# Family Care and the Utilization of Medical Services of Elderly in China: Complementary or Substitutive?

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**Abstract.** This paper uses the data of four-phase CHARLS (2011-2018). It adopts binary selection models with fixed effect and instrumental variables, studying the influence of family care on outpatient and inpatient medical services for the elderly in China and its heterogeneous effect. There are two main findings: Firstly, with the endogeneity considered, family care is significantly complementary to medical service utilization, increasing the outpatient and inpatient probabilities of the elderly by 10.5% and 36.5%, respectively; Secondly, when the elderly reach a particular age group (75 and above), the deterioration of physical function caused by increasing age may weaken the impact of family care, the complementarity is significantly weakened to insignificant. In short, increasing the supply of care for the elderly expands the service boundaries of medical institutions. It forms an integrated and complete service system for medical and elderly care and will have a vital improvement in the medical system to better cope with the context of aging.

**Keywords:** Elder Adult; Family care; Utilization of medical service; Binary Selection model.

## 1. Introduction

With China's average life expectancy increasing and the fertility rate declining, aging, a major social problem, has shown an accelerated trend. It took only 21 years for China to reach a deeply aging society, with over 14% of the population aged 65 years and over in 2000, significantly faster than many developed countries (France, 126 years; UK, 46 years; Germany, 40 years; Japan, 24 years. Data source: World Bank). Given that the "baby boomers" from 1962 to 1976 will enter the aging stage within 5-10 years, the pressure of aging in China will continue to increase. In 2016, 79.9% of China's elderly nursing care was provided by families, which is the fact that family care has become the main care for the elderly. Also, in 2016, the total number of older people with care needs in China reached 60-70 million. Obviously, the need for care for the elderly is derived from their deteriorating health levels, increasing potential medical services needs that have not been effectively met yet.

Family care improves the quality of life of the elderly and promotes them to obtain necessary medical services, differently impacting the medical services utilization. On the one hand, by caring for the elderly, family care may reduce the risk of physical accidents, which helps the elderly to develop healthy living habits. Meanwhile, it reduces the health problems caused by aging and finally reduces the utilization of medical services. On the other hand, family care may reduce the barriers to medical treatment for the elderly to stimulate their potential medical needs due to declining health conditions, thereby increasing their medical service utilization. Thus, the true impact of family care on health care utilization among older adults depends on the net effect of the complementarity of the former and the substitution of the latter.

## 2. Literature review and theoretical framework

Disagreements over the role of family care on medical service utilization still exist: For substitution, Van Houtven and Norton(2004, 2008) found that family care in the U.S. reduces the use of medical services and expenditures in the elderly; Weaver and Weaver(2014) found that family care significantly reduces long-term inpatient care, showing a certain sense of substitution. For complementarity, Bolin et al.(2008) found that the increase in family care significantly increases the probability of outpatient and inpatient for the European elderly. Condelius et al. (2010), in a study of

the elderly in Sweden, it is found that family care is complementary to outpatient service utilization. Yu and Feng (2018) verify the complementarity of family care using two-phase data of CHARLS.

Andersen's Behavioral Model of Health Services Use is an authoritative model for analyzing individual medical behaviors in medical and health service research. The latest revised version of the model(Andersen et al., 2013) takes the individual as the unit, constructing a structural equation model where four dimensions of "Contextual Characteristics," "Individual Characteristics," "Health Behaviors," and "Outcomes" interact with each other in pairs as shown in Figure 1, with each dimension containing different factors. The complementarity and substitution of family care for medical services utilization can be explained more clearly in this model.

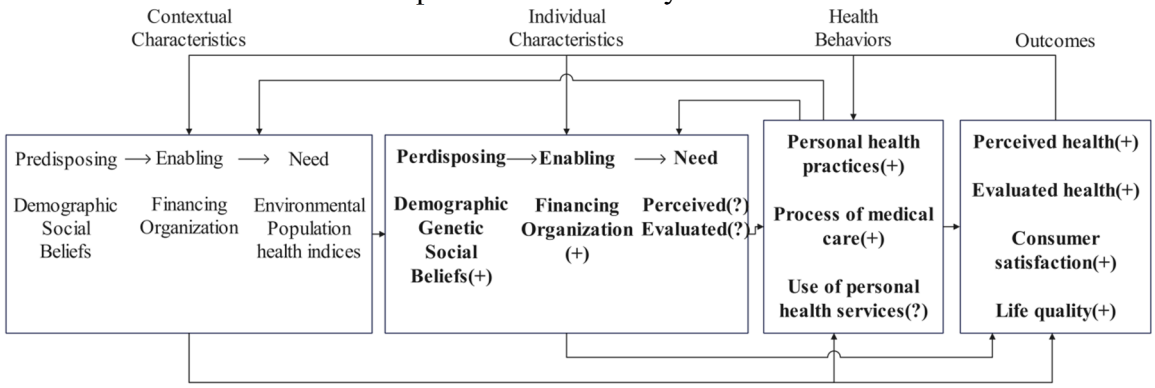


Figure 1. Andersen Model (2013)

In substitution, family care may reduce the health risks and the possibility of future adverse health conditions of the elderly through companionship and assistance(Van Houtven and Norton, 2004; Weaver and Weaver, 2014). In addition, family care gives the elderly spiritual comfort, reducing the possibility of a bad mental state and expanding social activities(Yu and Feng, 2018). By increasing the frequency of daily activities and social activities, physical health risks and mental depression levels can be reduced, and the health outcomes, satisfaction, and quality of life can be improved. It reduces the perceived and evaluated need in "Individual Characteristics," thereby reducing the utilization of medical services; Moreover, family care providers will help the elderly develop healthy living habits and practice health-promoting behaviors (Yu and Feng, 2018). In this way, "Personal health practices" in the dimension of "Health behavior" can be improved, further reducing medical service demand and utilization by improving health status.

For complementarity, family care, as an enabling resource within the "Organization" of the family, directly reduces the difficulties of seeking medical care, improving the accessibility of medical care services (Tobica et al., 2015). Thus, older people are more likely to be sent to medical institutions for treatment (Weaver and Weaver, 2014), which improves the utilization of medical services. Meanwhile, family care can also improve the quality of medical services by reducing communication barriers between doctors and patients, further reducing the difficulties for the elderly and increasing medical services utilization. In addition, the belief of medical services for the elderly (unwilling to face the fact that they suffer from various diseases, etc.) is corrected through caring, which changes their "Beliefs," a

In addition, the substitution or complementarity of family care may also be heterogeneous at different ages. According to Grossman's model of health demand (Grossman, 1972), aging increases the depreciation rate of health capital and reduces optimal health demand. However, an increase in the depreciation rate of health capital also reduces the supply of health capital. When the decline in the latter is greater than the former, consumers need to make additional health investments. Therefore, as age increases, although the consumers' demand for optimal health decreases, the demand for medical services increases (Blaxter, 1990). In reality, the risk of disease increases, and the ability to perform daily activities decline, corresponding to the increasing demand for medical services and barriers to seeking medical treatment. Therefore, the older a man gets, the more likely he is in a state of being susceptible to illness but difficult to seek medical care alone, so family care is more likely to show higher complementarity (It still needs to be considered that some subjective and objective

barriers to medical services of the elderly are factors restricting family care from turning potential medical needs into actual medical service utilization. The complementarity of medical service utilization may decrease significantly, which will be tested and explained in the empirical part).

In short, this paper is the first research in China to use four-phase CHARLS data with fixed effects to study the impact of family care on the utilization of medical services. This paper also constructs robustness tests and instrumental variable regression to confirm the validity of the conclusions.

## 3. Data, Variables, and Model settings

### 3.1 Data source

All data used are from the survey called China Health and Retirement Longitudinal Study (CHARLS), with the survey objects randomly selected from people over 45 in households. This project conducted a baseline survey in 2011-2012, covering more than 17,000 respondents, generally representing the elderly in China. CHARLS has three follow-up surveys in 2013, 2015, and 2018 based on the baseline survey. After excluding the samples where values of core variables are missing, the data are finally sorted into short panel data with T=4 and 49337 observations.

### 3.2 Variable Setting

#### 3.2.1. Family care

The respondents were asked, "Who most often helps you with dressing, bathing, eating, getting out of bed, using the toilet, controlling urination and defecation, doing household chores, preparing hot meals, shopping, making phone calls, taking medicine, managing money?". The optional answers to this question include relatives and non-relatives. When the respondent chooses at least one relative in the answer, this paper will assign the family care to 1. Otherwise, it will be 0.

#### 3.2.2. Medical Services Utilization

In all surveys, respondents were asked, "Have you been to medical facilities for outpatient care in the last month?" and "Have you received inpatient care during the past year?". Based on this question, this paper measures the utilization of the two medical services. If the respondent answers "yes," the medical service is assigned a value of 1. Otherwise, it is 0.

#### 3.2.3. Other explanatory variables: health status & individual characteristic variables

Given that chronic disease and disability can be measured in health level with persistence, adding these variables can alleviate the bias brought by the two-way causality between health and medical services utilization. Therefore, this paper puts 14 chronic disease and disability variables in dummy form into the model. Meanwhile, different individual characteristics are considered to avoid the omitted variable bias.

For two types of medical services, outpatient and inpatient, this paper has constructed the original control variable set containing the variables mentioned in the previous paragraph. Moreover, to maximize the effectiveness of the control variable set, this paper adopts the forward stepwise regression method to screen out the corresponding optimal control variable sets for outpatient and inpatient, respectively.

### 3.3 Model Setting

The dependent variable in this paper is a binary variable (whether use medical services), and a binary selection model is suitable:

$$\mathrm{E}(y \mid \boldsymbol{x}) = \mathrm{P}(y = 1 \mid \boldsymbol{x}) = F(\boldsymbol{x}, \boldsymbol{\beta}) \tag{1}$$

According to the difference in link function $F(\cdot)$, the models have three different forms: Linear Probability Model(LPM) (i), Logit (ii), and Probit (iii). Under the LPM, there are problems due to the unreasonable predicted values, not in [0,1], and the unavoidable heteroscedasticity. Therefore, this

paper chooses the Logit model as the baseline and uses the linear probability model in the robustness test.

$$\begin{aligned} &\text{i.}F(\boldsymbol{x},\boldsymbol{\beta}) = \boldsymbol{x'\beta} + \varepsilon, \text{LPM} \\ &\text{ii.}F(\boldsymbol{x},\boldsymbol{\beta}) = \Lambda(\boldsymbol{x'\beta}) \equiv \frac{e^{x'\beta}}{1+e^{x'\beta}}, \text{Logit} \\ &\text{iii.}F(\boldsymbol{x},\boldsymbol{\beta}) = \Phi(\boldsymbol{x'\beta}) \equiv \int_{-\infty}^{x'\beta} \frac{1}{\sqrt{2\pi}} e^{-\frac{t^2}{2}} \,\mathrm{d}t, \text{Probit} \end{aligned} \tag{2}$$

It is necessary to apply a fixed-effects model to account for the bias caused by omitting unobserved individual characteristic variables that do not change over time. A specific fixed-effects Logit model is used:

$$\begin{aligned} &\mathrm{P}(y_{it} = 1 \mid care_{it}, \boldsymbol{Chr_{it}}, \boldsymbol{X_{it}}) \\ &\quad = \Lambda(\alpha_i + \beta_1 care_{it} + \boldsymbol{Chr_{it}}'\boldsymbol{\gamma_1} + \boldsymbol{X_{it}}'\boldsymbol{\gamma_2} + \lambda_t) \end{aligned} \tag{3}$$

Where $\Lambda(\cdot)$ represents the cumulative distribution function of the logistic distribution. The binary variable $y_{it}$ represents whether the elderly $i$ use a particular medical service (outpatient or inpatient) in the year $t$; the binary variable $care_{it}$ represents whether the elderly $i$ received family care $t$. $\boldsymbol{Chr_{it}}$ represents the chronic disease vector, indicating whether the elderly suffer from a particular chronic disease in the year $t$; $\boldsymbol{X_{it}}$ represents the individual characteristic vector; $\alpha_i$ represents the individual effect that does not change with time and $\lambda_t$ represents the time effect that does not change with the individual.

However, the fixed-effects Logit model cannot be ideally adopted by adding dummy variables: a nonlinear short panel with many individuals leads to inconsistency in the estimates of individual effects, "contaminating" estimates of the coefficient of the independent variables (called "incidental parameter problem"). For availability of the fixed effects in the Logit model, Chamberlain (1979) constructed a sufficient statisticof each individual effectand estimates $\eta_i$ by maximizing the conditional likelihood function to obtain consistent estimates (According to Chamberlain(1979), $\eta_i = \sum_{t=1}^{T} y_{it}$ . $\eta_i$ can only take $1,2,3,...,T-1$ as the individuals where $\eta = 0$ or $\eta = T$ do not contain any information useful for estimating $\beta_1$).

Back to formula (3), if the coefficient estimate $\beta_1$ is significantly positive, it means that family care can significantly increase the probability of the elderly using a specific type of medical service. That is, family care shows complementarity; if itis significantly negative, it indicates a substitution between family care and medical services.

## 4. Empirical Results Analysis

### 4.1 Baseline Regression

This paper initially carries out cross-section, random -and fixed-effect regressions. Then, it has used the Hausman test of the fixed-effect model and the others. In addition, the average marginal effects (AMEs) of family care are calculated to see the impact of family care on medical service utilization intuitively. The results in Table 2 show that family care increased the probability of the elderly using both inpatient and outpatient services at the 1% significance level. The Hausman test adopted for the cross-section/fixed-effect and random-effect/fixed-effect pairs, where p-values are all less than 0.01, indicates that the fixed-effect model is the most effective. In particular, the AMEs under the fixed-effect model show that family care increases the probability of the elderly to the outpatient by 7.8% and increases the probability of inpatient for the elderly by 9.1%, indicating family care's complementarity to outpatient and inpatient services utilization.

### 4.2 Robustness Test

The sample size is reduced given the neglect of individual observations where $\eta = 0$ and $\eta = T$. In order to exclude the possible influence of this problem on the main conclusions, this paper uses a linear probability model to check the robustness of the conclusion.

Probit model uses the cumulative function of the standard normal distribution as the link function, which is different from the Logit model in terms of properties and applications. Meanwhile, based on the Probit model, the bivariate Probit model is applied considering the possible correlation between error terms of equations for outpatient and inpatient, which may affect the estimation efficiency.

The robustness test results have shown that the complementary of family care to the medical services utilization remains unchanged in the linear model, the Probit model, and the bivariate Probit model, demonstrating the robustness of the conclusion in the baseline model (Due to space limitations, the robustness test results are not reported in this paper and are available from the author upon request).

### 4.3 Consideration of Endogeneity

The method of instrumental variables can effectively eliminate the omitted variable bias and two-way causalities. Relevant pieces of literature generally believe that family-level variables are better choices, especially variables of the number, age, and gender characteristics of children. However, in the time span of the four surveys, the data about the children are not complete and precise, and their living conditions may also change over time, making data processing more difficult.

This paper will try another method of choosing instrumental variables. On the one hand, the decline in physical function leads to inconvenience in movement, which is one of the essential reasons for family care. However, on the other hand, the decline in physical function as a whole may also directly affect the medical behavior of the elderly. It is supposed to be an indicator closely related to family care. However, it is a unilateral indicator for measuring physical function, so it has little relationship with the utilization of medical services. In that case, such an indicator becomes an effective instrumental variable that satisfies both correlation and homogeneity requirements.

Whether it is difficult for the elderly to do housework and take medicine can only reflect the physical condition and has little correlation with outpatient service (Pearson correlation coefficient does not exceed 0.1). However, the two difficulties are related to the living environment and self-care ability, which significantly correlates with family care (Pearson correlation coefficients are 0.54/0.33). Thus, these two indicators are selected as the instrumental variables for family care to affect the utilization of outpatient services. It is applied the above idea to inpatient services, we choose difficulties in extending arms and holding coins as instrumental variables since they have little correlation with inpatient service (Pearson correlation coefficients less than 0.1) but are markedly related to family care with impatient service (Pearson correlation coefficients are not more than 0.1), but are significantly related to family care with high correlations (Pearson correlation coefficients are 0.28/0.24). In addition, the regression of 2SLS can also be used to judge whether instrumental variables are weak intuitively and, to a certain extent, detect the exogeneity of the instrumental variables through an over-identification test.

Table 1. Baseline Regressions

| | (1) Outpatient | (2) Outpatient | (3) Outpatient | (4) Inpatient | (5) Inpatient | (6) Inpatient |
|---|---|---|---|---|---|---|
| Family Care | 0.276*** | 0.322*** | 0.333*** | 0.496*** | 0.571*** | 0.532*** |
| | (8.93) | (9.02) | (7.42) | (14.36) | (14.16) | (9.81) |
| Family Care(AME) | 0.044*** | 0.045*** | 0.078*** | 0.056*** | 0.057*** | 0.091*** |
| | (9.27) | (9.32) | (6.96) | (15.04) | (14.79) | (5.95) |
| Model Setting | Pooled/Logit | RE/Logit | FE/Logit | Pooled/Logit | RE/Logit | FE/Logit |
| Pooled/FE | Hausman p: 0.0000 | | | Hausman p: 0.0000 | | |
| RE/FE | Hausman p: 0.0000 | | | Hausman p: 0.0000 | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Year Fixed-Effect | Yes | Yes | Yes | Yes | Yes | Yes |
| Observation | 45354 | 45354 | 21610 | 43784 | 43784 | 14753 |

Note: t-values with the robust standard error of heteroscedasticity are in parentheses. */**/*** represent significance at 10%/5%/1% levels, respectively.

The 2SLS regression results (second stage) based on the instrumental variables selected are reported in Table 2, with columns 1-4 reporting the results for the linear model and columns 5-6 reporting the results for the Probit model, which still support the conclusion of complementarity of family care to medical services. According to the output, all the statistics values indicated that we reject the weak instrumental variable hypothesis and cannot reject the exogenous hypothesis, which safely verifies the validity of the instrumental variables selected to a certain extent. Thus, our conclusion is still robust after considering endogeneity.

Table 2. Instrumental Variable Regressions

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| First-Stage | Family Care | | | | | |
| Instrument 1 | -0.569*** | -0.318*** | -0.430*** | -0.140*** | -0.569*** | -0.315*** |
| | (-90.51) | (-30.02) | (-51.25) | (-11.76) | (-91.01) | (-30.27) |
| Instrument 2 | -0.313*** | -0.277*** | -0.212*** | -0.125*** | -0.313*** | -0.278*** |
| | (-34.09) | (-40.21) | (-20.30) | (-15.78) | (-34.26) | (-41.18) |
| Second-Stage | Outpatient | Inpatient | Outpatient | Inpatient | Outpatient | Inpatient |
| Family Care | 0.110*** | 0.249*** | 0.105*** | 0.365*** | 0.360*** | 0.835*** |
| | (9.42) | (11.07) | (5.66) | (6.69) | (9.90) | (11.13) |
| Model Setting | Pooled/LPM | Pooled/LPM | FE/LPM | FE/LPM | Pooled/Probit | Pooled/Probit |
| Year Fixed-Effect | Yes | Yes | Yes | Yes | Yes | Yes |
| Province Fixed-Effect | Yes | Yes | No | No | Yes | Yes |
| Individual Fixed-Effect | No | No | Yes | Yes | No | No |
| Weak IV Test | 6867.272 | 1307.660 | 2862.668 | 244.102 | Wald p: 0.000<br>AR p: 0.000 | Wald p: 0.000<br>AR p: 0.000 |
| IV Exogeneity Test | 0.1852 | 0.3219 | 0.4285 | 0.9662 | A-L-N p: 0.152 | A-L-N p: 0.198 |
| Observation | 45232 | 45166 | 45156 | 43281 | 45232 | 43614 |

Note: For the linear model (columns 1-4), Cragg-Donald Wald F statistic is used for the weak instrumental variable test, with Jansen J statistic for the exogeneity test. For the Probit model(columns 5-6), Wald and AR chi2 statistic is used for the weak instrumental variable test, with Amemiya-Lee-Newey minimum chi2 statistic for the exogeneity

### 4.4 Heterogeneity across Different Age Groups

Regressions results using subsamples of different age groups are shown in Table 3, indicating a significant complementarity of family care to outpatient and inpatient services utilization in the 55-74-year-old group, which is insignificant in the older group. Furthermore, with the AMEs obtained, we found that the complementarity of family care forms a pattern of first increase(although the Fisher Permutation test showed that the increase was not significant) and then decreases as the age stage gets high.

It is common sense that the demand for medical services of the elderly increases with age, but the gradually degraded physical functions limit the actual utilization of medical services. To a certain extent, family care helps transfer this potential demand into actual needs, reflecting the complementarity of care and medical service utilization. Therefore, the choice of outpatient or inpatient services for the elderly largely depends on the net effect of the transformation of care on potential needs (+) and the impact of deteriorating physical condition on actual utilization(-) after offsetting. It can be inferred that for the elderly aged 65-74, the greater complementarity effect between family care and the utilization of medical services results from the release of the potential demand for medical treatment. For the elderly aged 75 and above, family care and the significant decline in the complementarity of the two medical services result from the rapid deterioration of the physical condition.

Table 3. Heterogeneity: Age Group

| | (1) Outpatient | (2) Outpatient | (3) Outpatient | (4) Inpatient | (5) Inpatient | (6) Inpatient |
|---|---|---|---|---|---|---|
| Family Care | 0.281*** | 0.381*** | 0.126 | 0.421*** | 0.678*** | 0.244 |
| | (3.05) | (3.85) | (0.97) | (4.02) | (5.08) | (1.14) |
| Age Group | 55-64 | 65-74 | 75 and above | 55-64 | 65-74 | 75 and above |
| Model Setting | Logit/FE | Logit/FE | Logit/FE | Logit/FE | Logit/FE | Logit/FE |
| Year/Province/Individual Fixed-Effect | Yes | Yes | Yes | Yes | Yes | Yes |
| Differences in coefficients | Empirical p: 0.325 | | - | Empirical p: 0.155 | | - |
| Observation | 6278 | 4032 | 1534 | 3972 | 2995 | 1321 |

Note: Fisher's Permutation Test tests the coefficient differences between 55-64 and 65-74 years old groups.

## 5. Conclusions

This paper uses four-phase CHARLS data from 2011 to 2018 to study the impact of family care on the utilization of outpatient and inpatient medical services. Linear and nonlinear models, cross-section and fixed-effects models, instrumental variable methods, and heterogeneity analysis were used, following conclusions are drawn: Firstly, family care is significantly complementary to outpatient and inpatient services utilization. The marginal effects on the outpatient and inpatient probabilities are 7.8% and 9.1%, respectively, with 10.5% and 36.5% further using instrumental variable regressions. Secondly, family care has the most remarkable complementarity among the elderly in the 65-74 age group, while the complementarity of family care to the utilization of medical services decreases and becomes insignificant for people over 75. Because of the above conclusions, some policy recommendations are given below.

Firstly, as family care is complementary to medical services, it converts the potential medical service needs of the elderly into actual medical services utilization and promotes the efficient

allocation of medical resources. In China, a home-based pattern still dominates the current system providing for the aged. However, the essential subjects of family care, children, often fail to accompany their parents well, leading to a lack of care for the empty-nest and left-behind elderly, restricting the positive impact of family care on the accessibility of medical services. Therefore, more attention should be paid to the care supply in addition to stimulating the use of medical services by the elderly through subsidies, transfer payments, etc. The first is to make specific preferential policies for children in the working stage. However, we are willing to care for their parents to provide more efficient care. The second is to cultivate more applied and specialized talents in the direction of geriatric nursing at this stage.

Secondly, the elderly aged 65-74 experienced a high complementarity of family care to medical services utilization, which began to decrease significantly after aging over 75. With the accelerated aging process, chronic diseases have become an important cause of disability and disorder. The increasing actual medical needs will be a challenge to improve the quality and expectancy of life and life and promote the matching of medical supply and demand. The new pattern of "medical care+elderly care" provided for the aged avoids the difficulties of medical services caused by disability and disorder and frees up medical resources. If a new service system can replace the traditional family care for the elderly to a certain extent, a starting point will come for the realization of "ensuring old-age support" and the effective allocation of medical resources in this age of aging.

## References

[1] Andersen, R. M., P.L.Davidson, and S. E. Baumeister, "Improving access to care in America", Changing the U.S. Health Care System: Key Issues in Health Services Policy and Management, Fourth Edition, San Francisco: Jossey-Bass, 2013, 33-69.

[2] Blaxter, M., "Health and Lifestyles", London: Routledge, 1990.

[3] Bolin, K., B. Lindgren, and P. Lundborg, "Informal and Formal Care among Single-Living Elderly in Europe", Health Economics, 2008, 17(3), 393-409.

[4] Chamberlain, G., "Analysis of Covariance with Qualitative Data", NBER Working Paper, 1979, No.w0325.

[5] Condelius, A., A. K. Edberg, I. R. Hallberg, and U. Jakobsson, "Utilization of Medical Healthcare Among People Receiving Long-Term Care at Home of in Special Accommodation", Scandinavian Journal of Caring Sciences, 2010, 24(2), 404-413.

[6] Grossman, M., "On the Concept of Health Capital and the Demand for Health", Journal of Political Economy, 1972, 80(2), 223-255.

[7] Torbica, A., S. Calciolari, and G. Fattore, "Does informal care impact utilization of healthcare services? Evidence from a longitudinal study of stroke patients", Social Science & Medicine, 2015, 124, 29-38.

[8] Van Houtven, C. H., and E. C. Norton, "Informal Care and Health Care Use of Older Adults", Journal of Health Economics, 2004, 23(6), 1159-1180.

[9] Weaver, F. M., and B. A. Weaver, "Does Availability of Informal Care within the Household Impact Hospitalisation?", Health Economics, Policy and Law, 2014, 9(1), 71-93.

[10] Yu, Y., and J. Feng, "Informal Care and Health Care Utilization of the Elderly", China Economic Quarterly, 2018, 17(3), 923-948.