

## Original Article

**Determinants of Out-of-Pocket Health Expenditure and Catastrophic Health Spending among Households with Elderly Individuals in Iran: An Application of the Heckman Model to Control Sample Selection**Haniyeh Aliakbar<sup>1</sup>, Mahbubeh Parsaeian<sup>1</sup>, Elham Ahmadnezhad<sup>2</sup>, Maryam Tajvar<sup>3</sup>, Mehdi Yaseri<sup>1\*</sup><sup>1</sup>Department of Epidemiology and Biostatistics, School of Public Health, Tehran University of Medical Sciences, Tehran, Iran.<sup>2</sup>Health System Observatory Secretariat, National Institute of Health Research, Tehran University of Medical Sciences, Tehran, Iran.<sup>3</sup>Department of Economics and Management Sciences for Health, School of Public Health, Tehran University of Medical Sciences, Tehran, Iran.

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## ABSTRACT

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**Introduction:** Universal health coverage is a critical goal for low- and middle-income countries, with equitable access to healthcare services being essential to achieving this objective. With the elderly population requiring greater healthcare services, it is crucial to plan for their healthcare needs. This study aims to evaluate the determinants of out-of-pocket payment (OOP) and catastrophic healthcare expenditure among households with elderly individuals in Iran.

**Methods:** This study analyzed the 2018 Household Income-Expenditure Survey in Iran to examine the socio-economic factors affecting OOP (per purchasing power parity International Dollar – PPP. Int \$) and catastrophic healthcare expenditure in households with elderly members. Using survey probit regression model with Heckman selection, the study identified determinants of OOP and catastrophic healthcare expenditures. A survey probit regression model with Heckman selection has been applied to identify the determinants of out-of-pocket (OOP) and catastrophic healthcare expenditures. The approach allowed for the examination of variables that may have impacted the likelihood of incurring OOP and catastrophic healthcare expenditures, while accounting for potential selection bias.

**Results:** Rural households (with difference 60.78 PPP. Int\$) and non-owning homes (with difference 98.83 PPP.Int\$) had higher OOP than their urban and owning counterparts, respectively. Larger households also had higher OOP, with those with five or more members having the highest. High-income households also had higher OOP. Additionally, smaller households had a lower chance of facing catastrophic healthcare expenses. Lastly, the Mills ratio was negative.

**Conclusion:** Our study reveals insufficient observed out-of-pocket (OOP) payments for healthcare in Iran to cover the "needed" OOP, indicating a possible financial burden on households. This highlights the need to address inequalities in healthcare access and expenditure for households with elderly individuals, particularly in rural areas and larger households. Policymakers should implement targeted interventions to reduce OOP for these vulnerable groups. Future research should include socio-economic factors that affect access to healthcare services.

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## Introduction

In the era of Universal Health Coverage (UHC), health has become a critical component of quality of life, due to demographic changes and the emergence of new diseases. As a result, healthcare services play a vital role in preserving people's health.<sup>1, 2</sup> Consequently, healthcare expenditure has been rising steadily, with approximately 10% of the global gross domestic product (GDP) being spent on healthcare. This expenditure includes government spending, out-of-pocket payment (OOP), voluntary insurance, employer-provided programs, and activities by non-governmental organizations.<sup>3</sup> OOP, defined by the World Health Organization (WHO) as direct payments made by individuals to healthcare providers at the time-of-service use, is one of the main dimensions of financial risk protections that should be monitored and evaluated for UHC.<sup>4</sup> Catastrophic health expenditure (CHE), defined by the WHO as OOP expenditure exceeding 40% of household income net of subsistence needs, is a critical issue to be tracked in UHC monitoring and evaluation.<sup>5</sup>

Studies have indicated that an increased need for OOP healthcare expenditure leads to a corresponding decrease in the utilization of health services in low- and middle-income countries (LMICs).<sup>6</sup> Inequities in access to health services, health payments, and distribution of healthcare are crucial public health issues in LMICs.<sup>7</sup> Many countries rely heavily on OOP payment by patients to finance their healthcare systems, which can impede some individuals from seeking care and lead to financial catastrophe and impoverishment for those who obtain care.<sup>8</sup> The distribution of health expenditures in households should

be equitable and based on their available payment,<sup>9</sup> as households with elderly members are at greater risk of high OOP,<sup>10</sup> resulting in CHE. This is especially critical in countries with a high proportion of elderly populations or those with an increasing rate of aging.<sup>11</sup>

Iran, as an LMIC, is experiencing rapid aging,<sup>12</sup> which has intensified in recent years.<sup>13</sup> Consequently, the number of elderly individuals in Iran is expected to increase, posing a significant burden on the healthcare sector in terms of expenditure. Therefore, it is crucial to explore the OOP and CHE in households with elderly members, as well as the demographic and socio-economic factors that influence these costs.<sup>14</sup>

The National Institute for Health Research (NIHR) of Iran reported that per capita direct OOP in households with elderly caretakers was over 1.5 times the average per capita OOP in the whole society in 2018.<sup>15</sup> Moreover, the occurrence of catastrophic and impoverishment health expenditures in households headed by elderly individuals (over 65 years) was almost twice that of households not headed by elderly individuals.<sup>15</sup> Since it is unlikely that these costs will be compensated in households with elderly caretakers, this group is at greater risk of financial health risks.<sup>16</sup>

Given the aforementioned points, this study aims to determine out-of-pocket payment and catastrophic healthcare expenditure, as well as the demographic and socio-economic determinants affecting these costs in households with elderly individuals in Iran. The study intends to provide insights into the cost burden of healthcare on households with elderly members, which could inform policymakers in developing effective strategies to reduce catastrophic health expenditure and improve

financial risk protection for households with elderly individuals. The results of the study could also contribute to the ongoing discourse on achieving UHC in Iran.

## Methods

### Study design and Sample

The study utilized data from the 'National Study of Household Income-Expenditure Survey (2018)', which is a cross-sectional national survey conducted by the National Statistical Center (NSC). The survey aimed to comprehensively assess various domains, including social characteristics of household members, housing characteristics, living facilities, and assets, household food and non-food expenditures, and household income. The survey included 38,960 households residing in both urban and rural areas across different provinces of the country, selected through a three-stage stratified random cluster sampling approach. The required information was collected through face-to-face interviews and questionnaire completion. The present study aimed to investigate the out-of-pocket payment (OOP) and catastrophic healthcare expenditure (CHE) in households with elderly individuals in Iran, as well as the demographic and socio-economic determinants affecting these costs. To achieve this, the collected data was analyzed.<sup>17</sup>

### Variable definition

The independent variables comprise the gender of the head of the household (Male/Female), the age category (years) of the head of the household ( $\leq 60$ , 61-80 and  $81 \leq$ ), education level of the head of the household (Illiterate, Elementary, Middle- and high-school, University degree),

the marital status of the head of the household (Married, Divorced/Widowed, Never married), the place of residence of the household (Urban/ Rural), homeownership (Owning/ Non-owning), the expenditure quintile of the household (one to five - one poorest and five richest), household basic health insurance status (No /Yes), number of household members ( $2 \geq$  members, 3-4 and  $5 \leq$  members), percentage of household members over 65, being elderly of the household's head (No/Yes), and the percentage of employees in households. The dependent variables in this analysis are OOP and CHE.

### Statistical analyses

Initially, we calculated the mean of OOP and the percentage of households with zero payment in each category of independent variables. Additionally, we calculated the standardized incidence of CHE in each category of independent variables. We used the STATA software (v. MP 17, StataCorp, US.) and the survey command (svy): proportion command to calculate the standardized incidence, considering the sampling method and the weight of each household in the region.

Due to the presence of zeroes in the OOP variable, indicating no health payments made by some households during the study period, we considered these zeroes as missing not at random (MNAR) values. The reason behind not spending health payments may vary among households, such as not requiring any health services or not seeking diagnosis or treatment due to socio-economic factors. Since these socio-economic factors may not have been observed or controlled in the study design, we employed methods that could treat such

non-observed factors properly. We treated the response variables as missing data and used appropriate methods to provide unbiased estimates while controlling for non-observed socio-economic factors. Ordinary least squares linear regressions were no longer efficient for this purpose; therefore, we employed other methods.<sup>18, 19</sup>

The present study employed the Heckman sample selection model, which accounts for missing data and mitigates potential sources of bias. The Heckman model was implemented as a two-step process, wherein the first step entailed assessing the determinants of individuals' willingness to pay OOP payments towards health-related expenditures. Subsequently, in the second step, the dependent variable of interest was estimated. It is important to note that certain latent or unobserved factors may exert an influence on the magnitude of health payments. As such, these variables may indirectly impact the independent variables included in the selection model and their relationship with the outcome variable of interest, i.e. OOP payment.<sup>20</sup> We operationalized the latent variable as the households' willingness to pay out-of-pocket, which served as a determinant of the probability of observing or not observing any such payments (the dependent variable in question, i.e., OOP). Specifically, the values of the willingness to pay out-of-pocket were dichotomized as zero and one. In cases where the OOP value equated to zero, the willingness to pay was also assigned a zero value, whereas when OOP exceeded zero, the willingness to pay was coded as one.<sup>21</sup>

In constructing the Heckman selection model, we introduced an additional variable, namely willingness to pay OOP, into the selection equation. It was postulated that the independent

variables of the selection section could potentially exert an indirect influence on the OOP payment variable via this latent variable. Thus, the implementation of the Heckman model permitted the incorporation of random self-selection. To calculate the final outcome variable, CHE, net effective household income after payments for essential goods and services was used as a measure of capacity to pay. The per capita capacity to pay was estimated by adjusting for equivalent household size. CHE was defined as transpiring when the proportion of total OOP surpassed 40% of the per capita capacity to pay.

To account for those with a higher probability of experiencing the outcome event, we employed a survey Probit regression model with Heckman selection for the estimation of CHE. We converted OOP in Rial (as country currency) to purchasing power parity (PPP) in international \$, adopting the World Bank database.<sup>22</sup> The 95% Confidence Interval (CI) has been applied.

## Results

### Baseline characteristic

Table 1 presents the baseline characteristics of the study population. A total of 8,845 households were included in this study, with a total of 24,831 individuals. Of these, 2,392 were elderly individuals. About half of the study population lived in rural areas (54.49%), while the other half lived in urban areas (45.51%). Most of the study population had insurance (85.92%), while the rest did not (14.08%). The mean OOP among households with an elderly member was 122.39 (95% CI: 115.08, 129.69) (PPP. Int \$).

Table 1. Baseline characteristics of households' heads\*

Variable	Groups	Percent (%)	OOP			CHE		
			Zero payment percentage	Mean	SD	Incidence	[95% CI]	
Gender	Male	72.96	24	180.04	12.35	0.04	0.03	0.04
	Female	27.04	31	149.83	17.57	0.05	0.04	0.06
Age category (years)	≤60	9.70	21	221.10	41.61	0.03	0.02	0.06
	61-80	72.64	26	173.58	13.28	0.04	0.03	0.05
	81≤	17.66	27	136.45	16.77	0.05	0.04	0.07
Education level	Illiterate	85.22	27	112.6	7.79	0.05	0.04	0.05
	Elementary	10.76	22	198.48	22.64	0.02	0.01	0.04
	Middle- and high-school	3.48	19	237.88	27.39	0.03	0.01	0.07
	University degree	0.53	19	295.85	39.84	0.00	-	-
Marital status	Married	66.99	24	184.68	12.83	0.04	0.03	0.04
	Divorced / widowed	31.84	31	136.66	14.38	0.04	0.03	0.06
	Never married	1.18	25	382.72	191.92	0.07	0.01	0.31
Place of residence	Urban	45.51	26	194.31	15.19	0.03	0.02	0.04
	Rural	54.49	26	113.17	10.41	0.06	0.05	0.07
Homeownership	Owning	89.20	25	162.27	10.85	0.04	0.03	0.05
	Non- Owning owning	10.80	31	228.36	36.80	0.04	0.03	0.06
Expenditure quintile	1	25.34	43	30.40	1.64	0.02	0.01	0.03
	2	22.15	26	69.47	3.65	0.03	0.03	0.05
	3	19.36	21	91.64	5.01	0.04	0.03	0.06
	4	17.80	18	150.52	9.22	0.04	0.03	0.05
	5	15.36	15	366.33	30.52	0.05	0.04	0.08
Basic Health Insurance	No	14.08	33	138.41	19.08	0.04	0.03	0.05
	Yes	85.92	25	179.33	13.18	0.04	0.03	0.05
Number of household members	2≥	54.75	28	142.53	10.79	0.05	0.04	0.06
	3-4	30.01	24	211.23	22.36	0.04	0.03	0.05
	5≤	15.24	22	197.16	21.23	0.02	0.01	0.04
Percentage of household members over 65	-	-	-	-	-	-	-	-
Being elderly of household's head	No	10.76	21	215.67	38.37	0.03	0.02	0.06
	Yes	89.24	27	167.02	11.83	0.04	0.03	0.05
The percentage of household employees	-	-	-	-	-	-	-	-

\* All the data presented in this table corresponds to the head of household, not the elderly.

### Out-of-pocket payment (OOP)

The data revealed that approximately 26% of households had no OOP payments. Moreover, the skewness and kurtosis indices of this variable were found to be 17.53 and 567.32, respectively. To assess the relationship between OOP expenses and the independent variables, Heckman's method was employed, and the results are presented in Table 2.

According to the results presented in Table 2, the inverse of the Mills ratio was found to be negative (-3.43; 95% CI: -9.22, 2.37), indicating that the observed OOP payment were lower than the "needed" OOP. Additionally, households with divorced or widowed heads were found to have lower OOP than those with married heads, with a statistically significant difference of 98.49 PPP. Int \$ (P=0.01). Interestingly, even though rural households were found to have a lower willingness to pay OOP for health than urban households, the payment rate from rural households was actually 60.78 PPP. Int \$ higher than that from urban households (P=0.01). Additionally, the willingness to pay OOP for health in households without home-ownership was found to be lower than those with home-ownership (P=0.04). However, the amount of payments made by households without home-ownership was significantly higher (98.83 PPP. Int \$) than those with private property (P=0.03).

An association was observed between OOP and household expenditure quintile, with households in higher quintiles exhibiting higher OOP (P<0.001). Moreover, households with three or four members were found to have significantly higher OOP than households with two members or fewer, with a difference of 107.10 PPP. Int \$. Similarly, households with

five or more members were found to have significantly higher OOP than households with two members or fewer, with a difference of 152.67 PPP. Int \$ (P<0.001), indicating that an increase in the number of household members leads to an increase in OOP. Households with insurance were found to have a higher willingness to pay OOP for healthcare than those without insurance (P=0.002), however, the actual amount of OOP in households with insurance was found to be 10.06 PPP. Int-\$ lower than those without insurance, though this difference was not statistically significant (P=0.70).

Furthermore, the impact of several other variables on the willingness and amount of OOP was also investigated. Specifically, variables such as the gender of the head of the household, the education level of the head of the household, the percentage of household members over the age of 65, the age group of the head of the household, and the percentage of employed members of the household were evaluated. However, the findings revealed that these variables did not have a statistically significant effect on the willingness and amount of OOP (P>0.05).

### Catastrophic health expenditures

The impact of independent variables on catastrophic health expenditure was assessed using Heckman's method, and the outcomes are displayed in Table 3. This table shows that as the expenditure quintile increases, the probability of encountering catastrophic health expenditure decreases, as evidenced by a significant p-value ranging from 0.03 to 0.12. In contrast, the willingness to pay OOP increases, with a highly significant (P=0.001).

Table 2. Results of Heckman model for out-of-pockets payments(PPP.Int \$)\*

Variable	Groups	Decision equation				Selection equation			
		Coefficients	[95% CI]		p-value	Coefficients	[95% CI]		p-value
Gender	Male	-	-	-	-	-	-	-	-
	Female	52.26	-28.79	133.32	0.21	-0.02	-0.21	0.16	0.82
Age classification (years)	≤60	-	-	-	-	-	-	-	-
	61-80	-83.05	-201.06	34.96	0.17	0.04	-0.36	0.44	0.83
	81≤	-69.77	-202.13	62.58	0.30	0.12	-0.30	0.54	0.58
Education level	Illiterate	-	-	-	-	-	-	-	-
	Elementary	5.80	-48.65	60.25	0.83	0.04	-0.08	0.15	0.56
	Middle- and high-school	-51.06	-126.14	24.03	0.18	0.13	-0.03	0.29	0.11
	University degree	-63.37	-162.73	35.99	0.21	0.15	-0.10	0.40	0.24
Marital status	Married	-	-	-	-	-	-	-	-
	Divorced / widowed	-98.49	-167.16	-29.82	0.01	-0.15	-0.34	0.04	0.13
	Never married	130.16	-313.48	573.80	0.57	-0.09	-0.53	0.34	0.67
Place of residence	Urban	-	-	-	-	-	-	-	-
	Rural	60.78	17.41	104.15	0.01	-0.06	-0.18	0.06	0.33
Homeownership	Owning	-	-	-	-	-	-	-	-
	Non- Owning owning	98.83	11.35	186.31	0.03	-0.14	-0.27	-0.01	0.04
Expenditure quintile	1	-	-	-	-	-	-	-	-
	2	71.63	54.55	88.71	<0.001	-	-	-	-
	3	129.94	105.63	154.25	<0.001	-	-	-	-
	4	213.57	176.11	251.03	<0.001	-	-	-	-
	5	514.77	418.09	611.45	<0.001	-	-	-	-
Basic Health Insurance	No	-	-	-	-	-	-	-	-
	Yes	-10.06	-61.98	41.86	0.70	0.24	0.09	0.40	<0.001
Number of household members	2≥	-	-	-	-	-	-	-	-
	3-4	107.10	35.00	179.21	<0.001	-0.05	-0.15	0.06	0.38
	5≤	152.67	62.88	242.46	<0.001	-0.01	-0.15	0.14	0.94
Percentage of household members over 65	-	-0.99	-2.18	0.21	0.11	-	-	-	-
Being elderly of household's head	No	-	-	-	-	-	-	-	-
	Yes	54.48	-17.58	126.54	0.14	-0.10	-0.49	0.29	0.62
The percentage of household employees	-	-0.67	-1.66	0.33	0.19	-0.0001	-0.0021	0.0020	0.95
Constant	-	28.34	-99.17	155.85	0.66	0.56	0.32	0.81	<0.001
Mills Ratio	-	-3.43	-9.22	2.37					

\* All the data presented in this table corresponds to the head of household, not the elderly.

Moreover, households with insurance were found to have a higher willingness to pay OOP than those without insurance ( $P=0.003$ ), but also a lower probability of facing CHE ( $P=0.04$ ). In addition, an increase in the number

of household members ( $n \geq 5$ ) was associated with a higher willingness to pay OOP ( $P=0.001$ ) and a lower probability of facing catastrophic health expenditure ( $P=0.01$ ) compared to the reference group with members  $\leq 2$ .

Table 3. Results of Heckman model for catastrophic health expenditures\*

Variable	Groups	Decision equation			Selection equation				
		Coefficients	[95% CI]	p-value	Coefficients	[95% CI]	p-value		
Gender	Male	-	-	-	-	-	-	-	
	Female	0.15	-0.06	0.37	0.17	-0.05	-0.24	0.13	0.57
Age classification (years)	$\leq 60$	-	-	-	-	-	-	-	
	61-80	-0.21	-0.68	0.26	0.37	-0.14	-0.54	0.26	0.48
	$81 \leq$	-0.24	-0.72	0.24	0.33	-0.06	-0.49	0.37	0.79
Education level	Illiterate	-	-	-	-	-	-	-	
	Elementary	0.02	-0.15	0.19	0.82	-0.15	-0.27	-0.02	0.02
	Middle- and high-school	-0.15	-0.50	0.19	0.38	-0.20	-0.37	-0.03	0.02
	University degree	-0.10	-0.51	0.31	0.65	-0.29	-0.55	-0.02	0.03
Marital status	Married	-	-	-	-	-	-	-	
	Divorced / widowed	0.02	-0.22	0.26	0.88	-0.22	-0.41	-0.02	0.03
	Never married	0.27	-0.28	0.82	0.34	-0.16	-0.60	0.27	0.46
Place of residence	Urban	-	-	-	-	-	-	-	
	Rural	0.06	-0.22	0.34	0.69	0.24	0.11	0.37	<0.001
Homeownership	Owning	-	-	-	-	-	-	-	
	Non- Owning owning	0.12	-0.02	0.26	0.10	-0.12	-0.25	0.02	0.10
Expenditure quintile	1	-	-	-	-	-	-	-	
	2	-0.32	-0.61	-0.04	0.03	0.56	0.43	0.68	<0.001
	3	-0.32	-0.69	0.04	0.08	0.67	0.53	0.80	<0.001
	4	-0.55	-1.01	-0.09	0.02	0.98	0.82	1.14	<0.001
	5	-0.50	-1.14	0.13	0.12	1.19	1.02	1.36	<0.001
Basic Health Insurance	No	-	-	-	-	-	-	-	
	Yes	-0.18	-0.35	-0.01	0.04	0.08	0.08	0.38	0.003
Number of household members	$2 \geq$	-	-	-	-	-	-	-	
	3-4	-0.07	-0.25	0.11	0.45	0.15	0.001	0.30	0.05
	$5 \leq$	-0.32	-0.57	-0.07	0.01	0.37	0.15	0.58	0.001
Percentage of household members over 65	-	-0.0003	-0.003	0.003	0.82	0.001	-0.001	0.004	0.37
Being elderly of household's head	No	-	-	-	-	-	-	-	
	Yes	0.28	-0.11	0.68	0.16	-0.12	-0.51	0.27	0.54
The percentage of household employees	-	0.0003	-0.002	0.003	0.85	-0.002	-0.004	0.0003	0.10
Constant		-0.24	-1.03	0.55	0.55	-0.02	-0.33	0.28	0.88

\*All the data presented in this table corresponds to the head of household, not the elderly.



According to the results presented in the study, the willingness to pay OOP ( $P < 0.001$ ) and the probability of facing CHE ( $P = 0.69$ ) were found to be higher in rural households compared to urban households. Furthermore, the study found that households with divorced or widowed heads had a higher willingness to pay OOP ( $P = 0.03$ ) and a higher probability of facing CHE ( $P = 0.88$ ) compared to households with married heads. Moreover, literacy by the head of the household was found to reduce the willingness to pay OOP ( $P$  ranging from 0.02 to 0.03) and the probability of facing CHE ( $P$  ranging from 0.32 to 0.82).

Lastly, it was observed that several other variables, such as the gender of the head of the household, the percentage of household members over 65 years old, the age group of the head of the household, and the percentage of employed members of the household, did not show any significant impact on the willingness to pay OOP and the probability of facing CHE ( $P > 0.05$ ).

## Discussion

This study aims to investigate the factors that impact OOP payments and CHE among households with elderly individuals in Iran. It explores the influence of demographic and socioeconomic variables such as age, gender, percentage of household members over 65 years old, being elderly of the household's head, and the percentage of employees in households on OOP payments and CHE using the Heckman model. The study's findings reveal that the demographic and socioeconomic variables considered did not significantly affect either OOP or CHE. These results are consistent with previous studies, such as Kim and Jacobson

(2022), who found no significant difference in exposure to CHE between males and females.<sup>23</sup> Similarly, Shahraki et al. (2022) reported that increasing the age, level of education, and employment of the head of the household led to an increase in OOP for the elderly households.<sup>24</sup> Additionally, Du et al. (2019) assessed the determinants of OOP pharmaceutical expenditure among Chinese middle-aged and elderly adults and found that having health insurance significantly reduced the likelihood of OOP for outpatient and inpatient services but increased OOP for self-medication.<sup>25</sup>

However, the study's results indicate that OOP decreased as the head of the household aged, although this effect was not statistically significant. The coefficient of willingness to pay OOP in the selection equation revealed that with the increasing age of the head of household, the willingness to pay OOP increases, but eventually, the OOP of households is reduced due to declining income levels.<sup>26</sup> Furthermore, households with five or more members had more OOP than households with two or less members, and the willingness to pay OOP was higher in households with two or three members over 65 years of age than in households with one member over 65 years of age.

The study also found that OOP was higher in rural households than in urban households. Despite the establishment of primary health care systems in rural areas for about 5 decades, high OOP payments in these areas need attention. Although the path of referring villagers to receive more specialized services is somewhat defined, it is still incomplete, and it is necessary to study the main determinants of OOP payments in this group. A study aimed at investigating the determinants of CHE shows

that the highest incidence of these expenses occurs in villagers with income quintile 5 and for outpatient services, indicating that this group has a very high share in OOP payments.<sup>27</sup> They do not benefit from the services provided in the village under the primary health care program. Therefore, reviewing the family physician program implemented in the village according to the results of this study is one of the most important requirements in designing more appropriate interventions.<sup>28</sup> Furthermore, the study's results suggest that rural households are probably willing to pay less OOP than urban households. The negative coefficient of willingness to OOP in the selection equation suggests that visiting a doctor in acute situations incurs higher health costs.

The study's strengths include the use of Heckman's method to control for selection bias, which allows for more accurate and reliable outcomes. However, the data used in this study were collected for other purposes, limiting the consistency of the type and number of variables with the study objectives and design. Moreover, the lack of information about individual-level variables such as underlying diseases and type of insurance used by the household is a limitation that could have enriched the results if available. The study's findings provide insights into the determinants of OOP payments and CHE among households with elderly individuals in Iran, which can inform policymakers to design appropriate interventions to improve healthcare access and financial protection for this vulnerable group.

This research study has both strengths and limitations that must be considered when interpreting its findings. One of the strengths of this study is the use of the Heckman method to control for selection bias, which has allowed

for more accurate and reliable results. Previous studies that have not accounted for random missing data in their analysis may have produced biased results. Therefore, the use of the Heckman model in this study is a significant improvement that enhances the reliability of the study's findings.

However, there are also limitations to this study that should be acknowledged. Firstly, the data used in this study were collected for other purposes, specifically the Household Income-Expenditure Survey. Therefore, the type and number of variables included in this dataset may not be fully compatible with the specific objectives and design of this study. This limitation may have introduced some error into the results, particularly if important variables were missing from the dataset. Secondly, the study only analyzed the results at the household level and did not have access to information about individual-level variables such as underlying diseases, insurance types, and other relevant information specific to elderly individuals. This limitation may have resulted in an incomplete picture of the factors influencing OOP payment and catastrophic health expenditures for elderly individuals in Iran. Therefore, it is important to consider these limitations when interpreting and applying the results of this study.

## **Conclusion**

Based on our study, we found that the observed out-of-pocket (OOP) payments for healthcare in the Iranian population are insufficient to cover the "needed" OOP, which suggests a potential financial burden on households. Our analysis indicated that certain demographic parameters such as age and gender of the household's head

did not significantly affect OOP and catastrophic healthcare expenditure. However, variables such as income level, education level of the household's head, place of residence, household basic health insurance status, homeownership, and number of household members significantly impacted these outcomes. These findings have significant implications for policymakers and health authorities in reducing healthcare costs for households with elderly individuals. Future studies should consider incorporating variables related to the deprivation of healthcare services due to socioeconomic factors and residency in rural areas.

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