Macro- and individual-level influence factors of depression: multilevel cross-provinces comparison in China

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Macro- and individual-level influence factors of depression: multilevel cross-provinces comparison in China

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Abstract

Background: Rapid social change has given rise to a general increase in psychological pressure, which lead to more and more Chinese people suffering from depression over the past 30 years. However, few literatures reported the influence of macro factors on depression of Chinese .The effects of macro-level and individual-level on depression of Chinese respondents aged 16-97 years were examined in this study.

Methods: We conducted a multilevel analysis of the 2018 longitudinal follow up of the Chinese Family Panel Studies (CFPS), with 19072 respondents nested within the 25 Chinese provinces. Data for macro-level are extracted from National Bureau of Statistics of China, including three predictors: gross regional product (GRP) per capita, expenditure for social security and employment (ESSE) and rural and urban household income inequality. Depression is measured with the eight-item short version of the Center for Epidemiologic Studies Depression Scale (CES-D8).

Result: We found that respondents who were female,30-59 years, divorced or widowed, less educated, rural residents, less body mass index (BMI) or had lower household income tended to report higher levels of depressive symptoms. After adjustment for individual-level features, a significant macro effect of provinces survives. The respondents who lived in province that were higher GRP, higher ESSE or smaller rural and urban household income inequality reported lower levels of depressive symptoms.

Conclusions: Our results have demonstrated that depression is not fully explained by individual features. Economic social factors appear to have an impact on depression and have to be considered when planning for improved public depression. Meanwhile, our research also provides a reference for some provinces to further investigation and improvement of depression.

Keywords: China; Individual-level; Macro-level; Influence factors; Depression; Multilevel analysis

1. Background

Depression are characterized by sadness, loss of interest or pleasure, feelings of guilt or low self-worth, disturbed sleep or appetite, feelings of tiredness, and poor concentration[1], which can be long-lasting or recurrent, substantially impairing an individual's quality of life and having the tendency to assume increasing disability possibility without treatment[2–4]. When depression gets most severe even can lead to suicide[4–6]. At a global level, there are more than 264 million people affected depression in 2017. In addition, depression is one of the three chronic NCDs (low back pain, headache disorders, and depressive disorders) which have prevailed as three of the top four leading causes of YLDs, collectively causing 162 million YLDs in 2017 and accounting for nearly one in five YLDs globally[7].

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In China, the economy has developed at an unprecedented rate over the past 30 years. Rapid social change gives rise to a general increase in psychological pressure, which lead to more and more Chinese people suffering from depression[8]. According to the World Health Organization, more than 54 million Chinese people suffer from depression in 2015, representing 4.2% of population[1, 9].

Given the global prevalence of depression, serious consequences caused by depression and the burden of depression being on the rise globally[10, 11], a World Health Assembly resolution passed in May 2013 has appealed to a comprehensive, coordinated response to mental disorders at the country level[5].Many Scholars and institutions are increasing interested in depression and do a lot of research on depression from various perspective. Generally, most of studies all demonstrated that basic sociodemographic factors are associated with depression, such as gender, age, marital, education attainment and occupation so on[12–15]. In addition, social circumstances and natural environment all have significant effects on depression. The results from three studies suggest that long-term exposure to air pollution may increase the risk of depression[16–18]. In recent decades, more researchers have concerned on the impact of social circumstances on depression. There are some scholars finding that economic level of country or district , income inequality, community building and other social circumstances have significant influence on depression in spite of after adjusting the basic demographic characteristics [19–23].Obviously, those studies together suggested that it is helpful to reduce the prevalence of depression when government makes the related macro policies with taking the macro influence factors of depression into account. So far, many studies have already shown that the depression is influenced by complex interactions between cultural, psychological and biological factors[24–27]. In China, there were many studies about depression conducted from individual-level or community-level[28, 29]. However, few studies pay attention to relevant factors of provinces-level.

For filling the above-mentioned gap, we develop this study. We combine the individual-level characteristic and provinces-level macro factors to study influence factors of depression, which data of individual-level characteristic was derived from the China Family Panel Studies (CFPS), thus the data of provinces-level macro was extracted from National Bureau of Statistics of China. As mentioned above, this study not only will again confirm the basic sociodemographic factors associated with depression, but also will provide a reference for the government to make macro policies.

2. Methods

2.1.Sources of data and study population

The data set was derived from the China Family Panel Studies (CFPS). The CFPS, conducted biennially by the Institute of Social Science Survey (ISSS) at Peking University, is a nearly nationwide, comprehensive, longitudinal social survey that is intended to serve research needs on a large variety of social phenomena in contemporary China[30]. The CFPS baseline survey was launched in 2010 whose sample covers 25 provinces/municipalities/autonomous regions (excluding Hong Kong, Macao, Taiwan, Xinjiang, Tibet, Qinghai, Inner Mongolia, Ningxia and Hainan), representing 95% of the Chinese population. The 2010 baseline survey interviewed a total of 14,960 households and 42,590 individuals, and it is China's first large-scale academically-oriented longitudinal survey project. To generate a nationally representative sample, the CFPS adopted a multi-stage stratification method and carried out a three-stage sampling process. In the first and second stage, 162 county-level units and 640 villages/communities were randomly selected. In the third stage, 14,960 households were selected according to the "Probability-Proportional-to-Size" (PPS) sampling strategy. The CFPS gathers a wealth of information covering such topics as economic activities, education outcomes, family dynamics and relationships, migration and health[30–32].

In this study, we utilized data from the most recent wave of China Family Panel Studies (CFPS) in 2018. Although the 2018 wave of CFPS sampling weights have not yet been published by CFPS official, we can still select a nationally representative sample based on official guide[33]. Finally, we chosen the national resampling sample of 2018 CFPS as ours study population including a total of 21,579

observations. We restricted the study population to aged ⩾ years, because their questionnaires have been completed by the themselves. After excluding observations with missing information on demographic and depression scale variables, we got 19,072 observations for the analyses.

2.2.Outcome variable: depression

The 2018 CFPS questionnaire employed the eight-item short version of the Center for Epidemiologic Studies Depression Scale (CES-D8), which is one of the most widely used self-evaluation scales originally developed by Radloff [34, 35]. In the 2018 CFPS questionnaire, the items who composed the scale were the following: (N1) "I am in a low spirit.", (N2) "I find it difficult to do anything.", (N3) "I cannot sleep well.", (N4) "I feel happy.", (N5) "I feel lonely."(N6) "I have a happy life."(N7) "I feel sad."(N8) "I feel that I cannot continue with my life." Then respondents were asked to indicate how often in the week before the survey they felt or behaved above mentioned. Responses to items on the CES-D are specified using a 4-point Likert scale where 0 represents the category "Never (less than one day/week)", 1 "Sometimes (1-2 days/week)", 2 "Often (3-4 days/week)", 3 "Most of the time(5-7 days/week)". Two positive worded items (N4 and N6) were reverse-coded. Eventually a total possible score ranges from 0 to 24, with higher scores indicating a greater frequency and severity of depressive symptoms. Reliability and validity of the CES-D8 are confirmed across gender and countries(Van de Velde et al., 2010;Alvarez-Galvez and Rojas-Garcia, 2019). The internal consistency reliability coefficients of this study 8-item scale were satisfactory (Cronbach $\alpha = 0.77$).

2.3.Individual level measures

The association between individual-level basic sociodemographic characteristics and depression has been well established in the literature. We also included the following individual demographic variables: gender (female ,male) ; age consisted of five dichotomous groups(16-29years, 30-44years, 45-59year , 60-74years and above 74years); education attainment was a dichotomous measure(no formal education, primary school, junior high, senior high and college or higher); marital status(married & living with spouse, unmarried and divorced or widowed); and per capita household net income in RMB(yuan) per years (measured in quartiles).Moreover, due to China's special dual household registration system(Hukou)[36], we also consider including type of residence to investigate rural and urban respondents' depression situation. This study used the definition of urban-rural classification based on the National Bureau of Statistics of China. In the end, we included the objective health indicator Body Mass Index from self-reported height and body weight and treated it as four dichotomous groups (below 18.5, 18.5-23.9, 24-27.9 and ⩾28.0).

2.4.Province level measures

At the macro level, there were three predictors included in this study: (1) gross region product (GRP) per capita, as a measure of the overall size of economy for every province; (2)the ratio of per capita disposable income of urban and rural(RUR), roughly measuring degree of rural and urban household income inequality; (3) expenditure for social security and employment (ESSE),as a predictor of the people's well-being. They were all viewed as continual variable. These province-level data were extracted from National Bureau of Statistics of China (detail information on the official website: http://www.stats.gov.cn/tjsj/ndsj/).

2.5.Statistical Analysis

This study we viewed the outcome variable, CES-D8, as a continuous variable, a possible value from 0 to 24. Considering the obvious hierarchical characteristics of the data, individuals (level-1 units) clustered within provinces (level-2 units) meaning that the standard assumption of independent observations is likely to be violated, a two-level multilevel linear regression model was used to appropriately access effects of individual basic sociodemographic characteristics as well as contextual level on the depression. Using multilevel analysis, we can correct the biases in parameter estimates for

the clustering data thus got more accurate parameter estimates[37]. The multilevel model can be described as follows with the restricted maximum likelihood method (REML) using the command "mixed" in Stata15.0[38]:

$$Y_{ij} = \beta_{00} + \beta_{10}X_{ij} + \beta_{01}Z_j + \mu_{0j} + e_{ij} \quad (1)$$

Where i: individual subscript; j: province subscript; Y: the value of CES-D8; X: a vector of individual-level variables, including gender, age, education, marital status, per capita household net income, residence (urban/rural), BMI; Z: a vector of province-level variables, including GRP, RUR, ESSE; u_{0j}: residual error at the province level; e_{ij}: residual error at the individual-level. This is a comparatively straightforward model, but in fact we have assumed that u_{0j} and e_{ij} have zero expectation [37, 38].

Firstly, a null model with only a constant term in the fixed part was fit, which allowed us to detect the possible existence of contextual variation in depression across provinces. After that, we included the individual-level variables in model. Then three province-level variables were added to the model respectively. Finally, all variables included individual-level and province-level was together added to the model.

Finally, it must be caution that our statistical analyses do not offer a causal explanation, so when the term "explain" is used in the follow sections, it should be understood in a statistical rather than a causal relationship sense[39].

3. Results

3.1.Descriptive statistic of sample

As shown in Table 1, the overall depression scores among these 19,072 respondents was relatively low(mean=5.53). Of all respondents 9589(50.28%) were men, and 9483(49.72%) were women; the age ranged from 16 to 97 years old, with 45-59 years old (29.87%) respondents being the largest number, followed by group 30-44 years old (24.75%). The majority of them were married or were living with their spouses. There were 5790 (30.36%) respondents having the junior high education attainment. There were 9125 (47.85%) and 9947 (52.15%) respondents respectively coming from rural and urban. BMI for most (54.17%) respondents was normal, between 18.5-23.9.

At the province-level, this study included 25 provinces of China related data. Averagely, the GRP per capita of 25 provinces were 68,300 yuan; per capita disposable income of urban residents was 2.50 times that of rural residents; the expenditure for social security and employment for 25 provinces were about 95.27 billion.

3.2.The null model

The model 1 in table 2 showed the null model (just with a constant term in the fixed part, while without any predictors at any level), which indicated statistically significant variations in severity of depressive symptoms at both the individual and the province level. The size of the intraclass correlation (ICC) in Model 1 was 0.026(P<0.01) suggesting 2.6% of the variance in the dependent variable can be attributed to the province-level. Though the ICC seemed to be so small, related studies have already showed that we cannot ignore it when explain the effects of macro-level measures[40–42]. Hence it is rational for us to conduct multilevel statistic.

Individual-level characteristics and depression

Association between depression and individual-level characteristics is mainly reflected in fixed effects which are interpreted as the average effect of the variable across province[23]. Model 2 added all individual-level variables including gender, age, marital status, education attainment, rural/urban residence, BMI and household net income. The results demonstrated that male respondents (b=-0.623, P<0.001), urban respondents (b=-0.251, P<0.001), high-income household (b=-0.840, P<0.001) were more likely to report lower depression scores suggesting a slight frequency and severity of depressive symptoms. We find that significant differences emerge between

married/living with spouse and divorced/widowed participants depressive scores (P<0.001), but there are no significant differences between married/living with spouse and unmarried. Respondents aged 30-44 years (b=0.432, P<0.001), 45-59 (b=0.344, P<0.01) years reported higher depression scores. Furthermore, ours study showed that more higher education attainment and values of BMI were at the low risk of depression (P<0.001).

3.3.Province-level variables and depression

After controlling the individual-level variables, we added the variables of province-level (RUR, GRP per capita, ESSE) into the model 3-5 respectively. We find that those respondents living in provinces with higher economic level (b=-0.065, P<0.05) and better people's well-being (b=-0.010, P<0.001) were more likely to report low depression scores. The results also suggested that respondents living in provinces with higher RUR were more likely to report higher depression scores (b=0.893, P<0.001). In the end, all variables including individual-level and province-level variables were added into the model 6. As showed by model 6, all individual characteristics were still significantly associated with the respondent's depression scores, but the effect of GRP per capita became statistically insignificant, suggesting that the GRP per capita in depression scores among these respondents was somewhat confounded by the individual-level variables and other two province-level variables of RUR (b=0.610, P<0.01) and ESSE (b=-008, P<0.001).

3.4.Residual analysis

Random-intercept predictions u_{0j} are sometimes viewed as measures of institutional performance[38]—in the present study, how much depression scores the provinces add for individuals. Therefore, caterpillar plot was depicted in order to demonstrate the situation of depression of 25 provinces of China clearly. Figure 1(a) showed the caterpillar plot after controlling the individual-level characteristics, indicating the respondents living in Guangdong, Shaanxi, Chongqing, Gansu and Guizhou were more likely to reported higher depression scores, compared to those living in Sichuan, Shandong, Shanghai, Zhejiang, Jiangsu, Henan and Liaoning. While after adjusted the individual-level as well as province-level variables, as showed by figure 1(b), the results have a little changed which the respondents living in Guangdong, Chongqing, Hunan were more likely to reported higher depression scores, compared to those living in Shandong.

4. Discussion

In this study, we combined the characteristics of individual levels and macro-level variables by performing multilevel analysis to study the influencing factors of depression. We re-confirmed the association between individual basic demographic characteristic and depression. Then after controlling individual-level variable, we compared depression in different provinces in China and examined the effect of provincial-level factors on depression.

At the individual-level, overall, our findings are consistent with some previous findings. This study showed that the occurrence of depression was related to age, gender, education, marital status, BMI, rural/urban residence as well as household net income. For example, this study confirms that women are more likely to report high levels of depressive symptoms, which is consistent with the results of many domestic and external studies[43–45]. This is mainly due to differences in biological, psychological and social status between men and women[43, 46]. Respondents aged 30-59 years old reported higher depression scores than aged 16-29 years, while the statistical difference between respondents over 60 years and 16-29 years has become insignificant, which seems to mean that the prevalence of depression first increased and then decreased with age increasing. This result was consistent with the results of two studies[47, 48]. In China, people aged 30-59 years were at work, facing various sources of pressure, while the people aged above 60 years were at retire, which partly explained why people aged 30-59 were more prone to depression.

Divorced or widowed as negative life events, were positively correlated with depression[49], which suggested divorced or widowed being potential risk factors for depression. This was why

respondents with divorced or widowed were more prone to depression. Education and income as two indicators of socioeconomic status showed significant association with depression[14]. High economic levels and high education attainment tend to lead to better health conditions and high life satisfaction[50], which explained the respondents with higher education attainment and house income tending to report low depression scores in this study. In China, medical standards, living facilities and economic conditions in rural are inferior to those in cities, so the health status of rural residents was often not as good as that of urban residents.

Interestingly, we found a result that was inconsistent with most studies, depression seemed to be significantly negatively associated with BMI. The results of this study demonstrated that the respondents with lower BMI reported higher depression scores. Although many studies suggested that overweight or obesity is a risk factor for depression[51–53], our study results was consistent with one study based on population of China[54]. We found that the studies based on European and American sample population all reported the positive relationship between BMI and depression, but a few studies were reported in China. Therefore, we boldly suspected that it is a cultural factor causing a negative relationship between depression and BMI in China. Just as there is a saying in China that being able to eat is a blessing, obese people are considered to be blessed in China, but it needs further scientific research and proof. At the same time, this also provided an idea for further study of Chinese BMI and depression.

Despite factors related to depression have been widely studied, a litter studies focused on the effects of province factors on depression, especially in China. We examined the effects of province factors in China on depression in this study. We found that the respondents living in provinces with lower rural and urban household income inequality, higher people's well-being reported lower depression scores. There is considerable macro-economic evidence that national economic figures relate systematically to both the nation's health[55].

Because of China's special dual household registration system[36] and other related factors, the income gap between urban and rural residents has always existed. However, a litter studies paid attention to association between income gap between urban and rural residents and overall depression. There were many studies suggesting that income inequality at macro-level was positively related to depression[21, 56]. This study also found the same results based on the gap in per capita disposable income between urban and rural residents, which suggested that the Chinese government should give more care to rural areas when formulating policies.

The main purpose of social security and employment expenditure is to reduce the income and property gap, ensure social equity, and maintain social stability[57].This study showed that respondents living in provinces with higher expenditure for social security and employment reported lower depression scores. Obviously, provinces with higher social security expenditures are better able to handle the problem of the gap between the rich and the poor and ensure social stability. Related research has shown that social stability has a significant positive impact on mental health[58]. This result combined with above result together suggested that it is necessary to increase expenditure for social security and employment in rural areas.

In the end, through the caterpillar plot, we could clearly observe the overall depression of residents in various provinces. Comparing Figure 1(a) and Figure 1(b), we found that 95% confidence interval of residual of Shaanxi provinces, Gansu and Guizhou have stretched across zero-horizon line in Figure 1(b) rather than been above the zero-horizon line in Figure 1(a). However, the 95% confidence interval of residual of Guangdong and Chongqing have still been above the zero-horizon line, indicating that respondents living in Shaanxi, Gansu and Guizhou being more likely to reported higher depression scores could been partly explained by provinces factors of RUR and ESSE, while province-level factors have not accounted for respondents living in Guangdong and Chongqing being more likely to reported higher depression scores. Therefore, future work is needed to understand why overall depression of Guangdong and Chongqing were higher than other province in China after adjusted the individual-level characteristic and related province-level factors.

5. Conclusions

This study re-confirms the association between individual-level characteristics and depression based on the most recent wave of China Family Panel Studies (CFPS) in 2018. And based on this, macro-level factors were introduced to this study. Ours findings could have important implications for government making macro policies aimed at reducing the damage of depression and more comprehensively improving and preventing depression in the population. The strength of this study lies in the use of multilevel statistical analysis to estimate the effect of province- and individual-level factors on depression, at the same time, performing the residual analysis and plotting the Caterpillar plot to show us how much depression scores the provinces add for individuals. However, our finding should be considered in light of the following limitations. Firstly, due to difficulties in obtaining data at the province-level, we only roughly treated the ratio of per capita disposable income of urban and rural (RUR) as measuring degree of rural and urban household income inequality. Secondly, the factors that affect depression were complex while we only included above mentioned variables because of limitation of data. So, we couldn't ignore the fact that many unobserved variables have been existed. Finally, this study as a cross-sectional study, we couldn't offer a causal explanation about various variables and depression.

Declarations

Abbreviations

CFPS: Chinese Family Panel Studies; GRP: Gross Regional Product; ESSE: Expenditure for Social Security and Employment; CES-D8: the eight-item short version of the Center for Epidemiologic Studies Depression Scale; BMI: Body Mass Index; NCDs: Non-Communicable Diseases; YLDs: Years Lived with Disability; ISSS: the Institute of Social Science Survey; RUR: the Ratio of Per Capita Disposable Income of Urban and Rural

Ethics approval and consent to participate：

Management Committee of China Social Science Survey Center, Peking University approved the study protocol. Participants in the CFPS provided written informed consent.

Consent for publication：

Not applicable

Author Contributions:

Both authors (N.W. and B.G.) were involved in the study conceptualization and study design. Statistical analyses were carried out by N.W. The first draft of the manuscript was written by N.W. B.G. approved the final manuscript.

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Availability of data and materials:

In this study, we utilized data from the most recent wave of China Family Panel Studies (CFPS) in 2018. According to the relevant terms of the CFPS user agreement, I can't link to or upload my research data. But the detailed information about the data can be found at official website of CFPS(http://www.isss.pku.edu.cn/cfps/). Furthermore, the macro-level data can be extracted from National Bureau of Statistics of China (http://www.stats.gov.cn/tjsj/ndsj/).

Competing interests:

The authors declare no conflict of interest.

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Figures

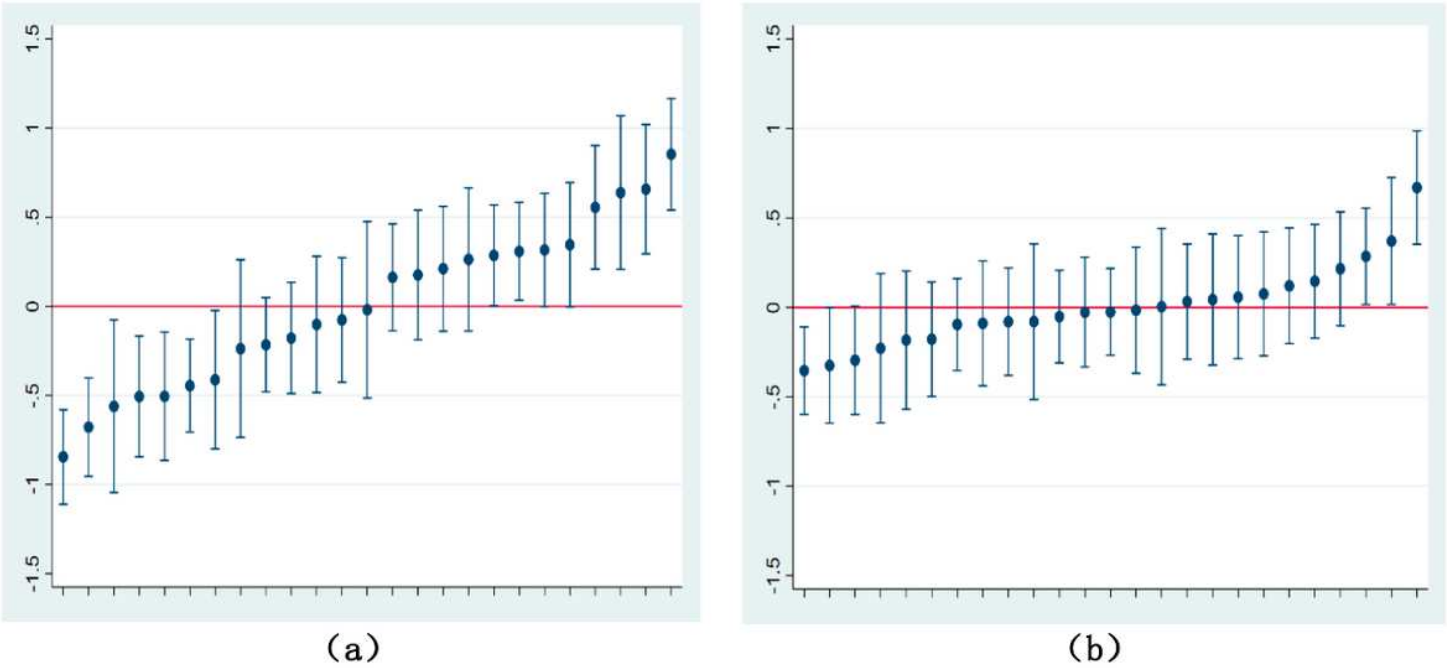

Figure 1

(a).Caterpillar plot of provinces residual and approximate 95% confidence intervals versus ranking (after controlling the individual-level characteristics;sequencing from left to right: Sichuan, Shandong, Shanghai, Zhejiang, Jiangsu, Henan, Liaoning, Tianjin, Hebei, Heilongjiang, Hubei, Anhui, Beijing, Yunnan, Jilin, Guangxi, Fujian, Shanxi, Guangdong, Hunan, Jiangxi, Shaanxi, Chongqing, Gansu, Guizhou). (b). Caterpillar plot of provinces residual and approximate 95% confidence intervals versus ranking (after controlling the individual-level characteristics and three province-level variables;sequencing from left to right: Shandong, Sichuan, Yunnan, Shanghai, Gansu, Zhejiang, Henan, Liaoning, Anhui, Tianjin, Shanxi, Guangxi, Hebei, Jiangsu, Beijing, Heilongjiang, Fujian, Guizhou, Jilin, Hubei, Shaanxi, Jiangxi, Hunan, Chongqing, Guangdong).

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