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Latent profile analysis of mental health among Chinese healthcare staff during the COVID-19 pandemic

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ABSTRACT

The mental health of individuals has become increasingly important during the novel coronavirus-2019 (COVID-19) pandemic. Given the number of healthcare staff that are helping to treat the victims of COVID-19 all over the world, there is a lack of research concerning the mental health of healthcare staff, and of the prior studies carried out, the research has been relatively descriptive and has not used more sophisticated types of analyses (e.g. latent profile analysis [LPA]). The aim of the present study was to investigate profiles of mental health among Chinese healthcare staff during the COVID-19 pandemic. The sample comprised of 456 healthcare staff, and participants completed an online survey including individual information and their working status during the COVID-19 pandemic. The survey included the Chinese Mental Health Scale (MHS-C), Self-Rating Anxiety Scale (SAS), and Self-Rating Depression Scale (SDS). Utilizing the LPA, two profiles of mental health (good mental health and poor mental health) were identified for Chinese healthcare staff during the COVID-19 pandemic. Compared to those with a good mental health profile, those with poor mental health profile had significantly higher scores on SAS and SDS. Female healthcare staff had higher mental health disturbances than males. Taking care and protecting the mental health of healthcare staff is very important in the fight against COVID-19. The need for employers to implement positive and effective measures among mental healthcare staff is likely to help them to cope better with mental health issues and improve mental health, as well as enhance resilience. Healthcare staff with good mental health can dedicate themselves to better nursing practice and nursing education during the COVID-19 epidemic.

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1. Introduction

A novel coronavirus-2019 (COVID-19) began to appear in Wuhan city, in the Hubei Province of China in November 2019 (Chan et al., 2020). COVID-19 has been confirmed as a severe infectious disease by Chinese and other countries' health authorities (WHO,

2020). COVID-19 not only has a high mortality rate, but for some individuals, unbearable psychological pressure (Xiao, 2020). Therefore, COVID-19 has become a health emergency around the world.

The mental health of healthcare staff became a salient issue during the Severe Acute Respiratory Syndrome (SARS) and Middle East Respiratory Syndrome Coronavirus (MERS-CoV) epidemics (Zhang et al., 2005; Chong et al., 2004; Wu et al., 2009; Khalid et al., 2016). Liu et al. (2003) reported that Chinese medical staff working on the frontline in hospitals had higher depression scores than the general Chinese population during the SARS pandemic. Several severe mental disorders such as depression, substance abuse, and posttraumatic stress disorder (PTSD) were reported among healthcare staff experienced SARS (Chong et al., 2004; Wu et al., 2009).

Healthcare providers of those with COVID-19 have been considered as a possible vulnerable group because of the lack of immunity to this new strain of coronavirus(Goyal et al., 2020). Furthermore, both physical and mental health of healthcare staff and the general public have both received research attention by medical experts and psychologists during the COVID-19 pandemic (Wang et al., 2020; Guan et al., 2020; Xiang et al., 2020; Das, 2020). Recent research has reported that healthcare staff had a higher prevalence of insomnia, depression, anxiety, somatization, and obsessive-compulsive symptoms than nonmedical health staff during the COVID-19 outbreak (Zhang et al., 2020). Rana et al. (2020) also reported that healthcare staff experienced physical and psychological pressure during the COVID-19 pandemic.

Both healthcare staff and the general public may have the feelings of fearing death and

anxiety about falling ill (Ahorsu et al., 2020), which can amplify the sense of hopelessness, helplessness, exhaustion, and burnout. Subsequently, negative emotions and various stressors may impact negatively on mental and physical wellbeing (Mukhtar, 2020). Healthcare staff working in isolated units of hospitals may also experience confinement phenomena that causes collective hysteria (Montemurro, 2020; Kang et al., 2020). Due to the COVID-19 outbreaks in China and the rest of the world, it is crucial to assess mental health for both healthcare staff and the general public, and provide social support, psychological treatment and services for those that need them (Xiang et al., 2020).

Zhao et al. (2020) found that over 60% frontline staff (e.g., medical staff, police officers, volunteers, community workers) suffered from at least one mental health problem during the COVID-19 epidemic, but did not examine differences in mental health between the occupations. In another study, the mental health of emergency department medical staff was investigated during the COVID-19 epidemic, and found more severe depression and post-traumatic stress disorder (PTSD) among males than females (Song et al., 2020). Huang et al. (2020) reported higher anxiety among nursing staff compared to medical staff, as well as higher stress disorder among females than males. The gender difference in mental health of healthcare staff during the COVID-19 epidemic are not fully understood. Kang et al. (2020) reported four levels mental health disturbances comprising subthreshold, mild, moderate and severe disturbance among medical and nursing staff working in Wuhan using the K-means clustering analysis. However, most studies published to date are relatively descriptive and have not used more sophisticated types of analyses such as latent profile analysis (LPA). LPA has the capacity to identify clusters of individuals

based on responses to a series of continuous variables. As a method of classification by maximum posterior probability, model-based LPA has greater advantage than subjective clustering analysis including smaller misclassification rate, being a person-oriented approach, and no transformation is necessary for indicators on different scales (Pastor et al., 2007; Flaherty & Kiff, 2012; Zhao et al., 2013; Mäkikangas & Kinnunen, 2016).

Due to the potential persistent distress for Chinese healthcare staff during the COVID-19 pandemic, mental health assessment and mental health problem prevention is urgently needed. The aims of the present study were to (i) identify profiles of mental health among Chinese healthcare staff; (ii) examine the relationship between the level of mental health, depression, and anxiety among Chinese healthcare staff; and (iii) examine the differences in mental health in terms of sociodemographic variables (e.g., gender and age), the type of medical facility they worked in, and their scores on the Self-rating Anxiety Scale and the Self-Rating Depression Scale among Chinese healthcare staff.

2. Methods

The present study used a cross-sectional design and a convenience sample to assess profiles of mental health using a self-report survey administered to a sample of 456 Chinese healthcare staff during the COVID-19 pandemic.

2.1. Participants

Data were collected from February 22, 2020 to February 25, 2020. The participants comprised 473 healthcare staff. However, 17 participants were excluded from the dataset owing to unreliable responses (i.e., all answers being scored the same). The final sample

comprised 456 participants (161 males, 35.3%; 295 females, 64.7%) .

2.2 Procedure

Data were collected from healthcare staff in nine provinces/municipality of China (e.g., Jiangsu, Hubei, Jiangxi, Zhejiang, Shanxi, Shandong, Guangdong, Fujian and Shanghai) from February 22 2020 to February 25 2020. The participants were recruited utilizing several *WeChat* groups on social media (e.g., medical forum group, health management group, medical working group, and related communities). The only inclusion criterion was that participants needed to be a member of healthcare staff at any level or type of medical and health institutions. The only exclusion criterion was being a retired member of healthcare staff.

An online survey hosted on the *Wenjuanxing* platform (www.wjx.cn) was completed by participants including a real name (to verify the authenticity of the information and to conduct longitudinal research in the future), sociodemographic information, and various psychometric scales assessing various aspects of mental health (see 'Measures' section).

2.3 Ethics

The study was approved by research team's University Research Ethics Committee and was compliant with the international ethical standards. All participants were informed of the purpose of the study, and Informed consent was provided electronically via *WeChat.*

2.4. Measures

2.4.1. Demographic data

Demographic data were collected including: gender, age (years), education level (postgraduate, undergraduate, or lower than undergraduate), subject studied at university (clinical medicine, nursing, pharmacy, clinical medicine laboratory, medical imaging, or public health, health management and other), hospital characteristics (public hospital or non-public hospital), categories of medical institution ('AAA' hospital, 'AA' hospital, 'A' hospital/community health center, or Centers for Disease Control [CDC] or others [in China, there are three grades of hospital; 'AAA' is superior to 'AA' and 'AA' is superior to 'A', which is based on medical resource allocation, such as funding, equipment, and medical personnel]), working status during the COVID-19 (COVID-19 team in Hubei province, COVID-19 team in other provinces except Hubei, or non-COVID-19 team in other provinces), and time since treating COVID-19 (before January 20, 2020 [when media began to first report COVID-19], January 20 to 30, 2020 [the Chinese Spring Festival Holiday], since February 1 to 28 [where the number of patients with the COVID-19 was increasing almost every day].

2.4.2. Chinese Mental Health Scale for healthcare staff during the COVID-19 pandemic

Mental health was assessed using the Chinese Mental Health Scale (MHS-C) developed by the present authors to include specific questions related to COVID-19. The symptoms of 16 items were adapted from the Symptom Checklist 90 (SCL-90) (Derogatis, 1973). The SCL-90 was translated into Chinese by Wang (1984). The 16-item MHS-C has five factors, including depression, anger, fear, somatization and anxiety. Participants rate the items on a four-point Likert scale, ranging from 1 ("*not at all"*) to 4 ("*extremely"*) with a total score ranging from 16 to 64. Higher scores represent greater mental health disturbance. The

16-item and five-factor model fitted the data well in exploratory factor analysis (EFA) (χ^2 = 112.50, *df* = 50, *p* < .001; TLI =0.922; CFI = 0.967; SRMR = .019; RMSEA = .052 [CL: .039, .065]). Confirmatory factor analysis (CFA) was also performed, which verified the five-factor model of MHS-C (χ^2 = 156.00, *df* = 94, *p* < .001; TLI =0.959; CFI = 0.968; SRMR = .034; RMSEA = .038 [CL: .027, .048]). The Cronbach's alpha and McDonald's ω in the present study for the total scale were 0.88 and 0.89, respectively.

2.4.3. Self-Rating Anxiety Scale (SAS)

The SAS was used to assess the level of anxiety. The 20-item scale was developed based on the clinical symptoms of anxiety disorders (Zung, 1971), and was translated into Chinese by Wang and Ch (1984) and has good factor structure (Zhao et al., 2020). Participants answer the items on a four-point Likert scale from 1 ("*a little of the time"*) to 4 ("*most of the time"*). Score are summed to create an anxiety score for every participant. The total score ranges between 20 and 80. Higher scores represent higher levels of anxiety. The score on each item is added together to provide an overall score and then classed into mild anxiety (50-59), moderate anxiety (60-69), and severe anxiety (more than 70). In the present study, the Cronbach's alpha and McDonald's ω of the SAS were 0.81 and 0.82, respectively.

2.4.4. Self-Rating Depression Scale (SDS)

The SDS was used to assess the level of depression (Zung, 1965), and was translated into Chinese by Wang and Chi (1984), and has good factor structures (Zhao et al., 2020). The SDS includes 20 items and participants answer the items on a four-point Likert scale from 1 ("*a little of the time"*) to 4 ("*most of the time"*). The total score ranges between 20

and 80. Higher scores represent higher levels of depression. The score on each item is added together to provide an overall score and then classed into mild depression (50-59), moderate depression (60-69), and severe depression (more than 70). The Cronbach's alpha and McDonald's ω of the SDS in the present study were 0.83 and 0.84, respectively.

2.5. Statistical analysis

Latent profile analysis (LPA) was used to classify individuals based on their levels of mental health on five dimensions (depression, anger, fear, somatization and anxiety) using Mplus 7.0. Five factors of the MHS-C were regarded as class indicators to perform the latent profile analysis. LPA may allow for more flexible parameterizations (e.g., variances can differ across clusters) than traditional techniques (Vermunt & Magidson, 2002). Therefore, a mixture likelihood (ML) model was used to estimate model parameters and determine the number of latent classes. Five latent profile models were tested to aggregate the participants into one to five groups. The best model was selected based on the best-fit statistics and clinical interpretability (McCutcheon, 2002). Several statistical indices were calculated including: Bayesian information criterion (BIC), Akaike information criteria (AIC), the sample size-adjusted BIC (ABIC), entropy (all ≥0.9), Lo-MendellRubin adjusted likelihood ratio test (LMRA-LRT) and Bootstrap Likelihood Ratio Test (BLRT) (both p<0.05), as well as number of free parameters (k) and minimum class membership size (i.e., more than 50, Yang, 2006). In LPA, the posterior probability was saved and exported using Mplus 7.0, and the group differences were calculated using SPSS 20. Descriptive statistics, Pearson's correlation, and chi-square test were performed using SPSS 20. The

t-tests, Cronbach's alpha, and McDonald's ω were calculated using JASP (Jeffrey's Amazing Statistics Program). For EFA and CFA of the MHS-C, data-model fit was assessed using Mplus 7.0 utilizing the comparative fit index (CFI > .90), Tucker-Lewis Index (TLI > .90), standardized root mean square residual (SRMR < .08), and root mean square error of approximation (RMSEA < .06) (90% CI) (Byrne, 2013).

3. Results

3.1. Description of participants

Participants ages were between 21 and 59 years (mean age=37.4 years; SD=8.2). The education level of 92.3% participants was undergraduate or postgraduate. Participants' university subject mainly focused on clinical medicine (n=207; 45.4%) and nursing (n=139; 30.5%). Most participants (93.4%) worked in a public hospital (of which 58.6% worked in a grade AAA hospital). A total of 28.5% worked in a COVID-19 team in Hubei province or a fever clinic in other provinces. Just under half of the participants (45.6%) worked in a COVID-19 team in January 2020 (Table 1).

3.2. Latent profile analysis

Models ranging from one to five profile solutions were evaluated with regard to five factors and the fit indices are shown in Table 2. Although the two-profile, three-profile, four-profile, and five-profile solutions demonstrated decreased AIC, BIC and A-BIC values, other profiles' LMR-LTR *p*-values were more than .05 except two-profile'. The entropy value for two-profile was .917, which indicated the model fitted well. In addition, the minimum class membership sizes were less than 50 participants for the four-profile model

(eight participants) and five-profile model (four participants), which indicated the unfitted profile models (Yang, 2006). The BIC decreased substantially when moving from a model with one to two latent subgroups than other models moving, which was a diminishing gain in BIC. This indicated that the two-profile model was the most parsimonious model (Jongedijk et al., 2020). Moreover, the theoretical meaningfulness and interpretability were also considered to determine the best profile. Two simple profiles of mental health were identified for healthcare staff: (i) good mental health group (n=341, 74.6%) and (ii) poor mental health group (n=115, 25.4%) (Figure 1).

3.3. Descriptive statistics and correlation analyses

The means, standard deviations, and bivariate correlations for all variables were presented in Table 3. The mental health (MHS-C) score was significantly positively associated with depression (SDS) (r=0.41, p<.01), anxiety (SAS) (r=0.71, p<.01), and working status during COVID-19 (r=0.12, p<.01). Depression (SDS) and anxiety (SAS) were significantly positively associated with working status during the COVID-19 (r=0.11, p<.01; r=0.10, p<.01, respectively).

3.4. Comparison of the two mental health classes

SAS and SDS scores in the poor mental health class were significantly higher than those of the good mental health class. The healthcare staff in the poor mental health class had significantly more mild and moderate anxiety of SAS than those in the good mental health class, whereas the healthcare staff in poor mental health class had significantly more mild, moderate, and severe depression of SDS than those in the good mental health class.

Female healthcare staff had higher mental health disturbance than males. Healthcare staff working in Hubei or in a COVID-19 fever clinic in other provinces had higher mental health disturbances than those in ordinary (non-COVID-19) posts during the COVID-19 pandemic (Table 4).

4. Discussion

The present study examined mental health profiles among Chinese healthcare staff during the COVID-19 pandemic and the relationships between psychological symptoms assessed by the MHS-C, SAS, and SDS, as well as the differences between two best identified profiles in the LPA. Two profiles of mental health (i.e., good mental health class and poor mental health class) were found for Chinese healthcare staff during the COVID-19 pandemic. The results indicated one-quarter of healthcare staff had mental health issues. Kang et al. (2020) reported that medical and nursing staff working in Wuhan had 71.3% subthreshold and mild mental health disturbances, whereas moderate and severe disturbances accounted for 28.6%, a similar to the findings reported here during the COVID-19 pandemic. Some studies have also reported that healthcare staff may be experiencing higher negative emotions and have severe mental health problems compared to Chinese norms (Yuan et al., 2020; Chen et al., 2020; Gong & Jiang, 2020).

It has been reported that medical health workers during the COVID-19 pandemic have more psychological symptoms, including depression, anxiety, somatization, insomnia, and obsessive-compulsive symptoms compared to nonmedical health workers (Zhang et al., 2020). In the present study, more psychological symptoms including depression, anger, fear of COVID-19, somatization, and anxiety were also found among healthcare staff in the

poor mental health class, and is similar to other findings (Liu et al., 2020; Mo et al., 2020; Kang et al., 2020; Zhang et al., 2020; Liang, Chen, Zheng & Liu, 2020). Healthcare staff face a high risk of being infected with COVID-19 due to their close contact with COVID-19 patients and healthcare staff fear infection themselves as well as the fear of infecting colleagues, family, and friends, which may cause other psychosomatic symptoms (e.g., anxiety, depression, somatization).

The present study also found that the poor mental health was positively associated with SAS score, SDS score, and working status during the COVID-19 pandemic. Higher mental health disturbance for nursing staff working in the fever clinics during the COVID-19 pandemic was found using the Stress Response Questionnaire (SRQ) compared to Chinese norms (Gong & Jiang, 2020). Working with COVID-19 victims impacted on mental health of healthcare staff especially in Wuhan city (Kang et al., 2020).

The five factors of mental health (i.e., depression, anger, fear, somatization and anxiety), SAS, and SDS in the poor mental health class had significant higher scores than those of good mental health class. Female healthcare staff had higher mental health disturbances, which is consistent with research findings during both the COVID-19 and SARS pandemics (Huang et al., 2020; Liu et al., 2004). Healthcare staff working in front-line hospitals and high-risk operating posts face enormous pressure, including the possibility of death because of contact with infected patients and lack of adequate protection equipment from contamination, being isolated from their families, overwork, and exhaustion during the COVID-19 pandemic (Kang et al., 2020). The negative impact on mental health disturbs the overall wellbeing for healthcare staff and can even be life-threatening.

Two profiles of mental health (good and poor) were identified among Chinese healthcare staff during the COVID-19 pandemic in the present study. Nevertheless, limitations of the present study should be noted when interpreting these findings. First, the present study relied exclusively on self-report and all the data were from a convenience sample (from nine different provinces of China), which may result in some response biases (e.g., social desirability and memory recall), as well as limiting the generalization of the findings to other provinces in China and countries outside of China. Future studies should utilize more representative random samples to conduct retrospective studies and use more objective methods to further explore the level of mental health for healthcare staff during the COVID-19 pandemic (e.g., clinical diagnosis and evaluation). Second, further research is required to give more insight into the features of mental health, such as anxiety and depression. For example, studies could examine the prevalence and negative outcomes of lower levels of mental health during the COVID-19, which may impact on sleep quality, diet, job, daily life, and (in extreme cases) even suicide. Third, further research may be necessary to delineate the relationship between mental health during the COVID-19 pandemic and subsequent posttraumatic stress disorder (PTSD) for survivors of different ages, countries, and occupations including healthcare staff, as well as conducting longitudinal studies. Moreover, mental health of healthcare staff in different occupations (e.g., doctors, nurse, paramedics) also needs to be examined to conduct sub-analysis by specific healthcare occupation. It would also be helpful to get an understanding of how widespread the use of social media and chat-groups in discussing mental health are among healthcare workers in future studies.

5. Conclusion

Overall, the results of the present study demonstrate two profiles of mental health for Chinese healthcare staff during the COVID-19 pandemic. Based on the findings, the level of mental health is of concern among Chinese healthcare staff. Engaging in good mental health practices will help reduce attrition rates of healthcare staff in the future.

Ethics approval and consent to participate

The study was approved by research team's University Research Ethics Committee and was compliant with the international ethical standards. All participants were informed of the purpose of the study, and all participants provided Informed consent electronically via *WeChat.*

Consent for publication

Not applicable.

Availability of data and materials

The dataset supporting underpinning this paper are available from the corresponding author upon reasonable request.

Competing interests

There are no financial or non-financial competing interests. None of the research staff

received incentives for recruiting participants or for any other purpose directly associated with the study.

References

1. Ahorsu, D. K., Lin, C.-Y., Imani, V., Saffari, M., Griffiths, M. D., & Pakpour, A. H. (2020). The Fear of COVID-19 Scale: Development and initial validation. *International Journal of Mental Health and Addiction*, Epub ahead of print. doi:10.1007/s11469-020-00270-8
2. Byrne, B. M. (2013). *Structural equation modeling with LISREL, PRELIS, and SIMPLIS: Basic concepts, applications, and programming*. New York: Psychology Press.
3. Chan, J. F., Yuan, S., Kok, K., To, K. K., Chu, H., Yang, J., ... & Yuen, K. (2020). A familial cluster of pneumonia associated with the 2019 novel coronavirus indicating person-to-person transmission: a study of a family cluster. *The Lancet, 395*(10223), 514-523.
4. Chen, J. G., Min, M., Yin, X. G., Luo, J., Chen, F. Y., ... & Gong, W. Q. (2020). Investigation on the psychological anxiety and analysis of its influencing factors among medical workers in Qingbaijiang district, Chengdu city during the COVID-19 outbreak. *Shandong Medical Journal, 60*(9), 70-72.
5. Chong, M., Wang, W., Hsieh, W., Lee, C., Chiu, N., Yeh, W., ... & Chen, C. (2004). Psychological impact of severe acute respiratory syndrome on health workers in a tertiary hospital. *British Journal of Psychiatry, 185*(2), 127-133.
6. Das N. (2020). Psychiatrist in post-COVID-19 era - Are we prepared? [published online ahead of print, 2020 Apr 7]. *Asian Journal of Psychiatry, 51*, 102082.

7. Derogatis, L. R., Lipman, R. S., & Covi, L. (1973). Scl-90: an outpatient psychiatric rating scale-preliminary report. *Psychopharmacology Bulletin, 9*(1), 13-28.

8. Flaherty, B. P., & Kiff, C. J. (2012). Latent class and latent profile models. *APA handbook of research methods in psychology (Vol. 3: Data analysis and research publication, pp. 391-404).* Washington, DC: American Psychological Association.

9. Gong, L, & Jiang, J. P. (2020). Investigation and analysis of psychological stress response of outpatient nurses with fever during COVID-19 pandemic. *Chinese General Practice Nursing, 18*(7), 834-835.

10. Goyal, K., Chauhan, P., Chhikara, K., Gupta, P., & Singh, M. P. (2020). Fear of COVID 2019: First suicidal case in India !. *Asian Journal of Psychiatry, 49*, 101989.

11. Huang J Z., Han M F., Luo T D., Ren A K., Zhou X P.(2020). [Mental health survey of medical staff in a tertiary infectious disease hospital for COVID-19]. Zhonghua Lao Dong Wei Sheng Zhi Ye Bing Za Zhi, 38(3), 192-195.

12. Jongedijk, R. A., Eising, D. D., van der, Aa. N., Kleber, R. J., & Boelen, P. A. (2020). Severity profiles of posttraumatic stress, depression, anxiety, and somatization symptoms in treatment seeking traumatized refugees. *Journal of Affective Disorders, 266*, 71-81.

13. Kang, L., Li, Y., Hu, S., Chen, M., Yang, C., Yang, B. X., ... & Liu, Z. (2020). The mental health of medical workers in Wuhan, China dealing with the 2019 novel coronavirus. *The Lancet Psychiatry, 7*(3), e14. doi.org/10.1016/S2215-0366(20)30047-X.

14. Kang, L., Ma, S., Chen, M., Yang, J., Wang, Y., Li, R., Yao, L., Bai, H., Cai, Z., Xiang Yang, B., Hu, S., Zhang, K., Wang, G., Ma, C., & Liu, Z. (2020). Impact on mental health and perceptions of psychological care among medical and nursing staff in Wuhan during the

2019 novel coronavirus disease outbreak: A cross-sectional study. *Brain, Behavior, and Immunity*, *87*, 11–17.

15. Khalid, I., Khalid, T. J., Qabajah, M. R., Barnard, A. G., & Qushmaq, I. (2016). Healthcare Workers Emotions, Perceived Stressors and Coping Strategies During a MERS-CoV Outbreak. *Clinical Medicine & Research, 14*(1), 7-14.
16. Liang, Y., Chen, M., Zheng, X., & Liu, J. (2020). Screening for Chinese medical staff mental health by SDS and SAS during the outbreak of COVID-19. *Journal of Psychosomatic Research*, *133*, 110102.
17. Liu, C. Y., Yang, Y. Z., Zhang, X. M., Xu, X., Dou, Q. L., Zhang, W. W., & Cheng, A. (2020). The prevalence and influencing factors in anxiety in medical workers fighting COVID-19 in China: a cross-sectional survey. *Epidemiology and Infection*, *148*, e98.
18. Liu, J. H., Wang, W., Gao, W. B., Zou, L., Lu, J., ... & Zhang, Z. J. (2004). Study on effect of SARS on mental health of medical staffs in fever clinic of military hospital. Journal of Nursing (China), 11(4), 9-10.
19. Liu, Z. H., Hua, Q., Yang, Z., Wu, H., Xu, W. Y., ... & Zhang, J. (2003). Psychological health status of 1806 medical works in SARS period. *Journal of Capital Medical University, 24*(4), 475-477.
20. Mäkikangas, A., & Kinnunen, U. (2016). The person-oriented approach to burnout: A systematic review. *Burnout Research, 3*(1), 11-23.
21. McCutcheon, A. L. (2002). Latent Class Analysis. Newbury Park: SAGE Publications.
22. Mo, Y., Deng, L., Zhang, L., Lang, Q., Liao, C., Wang, N., Qin, M., & Huang, H. (2020). Work stress among Chinese nurses to support Wuhan in fighting against COVID-19

epidemic. *Journal of Nursing Management*, *28*(5), 1002–1009.

23. Montemurro, N. (2020). The emotional impact of COVID-19: From medical staff to common people. *Brain Behavior and Immunity*, *87*, 23–24.
24. Mukhtar, S. (2020). Mental health and emotional impact of COVID-19: Applying Health Belief Model for medical staff to general public of Pakistan. *Brain Behavior and Immunity*, 87, 28-29.
25. Pastor, D. A., Barron, K. E., Miller, B. J., Davis, S. L. (2007). A latent profile analysis of college students' achievement goal orientation. *Contemporary Educational Psychology, 32*(1), 8-47.
26. Rana, Waleed., Mukhtar, Sonia., Mukhtar, Shamim. (2020). Mental health of medical workers in Pakistan during the pandemic COVID-19 outbreak. *Asian Journal of Psychiatry, 51*, 102080.
27. Song, X., Fu, W., Liu, X., Luo, Z., Wang, R., Zhou, N., Yan, S., & Lv, C. (2020). Mental health status of medical staff in emergency departments during the Coronavirus disease 2019 epidemic in China. *Brain, Behavior, and Immunity*, *88*, 60–65.
28. Vermunt, J. K., & Magidson, J. (2002). Latent class cluster analysis. In Hagenaars, J. A. & McCutcheon, A. L. (Eds.), *Applied latent class analysis* (pp. 89-106). Cambridge, UK: Cambridge University Press.
29. Wang, Z. Y & Chi, Y. F. (1984). Self-Rating Anxiety Scale (SAS). General Psychiatry, 2, 73-74.
30. Wang, Z. Y & Chi, Y. F. (1984). Self-Rating Depression Scale (SDS). General Psychiatry, 2, 71-72.
31. Wang, Z. Y. (1984). Symptom checklist-90 (SCL-90). *General Psychiatry, 2*, 68-70.

32. WHO. (2020). Statement on the second meeting of the International Health Regulations (2005) Emergency Committee regarding the outbreak of novel coronavirus (2019- nCoV). Retrieved May 5, 2020, from: https://www.who.int/news-room/detail/30-01-2020-statement-on-thesecond-meeting-of-the-international-health-regulations-(2005)-emergency-committee-regarding-the-outbreak-of-novel-coronavirus-(2019-ncov)
33. Wu, P., Fang, Y., Guan, Z., Fan, B., Kong, J., Yao, Z., ... & Hoven, C. W. (2009). The psychological impact of the SARS epidemic on hospital employees in China: exposure, risk perception, and altruistic acceptance of risk. *Canadian Journal of Psychiatry, 54*(5), 302-311.
34. Xiang, Y., Yang, Y., Li, W., Zhang, L., Zhang, Q., Cheung, T., & Ng, C. H. (2020). Timely mental health care for the 2019 novel coronavirus outbreak is urgently needed. *The Lancet Psychiatry, 7*(3), 228-229.
35. Xiao, C. (2020). A novel approach of consultation on 2019 novel coronavirus (COVID-19)-related psychological and mental problems: Structured letter therapy. *Psychiatry Investigation, 17*(2), 175-176.
36. Yang, C. C. (2006). Evaluating latent class analysis models in qualitative phenotype identification. *Computational Statistics & Data Analysis, 50*(4), 1090-1104.
37. Yuan, H., Wu, L., Wu, J. Y., Hu, D., Lei, K., Huang, J. Y. (2020). Mental health status and coping strategies among medical staff during outbreak of coronavirus disease 2019. *Medical Journal of Wuhan University.* Advance online publication. 1-6. doi: 10. 14188/j. 1671-8852. 2020. 0229.

38. Zhang, Q., Huang, X. Q., Yang, X. L., He, X. B., & Yu, S. Y. (2005). Relationship between attitudes towards SARS and mental health and defense styles in high-risk medical staff during post climax of SARS. *Journal of the Fourth Military Medical University, 26*(3), 268-271.

39. Zhang, W. R., Wang, K., Yin, L., Zhao, W. F., Xue, Q., ... & Wang, H. X. (2020). Mental health and psychosocial problems of medical health workers during the COVID-19 epidemic in China. *Psychotherapy and Psychosomatics*. Advance online publication. doi:10.1159/000507639

40. Zhao, JJ., Xu, R., Yang, ZL., Hu, CY., Chen, F., Wang, XD., & Wang, K. (2020). Considerations on the use of several commonly used psychological assessment scales during COVID-19. *Journal of Preventive Medicine of Chinese People's Liberation Army, 38*(4), 111-112.

41. Zhao, K., Zhang, G., Feng, R., Wang, W., Xu, D., Liu, Y., & Chen, L. (2020). Anxiety, depression and insomnia: A cross-sectional study of frontline staff fighting against COVID-19 in Wenzhou, China. *Psychiatry Research*, *292*, 113304.

42. Zhao, L., Li, L. X., Zhou, S. D., Zhang, Y. B., & Gao, Y. H. (2013). Comparison with the latent profile analysis and systemic clustering method. *Journal of Guangdong Pharmaceutical Universit*y, 29(2), 206-209.

43. Zung, W. W. (1965). A self-rating depression scale. *Archives of General Psychiatry, 12*(1), 63-70.

44. Zung, W. W. (1971). A rating instrument for anxiety disorders. *Psychosomatics, 12*(6), 371-379.

Table 1. Demographic characteristics of participants (N=456)

Variables		Number	Percentage (%)
Total		456	100
Gender			
	Male	161	35.3
	Female	295	64.7
Age (years)	37.4±8.2		
	21-30	102	22.4
	31-40	214	46.9
	41-50	109	23.9
	51-59	31	6.8
Educational level			
	Lower than undergraduate	35	7.7
	Undergraduate	279	61.2
	Postgraduate	142	31.1
University subject			
	Clinical medicine	207	45.4
	Nursing	139	30.5
	Pharmacy	11	2.4
	Clinical medicine laboratory	31	6.8
	Medical imaging	17	3.7
	Public health, health management or other	51	11.2
Hospital characteristics			
	Public hospital	426	93.4
	Non-public hospital	30	6.6
Categories of medical institution			
	"AAA" hospital	267	58.6
	"AA" hospital	159	34.9
	"A" hospital/community health center	22	4.8
	Centers for Disease Control (CDC) or other	8	1.7
Working status during COVID-19 pandemic			
	In a COVID-19 team in Hubei province	11	2.4
	COVID-19 team at fever clinic in other provinces except Hubei	119	26.1
	Ordinary team in other provinces	326	71.5
Time since being in a COVID-19 team			
	Since January 20, 2020	52	11.4
	January 20 to 30, 2020	156	34.2

	February 1, 2020 or later	248	54.4

Table 2. Fit indices for the latent profile analysis of the mental health factors

Model	*k*	AIC	BIC	A-BIC	Entropy	LMR-LTR *p*-value	BLRT *p*-value	Class membership size
Class 1	32	16254.603	16386.523	16284.965				
Class 2	49	15341.389	15543.391	15387.881	0.917	0.0146	<0.001	341 (74.6%)/115 (25.4%)
Class 3	66	14256.245	14528.330	14318.867	1.000	0.7511	<0.001	95 (20.8%)/275 (60.3%)/86 (18.9%)
Class 4	83	14086.508	14428.675	14165.260	0.923	0.1549	<0.001	321 (68.4%)/8 (1.8%)/20 (4.4%)/116 (25.4%)
Class 5	100	13806.449	14218.698	13901.330	0.856	0.2089	<0.001	4 (0.9%)/20 (4.4%)/4 (0.9%)/314 (68.9%)/114 (25%)

K=Number of Free Parameters, AIC=Akaike Information Criteria, BIC=Bayesian Information Criteria, A-BIC = Sample Size Adjusted BIC, LMR-LRT = Lo-MendellRubin Likelihood Ratio Test; BLRT = Bootstrap Likelihood Ratio Test

Table 3. Bivariate correlations, means, and standard deviations for the measures

	Measure	*M*	*SD*	1	2	3	4	5	6	7	8
1.	Mental health	24.18	6.62	1.00							
2.	Depression	7.86	2.65	0.90**	1.00						
3.	Anger	4.49	1.63	0.82**	0.68**	1.00					
4.	Fear	4.09	1.56	0.68**	0.49**	0.48**	1.00				
5.	Somatization	3.96	1.38	0.72**	0.57**	0.48**	0.33**	1.00			
6.	Anxiety	3.78	1.13	0.73**	0.57**	0.52**	0.37**	0.54**	1.00		
7.	SAS	44.92	6.10	0.71**	0.53**	0.55**	0.59**	0.60**	0.59**	1.00	
8.	SDS	51.39	6.69	0.41**	0.44**	0.32**	0.27**	0.24**	0.26**	0.47**	1.00
9.	Working status during the COVID-19	2.97	0.90	0.12*	0.10*	0.13*	0.14*	0.05	0.04	0.11*	0.10*

**p<.01, *p<.05 (SAS=Self-rating Anxiety Scale; SDS=Self-rating Depression Scale)

Table 4. Comparison of mental health scores of healthcare staff with different mental health classes during the COVID-19 pandemic

	Variables	Good mental health class (N=341)	Poor mental health class (N=115)	t/χ^2	*p*
SAS				96.601	<0.001
	≤49 (no anxiety)	300	51		
	50~59 (mild)	41	59		
	60~69 (moderate)	0	5		
SDS				18.912	<0.001
	≤49 (no depression)	143	26		
	50~59 (mild)	173	69		
	60~69 (moderate)	24	19		
	≥70 (severe)	1	1		
Gender				5.723	0.017
	Male	131	30		
	Female	210	85		
Age				5.042	0.169
	21~30	79	23		
	~40	150	64		
	~50	88	21		
	>50	24	7		
Educational level				1.726	0.422
	Lower than than undergraduate	28	7		
	Undergraduate	212	67		
	Postgraduate	101	41		
University subject				4.798	0.441
	Clinical medicine	162	45		
	Nursing	95	44		
	Pharmacy	8	3		
	Clinical medicine laboratory	23	8		
	Medical imaging	13	4		
	Public health, health management or others	40	11		
Hospital type				2.406	0.121
	Public hospital	315	111		
	Non-public hospital	26	4		
Categories of				0.251	0.969

medical institution					
	“AAA” hospital	198	69		
	“AA” hospital	121	38		
	“A” hospital/community Health center	16	6		
	Centers for Disease Control (CDC) or other	6	2		
Working status during COVID-19 pandemic				5.084	0.028
	Fight against COVID-19 in Hubei province	6	5		
	Fever clinic in other provinces except Hubei	83	36		
	Ordinary in other provinces	252	74		
Time since being in a COVID-19 team				0.033	0.984
	Since January 20	39	13		
	January 20 to 30	84	30		
	February 1 or later	184	64		

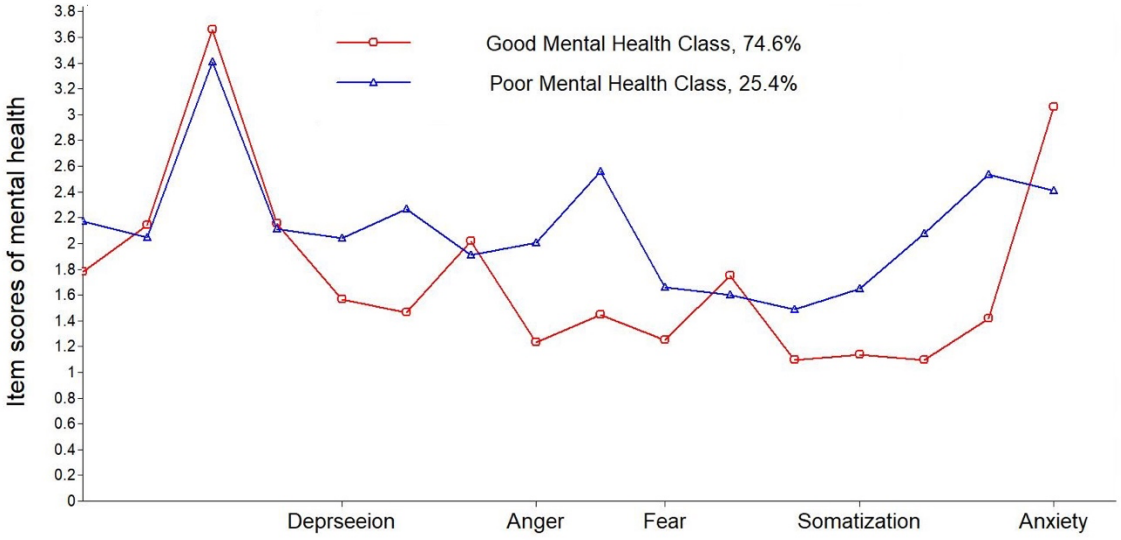

Fig. 1 Latent class profile related to the five mental health dimensions