Iranian Economic Review, 29(4), 1256-1288
DOI: https://doi.org/10.22059/ier.2023.360860.1007746

RESEARCH PAPER

Impact Evaluation of Instability of Financial Resources in Health System Transformation Plan on Achieving Financial Protection in Universal Health Coverage

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Received: 15 June 2023, Revised: 28 September 2023, Accepted: 17 October 2023, Published: 15 December 2025

Publisher: University of Tehran

Abstract

Universal health coverage is defined as the reception of health services by all individuals without fear of financial hardship. The goal of financial protection in universal health coverage is to ensure that direct payments for health by households (out-of-pocket expenses) are not catastrophic or impoverishing. The Health System Transformation Plan was implemented in Iran in 2014, fully aligned with the goal of financial protection in universal health coverage. However, the financing resources of this plan were not fully allocated in 2017, and the financial support to households decreased. This increased direct payments by households and the incidence of catastrophic health expenditure and impoverishing health expenditure for them in the coming years. This study examined the level of vulnerability of different groups of households with different socioeconomic characteristics due to the reduced support of this plan. The research method was the econometric strategy of policy impact evaluation by propensity score matching. The data used involved a household income and expenditure survey. Direct payments for health by households increased, especially in 2019, due to the decrease in financial support of this plan in 2017. Catastrophic health expenditure occurred mainly in low-income deciles in urban areas and middle-income deciles in rural areas. Besides, impoverishing health expenditure occurred more frequently among unemployed urban household heads, urban heads under 15 and over 64 years old, and rural female heads. Therefore, more vulnerable groups should be covered more by insurance in future health system policies.

Keywords: Catastrophic Health Expenditure, Impoverishing Health Expenditure, Iran, Out-of-Pocket Expenses, Propensity Score Matching.

JEL Classification: C40, D10, G52, I13, I18, R28.

1. Introduction

1.1 Universal Health Coverage

Universal health coverage (UHC) (a goal of sustainable development) is defined as the reception of health services by all individuals and all countries without fear

of financial hardship. UHC has two goals of increasing "financial protection" and increasing "access to quality health services" (World Health Organization, 2023b). In this research, only the goal of financial protection is considered. Out-of-pocket (OOP) expenses are expenses paid directly by households to providers of health goods and services. The goal of financial protection in UHC is that OOP expenses do not expose people to economic pressure and do not threaten living standards (World Health Organization, 2023a). The indicators used to measure the level of financial protection in UHC are defined on two bases:

A. The incidence of catastrophic health expenditure (CHE)

OOP expenses are considered CHE when they exceed a certain percentage of household consumption expenditures. The indicators defined based on the incidence of CHE include (World Health Organization, 2021a):

- $CHE_{\%10}$ and $CHE_{\%25}$: The proportion of the population with OOP expenses of more than 10% and 25% of the total household consumption expenditures, respectively (World Health Organization, 2021a).
- $CHE_{\%40}$: The proportion of the population with OOP expenses more than 40% of the total household non-food consumption expenditures (World Health Organization, 2021a).

B. The incidence of impoverishing health expenditure (IHE)

OOP expenses can either push households into poverty or aggravate their sub-poverty situation. The degree of impoverishment caused by OOP expenses can be measured by the proportion of the population whose total consumption expenditures are above the poverty line, but due to OOP expenses, they have gone below the poverty line (Hsu et al., 2020). The indicators defined based on the incidence of IHE include:

- $IHE_{\$1.9}$ and $IHE_{\$3.2}$: The proportion of the population with total consumption expenditures minus OOP expenses below the poverty line of 1.9 and 3.2 US dollars per person per day, respectively, based on purchasing power parity (PPP) in 2011 (World Health Organization, 2021a).

In fact, these indicators measure the vulnerability of households to OOP expenses.

1.2 Health System Transformation Plan

The Health System Transformation Plan (HTP) was implemented in Iran in 2014. One of the goals of HTP in terms of financial protection has been to reduce OOP expenses and the probability of CHE and IHE incidence for the household. In this regard, under HTP, a large number of people without health insurance were

covered by public health insurance provided by the Iran Health Insurance Organization (IHIO) (Iranian Ministry of Health and Medical Education, 2014). In fact, the goal of financial protection in HTP has been consistent with the goal of financial protection in UHC.

According to the law, HTP financing sources include a share of the government budget, 1% of value-added tax, 10% of sources of targeted subsidies, duties on the production, import, and supply of harmful goods and services, duties on tobacco and sugar products, and 10% of the third party insurance premium (Islamic Consultative Assembly of Iran, 2014). The most important challenge of HTP is the instability of its financing sources.

Table 1 shows the financial resources of HTP in 2014-2020. A high budget should have been allocated to HTP in 2017 according to the law, but the budget was drastically reduced in practice. This reduction was more intense in 2018. No information is available about the budget allocated to HTP in 2019 and 2020. Only a performance estimate is provided to evaluate these years. However, more detailed documentation is needed. Evidence suggests that HTP's financial resources have become unstable since 2017 (Plan and Budget Organization of Iran, 2021).

Table 1. Health System Transformation Plan Financing Sources

(billion Rials)	2014		2015		2016		2017		2018		2019		2020	
	Law	In practice	Law	In practice	Law	In practice	Law	In practice	Law	In practice	Law	Performance estimation	Law	Performance estimation
HTP	48000	43900	48000	36781	40000	40000	40000	25860	37000	17500	49000	47530	52000	52000

Source: Plan and Budget Organization of Iran, 2021.

Table 2. The Population Covered by the Iran Health Insurance Organization and its Share of the Total Health Expenditures

Year	2013	2014	2015	2016	2017	2018	2019
Population covered by IHIO* (million people)	33.8	39.6	38.4	38.4	41.2	41.3	42.1
IHIO payment of the total health expenditures ** (million Rials)	46027027	87114821	124045286	154693248	162986540	151840558	169437155
Total health expenditures** (million Rials)	656537807	909396935	1080717180	1209966019	1372165220	1544179019	1919514466
IHIO's share of total health expenditures *** (%)	7	9.5	11.4	12.7	11.8	9.8	8.8

Source: *Iran Health Insurance Organization, 2019, ** Statistical Center of Iran, 2013-2019, *** Research finding.

Table 2 shows the population covered by IHIO and the share paid by this organization from the total health expenditures in 2013-2019 (Iran Health Insurance Organization, 2019, and Statistical Center of Iran, 2013-2019). The size of the population covered by the IHIO was almost on the rise until 2019 (Iran Health Insurance Organization, 2019). Note that the share paid by IHIO of the total health expenditures increased during 2013-2016, but this share decreased in 2017 due to the instability of resources this year, and this downward trend has continued (Statistical Center of Iran, 2013-2019). Most health expenditures will have to be paid by the households themselves (in the form of OOP expenses) when health insurance coverage is reduced. This may put them in contact with CHE or IHE.

A revision of previous health system programs, such as HTP, will be the basis for designing new health system programs. The participation of households in the health system should be fair. This means that the participation of each household should be designed based on the "ability to pay" of the household. The most important contribution of households in the health system is OOP expenses (Hsu et al., 2020). To design a new system of financial protection for households in the health system based on the household's ability to pay, it is necessary to monitor the HTP to identify the vulnerable groups of society when the financial resources of this plan are reduced. Therefore, this study investigates the level of exposure of households to CHE and IHE in 2018-2019 due to the reduction of the HTP budget in 2017 and the increase in OOP expenses of households[1].

Moreover, considering that the socioeconomic status of households affects the probability of facing CHE and IHE, the effect of the instability of financial resources of the HTP on the incidence of CHE and IHE are examined separately in households with different income deciles, different places of residence, and different characteristics of the heads of households. The purpose of this analysis is to examine the differences in the level of vulnerability of households with different socioeconomic statuses, in relation to the instability of the resources of the HTP. This study makes it possible to design financial support in the future plans of the health system in such a way that more financial support is provided for more vulnerable groups and less financial support for less vulnerable groups. This will lead to a more optimal allocation of financial resources for health system plans and will make it possible to provide the necessary budget.

[1]. Note that only these two years can be analyzed due to data availability. Because national health accounts are provided only until 2019.

2. Literature Review

2.1 Theoretical Background

This study performed an economic analysis of health system plans (microeconomics of health).

As explained in the previous section, the instability of HTP's financial resources in 2017 reduced public health insurance coverage provided to households under HTP. The demand for health insurance is the demand to cover the financial risk caused by the occurrence of chronic diseases or health shocks, and actually prevent CHE and IHE for the family.

Souri (2022) presented the model of the demand for health insurance. Health insurance coverage is one of the main bases of the insurance contract between the insurance organization and the insured, according to which the health insurance organization undertakes to compensate the health expenses incurred by the insured. The health insurance organization provides health insurance coverage by receiving insurance premiums. In general, insurance coverage can be full or partial. In full coverage, all costs are paid by the insurance organization. In partial coverage, part of the costs will be compensated by the insurance organization, and the other part will be paid by the insured. Health insurance coverage is a type of partial coverage. The reason for providing partial health insurance is that people have the motivation to prevent diseases. Partial health insurance is known as coinsurance. In coinsurance, a fixed proportion of health expenses is paid by the health insurance organization. In this type of insurance, if X is the total health expenditures, the insurance organization always covers a fixed proportion λ of the total health expenditures (Equation 1).

$$C(X) = \lambda X \qquad 0 < \lambda < 1 \tag{1}$$

where $C(.)$ is the amount of insurance coverage by the health insurance organization. In this equation, $\lambda = 0$ means no insurance coverage and $\lambda = 1$ means full insurance coverage. In fact, coinsurance is a type of partial insurance coverage that divides the total health expenditures relatively between the health insurance organization and individuals. According to Equation 1, if the health insurance organization covers a higher proportion of the total health expenditures, the OOP expenses of the household will decrease.

It is worth mentioning that some people don't face only one risk or disease. It is possible for a person to have several diseases at the same time. For this reason, the health insurance organization defines X as a random variable that can be placed in the range of 0 to X_m ($X \in [0\,,\, X_m]$). In fact, X_m shows the

maximum health expenditures. $F(X)$ is the probability distribution function, and Equation 2 shows the probability density function of X.

$$f(X) = \frac{dF}{dX} \quad (2)$$

In this case, the insurance organization should estimate the amount of expected health expenditures ($E(X)$) (Equation 3).

$$E(X) = \int_0^{X_m} Xf(X)dX \quad (3)$$

The economic theory of Sun and Lyu (2020) defines the type of health insurance coverage, the socioeconomic conditions of households, and the level of household health as a basis for changes in OOP expenses and the occurrence of CHE and IHE for households (Equation 4).

$$\log(P_{it}) = \beta_0 + \beta_1 * I_{it} + \beta_2 * D_{it} + \beta_3 * H_{it} + \varepsilon_{it} \quad (4)$$

where P_{it} is the probability of the incidence of CHE or IHE for household i at time t, I_{it} is the type of health insurance of household i and its coverage at time t, D_{it} is the vector of demographic indicators and the socioeconomic status of household i at time t, and H_{it} shows the level of health (presence or absence of a patient with a chronic disease in the family) for household i at time t.

Woldemichael et al. (2021) calculated $\text{CHE}_{\%40}$. To calculate $\text{CHE}_{\%40}$, it is necessary to calculate household capacity to pay (CTP) first. CTP is equal to the total household consumption expenditure minus household food expenditure. In other words, CTP is equal to household non-food expenses (Equation 5).

$$CTP_h = T_h - F_h \quad (5)$$

where, CTP_h, T_h and F_h are the payment capacity of household h, total consumption expenditure of household h, and food expenditures of household h, respectively.

Household food expenditures are defined as household subsistence expenditures; therefore:

$$CTP_h = T_h - S_h \quad (6)$$

where S_h is the subsistence expenditure of household h.

Based on this, $\text{CHE}_{\%40}$ is defined as follows:

$$\text{CHE}_{\%40} = \frac{OOP_h}{CTP_h} \geq 0.4 \quad (7)$$

where OOP_h is the OOP health expenditure of household h.

Based on Equation 7, if the ratio of the OOP of household h to the CTP of household h is more than 40%, then household h has faced CHE.

In addition, the economic theory of Sirag and Nor (2021) shows the relationship between health OOP expenses and the incidence of poverty. OOP expenses for health care can increase the financial risk and, consequently, the possibility of poverty. Equation 8 expresses the relationship between OOP expenses and poverty at the household level.

$$pov_{ht} = \beta(oop_{ht}) + \pi(Z_{ht}) + \varepsilon_{ht} \quad (8)$$

where pov_{ht} is the probability of poverty in household h at time t, oop_{ht} is OOP expenses of household h at time t, Z_{ht} is the vector of control variables of household h at time t (including the socioeconomic characteristics of the household), and ε_{ht} is the error term.

For a more detailed examination, a threshold level can be considered for OOP expenses. In this case, the probability of poverty can be calculated separately for different levels of OOP expenses (less or more than the threshold level) (Equation 9).

$$pov_{ht} = \beta_1(oop_{ht} I(oop_{ht} \leq \gamma)) + \beta_2(oop_{ht} I(oop_{ht} > \gamma)) + \pi(Z_{ht}) + \varepsilon_{ht} \quad (9)$$

where γ indicates the threshold level. Based on Equation 9, the probability of poverty in the household depends on whether the OOP expenses of the household are higher or lower than the threshold level.

2.2 Empirical Background

Some studies investigated the effects of HTP implementation on the OOP expenses of households, in a specific province or a treatment center before 2017. Some of them are reviewed below.

Alipour et al. (2021) conducted an analytical-descriptive study of cardiovascular patients hospitalized in Ardabil hospitals (Iran) in 2016 (two years after the implementation of the HTP) compared to 2013 (before the implementation of the HTP). They concluded that the OOP expenses have decreased from 54.2% to 36.7% during the mentioned years.

Ahmadi et al. (2021) conducted a meta-analysis of studies analyzing HTP during the years 2014 to 2017 and showed that this plan had almost achieved its financial goals until 2017.

Abdi et al. (2020) compared the per capita indicator of OOP expenses, the percentage of people who faced CHE, and the percentage of people who faced IHE, in 2014 (the year of HTP implementation) and 2015 (one year after HTP implementation) by analyzing the household income and expenditure survey (HIES) data. During the mentioned period, the first index decreased by 2.5%, the

second index decreased by 0.8%, and the third index increased by 0.3%. In other words, this plan has been effective in improving the financial support of individuals against health expenses, but it has not had such effects on the poor.

Bayati et al. (2020) presented a time-series analysis of the effects of two fundamental reforms in the health system of Iran, including the implementation of the HTP and the Family Doctor Plan from 2009 to 2016, on the use of health services and health costs in Fars Province. The results showed that the Family Doctor Plan prevented the use of many unnecessary health services and additional health costs by correctly visiting patients. Nevertheless, the HTP increased the use of health services and, subsequently, the health costs in the Fars Province by increasing access to health services.

Harirchi et al. (2020) analyzed the goals, interventions, and achievements of the HTP after one year of implementation (2015). The goals of the plan related to financial support included stabilizing the financial resources of the health sector and expanding health insurance coverage. The interventions carried out in 2015 included defining more sources of funding for the health sector by the government, expanding insurance coverage for people without insurance, reducing insurance premiums and OOP expenses for inpatients or outpatients, covering most of the costs of incurable diseases, and controlling the price of medicines and medical equipment. The achievements of this plan in 2015, compared to the year 2013 (before the implementation of the plan), included an increase in government spending in the health sector, a rise in the number of people covered by insurance in the country, a reduction of informal payments, and a decrease in the number of people faced with CHE.

According to Noura and Zanganeh's (2020) short letter to the editor, the HTP implemented in Iran in 2014, with the goals presented in its constitution, is an important step towards the Alma-Ata declaration. This declaration, presented in 1978 by the World Health Organization as a turning point in the public health of all people of the world in the 20th century, states that since the year 2000, access to primary health services has been considered a basic human right. The main goal of this declaration is "health for all".

Seyedin et al. (2020) adopted an analytical-descriptive approach and examined patients hospitalized in five hospitals affiliated with the Iran University of Medical Sciences in 2016. They showed that the implementation of the HTP did not significantly reduce the OOP expenses of these patients.

In addition to the above studies, other studies such as those by Nemati et al. (2020), Vahedi et al. (2020), Doshmangir et al. (2019), Olyaeemanesh et al.

(2018), Rahmany et al. (2018), Ferdosi et al. (2017), and Piroozi et al. (2017) also evaluated the HTP in the early years of the plan's implementation.

The World Health Organization (2021b) calculated $CHE_{\%10}$, $CHE_{\%25}$, $IHE_{\$1.9}$, and $IHE_{\$3.2}$ for Iran in 2013 as 15.8%, 3.8%, 0.01%, and 0.17%, respectively.

Rezaei et al. (2020) calculated the CHE for thresholds of 20%, 30%, and 40% of the CTP for six years, including 1991, 1996, 2001, 2006, 2011, and 2017. The CHE for thresholds of 20%, 30%, and 40% of the CTP in 2011 was 13.86%, 6.43%, and 3.38% and in 2017, it was 22.16%, 10.88%, and 5.26%, respectively. The results of this study generally showed that the incidence of CHE was increasing from 1991-2017 for all three thresholds, even after the implementation of the HTP.

Hsu et al. (2020) reported that during 2007-2015, $CHE_{\%10}$ increased from 11.4% in 2007 to 17% in 2015. The rise in OOP expenses occurred mostly in the upper-income deciles. The $CHE_{\%25}$ rose from 2.9% in 2007 to 3.9% in 2015. The $CHE_{\%40}$ increased at a milder rate during the period compared to previous indicators. During 2007-2015, $IHE_{\$1.9}$ and $IHE_{\$3.2}$ were almost constant and at very low levels. The greatest effects of impoverishment were directed at low-income deciles and rural residents.

Hsu et al. (2021) found that $CHE_{\%10}$ and $CHE_{\%25}$ increased and $CHE_{\%40}$ decreased during 2005-2017. The $CHE_{\%10}$ and $CHE_{\%25}$ occurred more in lower-income deciles, and the $CHE_{\%40}$ occurred more in upper-income deciles. In this study, the CHE of the household is calculated by using Equation 10.

$$\frac{\sum_h m_h w_h \, 1(OOP-share_h>t)}{\sum_h m_h w_h} \tag{10}$$

where h is a household, m_h is the number of household h members, and w_h is the weight of the household h from the total health expenditure. $OOP - share_h$ indicates the share of OOP expenses of household h from total household consumption expenditures (in the calculation of $CHE_{\%10}$ and $CHE_{\%25}$) and the share of OOP expenses from total household non-food consumption expenditures (in the calculation of $CHE_{\%40}$). t indicates the threshold of CHE, which can be considered 10%, 25%, or 40%. The function $1(OOP - share_h > t)$ is equal to 1 when the desired condition occurs, and 0 otherwise. For example, in the calculation of $CHE_{\%10}$, if OOP expenses are more than 10% of the total household h consumption expenditures, the household h has faced $CHE_{\%10}$, and this function is equal to 1; otherwise, it will be zero.

Woldemichael et al. (2021) examined the incidence of CHE in dental care applicants in 2018.

Some studies provided qualitative analyses of the achievement of UHC goals before 2016 in Iran, through the implementation of HTP (Kouhpaye-Zadeh and Kasaeeyan, 2018; Letafat et al., 2018; Sajadi and Majdzadeh, 2019; Sajadi et al., 2019; Sajadi et al., 2020).

Previous studies have not conducted a financial evaluation of HTP since 2017, which was parallel to the reduction of funding sources. However, this study carries out a financial evaluation of HTP by measuring the incidence of CHE and IHE caused by the reduction of the HTP budget and uses a different method called econometrics of policy impact evaluation. This method can show what changes have occurred in the incidence of CHE and IHE in the following years, only due to the reduction of the HTP budget in 2017. In addition, this method takes into account the specific characteristics of each household, including the place of residence (urban and rural), income status (income deciles), and the status of the head of the household (age, sex, employment, marital status, and educational level). More detailed explanations about the research method will be provided in the methodology section.

3. Methods and Materials

3.1 Data

The statistical population under study includes all households living in urban and rural areas of Iran. The statistical sample includes households whose information is provided in HIES.

The data used in the HIES in 2016-2019 include the socioeconomic status of household heads (age, sex, employment, marital status, and educational level), household consumption expenditures, and household incomes (in urban and rural areas) (Statistical Center of Iran, 2016-2019a).

It is worth mentioning that in 2016, 2017, 2018, and 2019, the number of sample households living in urban areas was 18809, 18701, 20350, and 19898 households, respectively, and the number of sample households living in rural areas was 19337, 19261, 18610 and 18430 households, respectively (Statistical Center of Iran, 2016-2019b).

From the national health accounts, the total health expenditures and the share of IHIO from the total health expenditures were extracted. The national health accounts were presented only up to 2019, and, therefore, the evaluations of

this study were performed only up to this year (Statistical Center of Iran, 2013-2019).

The poverty line for different years was calculated using the PPP rate of Iranian rials against US dollars (The World Bank, 2017) and the consumer price index (Statistical Center of Iran, 2020).

3.2 Econometric Strategy

Data analysis was performed with the econometric method of policy impact evaluation by propensity score matching (PSM). The policy impact evaluation method measures the changes that can be attributed to the implementation of a policy. In the present study, the policy is the reduction of financial support for households in HTP due to the reduction of its budget in 2017. This method demonstrates the changes in the outcome variable (incidence of CHE and IHE) in two years after the implementation of the policy (2018-2019) compared to the year before its implementation (2016), taking into account the special characteristics of each household, including the place of residence, income status, and conditions of the household head.

In this method, the treatment and control groups are defined. The treatment group is the households exposed to the implementation of the policy (the households for which the public health insurance coverage was decreased due to the reduction of the HTP budget); the control group is the households not exposed to the implementation of the policy (the same households if the reduction of the HTP budget had not occurred and the public health insurance coverage had not decreased for them). According to Table 2, the share of the IHIO organization of the total health expenditures (in the form of public health insurance coverage) has dropped from 12.7 in 2016 to 9.8 in 2018 (equivalent to a decrease of 22.84%) and to 8.8 in 2019 (equivalent to a decrease of 30.7%). In 2018, compared to 2016, the IHIO organization paid 22.84% less from total health expenditures through the reduction of public health insurance coverage. These expenditures were inevitably paid by households in the form of OOP expenses. Therefore, in 2018, for the households that are members of the treatment group, the amount of OOP payments is considered according to the OOP data of the households in HIES; however, for the households that are members of the control group, the amount of OOP payments is considered 22.48% less than the OOP data of the households in HIES. Because the households in the control group would have paid 22.48% less (in the form of OOP expenses) if the reduction of the HTP budget had not occurred, in 2019,

compared to 2016, the decrease in OOP expenses of the households in the control group is considered to be 30.7%.

Heinrich et al.'s (2010) model measures the impact of a policy with the PSM method. In this method, γ_i is the impact of a policy on a household i and is defined as the difference between the outcome variable (incidence of CHE or IHE) in case of treatment (W_{1i}) and the outcome variable in the absence of treatment (W_{0i}) (Equation 11).

$$\gamma_i = W_{1i} - W_{0i} \quad (11)$$

In general, in the policy impact evaluation model, the average effect of a policy on all households is estimated, which is known as the average treatment effect (ATE) (Equation 12).

$$ATE = E(\gamma) = E(W_1 - W_0) \quad (12)$$

where $E(.)$ represents the expected value (average effect on all households).

To evaluate the effect of the policy on the households participating in the program (treatment group), the average treatment effect on the treated (ATT) is calculated (Equation 13).

$$ATT = E(W_1 - W_0|D = 1) \quad (13)$$

In addition, the average treatment effect on the untreated (ATU) shows the effect of the policy on households that do not participate in the program (the control group) (Equation 14).

$$ATU = E(W_1 - W_0|D = 0) \quad (14)$$

Equation 13 can be rewritten as follows:

$$ATT = E(W_1|D = 1) - E(W_0|D = 1) \quad (15)$$

where $E(W_0|D = 1)$ is an average of the outcome variable for the households in the program group if they had not participated in the program, which is not observed. In fact, this term is a counterfactual value of the outcome variable. However, the term $E(W_0|D = 0)$, which is the outcome variable for the households in the control group, is visible. Therefore, Λ can be defined as follows:

$$\Lambda = E(W_1|D = 1) - E(W_0|D = 0) \quad (16)$$
$$\Lambda = E(W_1|D = 1) - E(W_0|D = 1) + E(W_0|D = 1) - E(W_0|D = 0) \quad (17)$$
$$\Lambda = ATT + E(W_0|D = 1) - E(W_0|D = 0) \quad (18)$$
$$\Lambda = ATT + SB \quad (19)$$

where SB is the selection bias: the difference between the counterfactual for treated households and the observed outcome for the control households.

In the PSM method, the households in the treatment group are matched to the households in the control group by comparing the observable characteristics of the two households (vector of X). In fact, X is the conditional variables including variables describing the socioeconomic and demographic status of the household (residence area, household income, age, sex, marital status, educational level, and employment status of the head of the household). If an appropriate control group is selected for the treatment group based on conditional variables X, SB is equal to 0, and the ATT can be estimated by the difference between the mean observed outcomes (incidence of CHE or IHE) for treated and control households (Equation 20).

$$\tau_{ATT}^{PSM} = E(W|D=1) - E(W|D=0) \quad (20)$$

where $E(W|D=1)$ and $E(W|D=0)$ show the mean outcomes (incidence of CHE or IHE) for the treatment and control groups, respectively. τ_{ATT}^{PSM} is the ATT estimator in the PSM method (Heinrich et al., 2010).

3.3 Validity of the Propensity Score Matching Method

The validity of τ_{ATT}^{PSM} depends on the establishment of the conditional independence assumption and common support assumption.

Based on the conditional independence assumption, the potential outcomes W_1 and W_0 are independent of the treatment status by taking into account the set X of observable variables (Equation 21).

$$(W_1, W_0) \perp \mathrm{D} \mid X \quad (21)$$

This assumption is checked through the balance test. Establishing this assumption ensures that an appropriate control group is considered to construct the counterfactual value of the treatment group.

Based on the common support assumption, there is sufficient overlap in the characteristics of the treated and control groups to find adequate matches. In other words, for each value of X, the probability of being both treated and untreated is positive (Equation 22).

$$0 < P(D=1|X) < 1 \quad (22)$$

This assumption is checked by using the propensity score graph. Establishing this assumption ensures that households in the control group are near the distribution of the propensity score of the households in the treatment group (Heinrich et al., 2010).

3.4 Descriptive Statistics, Balance Tests Results, and Propensity Score Graphs

The sample descriptive statistics of conditional variables were analyzed separately for households in the treatment and control groups, living in urban and rural areas, and for the years 2016, 2018, and 2019. Descriptive statistics of conditional variables for 2016 are presented in Table 3. As an example, in the urban area, for households in the treatment group, the average logarithm of incomes was 19.26 rials, and the average heads' age was 53.43 years. In 2016, 9% of household heads were female and 91% were male; moreover, 90% of them were married, 8% were widowed, 1% were divorced, and 1% were unmarried. The average education level of heads in the treatment group was a middle-school degree (30.47); 97% of heads had completed their education, and 3% were studying. Furthermore, 85.17%, 0.08%, 0.35%, and 1.06% of them were employed, unemployed, homemakers, and others, respectively. Besides, 13.34% of heads had income without a job.

Table 3. Sample Descriptive Statistics of Conditional Variables (2016)

Conditional variables		In general		Urban area		Rural area	
		Treatment group Mean (std. dev.)	Control group Mean (std. dev.)	Treatment group Mean (std. dev.)	Control group Mean (std. dev.)	Treatment group Mean (std. dev.)	Control group Mean (std. dev.)
Ln household income		18.99 (0.69)	18.88 (0.69)	19.26 (0.64)	19.23 (0.71)	18.80 (0.67)	18.71 (0.62)
Age of the head		52.58 (13.33)	50.67 (13.08)	53.43 (13.18)	50.39 (12.11)	51.93 (13.40)	50.80 (13.50)
Sex of the head		1.09 (0.29)	1.08 (0.27)	1.09 (0.29)	1.04 (0.21)	1.09 (0.29)	1.10 (0.30)
Marital status of the head	Widowed	0.08 (0.28)	0.07 (0.26)	0.08 (0.27)	0.04 (0.19)	0.09 (0.29)	0.09 (0.29)
	Divorced	0.00 (0.09)	0.02 (0.14)	0.01 (0.13)	0.02 (0.60)	0.00 (0.02)	0.01 (0.13)
	Unmarried	0.01 (0.12)	0.01 (0.10)	0.01 (0.11)	0.03 (0.18)	0.01 (0.13)	0.00 (0.02)
The education level of the head		30.22 (21.00)	31.32 (20.49)	30.47 (19.6)	41.46 (20.60)	30.03 (22.05)	24.40 (17.29)
Education status of the head		1.98 (0.13)	1.98 (0.13)	1.97 (0.14)	1.95 (0.20)	1.98 (0.13)	1.99 (0.02)
Employment status of the head	Unemployed	0.0065 (0.0804)	0.0145 (0.1199)	0.0008 (0.0297)	0.0450 (0.2074)	0.0107 (0.1032)	0.0004 (0.0204)
	Making money without a job	0.0994 (0.2992)	0.1041 (0.3055)	0.1334 (0.3401)	0.1549 (0.3620)	0.0736 (0.2611)	0.0805 (0.2721)
	Studying	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Homemaker	0.0099	0.0008	0.0035	0.0018	0.0148	0.0004
	(0.0993)	(0.0292)	(0.0595)	(0.0424)	(0.1208)	(0.2040)
Others	0.0053	0.0120	0.0106	0.0009	0.0013	0.0171
	(0.7300)	(0.1089)	(0.1027)	(0.0300)	(0.0366)	(0.1300)

Source: Research finding.

The balancing test of the conditional variables was performed to check the assumption of conditional independence, and propensity score graphs were plotted to check the assumption of common support for all the estimated ATTs (presented in the next section), separately for $CHE_{\%10}$, $CHE_{\%25}$, $CHE_{\%40}$, $IHE_{\$1.9,}$ and $IHE_{\$3.2}$ and for all the characteristics of the heads of households living in urban and rural areas in 2018 and 2019. For example, Table A1 and Figure A1 respectively show the results of the balance test and the propensity score graph to estimate $ATT_{CHE\%10}$ in 2018.

In the balancing test, the square of the variables or their product can also be used to balance the conditional variables. As can be seen in Table A1, the null hypothesis of the equality of means of conditional variables for households in the treatment group and households in the control group cannot be rejected. Therefore, the assumption of conditional independence is valid.

Figure A1 shows that for each household in the treatment group, the same household was found in the control group, and there was no household for which the same control group was not found. Therefore, the assumption of common support is valid.

Both assumptions were also valid for other indicators in all years.

4. Results and Discussion

Figures 1 and 2 in general, and Figures 3 and 4 by urban and rural areas, show in 2018 and 2019 what percentage of households faced CHE and what percentage of them became poor precisely due to the instability of HTP financial resources and the reduction of financial support for households. In all cases, the assumptions of conditional independence and common support were established.

As can be seen in Figure 1, the instability of HTP's financial resources in 2017 led to the occurrence of CHE and IHE in the following years. However, these effects were more in 2019 than in 2018. In other words, the instability of HTP resources had more detrimental effects on households over time because the necessary treatments were not pursued by households when resources became unstable in 2017 and financial support decreased. All this affected their disease

status. The adverse effects of diseases intensified in the following years, and more CHE and IHE occurred.

Moreover, more households faced CHE based on the $CHE_{\%10}$ definition compared to other indicators because $CHE_{\%10}$ is defined as a measure of households facing CHE based on a lower level of OOP expenditures. Thus, more households will be included in this group. The number of households falling below the poverty line due to the instability of HTP's financial resources is less than those who faced CHE. Additionally, the number of households facing $IHE_{\$1.9}$ is higher than those facing $IHE_{\$3.2}$ because the poverty line is defined at a lower income level at $IHE_{\$1.9}$. Therefore, more households will be included in this group due to OOP expenditures.

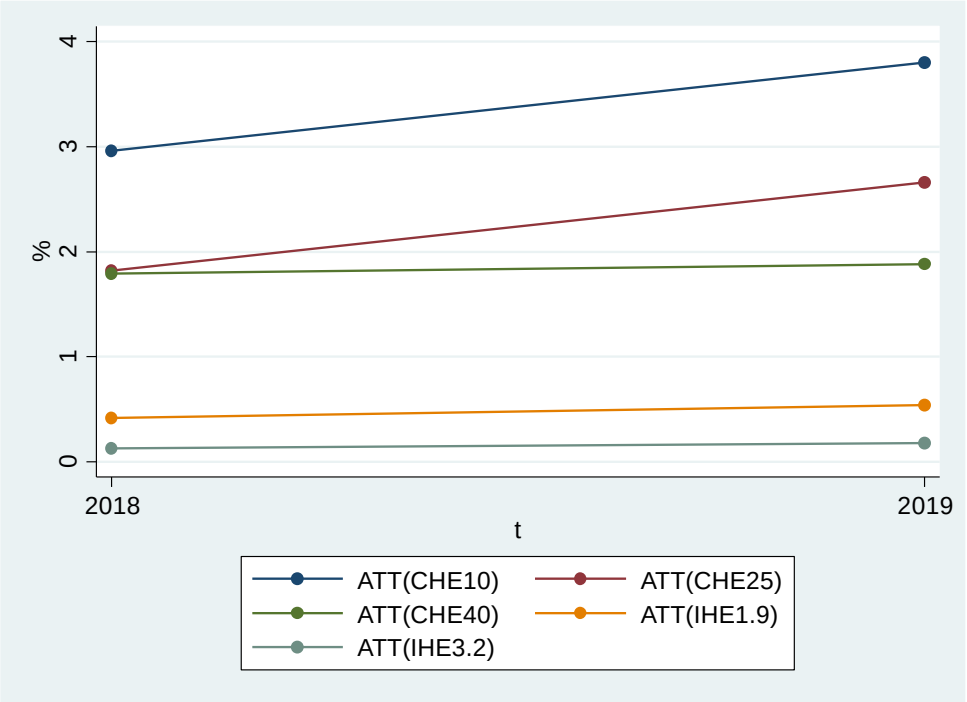


Figure 1. The Effects of the Instability of HTP Financial Resources on the Incidence of CHE and IHE in General
Source: Research finding.

In Figure 2, the heterogeneity in the incidence of CHE and IHE among households with different characteristics is investigated.

CHE indices significantly increased in each income decile in 2019 compared to 2018. However, IHE indices did not change significantly (Figure

2A). Low-income deciles encountered CHE and IHE a little more than middle-income deciles and much more than high-income deciles. The economic stability of the head of the household (having a suitable job and sufficient income) can generally make the household have a healthy lifestyle. The probability of disease occurrence is reduced due to the adoption of a healthy lifestyle by households because everything needed for a healthy life (healthy food and water, health services, etc.) can be purchased by them (U.S. Department of Health and Human Services, 2023, and World Health Organization, 1999). In other words, having a fixed income can decrease the probability of CHE and IHE occurrence for households because of having a healthy lifestyle, reduced probability of disease occurrence, and the increased ability to pay. Consequently, low-income deciles faced high CHE (Figure 2A).

Household heads with an academic education (AE) faced less CHE than heads without AE because the former group is more aware of a healthy lifestyle, is more likely to be employed, has a fixed income, and can invest more in a healthy lifestyle. In other words, this group focuses more on disease prevention and is thus less likely to get sick. Thus, this group faced less CHE. Household heads without AE have less knowledge about a healthy lifestyle and probably do not have reliable jobs and income. For this reason, this group of household heads faced more IHE (Figure 2B).

CHE and IHE were significantly lower for households with employed heads or non-working income heads than for those with unemployed heads, because the former group has income and uses it for the prevention or timely treatment of diseases. Therefore, they faced less CHE and IHE. While heads without jobs and income cannot prevent, and treat diseases on time. On the other hand, this group of households had lower consumption expenses due to not having enough income, and (according to the definition of CHE and IHE indicators) the probability of incidence of CHE and IHE is higher for this group of households (Figure 2C).

Household heads under the age of 15 faced more CHE and IHE than heads in the working-age range (15-64 years) because, on the one hand, they are often engaged in low-income jobs, and on the other hand, they are not of working age and are very likely to get sick from working. Household heads over 64 years of age who often did not have pensions faced more CHE and IHE as well (Figure 2D).

Household heads with spouses were less negatively affected by reduced HTP support. Single household heads (unmarried people or those who lost their

spouses) faced more CHE and IHE perhaps because they have less control over a healthy lifestyle, disease prevention, and family health. In these households, the family income decreases, and the whole burden of the family is on one person. Household heads with spouses have more control over family members in the field of healthy lifestyle, disease prevention, and timely treatment (Figure 2E).

According to $CHE_{\%10}$ and $CHE_{\%25}$, female household heads faced more CHE than male heads because they often have less ability to finance the household compared to male heads. Obviously, in these households, investment in the field of a healthier lifestyle and disease prevention will be less realized. However, there were no significant differences between men and women in $CHE_{\%40}$, $IHE_{\$1.9}$, and $IHE_{\$3.2}$; this is perhaps because female household heads received special social benefits that only supported them against low levels of CHE and IHE, but these benefits did not prevent higher levels of CHE (Figure 2F).

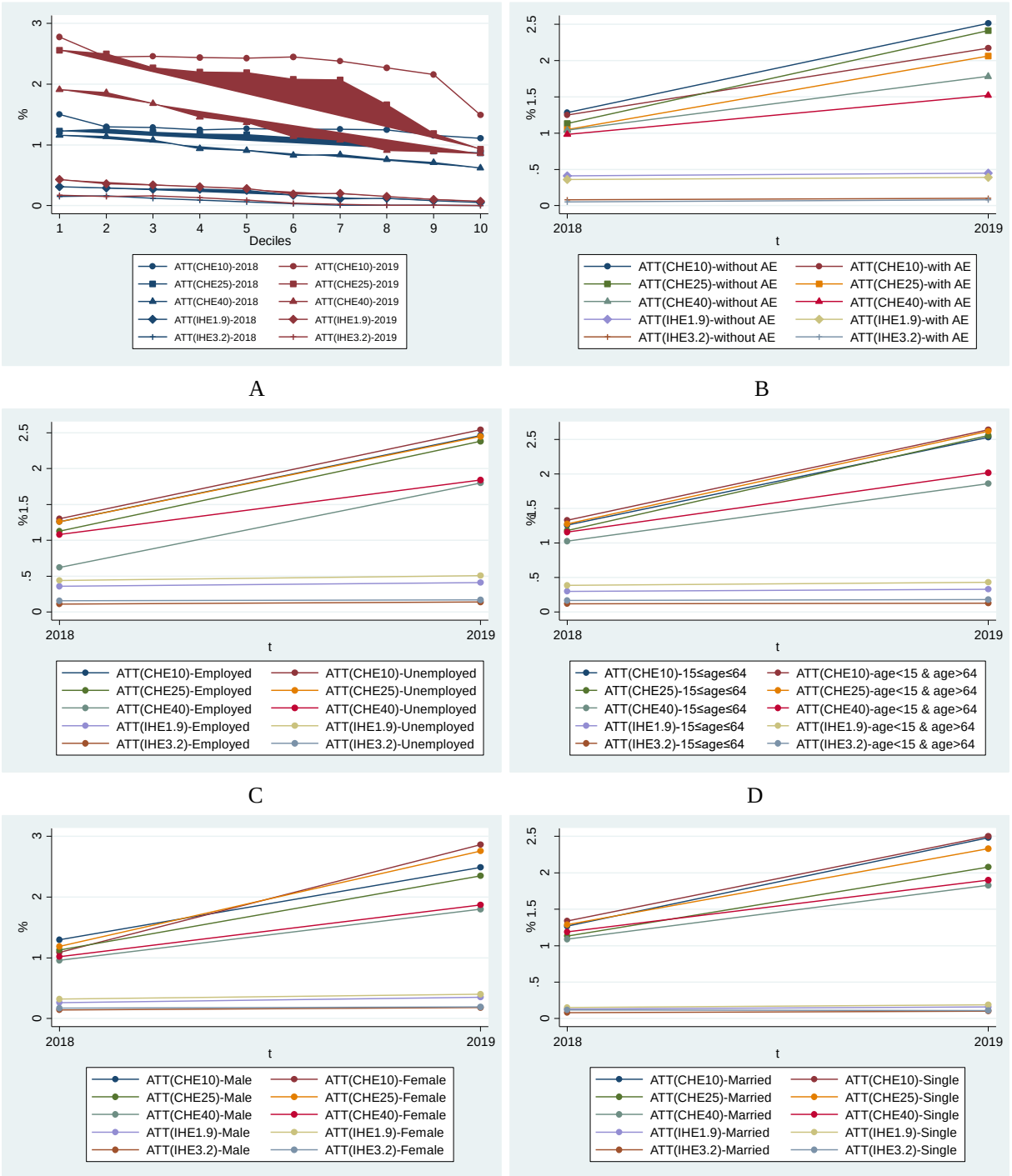


Figure 2. Heterogeneity in the Incidence of CHE and IHE in General

Source: Research finding.

As can be seen in Figure 3, rural residents faced more CHE than urban residents following the reduction in HTP financial support. This could be attributed to the less access of rural residents to specialized medical centers and the need to get an ambulance to go to these centers. Because specialized health services are not provided by health houses in rural areas. Rural residents should go to the nearest town or city for hospitalization. This increases the travel costs and accommodation costs of the patient's companions near the hospital. Besides, home visit costs are high for rural areas and are not covered by insurance. However, there is no significant difference between the two groups in terms of IHE. Figure 4 shows the details of the analysis.

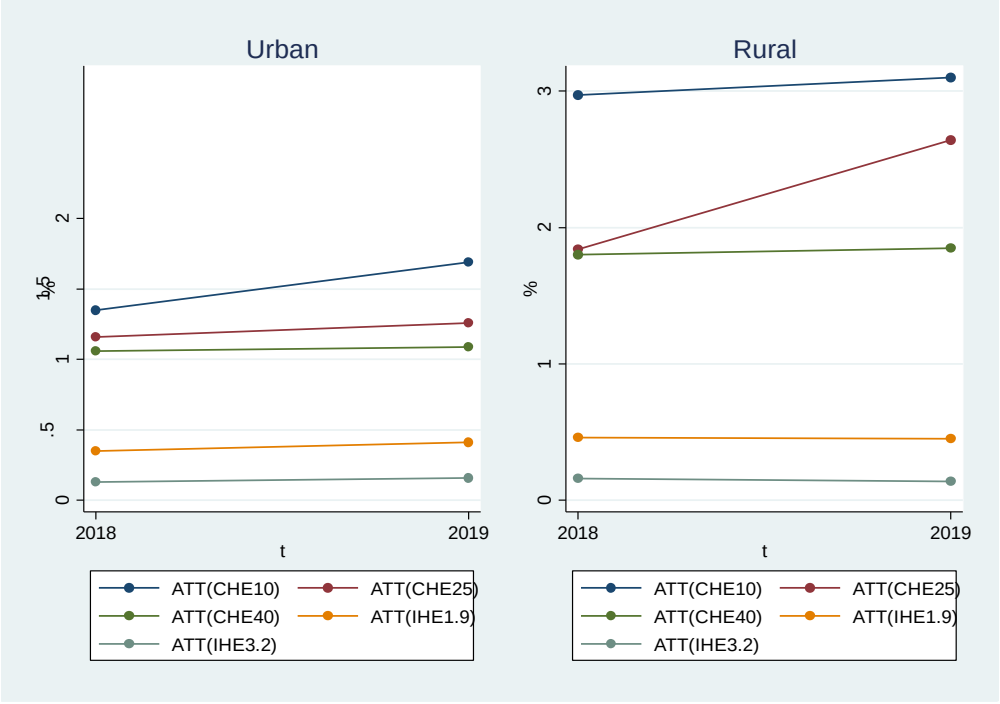


Figure 3. The Effects of the Instability of HTP Financial Resources on the Incidence of CHE and IHE by Regions
Source: Research finding.

The number of rural residents covered by health insurance sharply decreased in 2017 but remained almost constant in the years later. However, the IHIO payment for rural residents decreased by 10% in 2018 compared to 2017 and increased by 16% in 2019 compared to 2018 (Iran Health Insurance Organization, 2019). According to Figure 4A, only the first three deciles of rural

areas seem to be subject to the increase in IHIO support in 2019, and payments were made more to this group because the first three income deciles in rural areas faced less CHE and IHE in 2019 than both the first three deciles of rural areas in 2018 and the first three deciles of urban areas in 2019. According to health insurance laws, the first three deciles in rural areas were covered by public health insurance for free in 2019 (Iran Health Insurance Organization, 2023). Another reason for the low levels of CHE and IHE among the first three deciles in rural areas is that they often do not visit a doctor when they are sick and take some home treatments. Therefore, they do not face high OOP. The high-income decile in rural areas was almost unaffected.

According to the insurance laws, the 4^{th} to 8^{th} deciles in rural areas were covered by health insurance in 2019 by paying between 10%-50% of the premium, and the 9^{th} to 10^{th} deciles by paying the full premium (Iran Health Insurance Organization, 2023). The coverage of services was reduced while the insurance premiums paid for the 4^{th} and later deciles increased. This resulted in an increase in CHE for this group of households in rural areas.

Low-income deciles in urban areas faced more CHE and IHE. The insurance of this group seems to have failed to provide adequate coverage for them. The middle-income deciles were less affected by the decrease in HTP financial support. The upper-income deciles were not significantly affected by impoverishment. However, they faced CHE due to the exclusion of some services and private medical centers from health insurance coverage from 2017 onwards because the high-income deciles often used non-governmental medical centers, performed certain surgeries, especially cosmetic surgery, or made investments in their health (e.g., annual check-ups and imaging), all of which were excluded from the insurance coverage (Figure 4A).

Household heads with AE faced more CHE in rural than in urban areas. In general, rural households have a very healthy lifestyle, and the incidence of diseases is lower in rural areas. However, CHE is highly probable because people with AE in rural areas did not have high-paying jobs (proportionate to their education), thus facing more CHE. Statistics also show that in 2019, there was a significant difference in the unemployment rate of university graduates in urban and rural areas. The rate is 21.1% in rural areas and 16.3% in urban areas. This shows that improving the employment status of university graduates in rural areas can also be effective in reducing the incidence of CHE (Statistical Center of Iran, 2019). The academic education of household heads did not significantly affect the incidence of poverty in either rural or urban areas (Figure 4B).

CHE was higher in rural areas than in urban areas due to the reduction of HTP financial support for unemployed household heads, heads under 15 and over 64 years old, heads without spouses, and female heads (Figure 4C, 4D, 4E, and 4F). The details are provided in the following.

Agriculture is one of the common occupations in rural areas. Farmers are not employed all year round and have seasonal unemployment. The lack of fixed income in all months of the year among the heads of rural households may cause them problems in meeting health expenses. For this reason, the unemployed in rural areas faced more CHE compared to the unemployed in urban areas (Figure 4C).

However, the IHE is more prevalent among the urban unemployed than the rural unemployed. The incidence of chronic diseases and health shocks among rural households is less compared to urban households due to a healthy lifestyle and healthy air. For this reason, rural households are less likely to face OOP expenses that lead them below the poverty line. On the other hand, the cost of living in urban areas is higher than in rural areas. In case of chronic diseases that increase OOP expenses, the urban unemployed face more IHE in meeting health expenses compared to the rural unemployed (Figure 4C).

Most of the traditional jobs in rural areas, such as animal husbandry, agriculture, and carpet weaving, require a higher physical ability, which is often beyond the ability of heads under 15 or over 64 years old. Therefore, this group of heads in rural areas will have more problems in paying OOP health expenses and will face more CHE and IHE (Figure 4D).

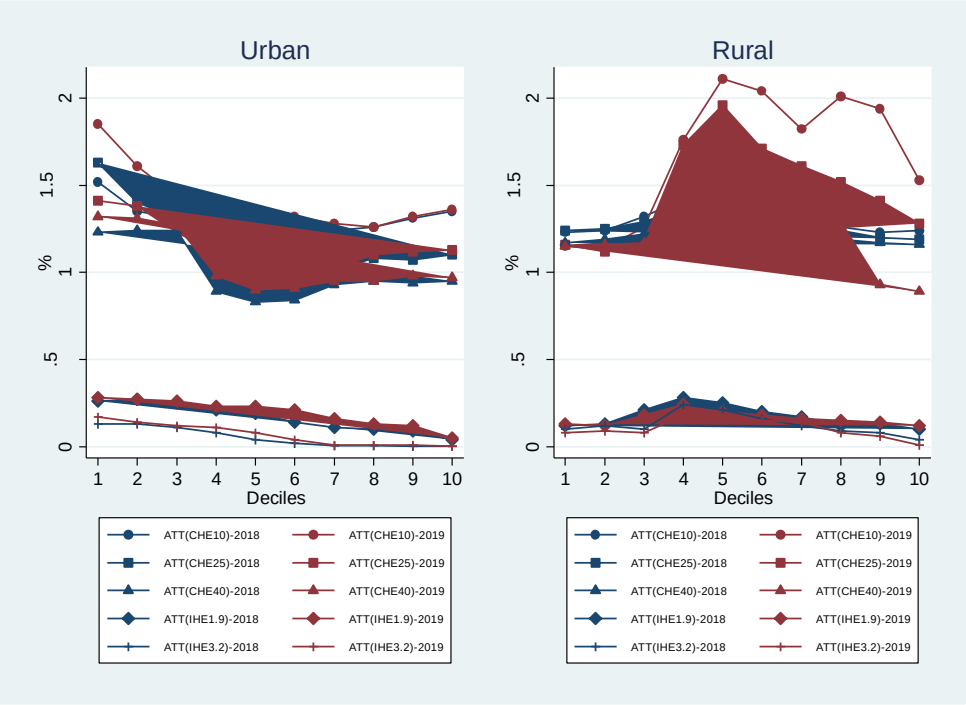
In rural areas, both the head of the household and the wife work in traditional jobs in the village and generate income. Therefore, in rural areas, heads of households with spouses have more income than single heads, and CHE is less for them. In addition, in rural areas compared to urban areas, single heads have faced higher CHE. This shows the importance of the presence of the wife and the income-generating role of rural women alongside men (Figure 4E).

Female heads of households in rural areas have faced more CHE and IHE compared to urban areas. As it was mentioned, rural jobs require higher ability and therefore women heads of households in rural areas cannot earn a high and stable income from these jobs. In other words, the main income of rural female heads comes from the social support of the government; otherwise, they will not have much income from their rural workplace. For this reason, this group of heads has faced more CHE and IHE (Figure 4F).

5. Conclusion

Adopting certain policies in all economic sectors (especially policies affecting disease prevention, income level, and household employment) can bring favorable results to move toward sustainable development, improve UHC in the health system, and reduce CHE and IHE. Policies to make the lifestyle of households healthy (allocating subsidies to healthy food, reducing pollution, etc.) and self-care will be effective in disease prevention. However, such policies did not receive much attention in HTP. Policy-making in the medical sector should thus be done by identifying vulnerable groups and giving them more financial support in the form of higher coverage insurance. This causes the optimal allocation of funds as well.

The OOP level increased in the years after 2017, especially in 2019, due to the reduction of HTP financial support in 2017. The low-income deciles in urban areas and the middle-income deciles in rural areas suffered the most. These deciles should be covered more by health insurance for medicine and treatment costs in new health policies. Moreover, CHE occurred among household heads with AE and IHE among household heads without AE in rural areas, indicating the need to improve the business situation, employment, and income, especially for rural educated people. IHE was more common among unemployed household heads, heads under 15 and over 64 years in urban areas, and female heads in rural areas. As such, they should be covered more by insurance.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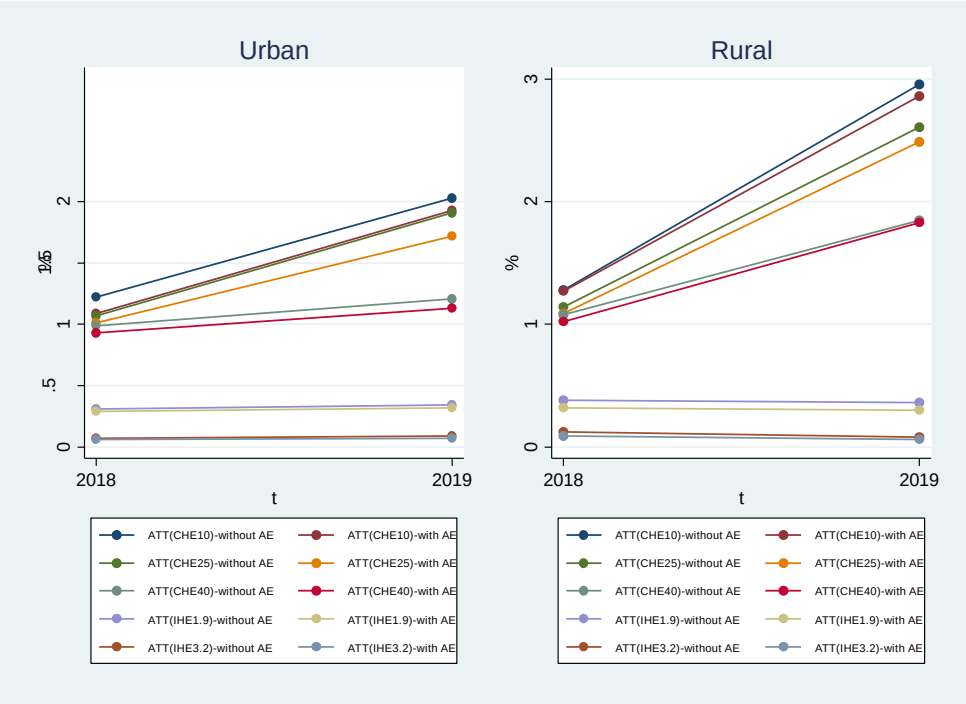
A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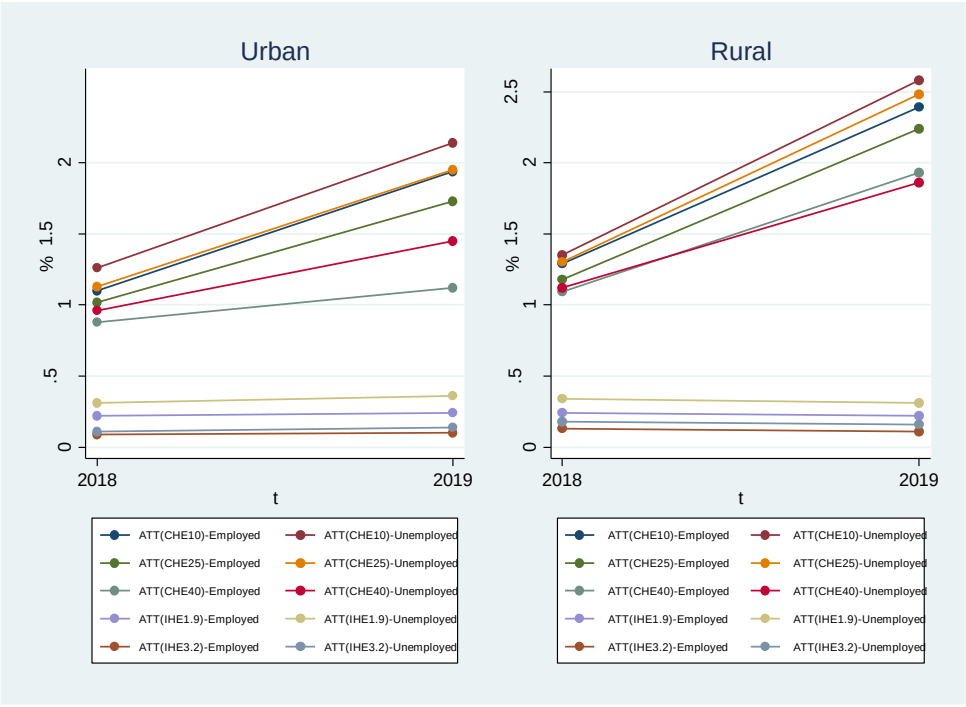
B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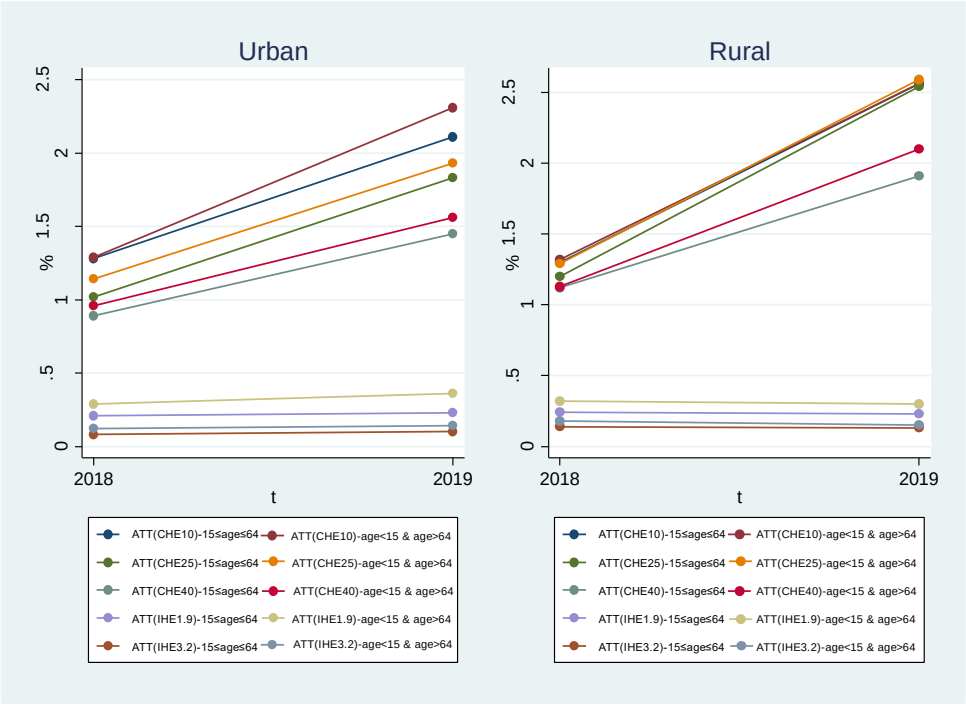
C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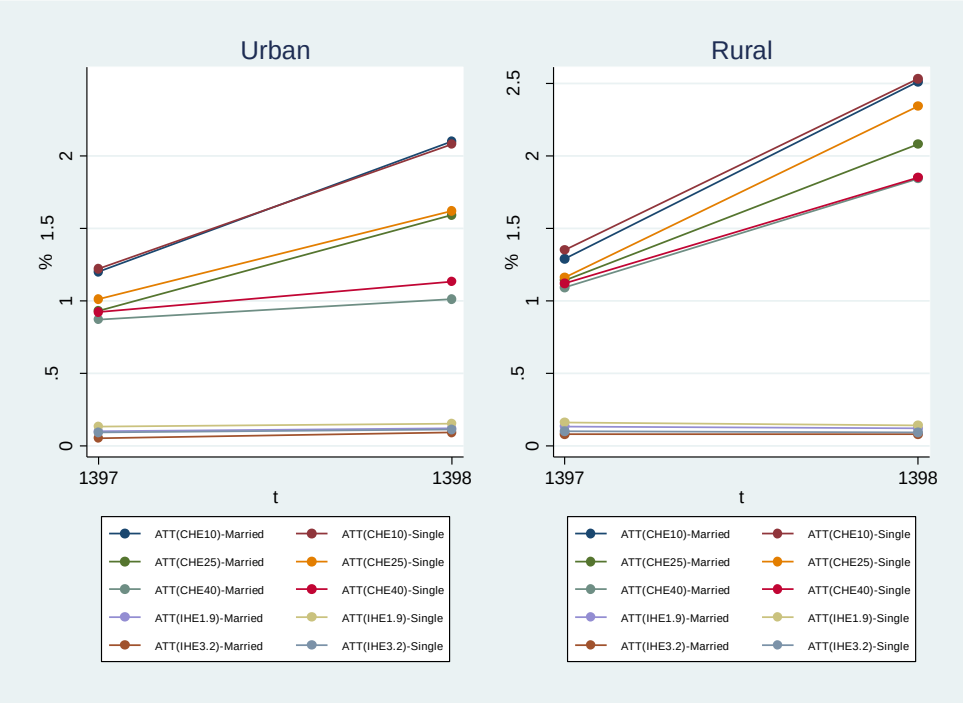
ATT(CHE25)-15≤age≤64
ATT(CHE25)-age<15 & age>64
ATT(CHE40)-15≤age≤64
ATT(CHE40)-age<15 & age>64
ATT(IHE1.9)-15≤age≤64
ATT(IHE1.9)-age<15 & age>64
ATT(IHE3.2)-15≤age≤64
ATT(IHE3.2)-age<15 & age>64

D



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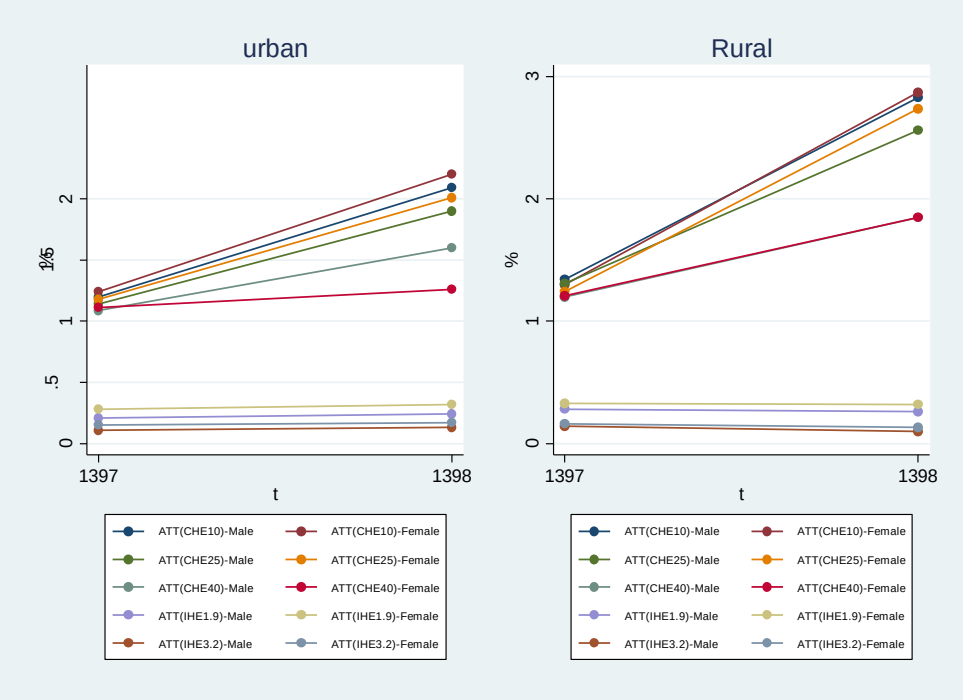

F

Figure 4. Heterogeneity in the Incidence of CHE and IHE by Regions
Source: Research finding.

Appendix

Table A1. The Results of the Balancing Test of Conditional Variables for $ATT_{CHE\%10}$ (2018)

Conditional variables	Mean		% bias	P-value
	Treated	Control		
Head's age^2	2522.40	2386.60	10.7	0.57
Head's sex	1.03	1.03	1.7	0.11
Head's employment	1.18	1.15	3.2	0.20
Head's marital status	1.09	1.03	10.1	0.87
Head's education status	1.97	1.97	-3.9	0.39
Head's sex* Head's employment	1.27	1.21	4.2	0.32
Ln household income * Head's age	1053.5	1084.3	-0.6	0.41
Head's marital status * Head's education status	2.15	2.04	9.4	0.80
Head's age * Head's education status	96.25	94.38	7.2	0.38

Source: Research finding.

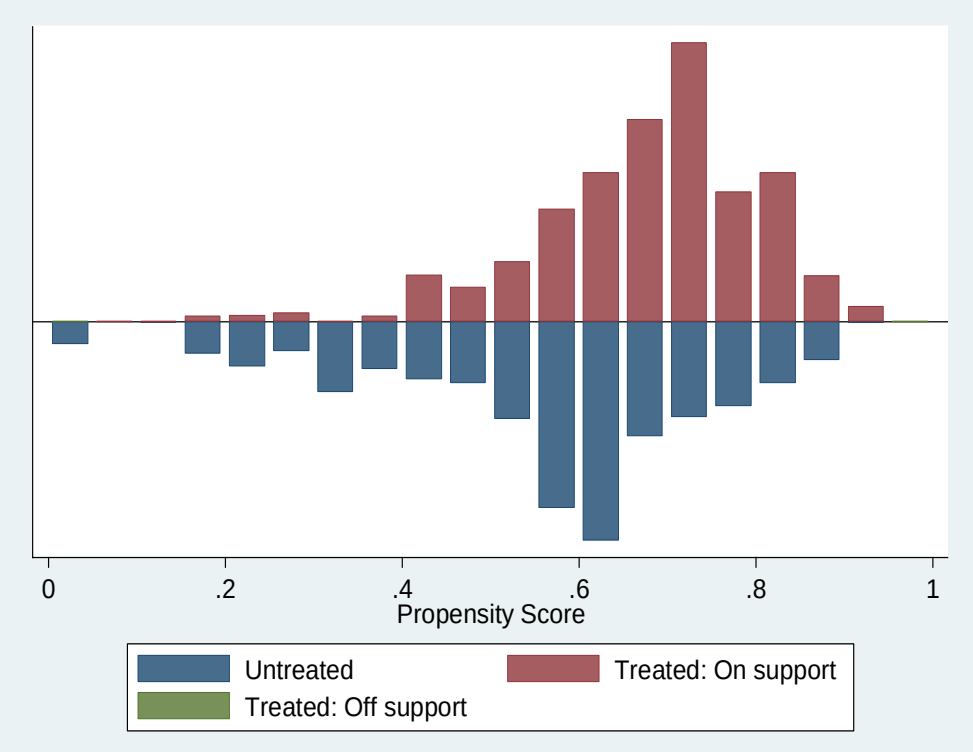

Figure A1. Propensity Score Graph for $ATT_{CHE\%10}$ (2018)
Source: Research finding.

Statements and Declarations

- Funding: This work does not receive any funding.
- Conflict of interest: The authors declare that there is no conflict of interest.

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Cite this article: Ghaemi, F., & Assari Arani, A. (2025). Impact Evaluation of Instability of Financial Resources in Health System Transformation Plan on Achieving Financial Protection in Universal Health Coverage. *Iranian Economic Review, 29*(4), 1256-1288.