Caspian Journal of Health Research

Original Article

Inequity in Access of Statins in Iran: A Panel Study Using Provincial Data

Rasoul Tabari-Khomeiran[1], Yahya Bayazidi[2], Shekoufeh Nikfar[2], Enayatollah Homaie Rad[1*], Mehdi Varmaghani[3], Fatemeh Kokabisaghi[4]

[1] *Social Determinants of Health Research Center, Guilan University of Medical Sciences, Rasht, Iran*

[2] *School of Pharmacy, Tehran University of Medical Sciences, Tehran, Iran*

[3] *Social Determinants of Health Research Center, Mashhad University of Medical Sciences, Mashhad, Iran*

[4] *Healthcare and Law Department, School of Health Policy and Management, Erasmus University, Rotterdam, Netherlands*

[*]*Corresponding author: Enayatollah Homaie Rad*

Email: homaierad@gmail.com

A B S T R A C T

Background: Statins are among useful drug to prevent hyperlipidemia and subsequent cardiovascular diseases. Having an equal access to these drugs are very important for health policy makers.

Methods: Provincial data of statin supply for Iran in 2013 were used in this study. Concentration index, GINI coefficient, concentration curve and Lorenz curve were calculated to show the level of inequality in access of statins. The percentage of population more than 65 years old was used as the need index. A panel data regression was used to estimate the contributing factors of inequality.

Results: GINI index was 0.297 for lovastatin, 0.322 for atorvastatin and 0.526 for simvastatin. GINI index for overall statin use was 0.303. Concentration index was not significant for atorvastatin and simvastatin while it was 0.160 for lovastatin. The coefficient of income was -1.75 for lovastatin, 1.04 for atorvastatin and -1.117 for simvastatin. The regression model showed that household income was independently contributed to decrease in Lovastatin (B = -1.752) and Simvastatin (B = -1.118) and increase in Atorvastatin (B = 1.04) access. Higher percentage of people with academic education, the number of physician, and price of drug were another significant predictors of statin access.

Conclusion: The inequality for access in Simvastatin was greater than other statins. Household income and price of drug were among important contributors of statin access. For increasing access to statins it is suggested to increase the coverage of health insurance.

Keywords: Concentration index, Inequality, Iran, Panel data, Statins

Citation: Tabari-Khomeiran R, Bayazidi Y, Nikfar S, Homaie Rad E, Varmaghani M, Kokabisaghi F. Inequity in Access of Statins in Iran: A Panel Study Using Provincial Data. Caspian J Health Res. 2019;4(2):33-37.

Introduction

Development of statins has been introduced as one of the most promising approach for treating cholesterolemia and preventing cardiovascular diseases. Clinical trials has shown that statins reduce the risk of vascular events in all age groups (1, 2). The useful effects of statins led to increase their acceptability all

over the world and categorized them as a useful preventive and therapeutic drugs (3). However, there are some variations in access of statins between and within countries. Statin access and improving adherence to this drug are very important for health policy makers (4). Previous studies suggest that people with lower socioeconomic condition are less likely to access statin (4, 5). Furthermore, there are some other non-modifiable characteristics such as age, sex, race and the experience of physicians that may influence statin access (6-9).

One of the most critical features of health service planning is a fair distribution of drug supply to meet health needs of all population in a community (10-13). To achieve the goal of health for all, health care should be available based on need and not willingness or ability to pay. Drug supply is considered as availability of drug in the market that is different from drug utilization. It is important to improve equity in utilization of drug, but amount of utilization is difficult to calculate because of requirement to expensive household surveys, and detailed information of completed treatment course in patients. Instead, calculating supply of drugs is more feasible using data registry at drug and food organizations that is publicly available in ministry of health organizations.

Iran is a middle income country in western Asia. The government is the major funder and responsible for drug distribution in Iran. Recent huge migration from rural areas along with population aging may cause some source of inequality in drug access. Inequality in health care access and drug supply been studied in several countries but there is limited evidence in Iran. Therefore, the aim of this study was to measure the inequality in statin access and contributing factors using provincial data. For this purpose we calculated concentration index (CI) and concentration curve for each type of statin and assessed the reason of inequality by regressing socioeconomic factors to statins access.

Methods

Study design and data

This was a cross sectional study using provincial level data. Provincial data of statins supply in Iran in 2013 were used in this study. We used statin supply as an indicator to show the access to statins. There are 3 forms of statin in Iran; lovastatin, atorvastatin and simvastatin. Data of statins supply were changed to the dose of supply for each province. Statins supply data were gathered from Iranian Ministry of Health annual Pharma Statistics, Iran food and drug organization. Socioeconomic data were gathered from Iran Statistical Center. Iran contain 30 provinces but data for 3 new separated provinces, Alborz, North Khorasan and South Khorasan were not available so this study contained 28 provinces data. GINI coefficient, concentration index (CI) and concentration curve (CC) were calculated to show the inequality in statin access in Iran. Percentage of people more than 65 years old was used as need index in CI and CC. These indicators were calculated for

each drug separately and an overall supply was also calculated. In this study because of using previously gathered data, no informed consent declaration was needed and no human/ animal rights were violated.

GINI and concentration index, Lorenz and concentration curve

The balance of drug accessibility is very important for policy makers. One of the indicators, which could show this balance is the Lorenz curve. Lorenz curve shows how much the drugs are supplied or accessed equally. Lorenz curve has an equality line. For between-province data, if the accessibility curve placed near the equality line, it is indicated that drug is accessed more equal between provinces in comparison with a curve placed further from equality line. GINI index is the numerical form of the Lorenz curve. It varies from zero and one. Zero is the complete equality and one is complete inequality.

Concentration curve shows the share of accessibility for cumulative percentage of provinces which are ranked from more needy ones to richer ones. Similar to Lorenz curve, if the accessibility curve places near the equality line, the drug is available equally. The difference between CC and Lorenz is that in CC, the inequality is calculated in regard with need. Concentration index (CI) is the numerical form of CC. The value of CI is varied between -1 and +1 which -1 is complete inequality favors the poor and +1 is complete inequality favors the rich.

Results of the model estimation

Panel data regression model was used for estimating the sources of inequality. These models were estimated for each drug separately. The dependent variable (util) was the dose of supply of each type of statin in each province between 2008 and 2013 in milligrams. Because the model is nonlinear, we transformed it to logarithm scale, as follows:

$$Log(util)_{it}=B_0+B_1Log(price)_{it}+B_2Log(edu)_{it}+B_3Log(urb)_{it}+B_4Log(doc)_{it}+B_5Log(pop65)_{it}+B_6Log(income)_{it}+u_{it}$$

Where B_0 is the intercept, B_1 to B_6 denote the coefficients of determinant variables in order: the average price of each drug in each province in Iranian Rials, the number of people with academic degree in the province, the number people lived in urban regions, the number of physician in each province, the number of people more than 65 years old, the average household income in Iranian Rials. The statistics were gathered for each province between 2008 and 2013. u_{it} is the the residual of the estimated model.

Hausman test was used for choosing fixed or random effect models. All analyses was performed in STATA SE version 14.

Results

Descriptive results

The trend and dose of access to statins are shown in table 1. These values are in milligram. As shown in the table, access to lovastatin and simvastatin has been decreased but atorvastatin access has been increased.

Table 1. The Trend and Dose of Access to Statins in Iran from 2008 to 2013

Drug Name	2008	2009	2010	2011	2012	2013
Lovastatin	$4.09 * 10^7$	$3.47*10^7$	$2.23*10^7$	$1.74*10^7$	$1.00*10^7$	$1.04*10^7$
Atorvastatin	$6.90*10^7$	$1.08*10^8$	$1.22*10^8$	$1.84*10^8$	$1.97*10^8$	$1.41*10^8$
Simvastatin	$1.11*10^7$	$1.24*10^7$	4865093	7016459	6880771	5000357
Overall	$1.21*10^8$	$1.55*10^8$	$1.49*10^8$	$2.09*10^8$	$2.14*10^8$	$1.57*10^8$

Doses are in milligram

The highest dose of overall statin access was in 2012 ($2.14*10^8$ Milligram) and the lowest was in 2008 ($1.21*10^8$ milligram).

Inequality indices

The results of GINI and concentration indices for per capita lovastatin, simvastatin and atorvastatin access are shown in table 2. According to standard error values, the estimates were significant for all of them. GINI index for overall statin use was 0.303. The GINI index revealed an inequality in access to statins between provinces in Iran. These inequalities were higher for simvastatin accessibility in comparison with other drugs. The need index used for concentration index calculates inequality in regard with need. In concentration index, population more than 65 years were used as the need index. So, it is inferred that in provinces with higher percentage of elderlies, there are more need to statins. The results of CI showed that only lovastatin had a significant unequal distribution between provinces (Concentration index = 0.160). Other statin accessibilities did not have significant unequal distributions in regard with need i.e. population over 65 years old.

Lorenz curves of statins supply are shown in figure 1. The Y-axis of this curve shows the cumulative access of per-capita statin supply for each province and the X-axis depicts the cumulative access of per-capita statin supply from lowest to highest access. As shown, the simvastatin curve is further from equality line in comparison with other curves so there is more inequality in distribution of simvastatin.
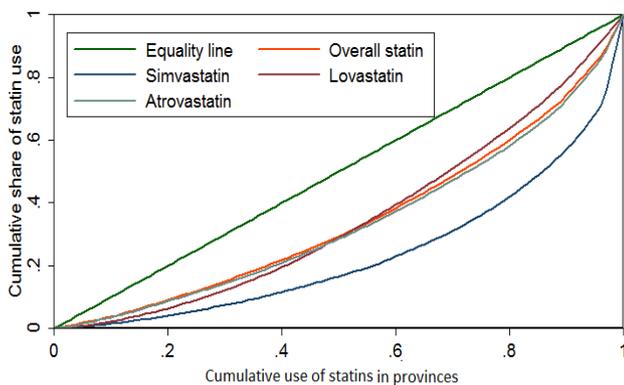

Figure 1. Lorenz Curve for Statin Access

In figure 2, concentration curves of statins supply are shown. The Y-axis of this figure is similar to figure 1, but in the X-axis, the provinces are ranked by percentage of population more than 65 years old. In both figures, the curves of lovastatin and overall statin supply were near to each other. This arises from the high proportion of lovastatin in overall statin supply which disappears the effects of other drugs.

The panel regression model

The results of three regression models are shown in table 3. Based on the results of Hausman test, the fixed effect model were used to estimate the coefficient. As shown in the table, income was a reason of inequality. However it has different association with each drugs. The coefficient of income was -1.75 for lovastatin, 1.04 for atorvastatin and -1.117 for simvastatin. Atorvastatin supply has been increased by increasing in per capita income of families but lovastatin and simvastatin supply has been decreased. Because of not using logarithm form model, these results could not be indicated as elasticity. In addition, in more educated provinces less statins were supplied. The coefficient of drug price was negative in all three models (lovastatin= -0.0153, atorvastatin = -0.00275, simvastatin = -0.01286) so it could be indicated that by increase in the price of statins, supply was decreased.
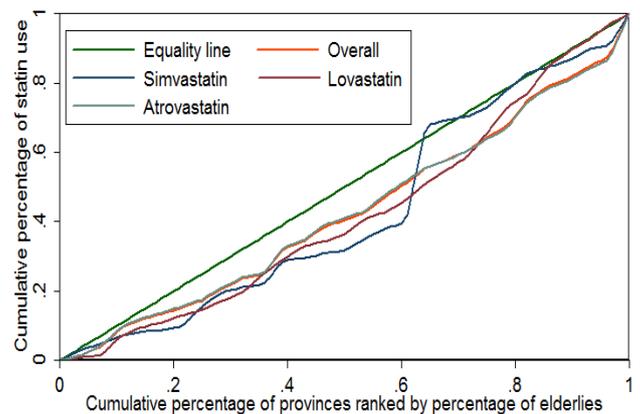

Figure 2. Concentration Curve of Statin Access

Discussion

The results of this study showed that statins supply has been increased till 2012 but for 2013 there was a decrease. The average price of statins were lower in 2012 in comparison with other years so the access of statins was higher in this year. The results of inequality indices showed that, however the per capita use of Atorvastatin and Simvastatin had unequal distributions between provinces, these distributions were in regard with the provinces with higher percentages of elderlies. So it was indicated that the distribution of statins supply was not significantly unequal when the need was noticed. However per capita supply of Lovastatin was unequal when we noticed to the need index.

The results of regression model showed that income had negative relationship with lovastatin and simvastatin supply. These drugs are substitutes of each other, when the income increases, atorvastatin supply increase because the prescription of atorvastatin in comparison with lovastatin and simvastatin increases.

Table 2. The Results of GINI and Concentration Indexes for Per Capita Lovastatin, Simvastatin and Atorvastatin Uses

Drug name	GINI index		Concentration index	
	Estimate	Standard error	Estimate	Standard error
Lovastatin	0.297248[*]	0.0392507	0.16029364[*]	0.05527351
Atorvastatin	0.322234[*]	0.0593675	0.14717523	0.08684474
Simvastatin	0.5264407[*]	0.1219441	0.14482777	0.07795357
Overall	0.3037152[*]	0.0542224	0.14816099	0.07905605

Table 3. Estimates of Demographic and Socioeconomic Factors on Dose of Statin Access Using Panel Regression Model

Variables	Lovastatin model		Atorvastatin model		Simvastatin model	
	coefficient	S.E	coefficient	S.E	coefficient	S.E
Household income	-1.751955 [**]	0.1112741	1.040632[**]	0.1133896	-1.117915 [**]	0.1613919
Population over 65 years	0.0146615	0.1426457	0.0727459	0.1597429	-0.0921143	0.2065258
No. of Physician	-0.2125734[**]	0.0607988	0.0401783	0.0681672	-0.04197[**]	0.0876829
No. of urban residence	-0.3820541	0.4940759	-0.1298312	0.4375009	0.0696575	0.7155336
Population	0.6620283	0.6055004	0.7357312	0.5295144	-0.3558397	0.8767591
No. of people with academic degree	0.0130898	0.0299901	0.041893[**]	0.01864	0.0192504	0.0435354
Price of drug	-0.01536[**]	0.0076585	-0.002756[**]	0.000767	-0.012866[**]	0.0058545
Constant	47.58353[**]	2.526452	-5.837366[**]	2.537528	38.85787 [**]	3.662275
Hausman teat	P-value = 0.0006		P-value = 0.0073		P-value = 0.0000	

Abbreviation: SE, Standard error. [**] Significant at P-value < 0.05

So by income increment, access to atorvastatin would be increased, but access to lovastatin and simvastatin would be decreased. It is important to note that the models are estimated and the coefficients of income are not income elasticity of demand and they are income elasticity of expenditures. If it is assumed that there is balance in supply and demand of statins, from the estimated coefficients, it could be indicated that lovastatin and simvastatin are inferior object, because income elasticity of supply in these two drugs are negative. The income elasticity of supply for atorvastatin was more than one and it could be indicated that atorvastatin was a luxury drug. Shimony et al. found that in higher income countries patients like to use more statins (14). Wallach-Kildemoes et al. in a study conducted in Denmark found that by decreasing in income, statin therapy would be decreased (15). Chan et al. found similar results for adherence to statins (16). Norris et al. in a study performed in New Zealand in 2014, assessed equity in use of statin. Using prescribing data, they found that statin use was in accordance with pattern of need and older ages used more statin (4). Chan et al. in 2010 found that elderly patients have more adherence to statins (16). Percentage of population more than 65 years old did not have any relationships with statins access. In a study performed by Ward et al. in Australia, the authors surveyed 132 general physicians (GP) practice about prescribing statins. They found inequity in statin prescribing among these GPs and tried to found the sources of inequity. They found that there was relationship between statin prescribing and age. They used age as a need index in this study (17). Education had positive relationship with atorvastatin supply. By increasing in the level of education, the population will be more aware about the diseases while try to adherence to preventive drugs. Similar results were found by stocks et al. in Australia and Thomson et al. in Denmark (9, 18). Thomsen et al. in a study done in Denmark, analyzed prescribing data between 1995 and 1999. After adjustment for age and urbanization, among men with higher socioeconomic status, use of statin was higher but no relationships were found for women (18). Manderbacka et al. found positive relationship between socioeconomic status and statin use in Finland (19). The price of drug had negative relationship with statin supply. In the balance between demand and supply, by increasing in the prices, the supply of drugs will be decreased. The coefficients of price in the models could be indicated as price elasticity of supply. All of drugs have very low price elasticity of supply, and changes in the prices, do not change the amount of supply. Drugs and other health services have similar price elasticity too(20). Jung et al. in United States found that Statin compliance was decreased when price of it increased(21). Karaca-Mandic found similar results in united states in 2013 (22). Health insurances are responsible to provide drugs with low price elasticity. These drugs are not face with moral hazard and other insurance failures. Increasing in insurance coverage of statins not only help to increase utilization and supply for lower income populations, but also improves equality in statin use (21, 23). Studies showed some other contributing factors to access of statin such as administrative factors being as minority (17). Norris et al. found that Maori as a minority group in New Zealand used more statins especially in older age groups with higher risk of cardiovascular diseases (4). Choudhry et al. found that low statin access may reflect problems with affordability, access to health care, and cultural barriers (23).

Limitations of the study
In this study macro data of provinces of Iran were used. Macro data could not be interpreted and inference to individuals. We used drug supply as an indicator for access to statins. We were not able to calculate financial access to drug use and only focused on drug supply in pharmacies. Access to statins does not mean prescribing or utilizing them. We assumed that if the statin market was in balance, the supply of statins could be indicated as its prescription.

Conclusion
Access to statin in Iran is not unequal in regard with need. Use of statins depended on income and prices. One of the main aims of the governments is to improve health in the population. Coronary heart disease is the first cause of mortality and is responsible for about half of all deaths in the population IRAN. Increase in level of Low-density lipoprotein (LDL) or bad cholesterol are the one of the major causes of cardiovascular disease. Decreasing hyperlipidemia is a way to decrease the incidence of cardiovascular diseases and using statins could be helpful for this purpose. Policy makers must make policies to increase use of statins due to the importance of these drugs to decrease prevalence of cholesterolemia. Policies like increase the coverage of insurances, education of physicians, people and promotion policies are very useful in this case. For future studies it is suggested to calculate inequality in use of statins at individual level.

Ethical consideration
Not applicable.

Conflicts of interests

Funding

References

1. LaRosa JC, He J, Vupputuri S. Effect of statins on risk of coronary disease: a meta-analysis of randomized controlled trials. JAMA. 1999;282(24):2340-2346. doi:10.1001/jama.282.24.2340.
2. Taylor F, Huffman MD, Macedo AF, Moore TH, Burke M, Davey Smith G, et al. Statins for the primary prevention of cardiovascular disease. Cochrane Database Syst Rev. 2013;(1):CD004816. doi: 10.1002/14651858.CD004816.pub5.
3. Tsivgoulis G, Kadlecová P, Kobayashi A, Czlonkowska A, Brozman M, Švigelj V, et al. Safety of statin pretreatment in intravenous thrombolysis for acute ischemic stroke. Stroke. 2015;46(9):2681-2684. doi: 10.1161/STROKEAHA.115.010244.
4. Norris P, Horsburgh S, Becket G, Keown S, Arroll B, Lovelock K, et al. Equity in statin use in New Zealand. J Prim Health Care. 2014;6(1):17-22. doi: 10.1071/hc14017.
5. Odubanjo E, Bennett K, Feely J. Influence of socioeconomic status on the quality of prescribing in the elderly -- a population based study. Br J Clin Pharmacol. 2004; 58(5):496-502. doi: 10.1111/j.1365-2125.2004.02179.x.
6. Lewey J, Shrank WH, Bowry AD, Kilabuk E, Brennan TA, Choudhry NK. Gender and racial disparities in adherence to statintherapy: A meta-analysis. Am Heart J. 2013;165(5):665-678, 678.e1. doi: 10.1016/j.ahj.2013.02.011.
7. Franks P, Tancredi D, Winters P, Fiscella K. Cholesterol treatment with statins: who is left out and who makes it to goal? BMC Health Services Research. 2010;10:68. doi: 10.1186/1472-6963-10-68.
8. González-Chica DA, Mnisi Z, Avery J, Duszynski K, Doust J, Tideman P, et al. Effect of health literacy on quality of life amongst patients with ischaemic heart disease in Australian general practice. PLoS One. 2016;11(3):e0151079. doi: 10.1371/journal.pone.0151079.
9. Stocks NP, Ryan P, McElroy H, Allan J. Statin prescribing in Australia: socioeconomic and sex differences. Med J Aust. 2004;180(5):229-231. doi: 10.5694/j.1326-5377.2004.tb05891.x.
10. World Health Organization. The world health report 2000: health systems: improving performance. Geneva, Switzerland: World Health Organization; 2000.
11. Sridhar D, McKee M, Ooms G, Beiersmann C, Friedman E, Gouda H, et al. Universal health coverage and the right to health: from legal principle to post-2015 indicators. Int J Health Serv. 2015;45(3):495-506. doi:

12. Homaie Rad E, Kavosi Z, Arefnezhad M. Economic inequalities in dental care utilizations in Iran: Evidence from an urban region. Med J Islam Repub Iran. 2016;30:383.
13. Homaie Rad E, Khodaparast M. Inequity in health care financing in iran: progressive or regressive mechanism? Eurasian J Med. 2016;48(2):112-118. doi: 10.5152/eurasianjmed.2015.32.
14. Shimony A, Grandi SM, Pilote L, Joseph L, O'Loughlin J, Paradis G, et al. Utilization of evidence-based therapy for acute coronary syndrome in high-income and low/middle-income countries. Am J Cardiol. 2014;113(5):793-797. doi: 10.1016/j.amjcard.2013.11.024.
15. Wallach-Kildemoes H, Andersen M, Diderichsen F, Lange T. Adherence to preventive statin therapy according to socioeconomic position. Eur J Clin Pharmacol. 2013;69(8):1553-1563. doi: 10.1007/s00228-013-1488-6.
16. Chan DC, Shrank WH, Cutler D, Jan S, Fischer MA, Liu J, et al. Patient, physician, and payment predictors of statin adherence. Med Care. 2010;48(3):196-202. doi: 10.1097/MLR.0b013e3181c132ad.
17. Ward PR, Noyce PR, St Leger AS. How equitable are GP practice prescribing rates for statins?: an ecological study in four primary care trusts in North West England. Int J Equity Health. 2007;6:2. doi: 10.1186/1475-9276-6-2.
18. Thomsen RW, Johnsen SP, Olesen AV, Mortensen JT, Bøggild H, Olsen J, et al. Socioeconomic gradient in use of statins among Danish patients: population-based cross-sectional study. Br J Clin Pharmacol. 2005;60(5):534-542. doi: 10.1111/j.1365-2125.2005.02494.x
19. Manderbacka K, Keskimäki I, Reunanen A, Klaukka T. Equity in the use of antithrombotic drugs, beta-blockers and statins among Finnish coronary patients. Int J Equity Health. 2008;7:16. doi: 10.1186/1475-9276-7-16.
20. McGuire A, Henderson J, Mooney GH. The economics of health care: an introductory text. Abingdon, UK: Routledge & Kegan Paul; 1988.
21. Jung K, Feldman R, McBean AM. Nonlinear pricing in drug benefits and medication use: the case of statin compliance in Medicare Part D. Health Serv Res. 2014;49(3):910-928. doi: 10.1111/1475-6773.12145.
22. Karaca-Mandic P, Swenson T, Abraham JM, Kane RL. Association of Medicare Part D medication out-of-pocket costs with utilization of statin medications. Health Serv Res. 2013;48(4):1311-1333. doi: 10.1111/1475-6773.12022.
23. Choudhry NK, Dugani S, Shrank WH, Polinski JM, Stark CE, Gupta R, et al. Despite increased use and sales of statins in India, per capita prescription rates remain far below high-income countries. Health Aff (Millwood). 2014;33(2):273-782. doi: 10.1377/hlthaff.2013.0388.