

## PEER REVIEW HISTORY

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### ARTICLE DETAILS

<b>TITLE (PROVISIONAL)</b>	Interpretation of China's 2017 health expenditure: a latent profile analysis of panel data
<b>AUTHORS</b>	Zang, Shuang; Zhao, Meizhen; OuYang, Jing; Wang, Xin

### VERSION 1 – REVIEW

<b>REVIEWER</b>	Tiemin Zhai China National Health Development Research Center
<b>REVIEW RETURNED</b>	19-Dec-2019

<b>GENERAL COMMENTS</b>	I reviewed this paper several months ago, and several questions were raised. These questions were fully reponed and addressed. I think this version is much better than the last one. I have no other comments.
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<b>REVIEWER</b>	Nilesh Shah University of Pittsburgh, USA
<b>REVIEW RETURNED</b>	27-Dec-2019

<b>GENERAL COMMENTS</b>	<p>The authors used latent class analysis to discover homogeneous groups of provinces based on health financing and hospital expenditure. The authors implemented many of the changes recommended in the first round of reviews. There are a few more suggestions for the authors:</p> <ol style="list-style-type: none"><li>1) The formatting for Table 1 does not look right and makes it hard to read the results. Authors may want to reformat the table.</li><li>2) The authors should consider naming the profiles with more descriptive/informative names. Profile 1, profile 2, etc leaves the reader continuously looking back to see which provinces are included in those profiles.</li><li>3) The authors state the use AIC, BIC, SS adj BIC, LMR, BLRT, and theoretical considerations to determine the number of profiles, but it looks like they only use (or emphasize) the BLRT. Further justification should be given for the reasoning behind the selection of the number of profiles, whether it is mathematical or theoretical.</li><li>4) The authors do not state if the latent class analysis adjusted for potential confounding or if it was an unadjusted analysis. A little more detail regarding the methodology and implementation of the latent class analysis would be helpful.</li></ol>
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	5) "Bootstrapped likelihood ratio test (BLRT), a significant p-value reveals a high degree of the fitting." -- Have a proofreader review this sentence fragment.
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### VERSION 1 – AUTHOR RESPONSE

#### Responds to the reviewer’s comments

##### # Reviewer 1 Comments

I reviewed this paper several months ago, and several questions were raised. These questions were fully responded and addressed. I think this version is much better than the last one. I have no other comments.

Response: We would like to express our great appreciation to you for suggesting how to improve our paper.

##### # Reviewer 2 Comments

1. The formatting for Table 1 does not look right and makes it hard to read the results. Authors may want to reformat the table.

Response: Thank you for your valuable suggestions. We revised Table 1 substantially. The modified version was marked in red on Page 10, lines 198-201 as below:

**Table 1 Per capita health expenditure in three profiles by different financing schemes (CNY)**

Median health expenditure (IQR)*						
Financing scheme	Profile 1:	Profile 2:	Profile 3:	Chi-Square	p-value	post hoc test between profiles†
	Highest government and lowest OOP (n=2)	Lowest government (n=27)	Highest social and OOP (n=2)			
Government health expenditure	2516.07(214 7.55-2884.59)	1099.87(996.7 8-1220.08)	2096.59(185 8.02-2335.16)	10.137	0.006	Profile 1> Profile 2 (p=0.016) Profile 3> Profile 2 (p=0.024)

Social health expenditure	1164.47(1106.34-1222.60)	1533.27(1121.09-1705.54)	5553.31(4998.10-6108.51)	6.899	0.032	Profile 3> Profile 1 ( $p=0.011$ ) Profile 3> Profile 2 ( $p=0.025$ )
OOP health expenditure	700.62(216.92-1184.32)	1065.29(912.84-1232.15)	1710.16(1652.05-1768.26)	4.921	0.085	-

\*IQR, interquartile range.

† Dunn-Bonferroni test was conducted for post hoc pairwise comparison.

2. The authors should consider naming the profiles with more descriptive/informative names. Profile 1, profile 2, etc leaves the reader continuously looking back to see which provinces are included in those profiles.

Response: Thank you for your insightful comment. We thought the suggestion was helpful. We gave each profile a brief label. We listed them and marked the modified sections below.

➤ **In the Methods section, we stated as below:**

On Page 8, lines 156-157.

The identified latent profiles were respectively defined as profile 1, profile 2, etc. Then we gave each profile a label according to the characteristic of it.

➤ **In the provincial subgroups of per capita health financing in 2017 section, we labeled the three profiles as below:**

Profile 1, Highest government and lowest OOP.

Profile 2, Lowest government.

Profile 3, Highest social and OOP.

The revision was marked in red as below:

**(1)The results section.**

1) On Page 9, lines 184-192.

Figure 1 graphically displayed the profile means. Profile 1, Tibet and Qinghai, were characterized as the high government, low household OOP payment, and low social health expenditure profile. We labeled this profile as Highest government and lowest OOP. Profile 2, enjoying a large share of 27 provinces, featuring the lowest government health expenditure, and medium household OOP payment and social health expenditure. As such, we labeled this profile as Lowest government. Profile 3, Beijing and Shanghai, we labeled this profile as Highest social and OOP due to health financing in this profile mainly depended on social health expenditure, which was 3.62 and 4.77 times as much as the other two profiles. OOP health expenditure in this profile was also the highest.

2) Page 10, lines 198-201, we reformatted the table 1. It was exhibited in the previous page.

**(2) The discussion section.**

1) On Page 14, lines 266-272.

The Highest government and lowest OOP profile, Tibet and Qinghai, represented the highest government health expenditure and the lowest OOP and social health expenditure, which can be corroborated by a relatively high level of government investment and policy support, smaller regional population, and low per capita economic output. The Highest social and OOP profile, Beijing and Shanghai, reported prominent social health expenditure.

2) On Pages 15-16, lines 295-301.

As showed in figure 1, the Highest social and OOP profile (Beijing and Shanghai) had the highest level of social health expenditure, indicating that the two municipalities were a lot more attractive to social and private funds than affluent coastal regions. The dominant difference in health spending financed by social health expenditure sources underscores the gap and potential to expand non-governmental agency payment mechanisms in both the Highest government and lowest OOP profile and the Lowest government profile.

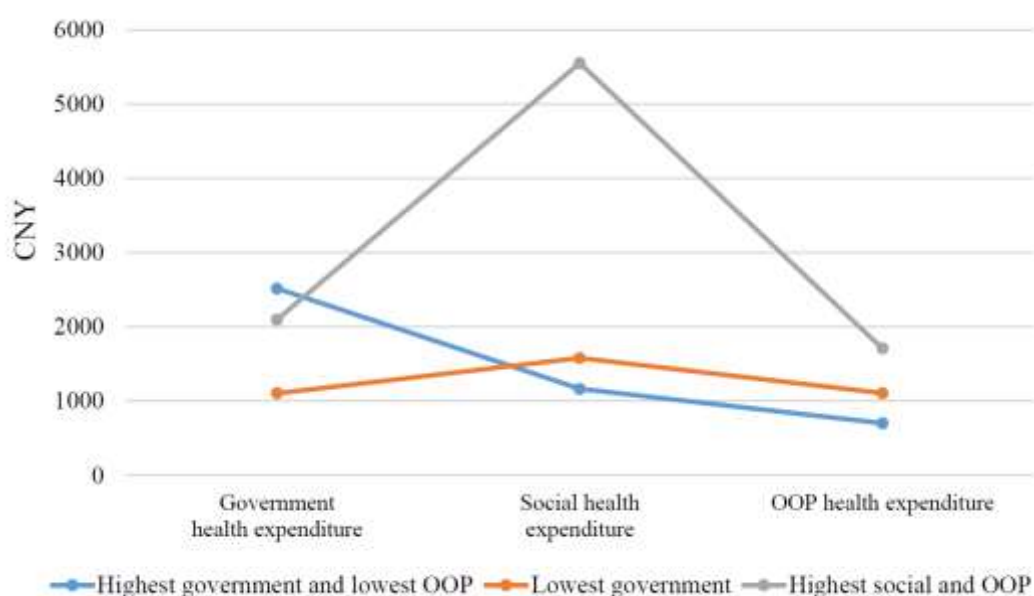
**(3) The conclusions section.**

On Page 19, lines 372-376.

From the perspective of per capita health expenditure, aside from Beijing and Shanghai (the Highest social and OOP profile), and Qinghai and Tibet (the Highest government and lowest OOP profile), the rest 27 provinces, which covers the majority of the population in mainland China, were grouped into the Lowest government profile.

**(4) The figure section.**

We modified the profiles' labels. The revised figure 1 was attached below.



**Figure 1** Differences in per capita financing of health expenditure for the three profiles.

➤ **In the Latent profile analysis: subgroups were extracted for hospital expense of different provinces in 2017 section, we labeled the two profiles as below:**

Profile 1, High county and township

Profile 2, High urban and community

The revision was marked in red as below:

**(1) The results section.**

1) On Page 11, lines 222-227.

Profile 1, labeled as High county and township, which consisted of 27 provinces, had more substantial health expenditure flow to the county hospitals and township health centers. Profile 2, embraced Beijing, Shanghai, Tianjin, and Guangdong. Given that Profile 2 had more massive expenditure flow to the urban hospitals and community health service centers, and smaller expenditure flow to county hospitals and township health centers, it was identified as the High urban and community profile (figure 2).

2) On Pages 12, lines 233-234.

**Table 2 Health expenditure in different levels of hospitals between the two profiles (Billion CNY).**

Variables	Median health expenditure (IQR)		Z	p-value
	High county and township (n=4)	High urban and community (n=27)		
Urban hospital	3.548(3.405-3.807)	5.702(5.480-6.325)	-3.182	0.001
County hospital	1.597(1.363-1.849)	0.462(0.124-0.797)	-3.182	0.001
Community health service center	0.143(0.091-0.173)	0.674(0.493-0.863)	-3.182	0.001
Township health center	0.638(0.496-0.733)	0.129(0.000-0.318)	-3.123	0.002
Other hospital	0.003(0.000-0.011)	0.009(0.003-0.016)	-0.780	0.435

3) On Pages 12-13, lines 239-240.

**Table 3 Comparison of socioeconomic factors between the two latent profiles (CNY).**

Variables	Median health expenditure (IQR)	Z
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	High county and township (n=4)	High urban and community (n=27)		<i>p</i> -value
Per capita total health expenditure	7062.45(4490.45-9722.43)	3644.80(2938.20-4010.10)	-2.887	0.004
Per capita GDP	126634.00(92357.50-128404.00)	46674.00(42060.00-60199.00)	-3.006	0.003
Per capita financial allocation for medical and health institutions	934.50(625.25-1355.50)	518.50(373.25-707.75)	-2.075	0.038
Per capita government health expenditure	1575.69(1210.27-2218.10)	1062.77(883.77-1231.33)	-2.180	0.029

**(2) The discussion section.**

1) On Pages 16-17, lines 305-327.

Both the health expenditure in urban hospital and community health service center was the highest for provinces in the High urban and community profile and the lowest in the High county and township profile. Understandably, patients tend to visit a medical institution close to home.<sup>35</sup> The feature of community health institutions adapts to provide a more accessible health service. Compared with the situation in the provinces of the High county and township profile, most residents in the High urban and community profile can access health service timelier and more convenient. Take Shanghai (belongs to the High urban and community profile) for example, community health service coverage is extensive, and more than 97% of residents who lived in Shanghai can have access to medical facilities, including community medical centers, within a 15-minute walk.<sup>36</sup> Correspondingly, in Sichuan province (belongs to the High county and township profile), only 39.4% of the population had access to the nearest hospital within a 30-minute drive.<sup>37</sup> Of note, health expenditure flowing to county hospitals and township health centers in the High county and township profile outran the High urban and community profile, which might be explained by the fact that the four provinces of the High urban and community profile are highly urbanized areas, and that county hospitals and township

health centers are rare in the regions. As a supplement, the primary care systems provide the residents in the High urban and community profile some convenient, person-centered health service at a lower cost than urban hospitals.

This study found that per capita GDP, per capita financial allocation for medical and health institutions, and per capita government health expenditure in the High urban and community profile was significantly higher than the High county and township profile.

2) On Page 18, lines 344-347.

Broader policy development may promote optimal allocation of medical resources,<sup>45</sup> which implies that differences between the profiles in this study could ultimately be used for directing more resources to provinces belonging to the High county and township profile.

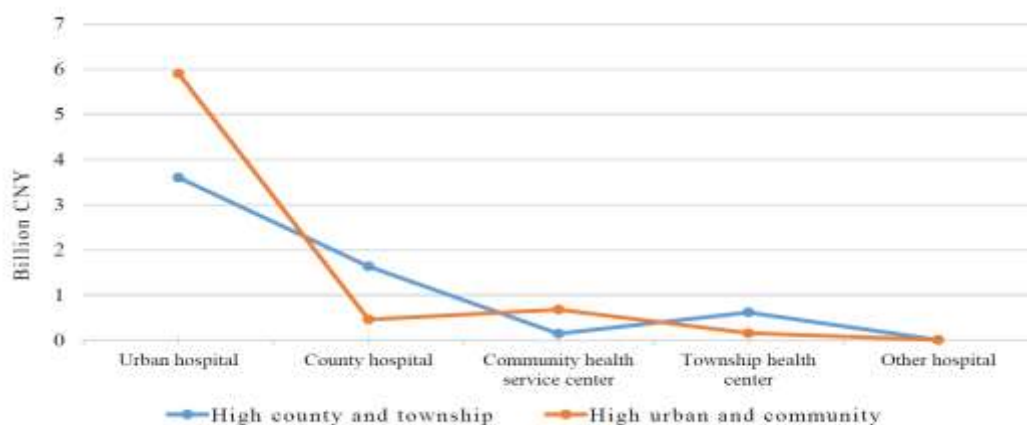
**(3) The conclusions section.**

On Page 19, lines 377-381.

From the facet of hospital expense, aside from the High urban and community profile (Beijing, Shanghai, Tianjin, and Guangdong), the rest 27 provinces, were grouped into the High county and township profile, meaning health economic issues of the largest share of the population covering the largest share of territory, need attention.

**(4) The figure section.**

We modified the profile labels. The revised figure 2 was attached below.





**Figure 2** Health expenditure flowed to different levels of hospitals in the two latent profile catalog.

3. The authors state the use AIC, BIC, SS adj BIC, LMR, BLRT, and theoretical considerations to determine the number of profiles, but it looks like they only use (or emphasize) the BLRT. Further justification should be given for the reasoning behind the selection of the number of profiles, whether it is mathematical or theoretical.

Response:

Thank you very much for your suggestion. To clarify the reasoning behind the selection of the number of profiles, we added some content.

(1) On Page 7, lines 140-143, we modified the manuscript as below:

The latent profile models for the best fit were determined by running multiple latent class models, starting with two classes and adding an additional class in each subsequent iteration until the model fit indices deteriorated or the model no longer converged.

(2) On Page 7, lines 151-153, we modified the manuscript as below:

However, as for all the fit indicators, LMR and BIC tend to be the robust predictors of a correct number of profiles, while AIC tends to predict profiles poorly.<sup>21</sup>

(3) On Page 11, lines 213-221, we modified the manuscript as below:

The goodness of fit indices for different profile models was examined. An entropy value closer to 1 indicates a high ability to discriminate between different profiles. The entropy value of the 2-profile model was 0.999, which was closer to 1 than the other latent profile models. BIC, LMR, and BLRT were all lower for the 2-profile model when compared to the 3-profile model and the 4-profile model. As for AIC, its value for the 2-profile model was slightly higher than the 3-profile model and the 4-profile model. When viewed in totality, these statistical indicators provided evidence that a 2-profile model was the best fit for the data. (For more detailed fit indices of the latent profile models, see appendix exhibit 3).

4. The authors do not state if the latent class analysis adjusted for potential confounding or if it was an unadjusted analysis. A little more detail regarding the methodology and implementation of the latent class analysis would be helpful.

(1) The authors do not state if the latent class analysis adjusted for potential confounding or if it was an unadjusted analysis.

Response:

Thank you very much for your suggestion. Because of the limited availability of secondary data, the absence of data on potential confounders exist. Meanwhile, the provincial fixed effects may remove some of the potentially confounding effects of provincial characteristics, such as the type of medical insurance and payment method of health expenses. We have added the weakness to the study limitation section.

On Page 18, lines 361-362, we added as follows:

Meanwhile, the absence of data on potential confounders exist, this study was an unadjusted analysis.

(2) A little more detail regarding the methodology and implementation of the latent class analysis would be helpful.

Response:

We agreed with the reviewer's opinion. To respond to the comment, we added more details to the methodology section of the latent class analysis.

1) On Page 7, lines 151-153, we make the following modifications

However, as for all the fit indicators, the LMR and BIC tends to be a robust predictor of a correct number of profiles, while AIC tends to predict profiles poorly.<sup>21</sup>

2) On Page 9, lines 181-183, we modified the manuscript as below:

When viewed in totality, the statistical metrics provided evidence that the 3-profile model was best suited to the data.

3) On Page 11, lines 213-221, we have also carried out further elaboration on the latent class analysis. Changes to this content are listed in the previous content.

5. "Bootstrapped likelihood ratio test (BLRT), a significant p-value reveals a high degree of the fitting."

-- Have a proofreader review this sentence fragment.

Response:

Thank you very much for your suggestion. We are very sorry for our negligence. We have checked this sentence and clarified the sentence as follows.

On Page 7, lines 147-149, we modified the manuscript as below:

Bootstrapped likelihood ratio test (BLRT) closed to zero indicated a profile added to the model improves fit, and a significant BLRT *p*-value reveals a high degree of the fitting.

**VERSION 2 – REVIEW**

<b>REVIEWER</b>	Nilesh Shah University of Pittsburgh
<b>REVIEW RETURNED</b>	09-Apr-2020
<b>GENERAL COMMENTS</b>	I reviewed a previous version of this manuscript and the authors sufficiently addressed my questions and comments. I have no further comments.