Method and Results: Is Physician Gender Associated with the Patient Recovery Time?

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Abstract

Many previous studies have found differences in medical experience brought between male and female physicians, with female physicians care more about mental comfort for the patients. However, similar studies in China havent been conducted and analyzed yet. Based on 2333 questionnaires collected from hospitals in three provinces and cities in China, we examined the relationship between the physician gender and the patient recovery time, adjusted for patient characteristics, physician characteristics, hospital fixed effects, region fixed effects and computationally selected features. We use Ridge, Lasso and Kfold cross validation to select those feature. We adopted the ordinal logistic regression approach for analysis and recovered a significant empirical result. ~~Patients treated by female physicians had shorter recovery time than patients cared for by male physicians, after accounting for potential confounders.~~ This finding suggests that the differences in medical practice pattern exist between male and female physicians, which may have important clinical implications for Chinas outgoing medical reform, for example, an on-job training provided for male physicians to enhancing mental comfort skills.

keywords: physician gender, medical experience, medical reform.

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1 Data

This study was supported by the China Center for Health Economic Research (CCHER) and patient consent was not required. We referred Guidelines for the Diagnosis and Treatment of Chronic Cough in Children for questionnaire design. We collected sample from hospitals in three regions and cities, Shanxi Province, Heilongjiang Province and Beijing, which can represent the big picture of whole Chinas medical reform since these three regions and cities are in the different development stage. Our study population was restricted to children under 16 with chronic cough, because (1 chronic cough is a high-occurrence disease during the data collection period, and (2) chronic cough normally happens, so we can exclude singular samples such as cancers or HIV. Our questionnaire has four parts, patient attributes, physician attributes, hospital attributes and regional fixed effect, Patient experience. Here is a summary statistics of the data.

Table 1: Summary Statistics of Patient Characterisitcs

		isnull	Female Physician	Male Physician	pval	ptest
n			1293	1040		
total time	long	0	592 (45.8)	424 (40.8)	0.017	Chi-squared
	medium		368 (28.5)	349 (33.6)		
	short		333 (25.8)	267 (25.7)		
patient gender	Female	0	785 (60.7)	338 (32.5)	¡0.001	Chi-squared
	Male		508 (39.3)	702 (67.5)		
patient age	0-5	0	289 (22.4)	193 (18.6)	¡0.001	Chi-squared
	5-8		339 (26.2)	330 (31.7)		
	8-12		581 (44.9)	410 (39.4)		
	above 12		84 (6.5)	107 (10.3)		
illness type	Allergic cough	0	123 (9.5)	116 (11.2)	0.410	Chi-squared
	Cough after respiratory infection		684 (52.9)	546 (52.5)		
	Cough variant asthma		60 (4.6)	56 (5.4)		
	Upper respiratory cough syndrome		426 (32.9)	322 (31.0)		

From Table 1 and Table 2, we can see that patient characteristics and physician characteristics are almost balanced across physician gender. A detailed summary statistic is in the appendix section.

Table 2: Summary Statistics of Physician Characterisitcs

		isnull	Female Physician	Male Physician	pval	ptest
n			1293	1040		
physician age	20-30	0	46 (3.6)	34 (3.3)	0.010	Chi-squared
	30-35		235 (18.2)	203 (19.5)		
	35-40		415 (32.1)	396 (38.1)		
	40-50		477 (36.9)	324 (31.2)		
	above 50		120 (9.3)	83 (8.0)		
physician title	Attending doctor	0	548 (42.4)	462 (44.4)	0.569	Chi-squared
	Chief physician		400 (30.9)	296 (28.5)		
	Deputy director		283 (21.9)	227 (21.8)		
	Resident physician		62 (4.8)	55 (5.3)		

2 Theory

Based on previous literature, logistic regression and meta-analysis is mostly used. Since our dependent variable is ordered, multinonial logistic regression is for non-ordered dependent variable. Therefore, this paper will use ordinal logistic regression for identification. Here is the equation:

$$\log\left(\frac{P(Y \leq j)}{1 - P(Y \leq j)}\right) = \alpha_j - (\beta_1 PhysicianGender + \beta_k Z_k) \quad j = 1, 2, ..., J-1 \quad (1)$$

where Y is the dependent variable total recovery time with three category (short, medium, long), PhysicianGender is the independent variable with two categories (1 for male and 0 for female), Z is a group of confounding variables.

We referred to the model specification in previous literature (Tsugawa et al., 2017) and tried to estimate the association between physician gender and total recovery time using 4 regression models.

Model A compared total recovery time between male and female physicians, adjusting for patient characteristics. Model B adjusted for all variables in model A plus hospital fixed effects (ie, hospital indicators and province indicators), effectively comparing male and female physicians within the same level of hospital. Model C adjusted for all variables in model B plus physician characteristics, to evaluate if the differences in patient recovery time between male and female physicians could be explained by other physician characteristics that are correlated with physician gender. As for Model D, for the features in the survey but have not included in the former model, we selected some of them using Ridge and Lasso method. After calculating the mean score from two methods, we choose two additional variables, which are num. of hospital (number of hospitals visited by the patient), num. of visits (number of visits by patient). Model D adjusted for all variables in model C plus selected features.

3 Analysis and Results

For the first three models, we can just simply run the ordinal logistic regression. Before that, for the Model D, we will do the feature engineering for the untouched variables using Ridge and Lasso. After that, we get the mean score of both methods and rank feature according to their mean score.

Table 3: Feature Importance using Ridge and Lasso

	Ridge	Lasso	Mean
num. of hospital	1.00	1.00	0.87
num. of visits	0.85	0.84	0.76
asking length	0.21	0.21	0.17
understanding	0.19	0.19	0.16
asking history	0.11	0.11	0.10
explanation	0.10	0.10	0.08
physician attitude	0.07	0.07	0.06
department type	0.07	0.07	0.06
clearify	0.07	0.07	0.06
total spending	0.06	0.06	0.05
cure time	0.03	0.03	0.03
chat	0.02	0.02	0.02
physical check time	0.01	0.01	0.01
asking history time	0.01	0.01	0.01
chat time	0.00	0.00	0.00
asking time	0.00	0.00	0.00
affordability	0.01	0.00	0.00

From the table 3, we selected the first two features, which are num. of hospital (number of hospitals visited by the patient), num. of visits (number of visits by patient). Then, we run the four models and incoporate them into one table. Using k-fold cross validation, we gain the MSE for each model.

$$MSE_A = 0.55, MSE_B = 0.52, MSE_C = 0.52, MSE_D = 0.49$$

Table 4: Association Between Physician Gender and Total Recovery Time

	Model A	Model B	Model C	Model D
total time				
physician gender	0.123	0.306***	0.306***	0.395***
	(1.54)	(3.69)	(3.68)	(4.61)
age	-0.0845***	-0.0597*	-0.0587*	-0.0679**
	(-3.41)	(-2.36)	(-2.30)	(-2.60)
gender	-0.0579	-0.135	-0.124	-0.0633
	(-0.73)	(-1.66)	(-1.51)	(-0.76)
illness type	-0.0301	-0.0561	-0.0308	-0.0511
	(-0.55)	(-1.00)	(-0.54)	(-0.89)
hospital type		0.0385	0.0520	0.0603
		(0.91)	(1.22)	(1.36)
province code		0.608***	0.587***	0.505***
		(12.66)	(12.14)	(8.83)
physician age			-0.128**	-0.0682
			(-3.00)	(-1.55)
physician title			-0.0320	-0.0224
			(-0.70)	(-0.48)
num. of hospitals				0.994***
				(12.85)
num. of visits				-0.507***
				(-9.32)
cut1				
Constant	-1.621***	0.0348	-0.405	-0.0877
	(-7.61)	(0.13)	(-1.35)	(-0.26)
cut2				
Constant	-0.293	1.449***	1.016***	1.460***
	(-1.39)	(5.32)	(3.38)	(4.29)
Observations	2333	2333	2333	2333

t statistics in parentheses

Source: data from a survey research conducted by CCER

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

From the table 4, we can see that Model A is not significant since we include too few variables. In the other three models, we obtained similar coefficient and all of them are significant. Based on Model D, we can get the following estimation (Agresti and Kateri, 2011).

$$\log\left(\frac{P(Y \leq 1)}{1 - P(Y \leq 1)}\right) = -0.0877 - (0.395 PhysicianGender + \beta_k Z_k) \tag{2}$$

$$\log\left(\frac{P(Y \leq 2)}{1 - P(Y \leq 2)}\right) = 1.460 - (0.395 PhysicianGender + \beta_k Z_k) \tag{3}$$

Then, the odds ratio for physician gender is

$$e^{-\beta_1} = e^{-0.395} = 0.67 \tag{4}$$

Thus the recovery time of patients treated by male physician are 0.67 times more likely than the recovery time of patients treated by female physician to be in the short category. This indicates that patient treated by male physician averagely recovered faster than those treated by female patient.

APPENDIX

A-1 Summary Statistics by Physician Gender

		isnull	Female	Male	pval	ptest
n			1293	1040		
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	medium		368 (28.5)	349 (33.6)		
	short		333 (25.8)	267 (25.7)		
physician gender	Female	0	1293 (100.0)		¡0.001	Chi-squared
	Male			1040 (100.0)		
physician age	20-30	0	46 (3.6)	34 (3.3)	0.010	Chi-squared
	30-35		235 (18.2)	203 (19.5)		
	35-40		415 (32.1)	396 (38.1)		
	40-50		477 (36.9)	324 (31.2)		
	above 50		120 (9.3)	83 (8.0)		
physician title	Attending doctor	0	548 (42.4)	462 (44.4)	0.569	Chi-squared
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	Resident physician		62 (4.8)	55 (5.3)		
patient gender	Female	0	785 (60.7)	338 (32.5)	¡0.001	Chi-squared
	Male		508 (39.3)	702 (67.5)		
patient age	0-5	0	289 (22.4)	193 (18.6)	¡0.001	Chi-squared
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	Cough variant asthma		60 (4.6)	56 (5.4)		
	Upper respiratory cough syndrome		426 (32.9)	322 (31.0)		
province code	1	0	384 (29.7)	218 (21.0)	¡0.001	Chi-squared
	2		155 (12.0)	110 (10.6)		
	3		754 (58.3)	712 (68.5)		
hospital type	clinic	0	604 (46.7)	446 (42.9)	0.008	Chi-squared
	first-class hospital		269 (20.8)	250 (24.0)		
	normal hospital		61 (4.7)	77 (7.4)		
	specilized children hospital		359 (27.8)	266 (25.6)		
	unknown			1 (0.1)		
asking history		0	4.0 [3.0,6.0]	4.0 [2.0,6.0]	0.104	Kruskal-Wallis
num. of hospital	0	0	423 (32.7)	273 (26.2)	0.003	Chi-squared
	1		794 (61.4)	704 (67.7)		
	2		76 (5.9)	63 (6.1)		
asking time		0	3.0 [2.0,8.0]	3.0 [2.0,8.0]	0.402	Kruskal-Wallis
num. of visits	0	0	564 (43.6)	525 (50.5)	0.010	Chi-squared
	1		613 (47.4)	420 (40.4)		
	2		40 (3.1)	35 (3.4)		
	3		21 (1.6)	21 (2.0)		
	4		55 (4.3)	39 (3.8)		
total spending	100-200	0	387 (29.9)	411 (39.5)	¡0.001	Chi-squared
	200-500		367 (28.4)	191 (18.4)		
	50-100		255 (19.7)	246 (23.7)		
	above 500		124 (9.6)	85 (8.2)		
	under 50		160 (12.4)	107 (10.3)		
asking length	long	0	485 (37.5)	417 (40.1)	0.061	Chi-squared
	medium		395 (30.5)	282 (27.1)		
	short		35 (2.7)	47 (4.5)		
	very long		346 (26.8)	271 (26.1)		
	very short		32 (2.5)	23 (2.2)		

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