



Catastrophic Health Expenditure and Impoverishment Among Households with Cardiovascular Patients in Tehran, 2017

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Abstract

Background: Considering the high prevalence and burden of cardiovascular diseases in Iran and the health expenditures imposed on households, the present study aimed to investigate the catastrophic and impoverishing health expenditures among households having cardiovascular patients.

Methods: This descriptive-analytical and cross-sectional study was conducted from March 2017 to September 2017. Data were collected from 385 patients who referred to the three main hospitals providing cardiovascular care in Tehran. Demographic and socio-economic data, household income, out-of-pocket payments of households having cardiovascular patients were collected via face-to-face interviews and based on the expenditure part of the World Health Organization's Health Survey questionnaire. The occurrence of catastrophic and impoverishing health expenditures due to cardiovascular care was calculated by income deciles. To identify the determinants of catastrophic and impoverishing expenditures, logistic regression was used.

Results: In this study, 24.6% of all households having cardiovascular patients experienced catastrophic health expenditures. Furthermore, the extent of experiencing impoverishing expenditures was 3.8% among the households. The variables such as education level, type of health insurance, household income, outpatient and inpatient expenditures had a significant relationship with the occurrence of catastrophic health expenditures. Moreover, the type of health insurance, household income, and inpatient expenditures had a significant relationship with the incidence of impoverishing health expenditures.

Conclusions: Mechanisms such as the development of financial risk pooling in the cardiovascular care setting, using generic medicines instead of brand names in patients and excluding poor patients' from payments can be effective for financial empowerment and reduction of the catastrophic and impoverishing health expenditures among cardiovascular patients.

Keywords: Catastrophic Expenditures, Impoverishment, Financial Risk, Cardiovascular Patients

1. Background

Cardiovascular diseases as an important part of the non-communicable conditions caused 30% of all deaths globally (1, 2). Over 80% of cardiovascular-related mortalities occur in developing countries. Annually, 2.8 million males and 3.4 million females die from coronary heart diseases. Furthermore, over 60% of the global burden of coronary heart diseases is related to developing countries (3). In 2005, the burden of cardiovascular diseases in Iran among people above 30 years was around 847,309 DALY, which is predicted to reach 1,728,836 DALY by 2025(4).

In developed countries, 80% of mortalities result from cardiovascular diseases occurring during older ages, while in developing countries most deaths occur during the economically active ages. As a result, the premature death and disability due to cardiovascular diseases during the work-

ing ages of the population significantly affect the productivity, production, and economy of countries (5, 6). During 2011 - 2015, the production loss in low and middle-income countries due to cardiovascular diseases has been predicted to be 3.76 trillion dollars (7). In addition, owing to the fact that long-term Healthcare is the most important characteristic of cardiovascular diseases and due to having multi-morbidity in cardiovascular patients; therefore, considerable health expenditures are imposed on the society (8). Direct and indirect medical expenditures resulting from cardiovascular diseases can cause increased out-of-pocket payments and in turn, expose patients to catastrophic and impoverishing medical care expenditures. In this case, households will experience a more complex and hard situation of the disease and poverty (9).

The studies conducted in this field show that 81% of

rural and 58% of urban people are unable to pay off the costly pharmacological regimens of cardiovascular diseases. This situation compels them to compensate the medical expenditures from their personal savings, selling assets, loans, and insurance (10). A national study in India indicates that the incidence of the catastrophic and impoverishing health expenditures in households with a hospitalized cardiovascular patient has been 1.12 and 1.37 times higher, respectively. According to the findings of this study, among hospitalized patients, cardiovascular diseases were the second cause of incidence of impoverishing health expenditures after cancer (11). Furthermore, based on the results of a study conducted in Iran, 55% of cardiovascular patients experienced catastrophic health expenditures, where medicine spending by 35.8%, claimed the maximum portion of expenditures imposed on the cardiovascular patients. However, in this study, the index of impoverishing health expenditures was not investigated (12).

Evidence suggests that between 1999 and 2014, generally a global steady increase has occurred in the expenditures of households for non-communicable diseases, including cardiovascular conditions (13). Thus the importance of this issue has been shown in the WHO Global action plan, emphasizing further studies on non-communicable diseases, including cardiovascular diseases and their economic effect on households on a microeconomic level (14-16). In spite of various studies in advanced countries, in developing countries, there is a need for sufficient evidence regarding the economic effects of cardiovascular diseases on households and patients based on the indices of catastrophic and impoverishing health expenditures. Given the high prevalence of cardiovascular diseases in Iran and the resources required for disease diagnosis, treatment, and management, considerable economic burden will be imposed on society and households. Currently, the main part of the resources of public or government hospitals is spent on the management and treatment of cardiovascular diseases (17). Therefore, identifying the out-of-pocket payments for treating cardiovascular diseases can help policymakers in planning cardiovascular Healthcare and effective management of cardiovascular-related expenditures.

2. Objectives

This study was conducted to investigate catastrophic and impoverishing health expenditures imposed on households having cardiovascular patients.

3. Methods

In this descriptive-analytical study conducted from March 2017 to September 2017, the statistical population

included the households having cardiovascular patients who utilized cardiovascular-related medical care in Tehran Heart Center, Rasoul-e Akram Hospital, and Shahid Rajaei Heart Hospital. The sampling method was simply random, and the sample size ($n = 385$) was calculated by the following formula. In this formula, where d represents the desired level of precision (0.05) and P was considered 0.5 to obtain the maximum sample size. Z value was considered 1.96 for 95% confidence level.

$$n = \frac{z_{1-\frac{\alpha}{2}}^2 p(1-p)}{d^2} \quad (1)$$

The standard WHO questionnaire was used for collecting general and medical care information of patients, which has previously been used in a similar study (18). This questionnaire includes socioeconomic information and also contains the general information of the household, living facilities, food and non-food expenditures, income, and out-of-pocket payments of a household to receive cardiovascular care. The information was collected via an interview. The reminder period for inpatient and outpatient care was considered one year and four weeks before the information collection time, respectively.

WHO methodology was to investigate the exposure of cardiovascular patients with catastrophic medical care expenditures. By definition, when the medical care expenditures were 40% more than the household capacity to pay, it was considered catastrophic (19). To calculate the impoverishing medical care expenditures, first the relative poverty line was determined, which was obtained from the level of household expenditures of living as follows:

- Food expenditures of the household were divided by the total expenditures of the household, and its share of the household expenditures was determined: $\text{Foodexp}_H = \text{food}_H / \text{exp}_H$

- Modification dimension of each household was calculated based on experimental studies as follows: $\text{Eqsize}_H = \text{size}_H^{0.56}$

- Furthermore, the modified food expenditures of each household was obtained by the following formula: $\text{Eqfood}_H = \text{food}_H / \text{eqsize}_H$

- The households were arranged in terms of share of food expenditures out of total household expenditures and then divided into 100 equal parts. We selected the 45th and 55th percentiles of the entire sample. Then the weighted mean of the modified food expenditures in the 45th and 55th percentiles was used to calculate the modified per capita living expenditures, which considered to be poverty line: $\text{Pl} = \sum w_H \cdot \text{eqfood}_H / \sum w_H$, $\text{food}_{45} < \text{pl} < \text{food}_{55}$

- The cost of living was calculated for each individual household via the following formula, and any household whose total expenditures were less than the cost of living was determined as poor: $\text{Se}_H = \text{pl} \times \text{eqsize}_H$

- Then, the households who fell below the poverty line due to cardiovascular care expenditures were specified as (20):

$$\begin{aligned} &\text{If } \text{Exp}_H \geq \text{Se}_H, \text{Exp}_H - \text{Hoop}_H < \text{Se}_H \rightarrow \text{imPoverish}_H = 1 \\ &\text{If } \text{Exp}_H \geq \text{Se}_H, \text{Exp}_H - \text{Hoop}_H \geq \text{Se}_H \rightarrow \text{imPoverish}_H = 0 \end{aligned}$$

To determine the relationship between the predisposing and empowering variables with the probability of catastrophic and impoverishing medical care expenditures, χ^2 test, as well as the Logit model, were used. The logistic model for estimation is as follows:

$$f(y_i) = \Pi_i^{y_i} (1 - \Pi_i)^{1-y_i} \tag{2}$$

Where, y_i is the dummy variable, which can take on the values 0 (nonoccurrence) and 1 (occurrence). The probability that a household incurs catastrophic or impoverished medical care expenditures in this function is:

$$p(y_i = 1/x_i) = \Pi_i$$

$$E(y/x) = p(y_i = 1/x_i) = \Pi_i = G(x_i\beta)$$

$$(x_i\beta) = \beta_1x_1 + \beta_2x_2 + \dots + \beta_nx_n$$

$$G(x_i\beta) = \frac{e^{x_i\beta}}{1 + e^{x_i\beta}} \rightarrow \Pi_i = \frac{e^{x_i\beta}}{1 + e^{x_i\beta}}$$

4. Results

According to the demographic characteristics of the studied sample (Table 1), 50.52% (n = 194) of the studied sample were male and 49.48% (n = 191) were female. In addition, 51.55%, 39.18%, 3.61%, and 0.52% had Social security health insurance, Iran health insurance, Armed forces health insurance, and Relief committee health insurances, respectively. Totally, 4.64% of the population did not have any health insurance coverage (Table 1).

Table 2 indicates the monthly average income, food expenditures, medical care expenditures, and the capacity to pay off households by income deciles. On average, the income of the 10th (the richest) decile households (\$992.9) was around 8.5 times more than the income of the first (the poorest) decile households (\$114.6). Furthermore, the monthly medical care expenditures of the 10th decile households (\$70.56) were 1.6 times more than the medical care expenditures of the first decile (\$43.7). The ratio of health expenditures to the capacity to pay off households was 0.61 and 0.08 in the first and 10th decile households, respectively (Table 2).

By definition, the catastrophic health expenditures occur when the health expenditures of households exceed

Table 1. The Demographic Characteristics of the Studied Sample

Variable	Frequency (%)
Gender	
Male	194 (50.52)
Female	191 (49.48)
Marital status	
Single	52 (13.40)
Married	261 (67.53)
Divorced/widowed	72 (19.07)
Level of education	
Illiterate	105 (27.32)
Primary	78 (20.62)
Guidance school	62 (15.98)
High school	76 (19.59)
University degree	64 (16.49)
Type of employment	
Unemployed	92 (23.71)
Self-employed	62 (15.98)
Government sector employee	18 (4.64)
Private sector employee	10 (2.58)
Housewife	139 (36.08)
Retired	60 (15.98)
Other	4 (1.03)
Insurance status	
Without insurance	17 (4.64)
Social security health insurance	198 (51.55)
Iran health insurance	152 (39.18)
Relief committee health insurances	2 (0.52)
Armed forces health insurance	14 (3.61)
Optional	2 (0.52)
Supplementary insurance	
No	130 (33.51)
Yes	255 (65.98)
Residents	
Owner	252 (65.46)
Tenant	99 (25.77)
Parental house	32 (8.25)
Serviceman	2 (0.52)

a certain threshold. In other words, if the ratio of household health expenditures to the capacity to pay off is equal to 40% or above, the household experiences catastrophic health expenditures. Based on the results, the poorest (first

Table 2. The Monthly Average Income, Health Expenditures, and Capacity to Pay Off the Households by Each Separate Income Decile (N = 385)

Income Decile	Household Income, US\$	Food Expenditures, US\$	Health Expenditures, US\$	Capacity to Pay, US\$	Ratio of Health Expenditures to Capacity to Pay	Households Experiencing Catastrophe Health Expenditures, Frequency (%)	Households Experiencing Impoverishing Health Expenditures, Frequency (%)
First (poorest)	114.6	126.1	43.7	70.7	0.61	36 (9.3)	11 (2.8)
Second	168.1	133.1	61.7	75.6	0.81	23 (5.9)	2 (0.5)
Third	256.6	154.3	89.4	87.0	0.84	14 (3.6)	1 (0.25)
Fourth	301.7	177.8	92.3	122.3	0.75	13 (3.3)	1 (0.25)
Fifth	357.8	208.0	98.6	171.5	0.57	6 (1.5)	0
Six	419.5	209.5	76.4	231.5	0.33	2 (0.5)	0
Seventh	476.1	250.9	114.3	290.7	0.39	2 (0.5)	0
Eighth	581.7	253.4	57.2	391.8	0.14	0	0
Ninth	636.6	259.0	106.5	435.7	0.24	0	0
Tenth (richest)	992.9	311.4	70.6	799.5	0.08	0	0

decile) households had the maximum amount of catastrophic cardiovascular-related medical care expenditures. In the 8th to 10th deciles (the richest), the extent of exposure with catastrophic medical care expenditures has been zero. Again, the first decile households (the poorest) had the maximum amount of impoverishing medical care expenditures. Impoverishing medical care expenditures in the 5th to 10th deciles were zero (Table 2).

The goodness of fit test is used to test how well it fits a set of observations. In this paper, we used Hosmer and Lemeshow's goodness-of-fit test, which commonly was used in logistic regressions. Goodness-of-fit test with the p-value of 0.17 shows that our model fits data well (Table 3). In logit model, the incidence of catastrophic and impoverishing medical care expenditures (non-exposure = 0/exposure = 1) was determined as binary dependent variable, while age, gender, level of education, household dimension, marital status, basic health insurance, supplementary health insurance, household income, smoking, alcohol consumption, physical activity, outpatient and inpatient expenditures were considered independent variables. The coefficients and marginal effects (dy/dx) estimated by logit model are shown in Table 3. According to the results, at 95% confidence interval, the level of education, health insurance status, household total income, outpatient and inpatient expenditures significantly affected the incidence of catastrophic medical care expenditures. The level of education and household total income had a negative effect on catastrophic medical care expenditures, while the type of health insurance status, outpatient and inpatient expenditures had a positive effect on the dependent variable (Table 3). According to the marginal effects estimations, with a unit increase in the level of educa-

tion, the probability of catastrophic medical care expenditures decreases by 6.7%. Furthermore, if the household total income increases by one unit, the probability of catastrophic medical care expenditures are diminished considerably. If outpatient costs grow by one unit, the probability of incidence of catastrophic health expenditures increases slightly.

Based on the results related to the determinants of impoverishing medical care expenditures, the coefficients of basic health insurance, household total income, and inpatient expenditures were statistically significant at 95% level. Indeed, although basic health insurances and household total income had a negative effect, inpatient expenditures had a positive effect on impoverishing medical care expenditures. Marginal effects showed that with changing each unit in the level of basic health insurance, the probability of impoverishing medical care expenditures decreased by 28%. Furthermore, changing of one unit in the total income decreased the probability of impoverishing medical care expenditures by 43% (Table 3).

5. Discussion

Based on the results of this study, 24.6% of all households (n = 385) with a cardiovascular patient experienced catastrophic medical care expenditures. Furthermore, the exposure of households with impoverishing medical care expenditures was 3.8%. Out of the 24.6% of the households who experienced the catastrophic medical care expenditures, about 37% were in the first income decile, while only 4% of them were in the 6th and 7th deciles.

The previous study indicates that out of 27% of cardiovascular patients' households who experienced catas-

Table 3. Logit Model Estimations^a

Explained Variable	Probability of Catastrophic Health Expenditures				Probability of Impoverishing Health Expenditures			
	β	S.E	P Value	dy/dx (Marginal Effects)	β	S.E	P Value	dy/dx (Marginal Effects)
Constant coefficient	0.719	2.3808	0.763	-	2.69	4.7364	0.569	-
Age	0.007	0.018	0.690	0.001	0.010	0.0297	0.730	0.0008
Gender	0.098	0.5639	0.861	0.014	-0.198	0.9994	0.843	-0.0037
Level of education	-0.444	0.1974	0.024	-0.067	0.301	0.3633	0.407	0.0058
Household dimension	0.031	0.1459	0.831	0.004	0.014	0.1355	0.645	0.026
Marital status	-0.607	0.4939	0.218	-0.091	0.001	0.2531	0.802	0.00041
Basic health insurance	0.545	0.2854	0.045	0.082	-0.354	0.4679	0.011	-0.288
Supplementary insurance	-0.217	0.5349	0.684	-0.032	-0.959	0.6186	0.390	-0.0087
Household income	-1.59	4.3927	0.000	-2.41	-0.505	0.4123	0.029	-0.4365
Smoking	0.389	0.6952	0.476	0.058	0.786	1.3088	0.548	0.0105
Alcohol consumption	1.52	1.1644	0.190	0.230	0.041	0.4570	0.428	0.0098
Physical activity	0.127	0.2939	0.664	0.019	-0.858	0.7832	0.273	-0.7156
Outpatient expenditures	6.06	2.3947	0.011	9.15	0.071	1.7380	0.510	0.0615
Inpatient expenditures	6.32	1.5730	0.000	9.55	0.184	0.8723	0.002	0.1301

^aNumber of observations = 385, Hosmer-Lemeshow $\chi^2 = 11.41$, Prob > $\chi^2 = 0.1797$.

trophic health expenditures, 28% were in the first income quintile (the poorest) and 14% in the 5th income quintile. On average, low-income households have spent 24% of their incomes on the treatment of cardiovascular diseases (21). Based on the evidence, after diagnosis of cardiovascular diseases, loss of income by households in high-income groups has been reported as 67.5%, 14.3%, 26.3%, and 63.5% in Argentina, China, India, and Tanzania, respectively. The loss of income has been higher in the lower-income groups (22).

Although in this study, the strategies of financing the expenditures of cardiovascular patients have not been addressed, studies suggest that a considerable portion of cardiovascular patients have either sold assets or received loans or borrowed money to finance their healthcare costs. For example, a study in Iran showed that 43.5% of patients have financed their out-of-pocket payments via selling valuable goods, 35% via receiving a loan, and 22% via borrowing money. Similarly, a study across 35 states of India showed that for financing the payment of inpatient expenditures resulting from cardiovascular diseases, 57%, 35%, and 8% of people resorted to household saving, borrowing, and selling assets, respectively (23).

Based on the results of this study, the level of education, type of basic health insurance, household total income, the outpatient and inpatient expenditures had a significant effect on catastrophic medical care expenditures. The level of education and household income had a negative effect on catastrophic medical care expenditures,

while the type of basic health insurance, as well as outpatient and inpatient expenditures, had a positive effect. Generally, the level of income is one of the variables that has a negative and significant effect on the probability of catastrophic health expenditures. The higher the household level of income, the greater the capacity and ability to pay off the household will be, whereby the probability of the household experiencing catastrophic health expenditures is diminished (13). Evidence suggests that loss of income affects patients and their care providers, causing them to confront poverty and catastrophic health expenditures (24). Based on the study by Su et al, the households standing in higher-income quartets were less likely to experience catastrophic health expenditures (25). In the study by Ekman, it has also been shown that an increased level of income diminished the probability of experiencing catastrophic health expenditures by households (26). The study by Sun et al. to investigate the effect of two protective programs for cardiovascular patients on catastrophic health expenditures showed that 3.30% of the households who benefited from both plans, and 6.01% of the households who benefited from only one plan experienced impoverishing health expenditures. Among the households who used both supportive plans, the second income quintile had the greatest exposure, while the third quintile had the least extent of exposure with impoverishing health expenditures. Incidence of catastrophic health expenditures had a negative relationship with the household's level of income (27).

Education is also a key variable affecting out-of-pocket payments globally. The highest educational level of the head of households is associated with 34% - 60% reduction in the probability of catastrophic health expenditures. Education is a proxy for wealth or lifetime income and since more awareness results in knowing and following up health needs seriously; thereby, it causes diminished health expenditures and out-of-pocket payment (28, 29). Health insurance as one of the effective mechanisms of risk pooling plays an important role in mitigating the catastrophic and impoverishing health expenditures. Indeed, most plans of health insurance are a suitable solution to reduce the catastrophic and impoverishing health expenditures resulting from inpatient services (30). The findings of this study are in line with the studies that suggest catastrophic and impoverishing payments due to cardiovascular diseases are more common among non-insured individuals than those who have been insured (31). Similarly, a study in China indicated that non-insured households had a high level of risk of the encounter with catastrophic health expenditures as compared with households covered by the medical insurance for urban employees as well as the medical insurance for urban resident scheme (32). In addition, a study in four media and low-income countries on the microeconomic consequences of cardiovascular diseases indicated that health insurance is associated with catastrophic health expenditures, where the probability of catastrophic health expenditures was two and four times greater among patients without insurance coverage in China and Argentina, respectively as compared with insured individuals. Based on these studies, cardiovascular diseases have a considerable effect on personal health and productivity functions (22).

Hospitalization among cardiovascular patients with a low level of income increases the probability of catastrophic health expenditures (33). For example, Adhikari et al. indicated that around 20% of households benefiting from inpatient services experienced catastrophic and impoverishing health expenditures and other households approached the poverty line (34). One of its reasons based on some evidence is the dominance of the private sector in providing inpatient and outpatient care for cardiovascular patients, though poorer patients are more dependent on the governmental sector, out-of-pocket payment for hospital care in cardiovascular patient's accounts for around 30% of total household costs (23). Generally, the difference of out-of-pocket payments and the catastrophic health expenditures across different studies and countries are affected by the level of poverty, extent of using services, and access to healthcare services, as well as the presence or absence of financial risk pooling mechanisms, including health insurance and tax-based systems.

5.1. Conclusions

The results of this study can be helpful to policymakers to develop policies for greater financial protection of cardiovascular patients. Development of financial risk pooling in the cardiovascular care setting, use of generic medicines instead of brand names in cardiovascular patients, and exempt poor patients' treatment from some payments can be effective mechanisms for financial empowerment and reduction of catastrophic and impoverishing health expenditures, especially in cardiovascular patients, belonging to low-income deciles. Nevertheless, further studies are required to examine the effect of implementing the Iranian health system transformation plan on equity indices for financing and offering outpatient and inpatient services for cardiovascular patients.

Footnotes

Authors' Contribution: Vahid Alipour: conceived and designed the study, analyzed data and wrote the paper. Vahid Alipour, Aziz Rezapour, Jalal Arabloo, Maryam Soleimani Movahed, Saeid Bagheri Faradonbeh, and Samira Alipour: collected data, performed the analysis, and wrote the paper.

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