39)** | **2.98 (1.36 to 6.51)** |
| **Mobility** | **0.12 (0.06 to 0.17)** | **4.45 (2.55 to 7.75)** | **2.01 (1.04 to 3.89)** |
| **Self-Care** | 0.02 (-0.01 to 0.04) | **3.94 (1.02 to 15.19)** | 1.67(0.29 to 9.54) |
| **Pain and discomfort** | **0.17 (0.11 to 0.23)** | **8.08 (4.28 to 15.23)** | **4.57 (2.18 to 9.49)** |
| **cognition** | **0.08 (0.04 to 0.13)** | **4.64 (1.89 to 11.32)** | **2.84 (1.04 to 7.71)** |
| **Interpersonal activities** | **0.06 (0.02 to 0.09)** | **5.59 (2.15 to 14.59)** | **6.40 (1.91 to 21.36)** |
| **Vision** | **-0.02 (-0.04 to -0.01)** | 0.63 (0.19 to 2.06) | 1.09 (0.75 to 1.63) |
| **Sleep and Energy** | 0.04 (-0.02 to 0.10) | 1.50 (0.88 to 2.55) | 0.90 (0.50 to 1.61) |
| **Affect** | **0.08 (0.02 to 0.14)** | **1.80 (1.07 to 3.02)** | 1.12 (0.64 to 1.97) |

**a Model 1 adjusted for age**
**b Model 2 adjusted for age, sex, wealth, marital status**
**Bold indicates *P*< 0.05**

## Discussion

To our best knowledge, this is the first study in Iran to examine and compare socio-economic inequality in various health domains with that of overall self-rated health.

Based on our findings, the prevalence of poor health in the all domains along with SRH were relatively higher in comparison to lower-income countries from Hosseinpoor et.al findings (11). When compared to high-income countries, there was seen higher prevalence of poor health in the all domains and SRH (11).

Based on our results, different health domains have been unequally distributed among the residents of Tehran. For all health domains and SRH, the prevalence of poor health fell in descending order moving from the poorest to the richest wealth quintile and from the lowest to the highest level of education. The RII for SRH and all health domains (except for vision) were greater than 1 according to both wealth and education. For wealth-related RII, after controlling for the effect of age, sex, marital status and education, it remained greater than 1 and statistically significant for SRH and the sleep and energy, affect, pain and discomfort and mobility domains only. Education-related RII was greater than one and statistically significant for SRH, interpersonal activities, cognition, pain and discomfort and mobility.

Although it is difficult to compare our results with those of other studies because of the lack of similar such studies, but they are consistent with the few that are available.

In a similar study, Hosseinpoor et al. used the World Health Survey of 2002-2004 to investigate socio-economic inequality of different health domains. Upon analysis, they too observed similar inequality results among low-income countries for most health domains (11). Inverse associations between poor SRH and education and wealth have been observed in other studies conducted in the City of Tehran as well (13, 22). Furthermore, our results are consistent with those of studies conducted elsewhere in the world between SRH and SES (23-24). The association between SES and the cognitive aspect of health has been examined in a couple of studies, which indicate a better cognitive performance among individuals of higher educational levels (25-26). Although the results of the latter studies are consistent with ours, we must keep in mind that most of these studies have been conducted on specific population, such as the elderly. Research on individuals' functional capacity indicate that people of lower educational level have lower functional capacity too, another finding similar to ours (27-28).

Like other similar studies conducted in the past, our findings indicate that sleep disorders are more common among individuals living in poorer households (wealth-wise) (29-30). However, unlike other studies, we found no association between sleep disorders and educational level. The reason behind this

conflicting finding may be attributed to the method with which sleep disorders have been evaluated in previous studies compared to ours.

Unlike the current study which indicated that socio-economic inequality does not significantly exist in the vision domain, earlier studies show that visual disorders are less prevalent among groups of higher SES (11, 31). A possible explanation behind this difference may be the difference with measurement for this variable (objective vs. self-reported assessments) (31).

One of the principles recommended by the WHO *Social Determinants of Health Commission* to reduce inequalities is to understand and measure the problems and to assess the impact of the measures taken (32). The prerequisite of this task is to have appropriate evidence on different aspects of health and its distribution (32). SRH integrates many health-related factors, so it may not show the differences in various health domains (33). Therefore, understanding the key components of health can provide policymakers with more in-depth information to improve the different aspects of health and health as a whole.

The results of this study show that although inequality is seen in overall SRH, but the inequality seen in some health domains is different from the inequality seen in overall SRH, and that inequality does not exist in some domains. For example, although the prevalence of poor SRH in individuals with no formal education is almost three times that in individuals with academic education, the prevalence of interpersonal activities in individuals with no formal education is 6.4 times those with academic learning.

Having improved the total health indices in Iran, the Primary Health Care (PHC) network, and recently implemented Heath System Reform and Universal Health Coverage (UHC) have had a substantial role in decreasing inequality in the country. These policies, however, are being implemented at the population level. On the other hand, evidence have shown that interventions targeting disadvantaged populations could decrease the inequity on a great deal. Due to multidimensionality of the inequity, the results of the present study would incorporate into determination of educationally and economically disadvantaged populations, as well as gauging future interventions. Consistent with the objectives of UHC, identification of the disadvantaged populations could also lead to better protection of these people against catastrophic health costs.

As one of the limitations the health domains have been measured with self-rated data and clinical examinations have not been performed to evaluate them. The data come from a cross-sectional study, hence a causal interpretation of associations between socio-economic factors and health should be done with caution. The distribution of households that refrained from responding was not equal across the

different districts of Tehran. Nevertheless, the age and sex distribution of the participants did not significantly differ from those participating in the survey (p=0.30). Since it is difficult to assess the income and costs of households in developing countries (34), their assets were used as a proxy of economic status.

## Conclusions

The considerable socio-economic inequality was observed in different health domains in favor of groups of better socio-economic status. This inequality differed in different domains. Subsequently, the results suggest that policymaking aimed attacking inequalities should pay attention to different health domains as well as to overall health. Since magnitude of inequalities may change depending on the socio-economic indicators used, it is essential that both education-related and wealth-related indices be measured to reflect socioeconomic inequality to planning effective interventions, for this purpose it is necessary to conduct further quantitative and qualitative studies.

## Competing of interest

The authors declare that they have no conflict of interest.

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### Ethics approval

This study has been ethically approved by the Ethics Committee of Tehran University of Medical Sciences with code number of IR.TUMS.REC.1394.532.

### Data sharing statement

Additional unpublished data are available by request to the correspond author.

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STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

| | Item No | Recommendation |
|---|---|---|
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| | | (*b*) page 2 |
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| Background/rationale | 2 | Page 4 (line 1 to 23) |
| Objectives | 3 | Page 4 (line 21 to 24) |
| **Methods** | | |
| Study design | 4 | Page 4 (line 26 and 27) |
| Setting | 5 | Page 4 and 5 (26 to 28) |
| Participants | 6 | (*a*) page 4 (26 to 31) |
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| Study size | 10 | Page 4 (line 33) , page 5 (line 1 and 2) |
| Quantitative variables | 11 | Page 5 (line 13 to 31), page 6 (line 1 to 5) |
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| | | (*d*) page 6 (line 23 to 26) |
| | | (*e*) not applicable |
| **Results** | | |
| Participants | 13* | (a) page 6 (line 29 to 31) |
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| Descriptive data | 14* | (a) page 6 (line 29 to 32), page 7 (line 1 , 2) |
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| Outcome data | 15* | page 6 (line 29 to 32), page 7 (line 1 , 2) and table 1 (p. 7) |
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# Socio-economic inequality in health domains in Tehran: a population-based cross-sectional study

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# Socio-economic inequality in health domains in Tehran: a population-based cross-sectional study

Vali Baigi[1], Saharnaz Nedjat[2]*, Ahmad Reza Hosseinpoor[3], Majid Sartipi[4], Yahya Salimi[5], Akbar Fotouhi[6]

**Vali Baigi**

PhD Student in Epidemiology, Department of Epidemiology and Biostatistics, School of Public Health, Student's Scientific Research Center (SSRC), Tehran University of Medical Sciences, Tehran, Iran

**Saharnaz Nedjat**

Professor of Epidemiology, Department of Epidemiology and Biostatistics, School of Public Health, Knowledge Utilization Research Center, Tehran University of Medical Sciences, Tehran, Iran

**Ahmad Reza Hosseinpoor**

MD PhD, Technical Officer, Department of Information, Evidence and Research, World Health Organization Geneva, Switzerland

**Majid Sartipi**

Assistant Professor in Epidemiology, Department of Epidemiology and Biostatistics, School of Public Health, Zahedan University of Medical Sciences, Zahedan, Iran

**Yahya Salimi**

PhD in Epidemiology, Department of Epidemiology, School of Public Health, Kermanshah University of Medical Sciences, Kermanshah, Iran

**Akbar Fotouhi**

Professor of Epidemiology, Department of Epidemiology and Biostatistics, School of Public Health, Tehran University of Medical Sciences, Tehran, Iran

*** Corresponding Author**: Saharnaz Nedjat (MD, PhD), Department of Epidemiology and Biostatistics, School of Public Health, Tehran University of Medical Sciences, Tehran, Iran

Email: nejatsan@tums.ac.ir

Tel: 0098 21 88992969

Fax: 0098 21 88889123

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## Authors' contribution

**VB, SN** made substantial contributions to the study conception and design, the acquisition, analysis and interpretation of data, drafting the manuscript, and revising the manuscript critically for important intellectual content. **AF, MS** contributed to the study design, acquisition and interpretation of data and revised the manuscript critically. **ARH, YS** participated in statistical analysis, interpretation of data and revising the manuscript critically for important intellectual content. **All authors** agreed the final manuscript prior to submission. **All authors** agree to be accountable for all aspects of this work.

## Abstract

**Objective:** Reduction of socio-economic inequality in health requires appropriate evidence on health and its distribution based on socio-economic indicators. The objective of this study was to assess socio-economic inequality in various health domains and Self-Rated Health (SRH).

**Methods:** This study was conducted using the data collected in a survey in 2014 on a random sample of individuals aged 18 and above in the city of Tehran. The standardized World Health Survey (WHS) Individual Questionnaire was used to assess different health domains. The age-adjusted prevalence of poor health was calculated for each health domain and self-rated health based on levels of education and wealth quintiles. Furthermore, the Slop Index of Inequality (SII) and Relative Index of Inequality (RII) were applied to assess socio-economic inequality in each of the health domains and self-rated health.

**Results**: The age-adjusted prevalence of poor health was observed in descending order from the lowest to the highest wealth quintile, and from the lowest level of education to the highest. RII also showed varying values of inequality among different domains favoring rich subgroups. The highest wealth-related Relative Index of Inequality was observed in the 'Mobility' domain with the value of 4.16 (95% CI 2.01 to 8.62) and the highest education-related Relative Index of Inequality with the value of 6.40 (95% CI 1.91 to 21.36) was observed in the 'Interpersonal Activities' domain.

**Conclusions**: Substantial socio-economic inequalities were observed in different health domains in favor of groups of better socio-economic status. Based on these results, policymaking aimed at tackling inequalities should pay attention to different health domains as well as to overall health.

**Keywords: Inequality; Inequity; social status; Iran; Relative Index of Inequality**

## Strengths and limitations of this study

**Limitation:**

- The study design is cross sectional, hence can only describe associations between socio-economic indicators and health domains.
- The health domains have been measured with self-rated information and clinical examinations have not been performed to evaluate them.

**Strengths:**

- Inequality in health is multidimensional and magnitude of inequalities may change depending on the socio-economic indicators used. The present study measured socio-economic inequality by various indicators.
- To the best of our knowledge, this is the first study in Iran to investigate socio-economic inequality in various health domains.

## Introduction

Based on the World Health Organization's (WHO) recommendations, one of the main parts of assessing health systems' performance is to measure health inequalities (1). Many of these inequalities which are a result of socio-economic differences between different groups of people are unfair (2). Socio-economic inequality in health is a major challenge in public health (3) and is seriously under consideration by policy-makers and researchers (4). All over the world, evidence suggests that people of poorer socio-economic status suffer from lower levels of health (5).

Based on the definition given by WHO; health is a multi-dimensional concept (6). Hence, to determine the status of health and to assess the impact of health interventions we must first evaluate the health status of individuals from all its aspects. Self-Rated Health (SRH) is a health indicator that is usually employed in research on socio-economic inequalities (7). Studies indicate that SRH may predict outcomes such as disability, morbidity and morbidity, and cardiovascular diseases (8-9). Although SRH has shown good reliability for indicating a society's health, but its utilization as a public health measure for inequality studies has led to under-estimation of inequality among different socio-economic groups(10). The WHO has outlined eight main health domains for individuals in its World Health Survey Individual Questionnaire, irrespective of their socio-economic status: mobility, self-care, cognition, interpersonal activities, vision, sleep and energy, pain and discomfort, and affect (11).

In the World Health Surveys conducted between 2002 and 2004, different health domains were measured in different countries (12), and, using the same data, socio-economic inequality was investigated as well (11).

In Iran too, studies have been conducted in the field of socio-economic inequality on different health outcomes including SRH (13). However, to our knowledge, no study has been conducted on socio-economic inequality of different health domains. The current study therefore, attempts to investigate the latter using the standardized WHO tool, and to compare it with SRH socio-economic inequality.

## Methods

This study used the data of the survey conducted in 2014 on Tehran's residents aged 18 and above. The individuals were selected using multi-stage sampling. The city of Tehran was divided into 22 municipal districts as strata. Proportional to the population size of each district a number of blocks randomly were chosen. From each block, 10 households were systematically selected and only one person was interviewed from each household. The respondent was selected from all eligible individuals of the household through quota sampling for age and gender. Face to face interviews were held with the respondents at their doorsteps at times when all members of the household would most likely be at home, to maximize the possibility of including all age and gender groups. Overall, 2987

households were visited to collect data, of which, eventually, 1995 households (individuals) were interviewed (response rate=66.9%). Data were collected by 10 questioner teams, each consisting of 4 trained questioners. All the questioners had a bachelors or higher academic degree. For quality control purposes, the execution of the project was monitored by 4 teams. First, the objectives of study were explained clearly and then participants with informed consent were included in the study. This study has been ethically approved by the Ethics Committee of Tehran University of Medical Sciences with code number of IR.TUMS.REC.1394.532.

***Data collection tool***

To assess the different domains of health we used the World Health Survey (WHS) Individual Questionnaire which has been translated and standardized in Iran (14). The Intra-Class Correlation (ICC) of the questionnaire was 0.89 (14). This questionnaire assesses an individual's health status in eight domains, namely, mobility, self-care, cognition, interpersonal activities, vision, sleep and energy, pain and discomfort, and affect.

The respondents were asked to report the extent of their problems in each domain by selecting one of the five options of none, mild, moderate, severe, extreme/cannot do. The individuals fell into one of the groups of good health (if either option of none, mild and moderate was chosen) and/or poor health (if either severe or extreme was chosen) (11).

The individuals' SRH was measured with the standard question of "In general, how would you rate your health today?". Those who rated their health as 'bad' or 'very bad' were assigned to the 'poor health' group, and those who rated their health as 'very good', 'good' or 'moderate' were classified as the 'good health' group (13, 15).

To assess the economic status of individuals, the Principal Components Analysis (PCA) method (16-17) was applied to the net assets of each household, and the household wealth index was created. The PCA analysis conducted on variables of assets and household data included: owning a car (not for money-making purposes), motorcycle (not for money-making purposes), cellphone, freezer, dishwashing machine, microwave oven, personal computer, vacuum cleaner, washing machine, having a bath in the house, color TV, any type of video player (VHS, VCD or DVD etc.), and per capita number of bedrooms and per capita area of residence. In PCA, the first component justifies the greatest share of total variance among the variables, hence is considered as the wealth index of each household (18).

In this study, the first component justified 25.2% of the total variance. Based on the PCA result, individuals were classified into 5 groups of lowest to highest economic status.

From the standpoint of years of education received, the participants were grouped into no formal education, primary (1-5 years), intermediate (6-8 years), high school (9-12 years) and tertiary (13 years or more).

Moreover, the data related to age, sex, marital status (single, married, separated, widow) were also collected.

***Statistical analysis***

The age-adjusted prevalence of poor health was calculated for each of the health domains and SRH based on educational level and economic status. Moreover, the Slop Index of Inequality (SII) and Relative Index of Inequality (RII) were used to assess absolute and relative socio-economic inequality, respectively in each of the 8 health domains and SRH. RII and SII are regression-based measures of socio-economic inequality (19).

To calculate RII and SII on grounds of socio-economic status (SES) the individuals were ranked (from the highest to the lowest wealth index or educational status); the highest and lowest values ranked zero and one, respectively (20). RII represents the ratio of poor health among individuals at the highest relative inequality related to assets rank (i.e. the lowest level of education or wealth) to those who are ranked at zero (the highest level of education or wealth) taking into account the whole entire distribution of socio-economic status (11). An RII greater than 1 indicates that the prevalence of poor health among people of low SES is greater. SII is a measure of the difference in health among individuals at the highest relative inequality related to assets rank to those who are ranked at zero taking into account the whole entire distribution of socio-economic status.

In model 1, age-adjusted SII and RII were calculated. In model 2 we just calculate RII and in this model in addition to age, to estimate pure effect of each of wealth index or education variables the sex, marital status and wealth index or education were also adjusted. To adjust for the population distribution, post-stratification corrections were made to sampling weights. However, the design effect of health outcomes were close to one (21) were not taken into account in the analysis.

Statistical analysis was done with STATA V12 (STATA Corp., Texas, USA).

## Results

The mean age of the participants was 41.8 years (range=18-90; SD=15.45). Thirty-six percent of the participants had received tertiary education. Table 1 shows the age-adjusted prevalence of poor health in different health domains and SRH. The lowest age-adjusted prevalence of poor health was observed in the '**Self-Care**' domain (2.5%) and the highest prevalence was seen in the 'Affect' domain (**14.7**%). Moreover, overall, the age-adjusted prevalence of poor health was higher in people with no formal education and the poorest wealth quintile (Table 1).

Table 2 illustrate the wealth-related Slop Index of Inequality and Relative Index of Inequality in poor health for different health domains and SRH. In model 1, age-adjusted SII for most domains are statistically significant. Accordingly, difference in the prevalence of poor health of the 'Mobility' domain between the lowest wealth quintile and the highest wealth quintile is 12 percent. In model 1, age-adjusted RII is greater than 1 and statistically significant in all domains but 'Vision'. The range of statistically significant RIIs was 2.35 for the sleep and energy domain to 6.4 for the mobility domain. According to the results of this model, the prevalence of poor health of the 'Mobility' domain in the lowest wealth quintile was 6.4 times the prevalence of poor health in the highest wealth quintile ($p<0.001$). In addition SRH's RII was 6.83 that show poor SRH was 6.83 as prevalent in the poorest, compared with the richest people. Controlling for age, sex, marital status and educational status in model 2 led to the weakening of inequality. Furthermore, in model 2, RII was statistically significant only for SRH and the domains of mobility, pain and discomfort, affect, and sleep and energy. Based on the results of this model, the prevalence of poor SRH in the lowest wealth quintile was 3.8 times that of the highest wealth quintile.

Table 3 show the education-related Slop Index of Inequality and Relative Index of Inequality in poor health for different health domains and SRH. In model 1, age-adjusted SII is statistically significant in all domains but 'Self-Care' and 'Sleep and Energy'. According to the results of this model, difference in the prevalence of poor health of the 'Pain and Discomfort' domain between individuals with no formal education and those in tertiary education level is 17 percent. In model 1, age-adjusted RII for all domains except for vision and sleep & energy were greater than one and statistically significant. The range of statistically significant RIIs was 1.80 for the affect domain to 8.08 for the pain and discomfort domain. Based on these results, the prevalence of poor health of the pain and discomfort domain in individuals with no formal education was 8.08 times that in those with tertiary education level. Also, SRH's RII was 5.49 that show poor SRH was 5.48 as prevalent in individuals with no formal education, compared with those in tertiary education level. In model 2, in addition to the effect of age, the effects of sex, marital status and wealth quintile were also adjusted. RII was greater than one and statistically significant for SRH and the domains of mobility, pain & discomfort, interpersonal activities and cognition. Based on the results of this model, the prevalence of poor health in the interpersonal activities domain in people with no formal education was 6.40 as high in people with tertiary education level (0.003). There were no significant differences in sex distribution on association between wealth index or education variable across all health domains and SRH ($P>0.05$).

Table1: Age-adjusted prevalence of poor health across health domains and self -rated health among adults aged 18+, by wealth and education

| | Self-Rated Health | | Mobility | | Self-Care | | Pain and Discomfort | | Cognition | | Interpersonal activities | | Vision | | Sleep and Energy | | Affect | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | % | SE | % | SE | % | SE | % | SE | % | SE | % | SE | % | SE | % | SE | % | SE |
| average | **9.8** | 0.6 | **10.7** | 0.7 | **2.5** | 0.3 | **12.8** | 0.7 | **7.3** | 0.6 | **3.5** | 0.4 | **2.6** | 0.3 | **11.8** | 0.7 | **14.7** | 0.8 |
| Wealth Quintile 1 | **16.4** | 1.4 | **18.2** | 1.6 | **3.4** | 0.7 | **20.5** | 1.6 | **11.1** | 1.3 | **4.8** | 0.9 | **2.8** | 0.6 | **15.9** | 1.5 | **19.9** | 1.6 |
| Wealth Quintile 2 | **11.7** | 0.7 | **13.2** | 0.8 | **2.6** | 0.4 | **15.4** | 0.9 | **8.6** | 0.7 | **4.1** | 0.5 | **2.6** | 0.4 | **13.7** | 0.9 | **17.0** | 1.0 |
| Wealth Quintile 3 | **8.2** | 0.6 | **9.3** | 0.7 | **2.0** | 0.3 | **11.3** | 0.7 | **6.7** | 0.6 | **3.4** | 0.4 | **2.5** | 0.4 | **11.7** | 0.7 | **14.4** | 0.8 |
| Wealth Quintile 4 | **5.6** | 0.7 | **6.4** | 0.7 | **1.5** | 0.4 | **8.1** | 0.8 | **5.2** | 0.6 | **2.8** | 0.5 | **2.4** | 0.5 | **9.9** | 0.8 | **12.2** | 0.9 |
| Wealth Quintile 5 | **3.8** | 0.7 | **4.4** | 0.7 | **1.1** | 0.4 | **5.8** | 0.9 | **3.9** | 0.7 | **2.4** | 0.6 | **2.2** | 0.6 | **8.4** | 1.1 | **10.2** | 1.2 |
| No formal education | **23.1** | 2.9 | **23.9** | 3.1 | **4.2** | 1.0 | **35.1** | 3.7 | **17.2** | 3.0 | **8.6** | 2.3 | **2.3** | 0.8 | **17.4** | 2.7 | **22.5** | 3.0 |
| Primary | **16.4** | 1.5 | **17.7** | 1.7 | **3.2** | 0.5 | **24.4** | 2.1 | **12.5** | 1.6 | **6.2** | 1.1 | **2.4** | 0.6 | **15.1** | 1.7 | **19.4** | 1.8 |
| Intermediate | **11.3** | 0.8 | **12.7** | 0.8 | **2.5** | 0.3 | **16.1** | 1.0 | **8.9** | 0.8 | **4.4** | 0.6 | **2.5** | 0.4 | **13.1** | 0.9 | **16.7** | 1.1 |
| High school | **7.6** | 0.7 | **8.9** | 0.7 | **1.9** | 0.4 | **10.1** | 0.7 | **6.3** | 0.6 | **3.1** | 0.4 | **2.6** | 0.4 | **11.3** | 0.7 | **14.3** | 0.8 |
| Tertiary | **4.9** | 0.7 | **6.2** | 0.7 | **1.5** | 0.4 | **6.2** | 0.7 | **4.4** | 0.6 | **2.2** | 0.4 | **2.7** | 0.5 | **9.8** | 0.9 | **12.2** | 1.1 |

**Table 2: Wealth-related inequality in poor health by health domains and Self –Rated Health**

| Health domains | Model 1[a] SII (95% CI) | Model 1[a] RII (95% CI) | Model 2[b] RII (95% CI) |
|---|---|---|---|
| **Self-Rated Health** | **0.05 (0.01 to 0.10)** | **6. 83 (3.83 to 12.17)** | **3.86 (1.83 to 8.15)** |
| **Mobility** | **0.12 (0.08 to 0.17)** | **6.40 (3.50 to 11.66)** | **4.16 (2.01 to 8.60)** |
| **Self-Care** | 0.01 (-0.01 to 0.02) | **5.17 (1.25 to 21.32)** | 3.30 (0.55 to 19.92) |
| **Pain and discomfort** | **0.15 (0.10 to 0.21)** | **5.36 (3.29 to 8.70)** | **2.37 (1.32 to 4.26)** |
| **Cognition** | **0.07 (0.03 to 0.11)** | **3.84 (2.01 to 7.33)** | 2.01 (0.96 to 4.22) |
| **Interpersonal activities** | 0.02 (-0.01 to 0.05) | **2.56 (1.10 to 5.96)** | 1.08 (0.38 to 3.07) |
| **Vision** | -0.001 (-0.03 to 0.03) | 1.06 (0.54 to 3.57) | 1.01 (0.48 to 3.80) |
| **Sleep and Energy** | **0.09 (0.03 to 0.15)** | **2.35 (1.52 to 3.64)** | **2.20 (1.28 to 3.77)** |
| **Affect** | **0.13 (0.07 to 0.19)** | **2.44 (1.62 to 3.61)** | **2.22 (1.37 to 3.59)** |

**a Model 1 adjusted for age**
**b Model 2 adjusted for age, sex, education, marital status**
**Bold indicates *P*< 0.05**

**Table 3: Education -related inequality in poor health by health domains and Self –Rated Health**

| | Model 1[a] | Model 1[a] | Model 2[b] |
|---|---|---|---|
| **Health domains** | **SII (95% CI)** | **RII (95% CI)** | **RII (95% CI)** |
| **Self-Rated Health** | **0.07 (0.02 to 0.13)** | **5.48 (2.89 to 10.39)** | **2.98 (1.36 to 6.51)** |
| **Mobility** | **0.12 (0.06 to 0.17)** | **4.45 (2.55 to 7.75)** | **2.01 (1.04 to 3.89)** |
| **Self-Care** | 0.02 (-0.01 to 0.04) | **3.94 (1.02 to 15.19)** | 1.67(0.29 to 9.54) |
| **Pain and discomfort** | **0.17 (0.11 to 0.23)** | **8.08 (4.28 to 15.23)** | **4.57 (2.18 to 9.49)** |
| **cognition** | **0.08 (0.04 to 0.13)** | **4.64 (1.89 to 11.32)** | **2.84 (1.04 to 7.71)** |
| **Interpersonal activities** | **0.06 (0.02 to 0.09)** | **5.59 (2.15 to 14.59)** | **6.40 (1.91 to 21.36)** |
| **Vision** | **-0.02 (-0.04 to -0.01)** | 0.63 (0.19 to 2.06) | 1.09 (0.75 to 1.63) |
| **Sleep and Energy** | 0.04 (-0.02 to 0.10) | 1.50 (0.88 to 2.55) | 0.90 (0.50 to 1.61) |
| **Affect** | **0.08 (0.02 to 0.14)** | **1.80 (1.07 to 3.02)** | 1.12 (0.64 to 1.97) |

**a Model 1 adjusted for age**
**b Model 2 adjusted for age, sex, wealth, marital status**
**Bold indicates *P*< 0.05**

## Discussion

To our best knowledge, this is the first study in Iran to examine and compare socio-economic inequality in various health domains with that of overall self-rated health.

Based on our findings, the prevalence of poor health in the domains of mobility, pain and discomfort, cognition, sleep and energy and affect were relatively higher in comparison to those in lower-income countries from Hosseinpoor et.al findings (11). However, the prevalence of poor SRH was lower in comparison to lower-income countries (11). When compared to high-income countries, there was seen higher prevalence of poor health in the all domains and SRH (11).

Based on our results, different health domains have been unequally distributed among the residents of Tehran. For all health domains and SRH, the prevalence of poor health fell in descending order moving from the poorest to the richest wealth quintile and from the lowest to the highest level of education. The RII for SRH and all health domains (except for vision) were greater than 1 according to both wealth and education. For wealth-related RII, after controlling for the effect of age, sex, marital status and education, it remained greater than 1 and statistically significant for SRH and the sleep and energy, affect, pain and discomfort and mobility domains only. Education-related RII was greater than one and statistically significant for SRH, interpersonal activities, cognition, pain and discomfort and mobility.

Although it is difficult to compare our results with those of other studies because of the lack of similar such studies, but they are consistent with the few that are available.

In a similar study, Hosseinpoor et al. used the World Health Survey of 2002-2004 to investigate socio-economic inequality of different health domains. Upon analysis, they too observed similar inequality results among low-income countries for most health domains (11). Inverse associations between poor SRH and education and wealth have been observed in other studies conducted in the City of Tehran as well (13, 22). Furthermore, our results are consistent with those of studies conducted elsewhere in the world between SRH and SES (23-24). The association between SES and the cognitive aspect of health has been examined in a couple of studies, which indicate a better cognitive performance among individuals of higher educational levels (25-26). Although the results of the latter studies are consistent with ours, we must keep in mind that most of these studies have been conducted on specific population, such as the elderly. Research on individuals' functional capacity indicate that people of lower educational level have lower functional capacity too, another finding similar to ours (27-28).

Like other similar studies conducted in the past, our findings indicate that sleep disorders are more common among individuals living in poorer households (wealth-wise) (29-30). However, unlike other

studies, we found no association between sleep disorders and educational level. The reason behind this conflicting finding may be attributed to the method with which sleep disorders have been evaluated in previous studies compared to ours.

Unlike the current study which indicated that socio-economic inequality does not significantly exist in the vision domain, earlier studies show that visual disorders are less prevalent among groups of higher SES (11, 31). A possible explanation behind this difference may be the difference with measurement for this variable (objective vs. self-reported assessments) (31).

One of the principles recommended by the WHO *Social Determinants of Health Commission* to reduce inequalities is to understand and measure the problems and to assess the impact of the measures taken (32). The prerequisite of this task is to have appropriate evidence on different aspects of health and its distribution (32). SRH integrates many health-related factors, so it may not show the differences in various health domains (33). Therefore, understanding the key components of health can provide policymakers with more in-depth information to improve the different aspects of health and health as a whole.

The results of this study show that although inequality is seen in overall SRH, but the inequality seen in some health domains is different from the inequality seen in overall SRH, and that inequality does not exist in some domains. For example, although the prevalence of poor SRH in individuals with no formal education is almost three times that in individuals with academic education, the prevalence of interpersonal activities in individuals with no formal education is 6.4 times those with academic learning.

Having improved the total health indices in Iran, the Primary Health Care (PHC) network, and recently implemented Heath System Reform and Universal Health Coverage (UHC) have had a substantial role in decreasing inequality in the country. These policies, however, are being implemented at the population level. On the other hand, evidence have shown that interventions targeting disadvantaged populations could decrease the inequity on a great deal. Due to multidimensionality of the inequity, the results of the present study would incorporate into determination of educationally and economically disadvantaged populations, as well as gauging future interventions. Consistent with the objectives of UHC, identification of the disadvantaged populations could also lead to better protection of these people against catastrophic health costs.

As one of the limitations the health domains have been measured with self-rated data and clinical examinations have not been performed to evaluate them. The data come from a cross-sectional study, hence a causal interpretation of associations between socio-economic factors and health should be done

with caution. The distribution of households that refrained from responding was not equal across the different districts of Tehran. Nevertheless, the age and sex distribution of the participants did not significantly differ from those participating in the survey (p=0.30). Since it is difficult to assess the income and costs of households in developing countries (34), their assets were used as a proxy of economic status. Because of lacking of convergence in the Slope Index of Inequality full models (adjusted for age, sex, marital status and wealth or education level), we have not reported the results of these models.

## Conclusions

The considerable socio-economic inequality was observed in different health domains in favor of groups of better socio-economic status. This inequality differed in different domains. Subsequently, the results suggest that policymaking aimed attacking inequalities should pay attention to different health domains as well as to overall health. Since magnitude of inequalities may change depending on the socio-economic indicators used, it is essential that both education-related and wealth-related indices be measured to reflect socio-economic inequality to planning effective interventions, for this purpose it is necessary to conduct further quantitative and qualitative studies.

## Competing of interest

None declared.

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### Ethics approval

This study has been ethically approved by the Ethics Committee of Tehran University of Medical Sciences with code number of IR.TUMS.REC.1394.532.

### Data sharing statement

Additional unpublished data are available by request to the correspond author.

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STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

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