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Drug Demand Function for Iranian Urban Households Based on Households' Budget

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Background: One of the most important indicators of any society development is its health status and one of the most substantial issues in the field of community health status is its access to essential drugs so that the timely and adequate provision of essential drugs is one of the components of primary health care (PHC) principles.
Objectives: This research aimed to study the influence of various factors such as drug price index, inflation rate, income, the number of physicians, etc. on the drug demand and consumption for Iranian urban households based on households' budget during 1990-2010.
Patients and Methods: This research was a descriptive-analytical study which, used time-series data econometrics method to examine the relationships between the costs of drug consumption in urban households with variables such as drug price index, inflation rate, income, and tariff of the Medical staff visits. In addition, ADF test was used to show that whether variables were stationary or not. Furthermore, the OLS technique was employed to estimate the drug demand function using Eviews7 and STATA 11 software.
Results: The results showed that the estimated effects of sub-specialist visits tariff and general physician visits tariff on the drug demand were positive but not significant ($P > 0.05$) and urban households' income and drug price index had positive and significant effects on the drug demand ($P < 0.05$).
Conclusions: Based on the results of this research, it seems that allocating public resources in the form of providing health insurance or government subsidies can decline financial burden of drugs on patients.

Keywords: Consumption; Households; Demand

1. Background

One of the main indicators of society development is health status and access to essential drugs is one of the most important issues in this field. Also, developing an efficient and rational medicine system is one of the primary targets for all countries all over the world, and WHO focuses on the improvement of the drug consumption and move towards a society with a safe and rational use of drugs (1).

According to WHO statistics, Iran is among the first 20 countries of the world in terms of drug consumption and has the second highest place in Asia after China (2).Considering the government subsidies in 2011, the overall spending on medicines in Iran has been about 16000 billion Iranian Rials. In addition, the cost of per capita drug consumption and the number of drugs consumed have been, 136000 Iranian Rials and 341 items, respectively (3). During 2010, 60 Iranian pharmaceutical companies had produced a number of 1.23 billion drugs, which was equivalent to 97% of total drug consumption in Iran (4).

Though the implementation of generic drug plan in Iran supply system has had an important role in making arrangements for supplying and prescribing drugs, this shows that the country drug system has paid more attention to the supply side of the drugs. In addition, some available evidence suggests that high consumption of drugs have been due to the problems of managing demand or at least a lack of paying special attention to the growing demand for drugs (5). Furthermore, Iran with an average drug consumption annual growth rate of 11.5%, compared with 7% in developing countries and 9% in the whole world, is one of the largest consumers of pharmaceutical products in the world (6).

While in Denmark, the number of drugs per prescription is 1.9 and the number of antibiotics and intravenous drugs are 1.6 and 1.9 respectively and also, WHO has considered 1.3 to 1.5 average number of drugs per prescription as the appropriate number of drugs per prescription, in Iran the average number of drugs prescribed per prescription has been reported about 3.3 in 2001 (5, 7). Furthermore, some studies show that annual drug consumption per capita has increased from 214.2 in 1989 to 312 in 2002 that indicate an approximately 45.7% growth rate over 13 years, while the population has increased from 53 million to 65.5 million during this period with a 24% growth rate. Therefore, the drug consumption per capita has experienced a 17.47% growth rate from 1989 to

2002. In other words, every Iranian has consumed about 46.4 drugs in 2002 or approximately 4 drugs per month more than that in 1989 (8).

One of the objectives of analyzing drug demand is to study and identify factors having major effects on the households' drug consumption. A better understanding of these factors can help health policy makers to better identify and classify the variables affecting the quality and quantity of drug consumption in the community. This can help more accurately predicting the different scenarios according to the trends and influential factors, as well as provide more control and modification of drug consumption and make more favorable policies through determining the more effective variables in making decisions (9).

Several studies have been conducted in the field of demand for drugs. Klick and Stratmann estimated the demand curve for prescribed drugs among elderly Medicare beneficiaries. Their results indicated that 1% increase in the coinsurance rate led to 1.01% decrease in the number of prescriptions filled and a 0.69% decrease in the total drug expenditures (10). Duggan in a study concluded that the 610% increase in Medicaid expenditures during 1993-2009 was due to increase in demand for new antipsychotic drugs (11). Atherly used data from a survey of Medicare Current Beneficiary in 1991 and estimated the costs that supplemental insurance plans imposed on Medicare. The results showed that the moral hazard influence of Medigap plans on Medicare part B (essentially outpatient services and medical equipment) was estimated 5% to 15% increase in the probability of any use of outpatient services and medical equipment and a 24% to 28%increase in the level of expenditures (12). Moreover, Smith and Kirking reviewed a number of studies on the demand for drugs and found estimates of price elasticity ranged from -0.10-0.33 (13). Ettner used data from a survey of Medicare Current Beneficiary in 1991 and studied the effects of adverse selection and moral hazard on supplemental health insurance. She compared differences in medical care expenditures between individuals with each type of private supplemental insurance (employer-sponsored and Medigap) and those with fee-for service (FFS) Medicare only. The findings showed that supplemental insurance increased total health care expenditures between $281 and $760, depending on the comprehensiveness of coverage. In addition, adverse selection increased heath care expenditures between $446 and $516 (14). Glazer and Johnstone examined the relationship between the uses of second generation anti-psychotics and total health care spending. Their finding showed that the use of these drugs reduced health care expenditures (15). The researchers of the present study in their searches found only a few studies in Iran in which a small number of variables affecting the drug consumption had been studied.

2. Objectives

Regarding the importance of identifying such factors, the current research aimed to study the effects of factors such as drug price index, inflation rate, income, the number of physicians, general physician visits tariff, specialist visits tariff, and subspecialist visits tariff on the drug demand and consumption for Iranian urban households based on households' budget during 1990-2010 and offer some suggestions for improving the decision- and policy-making systems of Iran drug demand management.

3. Patients and Methods

This time-series study was a descriptive-analytical one which was conducted to examine the influence of various factors such as drug price index, inflation rate, income, the number of physicians, visits tariff of general physician, specialist, and subspecialist on the drug demand and consumption of the Iranian urban households based on households' budget during 1990-2010. The required data were collected from the Iran Statistical Center, Iran Ministry of Health and Medical Education and Iran Central Bank websites and entered into Excel 2007. Then, the OLS technique was employed to estimate the drug demand function using Eviews 7 and STATA 11.1. Given that the studied time series was included 20 years, it was required to explore the stationary tests. A series is said to be stationary if the mean and auto-covariance function of the series are not in dependent on time. Any series that is not stationary is said to be non-stationary.

In this study, augmented Dickey-Fuller (ADF) test was used to show that whether variables were stationary or not. This test is a test for a unit root in a time-series sample and is a version of the Dickey-Fuller test for a larger and more complicated set of time series models. The augmented Dickey-Fuller (ADF) statistic, used in this test, is a negative number. The more negative it is, the stronger the rejection of the hypothesis will be, which there is a unit root at some level of confidence (16). In this study, the econometric models have been used, too. First, the factors affecting the drug demand and then, the following basic econometric model were determined (Equation 1):

Equation 1.

$DE = f(DPI, INRATE, I, PH, GPTAR, SPETAR, SUTAR)$

Where:

DE, drug expenditure; DPI, drug price index; INRATE, inflation rate; I, urban household's income; PH, the number of physicians, GPTAR, general physician visits tariff; SPETAR, specialist visits tariff; SUTAR, subspecialist visits tariff.

The equation can be written in a double logarithmic linear form, implying that the coefficients of the variables are to be interpreted as constant elasticity. By applying this functional form, Equation 1 can be written as Equation 2:

Equation 2.

$DE = \beta_1 DPI^{\beta 2} \times INRATE^{\beta 3}t \times I^{\beta 4}t \times PH^{\beta 5}t \times GPTAR^{\beta 6}t \times SPETAR^{\beta 7}t \times SUTAR^{\beta 8}t$

By taking natural logarithms (ln) of Equation 2, and adding an error term ε, Equation 2 can be written as Equation 3:

Table 1. The Results of the Augmented Dickey-Fuller Test to Check the Stationery of the Variables

Variables	Lag	ADF Test Statistic [a]	MacKinnon Critical Values		
			1%	5%	10%
Drug expenditure	1	2.86	-3.83	-3.02	-2.65
Number of physician	1	-3.89	-3.83	-3.02	-2.65
General physician visits tariff	1	4.17	-3.83	-3.02	-2.65
Specialist visits tariff	1	3.028	-3.83	-3.029	-2.65
Subspecialist visits tariff	2	2.69	-3.85	-3.04	-2.69
Urban household's income	0	7.42	-3.80	-3.01	-2.65
Drug price index	1	3.69	-3.83	-3.02	-2.65
Inflation rate	1	-2.28	-3.83	-3.02	-2.65

[a] Abbreviation: ADF, augmented Dickey-Fuller.

Table 2. The Results of Estimating Equation After Removing Autocorrelation

Variables	Coefficients	P Value [a]	Durbin Watson Test Statistic	R^2
LOG, INCOME	0.73	0.03	2.04	0.98
LOG, DPI	0.57	0.03		
LOG, SPETAR	1.32	0.1		
LOG, SUTAR	-1.02	0.1		

[a] A P value < 0.05 was considered statistically significant.

Equation 3.

$$ln\ DEt = \beta_1 + \beta_2 lnDPI\ it + \beta_3 lnINRATEt + \beta_4 lnIt + \beta_5 lnPHt + \beta_6 ln\ GPTARt + \beta_7 lnSPETARt + \beta_8 lnSUTARt + \varepsilon$$

In all analytical and statistical tests used in this study, a P value < 0.05 was considered statically significant.

4. Results

Table 1 shows the results of the ADF test used to examine the stationery of the variables such as the number of physicians, general physician visits tariff, income at the MacKinnon critical values, which were stationary. Also, other variables such as the costs of drugs, drug price index and specialist visits tariff, were stationary at the significance level of 10%. However, the inflation rate and subspecialist visits tariff at the MacKinnon critical values, were non-stationary. Table 2 shows the results of the estimating equation after removing autocorrelation.

The estimated effects of subspecialist visits tariff and general physician visits tariff on the drug demand were positive but not significant (P > 0.05) and urban households' income and drug price index had a positive and significant effect on the drug demand (P < 0.05). Considering the logarithmic form of estimated equation (Equation 3), the coefficients of the variables are to be interpreted as elasticity. Therefore, the elasticity of drug price index was 0.57 representing the price elasticity of demand and; consequently, 1% increase in drug price index could lead to 57% increase in the drug expenditures. Furthermore, the elasticity of urban households' income was 0.73. In other words, 1% increase in the income could result in only 0.73% increase in the drug expenditures. As a result, drugs were inelastic and basic and normal goods among urban households. In addition, the results showed that for every 1% increase in specialist visits tariff and subspecialist visits tariff, the demand for drugs increased 1.32% and reduced 1.02%, respectively. Internal coefficient of determination (R^2) indicated that 98% of the variability of dependent variable could be explained by the explanatory variables in this linear model. Moreover, the Durbin-Watson statistic (DW = 2.04) showed that estimated equation had not any serial correlation.

5. Discussion

In this research, the factors affecting the drug demand and consumption of Iranian urban households during 1990-2010 were studied. The results showed that among the studied variables, urban households' income was one of the main factors affecting the demand for drugs, and its elasticity was estimated to be 0.73. Therefore, from an economic perspective, drugs could be considered as basic and normal goods among urban households, and income and drug consumption changes were aligned with each other. This showed that how consumers responded to the amounts of money paid out of pocket to meet the excess demand for drugs. In other words, consumers had to economize on the consumption of other needed commodities in order to buy drugs.

Furthermore, the results of model estimation showed that drug price elasticity was less than one and, hence, the demand for drugs among urban households was inelastic. As a result, implementing price increase policy not only cannot reduce the demand for drugs but even imposes additional financial pressure on the patients.

In Iran, drugs and new health technologies may take some time to get into the benefit packages due to its long-term legal processes. On the other hand, health insurance benefit packages are limited and do not cover a wide range of the drugs, and contribution rate of the insured is high in some insurance programs. Also according to

the results of the current study which the drug price elasticity was less than one, it seems that effective measures should be taken by the Iran Ministry of Health and Medical Education to protect households from catastrophic drug expenditures. Moreover, it appears that only making price policies on the households' drug demand and drug expenditures by the government cannot control their drug consumption effectively and some other options decreasing the households' drug consumption and expenditures should also be paid special attention.

These options may include providing appropriate training for both households and medical teams, using high-quality generic drugs and products, which are generally cheaper than commercial ones, making whole purchases by medical centers to reduce the price of drugs, as well as increasing the rational use of medicines by consumers. The study findings about price elasticity of demand for drugs were similar to the results of Ebadifard Azar et al. (17), Rahbar et al. (18), Chalmers et al. (19), Bishai et al. (20), Liu et al. (21), Van Ours (22), Smith and Kirking (13), and Nisbet and Vakil's (23) studies.

In the present study, the cross-elasticity of demand for the specialist visits tariff and subspecialist visits tariff were positive and negative respectively, but statistically insignificant. The positive cross-elasticity of demand for drugs to the specialist visits tariff indicated that the drugs and specialist visits tariff were substitute goods among the Iranian urban households. Therefore, any increase in the specialist visits tariff could increase the households' self-medication instead of referring to the specialist. Consequently, the government should consider the potential effects of increasing specialist visits tariff on the consumption of other goods such as drugs when setting health services tariffs.

On the other hand, a negative cross-elasticity of demand for drugs to the subspecialist visits tariff showed that the drugs and subspecialist visits tariff were complementary goods among the Iranian urban households. In other words, any increase in the subspecialist visits tariff could decrease the households' demand for drugs. It can be due to the high tariffs of subspecialist visits, which cause individuals to refuse further treatments because of being faced with catastrophic drug expenditures and, therefore, drug demand will be decreased.

This study had a limitationbecause the researchers did not have access to such data as the exchange rate of the drugs, burden of the diseases, coverage of supplementary health insurance schemes, moral hazards and adverse selections, and could not consider them in their study. Therefore, conducting studies to examine the effects of these variables on drug consumption for future studies are suggested.

In conclusion, the results showed that urban households' income and drug price index had positive and significant effects on the drug demand; also the demand for drugs among urban households was inelastic. Based on these results, the following polices are suggested:

Allocating public resources in the form of providing health insurance or government subsidies for drugs to decline financial burden on patients;

Establishment of a single universal health insurance scheme that provides uniform services to all individuals and greater protection against catastrophic drug expenditures than the current health insurance programs in Iran;

And reducing drug items in the physicians' prescriptions through regular supervision of the Ministry of Health and Medical Education, imposing punishment over drug distribution centers in case of additional sale of drugs, using incentive policies for physicians prescribing the least drugs to achieve the desired clinical outcomes, and reforming the pattern of drug consumption through educating consumers.

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Authors' Contributions

Ramin Ravangard and Abdosaleh Jafari conceived, designed, analyzed, and interpreted the data; Soraya Nouraei Motlagh performed data collection. All authors were responsible for writing and editing of the relevant methods, results and discussion sections of the manuscript. Therefore, all authors read and approved the final manuscript.

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