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Analysis on Differences of Public Medical Institutions' Medical Expenses in Qingdao

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Abstract: Research on differences of medical expenses in Qingdao could provide reference to take control of medical expenses reasonably. This study uses hierarchical cluster analysis of two variables, outpatient costs for each people and hospitalization expenses for each day of Qingdao in the first half of 2012. According to the medical cost, the 22 governmental hospitals in Qingdao are divided into four grades: "lowest cost", "lower cost", "higher cost", "highest cost". Then make the clustering results for significant test using the single factor variance, LSD method and S-N-K method. It shows that the four levels have obvious differences. Finally, the countermeasure for controlling medical expenses is put forward in Qingdao, China.

Key words: Medical expenses, cluster analysis, variance analysis

INTRODUCTION

With the rapid rise of expenses, the research about status of social medical insurance economic operation and the inherent law have become a hot spot in this field since 1980 (Qiu *et al*., 2010; Li, 2012). The level of medical expenses is always growing and the reasons seem perplexing (Chen *et al*., 2013; Li and Liu, 2011). Some international organizations such as the International Social Security Association (IS-SA), Organization for Economic Cooperation and Development (OECD), International Labor Organization (ILO), World Health Organization (WHO) and European Community (EC) have done some research and analysis on the trends or reasons of the growth of medical expenses (Shen and Zhang, 2012). A large number of scholars were engaged in macroeconomic model of medical expenses and the medical expenses in different countries were compared and analyzed (Peng and Luo, 2013; Chen, 2006).

At the end of 2012, there are 2606 medical institutions (including clinics), 55000 health technicians and 47000 bed spaces in Qingdao. Generally medical expense was declining but not optimistic. Study on medical expenses is related to people's daily life and health policy formulation (Guo, 2005) and is also closely connected with the improvement of medical institution and the sound of health system. Clearing the differences of medical expenses in Qingdao could provide reference for control medical costs reasonably.

After hierarchical clustering on medical expenses, 22 governmental hospitals in Qingdao are made significance test with the single factor variance analysis, LSD method and S-N-K method. The results of research would help to control medical expenses in different economic development areas in Qingdao, understand the medical expenses of each hospital and the difference of Qingdao and provide a reliable basis for strengthening the reform of the resident's medical security system.

ANALYSIS ON DIFFERENCES OF MEDICAL EXPENSES

Statistical description: The medical expenses of 22 governmental hospitals at the level of secondary or above in Qingdao in the first half of 2012 are shown in Table 1. Now take outpatient costs for each people and hospitalization expenses for each day for descriptive analysis and the results are shown in Table 2.

Table 2 represents mean, variance and others of hospitalization expenses for each day and outpatient costs for each people. Hospitalization expenses for each day have 21 valid data. The mean value is 797.7924 yuan, the median is 749.77 yuan and the variance is 139539.856. There are 22 outpatient costs for each people and hospitalization expenses data effectively. The mean is 301.6877 yuan, the median is 254.4 yuan and the variance is 18293.273. The variance is bigger for both variables.

Cluster analysis: Hierarchical cluster analysis is done for outpatient costs for each people and hospitalization expenses for each day. The 22 governmental hospitals can be divided into four grades, respectively defined as

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Table 1: Medical expenses of 22 governmental hospitals at the level of secondary or above in Qingdao in the first half of 2012 Unit: RMB

	Outpatient costs for		Hospitalization expenses		Average hospitalization	
Hospital	Amount of money	Growth (%)	Amount of money	Growth (%)	No. of days	Sliding
Qingdao municipal hospital	284.21	9.34	1244.86	8.88	11.20	-0.52
Qingdao HaiCi medical treatment group	246.00	8.09	749.77	-6.54	12.68	0.79
Qingdao central hospital	321.51	6.49	921.65	12.81	13.03	0.13
Qingdao eighth people's hospital	215.95	3.97	760.10	0.23	9.76	-0.12
Qingdao Jiaozhou center hospital	259.30	-5.10	775.06	2.90	9.09	-0.06
Qingdao third people's hospital	188.97	2.87	688.92	7.09	11.68	-0.30
Qingdao fifth people's hospital	252.04	-23.72	522.94	13.36	19.26	-2.05
Qingdao ninth people's hospital	188.19	32.59	522.94	14.13	12.18	-0.17
Qingdao chest hospital	236.34	-6.24	367.16	6.87	52.48	0.27
Qingdao infectious diseases hospital	463.51	14.36	450.16	10.60	36.31	-5.47
Qingdao mental health center	427.71	37.60	184.88	13.43	100.31	-11.16
Qingdao stomatology hospital	203.42	6.01	-	-	-	-
Qingdao tumor hospital	774.75	21.90	727.83	14.91	727.83	-0.71
Qingdao women and children's hospital	241.36	-10.21	765.82	21.41	9.45	-1.58
The hospital of medical college	363.73	4.37	1806.49	8.49	9.59	-0.52
Navy four zero one hospital	387.12	14.44	1135.10	10.07	13.15	-1.10
Qingdao fuwai cardiovascular hospital	202.77	-0.92	1006.97	35.55	12.06	-0.90
Qingdao sifang factory worker's hospital	256.76	15.78	661.79	35.12	12.54	0.13
Shandong ophthalmologic hospital	243.57	-0.25	1438.15	25.87	5.09	-0.60
Songshan hospital	166.52	18.36	557.18	14.86	10.40	-1.79
Qingdao cardiovascular disease hospital	424.10	14.38	573.77	3.37	9.19	-0.52
Qingdao business worker's hospital	289.30	29.67	892.10	15.62	12.21	-0.45

Data sources: http://sd.people.com.cn

Table 2: Statistical description of governmental hospitals at the level of secondary or above in Qingdao in he first half of 2012

	Hospitalization expenses for each day	Outpatient costs for each person
N vaild	21.0000	22.0000
N missing	1.0000	0.0000
Mean	797.7924	301.6877
Median	749.7700	254.4000
Variance	139539.8560	18293.2730
Skewness	1.0660	2.2380
Std. error of skewness	0.5010	0.4910
Kurtosis	1.5780	6.4250
Std. error of kurtosis	0.9720	0.9530
Range	1621.6100	608.2300
Minimum	184.8800	166.5200
Maximum	1806.4900	774.7500

Table 3: Results of hierarchical cluster analysis

Hospital	Outpatient costs for each person	Hospitalization expenses for each day	CLU
Qingdao municipal hospital	284.21	1244.86	1
Qingdao HaiCi medical treatment group	246.00	749.77	2
Qingdao central hospital	321.51	921.65	2
Qingdao eighth people's hospital	215.95	760.10	2
Qingdao Jiaozhou center hospital	259.30	775.06	2
Qingdao third people's hospital	188.97	688.92	2
Qingdao fifth people's hospital	252.04	522.94	2
Qingdao ninth people's hospital	188.19	522.94	2
Qingdao chest hospital	236.34	367.16	2
Qingdao infectious diseases hospital	463.51	450.16	3
Qingdao mental health center	427.71	184.88	3
Qingdao stomatology hospital	203.42	.	.
Qingdao tumor hospital	774.75	727.83	4
Qingdao women and children's hospital	241.36	765.82	2
The hospital of medical college qingdao university	363.73	1806.49	1
Navy four zero one hospital	387.12	1135.10	1
Qingdao fuwai cardiovascular hospital	202.77	1006.97	2
Qingdao sifang factory worker's hospital	256.76	661.79	2
Shandong ophthalmologic hospital	243.57	1438.15	1
Songshan hospital	166.52	557.18	2
Qingdao cardiovascular disease hospital	424.10	573.77	3
Qingdao business worker's hospital	289.30	892.10	2

"lowest cost", "lower cost", "higher cost", "highest cost". The 4 classes into which the samples are gathered can be seen from Table 3.

According to Table 3, sample 1, 15, 16, 19 belong to the first grade. Namely Qingdao municipal hospital, the affiliated hospital of medical college Qingdao university,

Table 4: Test of homogeneity of variances

	Levene statistics	df1	df2	Significant
Outpatient costs for each people	2.571	2	17	0.106
Hospitalization expenses for each day	0.675	2	17	0.522

Table 5: ANOVA

Variables			Sum of squares	df	Mean square	F-value	Significant
Outpatient costs for each person							
Between groups	(Combined)		337210.190	3	112403.397	51.880	0.000
	Linear term	Unweighted	210840.935	1	210840.935	97.314	0.000
		Weighted	149551.641	1	149551.641	69.026	0.000
		Deviation	187658.548	2	93829.274	43.307	0.000
	Within groups		36832.160	17	2166.598		
	Total		374042.350	20			
Hospitalization expenses for each day							
Between groups	(Combined)		2059932.076	3	686644.025	15.971	0.000
	Linear term	Unweighted	469246.452	1	469246.452	10.915	0.004
		Weighted	1289398.231	1	1289398.231	29.992	0.000
		Deviation	770.533.846	2	385266.923	8.961	0.002
	Within groups		730865.040	17	42992.061		
	Total		279079.117	20			

Table 6: LSD multiple comparison

						Confidence interval 95(%)	
Dependent variable	Average linkage (I)	Average linkage(J)	Mean difference (I-J)	Std. error	Significant	Lower bound	Upper bound
Outpatient costs (LSD) for each person	1	2	83.88750*	26.61411	0.006	27.7366	140.0384
		3	-118.78250*	35.55065	0.004	-193.7878	-43.7772
	2	1	-83.88750*	26.61411	0.006	-140.0384	-27.7366
		3	-202.67000*	29.81376	0.000	-265.5715	-139.7685
	3	1	118.78250*	35.55065	0.004	43.7772	193.7878
		2	-202.67000*	29.81376	0.000	139.7685	265.5715
Hospitalization expenses (LSD) for each day	1	2	699.04231*	1.1855E2	0.000	448.9148	949.1698
		3	1003.21333*	1.5836E2	0.000	669.0975	1337.3291
	2	1	-699.04231*	1.1855E2	0.000	-949.1698	-448.9148
		3	304.17103*	1.3280E2	0.035	23.9722	584.3699
	3	1	-1003.21333*	1.5836E2	0.000	-1337.3291	-669.0975
		2	-304.17103*	1.3280E2	0.035	-584.3699	-23.9722

navy four zero one hospital and Shandong ophthalmologic hospital belong to the category "lowest cost". Sample 2, 3, 4, 5, 6, 7, 8, 9, 14, 17, 18, 20, 22 belong to the second kind, namely Qingdao HaiCi medical treatment group, Qingdao central hospital, Qingdao eighth people's hospital, Qingdao Jiaozhou center hospital, Qingdao third people's hospital, Qingdao fifth people's hospital, Qingdao ninth people's hospital, Qingdao chest hospital, Qingdao women and children's hospital, Qingdao fuwai cardiovascular hospital, Qingdao sifang factory worker's hospital, Songshan hospital of medical college Qingdao university and Qingdao business worker's hospital belongs to the "lower cost" category. Sample 10, 11, 21 belong to the third grade. Namely Qingdao infectious diseases hospital, Qingdao mental health center and Qingdao cardiovascular disease hospital belong to the "higher cost" category. Sample 13 belongs to the fourth category. Namely, Qingdao tumor hospital belongs to the "highest cost" category.

Variance analysis: Variance analysis can be used to test whether the mean of two or more samples is significant. Take the cluster analysis results for variance analysis in order to test the differences among "lowest cost", "lower cost", "higher cost", "highest cost" whether are significant.

Firstly, take outpatient costs for each people and hospitalization expenses for each day for condition test. The results are shown in Table 4.

Concomitant probability is 0.106 and 0.522. They are more than the significance level of 0.05. So, we can consider that all groups' variance are equal. According to the requirements of the variance test, this group of data is suitable for single factor variance analysis. Variance analysis is shown in Table 5.

The F value is 51.880 and 15.971 in variance test of outpatient costs for each people and hospitalization expenses for each day. Their associated probability is less than the significance level of 0.05, so declining to null hypothesis, namely at least one group has significant difference from others.

Figure 1 and 2 are average linkage the two variables.

Because that the 4.st grade only has one case, namely "highest cost" category only has one hospital (Qingdao tumor hospital) and it has significant difference from other three types which can be seen from the linkage, only comparising 1, 2, 3 classes. The result of LSD multiple comparison is shown in Table 6.

Table 7: Student-newman-keuls method of outpatient costs for each people

			Subset for alpha = 0.05		
	Average linkage	N	1	2	3
Student-newman-keuls[a]	2	13	2.3577E2		
	1	4		3.1966E2	
	3	3			4.3844E2
	Significance		1.000	1.000	1.000

Table 8: Student-newman-keuls method of hospitalization expenses for each day

			Subset for alpha = 0.05		
	Average linkage	N	1	2	3
Student-newman-keuls[a]	3	3	4.0294E2		
	2	13		7.0711E2	
	1	4			1.4062E3
	Significance		1.000	1.000	1.000

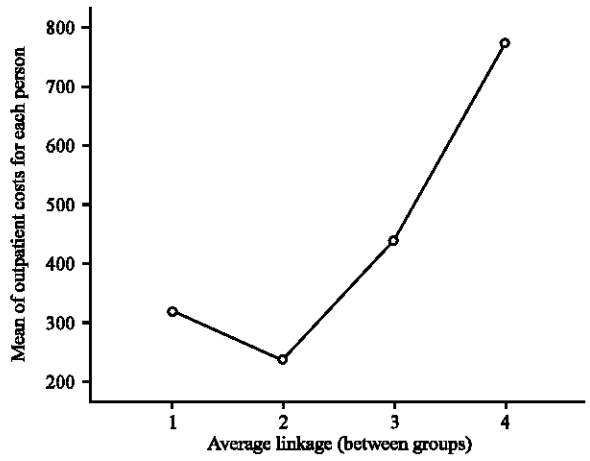

Fig. 1: Linkage of outpatient costs for each person

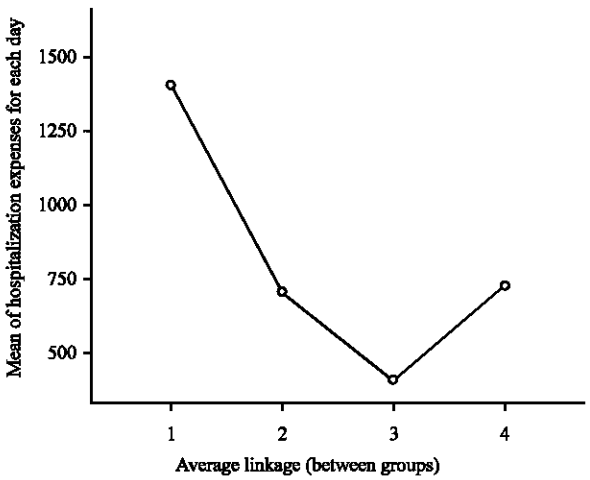

Fig. 2: Linkage of hospitalization expenses for each day

From LSD multiple comparison of 1, 2, 3 groups, it can be seen that three classes' concomitant probabilities are all less than the significance level. We can conclude that there are significant differences among three classes. The results of S-N-K method of multiple comparison are shown in Table 7 and 8 which can also illustrate that there is significant difference among three groups.

MATERIAL AND METHODS

In order to ease the problem of "difficulty and high cost of the doctor", Qingdao rectified the medical service charge system, carried out the more clear price and other effective measures. It has achieved obvious changes. In spite of this, Medical expense control in Qingdao is still need to work hard. Due to factors affecting medical expenses are various, to rein in its high persistent ailment need "multi-pronged".

First of all, Many measures need to be taken, such as strengthening the social public disease prevention and the health care consciousness, establishing a health lifestyle and reducing the occurence of the disease. Secondly, the system of fair competition in medical market needs to be set up. The function of the government department will focus on making strict rules and regulations and industry standards in the future. The market participants will have a fair competitive market. Sufficient competition is one of the most effective means to assure the consumer rights and interests. So we should make great efforts to achieve the combination of government regulation and fully competitive in the medical market. Finally, to strengthen supervision. Due to the particularity of medical market, the strict market regulation is not to be missing. With new medical equipment importing and new drug purchasing, strengthen supervision would avoid the waste of resources caused from repeated introduction.

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