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Subtypes of work engagement in frontline supporting nurses during COVID-19 pandemic: A latent profile analysis

Yizhen Yin[1] | Mengmeng Lyu[2] (ID) | Man Zuo[3] | Shuyu Yao[4] | Hui Li[5] | Juan Li[1] (ID) | Jie Zhang[6] | Jingping Zhang[1] (ID)

[1]Xiangya Nursing School, Central South University, Changsha, P.R. China

[2]Alice Lee Centre for Nursing Studies, Yong Loo Lin School of Medicine, National University of Singapore, Singapore

[3]Department of Respiratory Medicine, Heyuan Branch of Guangdong Provincial People's Hospital, Heyuan, P.R. China

[4]State Key Laboratory of Ophthalmology, Zhongshan Ophthalmic Center, Sun Yat-sen University, Guangzhou, P.R. China

[5]Department of Orthopedics, West China Hospital/Sichuan University West China School of Nursing, Sichuan University, Chengdu, P.R. China

[6]School of Nursing, Hunan University of Chinese Medicine, Changsha, P.R. China

Correspondence
Jingping Zhang, Xiangya Nursing School, Central South University, Changsha, Hunan 410013, P.R. China.
Email: jpzhang1965@csu.edu.cn

Jie Zhang, School of Nursing, Hunan University of Chinese Medicine, No. 300, Xueshi Road, Yuelu District, Changsha, Hunan 410208, P.R. China.
Email: zzuzhangjie@163.com

Abstract

Aim: The aim was to examine the subgroups of work engagement in frontline nurses during the COVID-19 pandemic.

Background: The pandemic may affect the work engagement of nurses who have direct contact with infected patients and lead to a poor quality of care. Identifying classification features of work engagement and tailoring interventions to support frontline nurses is imperative.

Design: This study utilized a cross-sectional study design.

Methods: Three hundred fifty-five nurses were enrolled in this cross-sectional study from 14 February to 15 April 2020. A latent profile analysis was performed to identify classification features of work engagement. Multiple logistic regression analyses were used to examine predictors of profile membership.

Results: A four-profile model provided the best fit. The four profiles were titled 'low work engagement' ($n = 99$), 'high vigour-low dedication and absorption' ($n = 58$), 'moderate work engagement' ($n = 63$) and 'high work engagement' ($n = 135$). A regression analysis suggested that young nurses and nurses who were the only children of their family were more likely to be in the 'low work engagement' and 'high vigour-low dedication and absorption' groups.

Conclusion: This study highlights the importance of tailoring interventions for frontline supporting nurses by considering their distinct work engagement patterns, especially during the COVID-19 pandemic, to improve the promotion of work satisfaction and quality of care.

Impact: This was the first study to explore the latent profiles of work engagement in frontline nurses during the COVID-19 pandemic. Over 40% of nurses were in the 'low work engagement' and 'high vigour-low dedication and absorption' groups and reported low levels of work engagement. Understanding different patterns of work engagement in frontline nurses can help nursing managers provide emotional, material and organizational support based on the features of each latent profile, which may improve the quality of care and patient safety.

KEYWORDS
COVID-19, latent class analysis, nurses, work engagement

Yizhen Yin and Mengmeng Lyu share first authorship together.

1 | INTRODUCTION

COVID-19 is a respiratory infectious disease that is characterized as severe acute respiratory syndrome coronavirus type 2. As of 3 December 2021, there were approximately 264 million global COVID-19 patients and approximately 5.22 million people have died of this disease (WHO, 2021). In Hubei, China, from 22 January 2020 to 15 April 2020, the number of confirmed cases of COVID-19 increased from 444 to 67,803 with 3222 confirmed fatalities (WHO, 2021). The surge in COVID-19 patients in Hubei resulted in a severe shortage of medical supplies and nurses in local hospitals. To control the pandemic and support the local health care system, from 26 January 2020 to 15 April 2020, the China Health and Construction Commission dispatched more than 28,600 nurses to assist local health care providers in caring for patients who contracted COVID-19 (Hu et al., 2020).

Frontline supporting nurses must quickly adapt to local hospital management procedures and work environments and also be available at infection departments nearly 24/7 (Villar et al., 2021; Zhang et al., 2021). Due to this new working environment, heavy workload, longer working hours, long hours of wearing personal protective equipment, direct contact with infected patients, a lack of experience in managing infectious disease and isolation from supportive networks, the work engagement of frontline nurses is inevitably affected (Allande-Cussó et al., 2021; Zhang et al., 2021). Work engagement is defined as the positive physical, emotional and cognitive state in workers (Simpson, 2009). It includes three dimensions as follows: vigour, dedication and absorption. Vigour indicates being full of energy and having mental resilience whilst working, dedication is characterized by being immersed in work and having an associated sense of accomplishment and significance, and absorption refers to a state of being concentrated on work and a strong sense of pleasure (Kulikowski, 2019). Previous studies on nurses revealed that participants' perception of the strength of the COVID-19 crisis had an adverse impact on their work engagement (Giménez-Espert et al., 2020; Liu et al., 2021). With an increasing number of new COVID-19 cases, the emergence of the COVID-19 variant Omicron and a foreseeable long-term fight against COVID-19 (Kissler et al., 2020), the work engagement of frontline nurses will continue to be affected unless measures are taken to alleviate negative outcomes.

2 | BACKGROUND

Work engagement affects the physio-psychological health and job performance of nurses. Previous studies on nurses demonstrated positive effects of work engagement on job satisfaction, workforce stability, organizational commitment and the quality of care (Giallonardo et al., 2010; Kunie et al., 2017; Van Bogaert et al., 2014). Higher work engagement levels are also associated with lower burnout and depression (Giesbers et al., 2021). Furthermore, sustaining a highly engaged nursing workforce may improve the quality of care delivered to COVID-19 patients and lead to better prognosis and outcomes. Using standardized mortality and complication indices, Blizzard (2005) surveyed the impact of nurse work engagement on patient outcomes at more than 200 hospitals. A regression analysis revealed that higher levels of work engagement were associated with decreased mortality and complication index in patients (Blizzard, 2005). Therefore, investigating work engagement and its influencing factors on frontline nurses is essential because it enables nursing managers to identify and support nurses with low work engagement and ensure the appropriate quality of care is delivered to COVID-19 patients.

Despite the importance of work engagement in maintaining nurses' work outcomes as well as patients, studies on work engagement and associated factors of nurses working on the frontline are limited. A study of Spanish nurses found that frontline nurses generally reported high levels of work engagement (Allande-Cussó et al., 2021). A study on Chinese frontline nurses found that they reported moderate levels of work engagement (Zhang et al., 2021). Both studies calculated the mean score of the Utrecht Work Engagement Scale short version (UWES-9) (Kulikowski, 2019). However, these studies did not indicate cut-off scores for differentiating various levels of work engagement and did not provide related references. A lack of consensus for cut-off scores to classify levels of work engagement hinders the ability to obtain precise recommendations for intervention. Additionally, the assumption underlying traditional statistical methods (calculating the average overall score of working engagement) is that all cases react in a unitary style to a phenomenon, but it is more reasonable to hypothesize that there are heterogeneous subgroups of cases who react to events in different ways (Watanabe & Yamauchi, 2019). For example, although the average score indicated that Spanish frontline nurses had high work engagement, 47% of them were classified as having only intermediate work engagement (Allande-Cussó et al., 2021), which suggests that patterns of work engagement in frontline nurses may be different. In this case, evaluating the average score is generally too simple and cannot differentiate between subgroups of nurses with different patterns of work engagement, and a 'person-centred' approach is more appropriate (Wang et al., 2017).

Latent profile analysis (LPA) is a person-centred approach that can identify subgroups of participants who share similar patterns based on the variables of interest (Ding, 2018). By using LPA, researchers can portray potentially different patterns of work engagement amongst nurses, which could help nursing managers and other stakeholders tailor interventions to support frontline nurses. Previous studies in the nursing field applied LPA to determine the subgroups of work demands, interaction styles, healthy preemployment lifestyle and moral sensitivity to obtain associations between different profiles and turnover and job satisfaction (Duprez et al., 2020; Han et al., 2019; Zhang et al., 2020). The findings of these studies provide targeted guidance for intervention.

3 | THIS STUDY

3.1 | Aim

This study employed LPA to (a) explore potentially different profiles of work engagement in frontline nurses and (b) identify the features of each profile using a range of demographic and work-related variables. This study provides certain suggestions for developing supportive strategies to improve the work engagement of frontline nurses during the epidemic and the quality of care for COVID-19 patients.

3.2 | Design

This study was a cross-sectional study conducted from 14 February to 15 April 2020 in three hospitals treating COVID-19 patients in Hubei Province, and it was approved by the university's Institutional Review Board.

3.3 | Participants

The study was conducted amongst frontline clinical nurses working at hospitals in Hunan and Guangzhou who supported the special isolation wards of three designated COVID-19 hospitals in Hubei, China, from 30 March to 15 April 2020. Eligible participants were nurses who: (i) participated in the frontline support in hospitals located in Hubei; (ii) were working in the frontline departments such as the isolation ward, ICU and infection department where infected patients stayed; (iii) had been employed full time and (iv) were registered nurses (RNs). Nurses infected by novel coronavirus were excluded because contracting the virus can decrease nurses' work engagement.

3.4 | Sample size

This study examined the latent profiles of work engagement amongst frontline supporting nurses. In a previous study, Nylund-Gibson and Choi (2018) suggested that the minimum sample size for LPA is 300 cases.

3.5 | Data collection

This study was conducted using an online survey and a questionnaire. The online questionnaire was distributed through an online data collection website called Questionnaire Star (Pinyin: Wen Juan Xing). A link to the questionnaire was distributed by applying convenience sampling and snowball sampling. An advertising poster included the study aim, criteria, procedure and contact information of the second author and this was posted on the second author's personal WeChat account. Potential participants who contacted the author were provided with a link to the online questionnaire. Concurrently, the authors sent the advertising poster and link to nurses working at three hospitals in Hunan and Guangzhou who supported the special isolation wards of three designated COVID-19 hospitals in Hubei. Nurses who volunteered to participate in the study were encouraged to invite and introduce other potentially eligible nurses to the author after obtaining permission. Then, the advertising poster and questionnaire link was sent to the interested nurse via email or through an online chatting platform.

3.6 | Measures

3.6.1 | Demographic characteristics

Demographic data collected in this study included age, gender, education level, professional title, family situation, marital status and years of working experience. In China, RNs were classified into 'nurse practitioner,' 'supervisor nurse,' and 'chief nurse' based on the year of the RNs' experience, the score of the qualification examination, the number of research grants being awarded and the number of research papers. The responsibilities of nurses with different professional titles are also different. Nursing practitioners are responsible for taking care of patients. Supervisor nurses instructed nursing practitioners to formulate and implement nursing plans for critically ill patients, analyse the defects of nursing plans and propose nursing preventive measures. Chief nurses are responsible for inspecting and guiding the formulation of nursing plans for critically ill patients, evaluating the effect of nursing plans and providing opinions on the structure of nursing staff, nursing technical training and scientific research management in the hospital.

3.6.2 | Work engagement

Work engagement was measured by the Chinese version of the UWES (Liu et al., 2020), a self-reported instrument that comprises 15 items divided into three domains: vigour, dedication and absorption. The frequency of positive physical, emotional and cognitive state in workers was assessed using a 7-point Likert scale ranging from 0 (never) to 6 (all the time). The Cronbach's alpha of the Chinese version of UWES ranged from 0.74 to 0.77. The Cronbach's alpha of UWES in this study ranged from 0.81 to 0.88.

3.7 | Ethical considerations

The study was approved by the Institutional Research Board of the researchers' university (Reference No. E202027). The online informed consent document was provided to all participants, they were informed of the aim and procedure of the survey, the responsible organization and the contact information of the corresponding

Model	k	AIC	BIC	aBIC	Entropy	LMR	BLRT
1 profile	30	23,017.070	23,133.233	23,038.060	—	—	—
2 profiles	46	20,772.753	20,950.871	20,804.939	0.964	0	0
3 profiles	62	19,726.175	19,966.246	19,769.555	0.977	0.0004	0
4 profiles	**78**	**18,718.272**	**19,020.298**	**18,772.848**	**0.989**	**0.0003**	**0**
5 profiles	94	18,050.033	18,414.012	18,115.803	0.993	0.0681	0

Abbreviations: aBIC, adjusted Bayesian information criteria; AIC, Akaike information criterion; BIC, Bayesian information criteria; BLRT, Bootstrapped Likelihood Ratio Test; LMR, Lo–Mendell–Rubin.

author as well as data security. All participants provided an electronic signature for the consent and sent it via electronic means (email, WeChat) to indicate that they had given informed consent. All data collected were anonymized and stored in an encrypted computer of the university; only the research team has access to it.

3.8 | Data analysis

The LPA was conducted using Mplus 7.0 to examine the latent profiles of work engagement in frontline nurses. Five models, ranging from the initial (1 profile) to the final (5 profiles), were estimated by gradually increasing the profile number until the fitness indices had achieved optimal levels. Several recommended fitness indices were used to facilitate the model choice, including the Akaike information criterion (AIC), the Bayesian information criterion (BIC) and the sample size adjusted Bayesian information criterion (aBIC), with smaller values indicating better model fit (Ding, 2018). Entropy values were also calculated, with an entropy value close to 1.0, which indicated a great precision of classification (Ding, 2018). Additionally, the Lo–Mendell–Rubin (LMR) and Bootstrap Likelihood Ratio (BLR) tests were also conducted to calculate the p value, with $p < .05$ indicating that the current model is a significantly better fit for the data than the former (Ding, 2018). After obtaining the optimal model, multinomial logistic regression analyses were used to examine the predictors of profile membership. Data were considered statistically significant if the p value $< .05$. Data were analysed using IBM SPSS v 23.0.

3.9 | Validity, reliability and rigour

This study used Chinese translations of the scale measuring work engagement. Psychometric properties for the Chinese version of UWES have been reported in a past study (Liu et al., 2020). In this study, the scale also indicated high reliability (Cronbach's $\alpha = .81–.88$).

4 | RESULTS

A total of 359 electronic questionnaires were issued, and 355 questionnaires were returned, for a response rate of 98.9%. The mean

age of the 355 participants was 31.8 (standard deviation [SD] = 7.0) years (ranging from 16 to 71). Most of the frontline nurses were female (94.4%). Nearly three-quarters of the participants had a bachelor's degree (74.1%). Approximately 34.6% of them had been working in the nursing profession for more than 10 years. Additionally, 64.8% of the participants were married, and over half had the title of 'nurse practitioner' (54.9%).

4.1 | Latent profiles of work engagement

Four latent profile models were estimated, and the fit indices of each model are shown in Table 1. Overall, the four-profile model provided the best fit indices since the AIC, BIC and aBIC values in the four-profile model were lower than those of the three-profile model, and the entropy value was higher than 0.9. The LMR value of the five-profile model was nonsignificant, which indicates that the four-profile model is better than the five-profile model. Thus, the four-profile model fit data were considered optimal, and the fit indices of this model were highlighted in bold in Table 1.

The scores of the four profiles on 15 items of the UWES are shown in Figure 1. Nurses in Profile 1 endorsed 'Never' to most of the items in all three dimensions; thus, this subgroup was named the 'low engagement' group. Profile 1 accounted for 27.7% ($n = 99$) of the sample. For nurses in Profile 2, their response rates of 'All the time' to half of the items in the 'vigour' dimension were much higher than average, whilst their responses were 'Never' to most of the items in the 'dedication' and 'absorption' dimensions. Therefore, this subgroup was named 'high vigour-low dedication and absorption.' Profile 2 accounted for 16.2% ($n = 58$) of the sample. Nurses in Profile 3 showed a moderate level of all items, which accounted for 17.9% ($n = 63$) of the sample. Therefore, this subgroup was named 'moderate work engagement.' Profile 4 was named the 'high work engagement' group because it had the highest scores on all UWES items. Profile 4 accounted for 38.1% ($n = 135$) of the sample.

4.2 | Demographic and work-related characteristics of each profile

The mean scores of the UWES of all participants and nurses in Profiles 1, 2, 3 and 4 were 47.3 (SD = 22.8), 23.0 (SD = 11.4), 36.7

FIGURE 1 Latent profiles of work engagement amongst the frontline supporting nurses. For analytical purposes, we sort the items of the Utrecht Work Engagement Scale by a factor that corresponds to 1–6 for vigour, 7–10 for dedication and 10–15 for absorption.
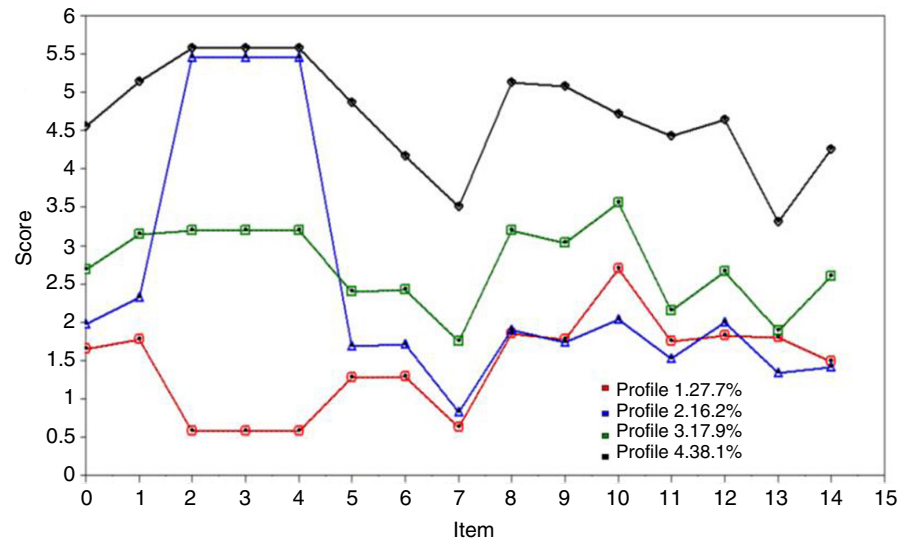
(SD = 9.1), 43.6 (SD = 11.2) and 71.4 (SD = 10.2), respectively. Nurses in the 'low work engagement' group reported the lowest levels of work engagement, lower than other subgroups. Nurses in the 'high vigour-low dedication and absorption' and 'moderate work engagement' groups reported similar levels of work engagement, whereas nurses in the 'high work engagement' group had the highest levels of work engagement. The frequencies and percentages of the demographic and work-related features for each profile are shown in Table 2. The low work engagement group had the largest percentage of nurses aged less than or equal to 35 years old [85.9% vs. 68.3%, 70.2% and 74.3%]. The high work engagement group had the smallest percentage of only children [5.9% vs. 19.0%, 20.2% and 36.2%].

4.3 | Predictor of latent profile membership

Multinomial logistic regression analyses were conducted to identify the demographic and work-related influencing factors of profile membership with the 'high work engagement' group as the reference group (Table 3). Nurses aged less than or equal to 35 years were more likely to be in the 'low work engagement' group compared with those in the 'high work engagement' group (OR = 4.61, p = .04). Nurse practitioners were more likely to be in the 'low work engagement' group compared with those in the 'high work engagement' group (OR = 7.63, p = .04). Compared with those in the 'high work engagement' group, nurses who were not the only child of their family were less likely to be in the 'low work engagement' group (OR = 0.22, p < .01), 'high vigour-low dedication and absorption' group (OR = 0.26, p = .01) or 'moderate work engagement' group (OR = 0.13, p < .01). Predictors of latent profile membership were highlighted in bold in Table 3.

5 | DISCUSSION

The study examined the work engagement amongst frontline supporting nurses during the COVID-19 pandemic. The results indicated that participants reported on average moderate levels of work engagement. A study in Spain found that nurses working on the front line against COVID-19 reported high levels of work engagement. This discrepancy is likely to be related to the differences in the scales used for assessing work engagement. Allande-Cussó et al. (2021) used the 9-item UWES questionnaire, which is different from the 15-item UWES used in this study. Besides, part of the participants worked in the primary care department (n = 187, 36.6%) and had no direct contact with the infected patients. Whereas, in the current study, all participants work in the frontline departments where infected patients stayed. This may also constitute a partial explanation for the heterogeneity of the results on the levels of work engagement. Because caring for infected patients may cause psychological distress, which has an impact on the work engagement amongst health professionals (Liu et al., 2021; Nashwan, Villar, et al., 2021). Cultural differences may also contribute to the differences. In China, nurses are not as respected as doctors, and the public regards nurses as subordinates of doctors. The media propaganda about the fight against COVID-19 mainly focused on doctors, which may decrease nurses' sense of self-realization and self-esteem, leading to decreased levels of work engagement (Ma et al., 2022).

The study results revealed the obvious classing features of work engagement in frontline nurses during the outbreak of COVID-19. Based on the response of each item, four subgroups, including the 'low work engagement,' 'high vigour-low dedication and absorption,' 'moderate work engagement' and 'high work engagement' groups, were identified. Approximately 27.7% of the participants were in the 'low work engagement' group. Nurses in Profile 1 had the lowest scores in all dimensions, especially in the 'vigour' dimension. In this group, frontline nurses were reluctant to devote time and energy to work, easily surrendered to the difficulties faced at work and were unable to concentrate on work tasks. The job demands–resources model proposes that work engagement is driven by job and personal resources (Taris & Schaufeli, 2015). Sufficient job and personal resources can enhance work engagement by helping employees achieve work goals and motivating employees to develop personal capabilities (Courson et al., 2022; Watanabe & Yamauchi, 2018).

TABLE 2 Demographic and work-related characteristics by latent profile

	Overall (N = 355)	Low work engagement (n = 99) n (%)	High vigour-low dedication and absorption (n = 58) n (%)	Moderate work engagement (n = 63) n (%)	High work engagement (n = 135) n (%)
Age					
≤35	269 (75.8)	85 (85.9)	40 (69.0)	43 (68.3)	101 (74.8)
≥36	86 (24.2)	14 (14.1)	18 (31.0)	20 (31.7)	34 (25.2)
Gender					
Male	20 (5.6)	6 (6.1)	7 (12.1)	4 (6.3)	3 (2.2)
Female	335 (94.4)	93 (93.9)	51 (87.9)	59 (93.7)	132 (97.8)
Education level					
Associate degree and below	78 (22.0)	24 (24.2)	27 (46.6)	14 (22.2)	28 (20.7)
Bachelor's degree	263 (74.1)	74 (74.7)	30 (51.7)	43 (68.3)	101 (74.8)
Master's degree and above	14 (3.9)	1 (1.1)	1 (1.7)	6 (9.5)	6 (4.4)
Professional title					
Nurse practitioner	195 (54.9)	68 (68.6)	21 (36.2)	39 (61.9)	67 (49.6)
Supervisor nurse	141 (39.7)	29 (29.3)	34 (58.6)	20 (31.7)	58 (43.0)
Chief nurse	18 (5.4)	2 (2.1)	3 (5.2)	4 (6.3)	10 (7.4)
Family situation					
Non-only-child	294 (17.2)	79 (79.8)	37 (63.8)	51 (81.0)	127 (94.1)
Only-child	61 (82.8)	20 (20.2)	21 (36.2)	12 (19.0)	8 (5.9)
Marital status					
With a spouse	230 (64.8)	57 (57.6)	43 (74.1)	36 (57.1)	94 (69.6)
Without a spouse	125 (35.3)	42 (42.4)	15 (25.9)	27 (42.9)	41 (30.4)
Years of experience					
Less than 5	132 (37.2)	40 (40.4)	17 (29.3)	25 (39.7)	50 (37.0)
5 to 9	100 (28.2)	34 (34.3)	15 (25.9)	17 (27.0)	34 (25.2)
10 to 15	62 (17.5)	17 (17.2)	13 (22.4)	10 (15.9)	22 (16.3)
More than 15	61 (17.2)	8 (8.1)	13 (22.4)	11 (17.5)	29 (21.5)

However, most frontline nurses at the early stages of the pandemic stated that they experienced periodic material deficiencies and a lack of knowledge about coping with infectious diseases and caring for critical patients, which may affect the work engagement nurses (Courson et al., 2022). Moreover, when supporting nurses arrived in the infection wards, they had to take care of critically ill patients immediately. High-intensity rescue work and heavy workload place frontline nurses under great psychological pressure, and they are prone to severe insomnia (Hu et al., 2020; Nashwan, Villar, et al., 2021; Zhang et al., 2021), which impairs their willingness to work. Previous studies supported that a heavier workload would affect nurses' willingness to support epidemic-stricken areas (Hu et al., 2020; Nashwan, Abujaber, et al., 2021; Zhang et al., 2021).

The 'high vigour-low dedication and absorption' group consisted of 16.3% of participants. Nurses in this group endorsed high levels of items in the 'vigour' dimension and had the lowest response rates of items in the dedication and absorption dimensions. Nurses in this subgroup had enthusiasm and mental resilience whilst working but also had difficulty in devoting themselves

to work and were unable to experience an associated sense of significance and accomplishment. One possible reason is that nurses working in isolation wards must wear protective equipment, such as protective clothing, masks and goggles, when working. Nursing staff that wear protective equipment often stay in a confined space for a long time and experience symptoms such as suffocation and chest tightness (Hu et al., 2020; Labrague & de los Santos, 2021), which makes it difficult to concentrate on work. Additionally, in the early stages of the pandemic, frontline supporting nurses lacked knowledge regarding the fatality rate and severity of COVID-19. When facing conditions of critically ill patients deteriorating rapidly and a surge in the number of confirmed cases and deaths, nurses felt frustrated and disappointed (Liu et al., 2021), which affects their professional identity.

The 'high work engagement' group consisted of 38.1% of the participants. Nurses in this subgroup had the highest scores of all items amongst the four subgroups, especially for vigour and absorption. The average score of work engagement for this subgroup of nurses was also higher than that of previous studies (Cai et al., 2021; Zhang

TABLE 3 Predictors of latent profile membership

	B	Std. error	Odds ratio	95% confidence interval	p
P1 Low work engagement (vs. P4 high work engagement)					
Age: ≤35, ref.: ≥36	**1.53**	**0.76**	**4.61**	**1.04–20.53**	**0.04**
Gender: male, ref.: female	−0.39	0.76	0.67	0.15–3.01	0.61
Family situation: not the only child, ref.: only-child	**−1.50**	**0.47**	**0.22**	**0.09–0.56**	**0.00**
Education level: associate degree and below, ref.: master's degree and above	1.01	1.18	2.75	0.27–27.71	0.39
Education level: bachelor's degree, ref.: master's degree and above	0.95	1.14	2.59	0.28–24.11	0.40
Marital status: without a spouse, ref.: with a spouse	0.47	0.36	1.59	0.79–3.20	0.19
Professional titles: nurse practitioner, ref.: chief nurse	**2.03**	**0.98**	**7.63**	**1.12–51.97**	**0.04**
Professional titles: supervisor nurse, ref.: chief nurse	1.00	0.89	2.72	0.48–15.47	0.26
Years of nursing experience (years): less than 5, ref.: more than 15	0.30	0.88	1.35	0.24–7.55	0.73
Years of nursing experience (years): 5–9, ref.: more than 15	1.09	0.79	2.99	0.64–14.01	0.17
Years of nursing experience (years):10–15, ref.: more than 15	1.04	0.56	2.82	0.93–8.52	0.07
P2 High vigour-low dedication and absorption (vs. P4 high work engagement)					
Age: ≤35, ref.: ≥36	−0.70	0.80	0.49	0.10–2.35	0.38
Gender: male, ref.: female	−0.68	0.83	0.51	0.10–2.55	0.41
Family situation: not the only child, ref.: only-child	**−1.34**	**0.51**	**0.26**	**0.10–0.71**	**0.01**
Education level: associate degree and below, ref.: master's degree and above	−1.33	0.75	0.27	0.06–1.15	0.08
Education level: bachelor's degree, ref.: master's degree and above	−1.35	0.67	0.26	0.07–0.96	0.05
Marital status: without a spouse, ref.: with a spouse	0.67	0.41	1.95	0.87–4.37	0.11
Professional titles: nurse practitioner, ref.: chief nurse	1.59	0.90	4.90	0.84–28.62	0.08
Professional titles: supervisor nurse, ref.: chief nurse	0.39	0.73	1.47	0.35–6.12	0.59
Years of nursing experience (years): less than 5, ref.: more than 15	−0.61	1.04	0.54	0.07–4.13	0.55
Years of nursing experience (years): 5–9, ref.: more than 15	0.10	0.94	1.11	0.18–6.93	0.91
Years of nursing experience (years):10–15, ref.: more than 15	0.15	0.59	1.16	0.37–3.69	0.80
P3 Moderate work engagement (vs. P4 high work engagement)					
Age: ≤35, ref.: ≥36	−0.70	0.62	0.50	0.15–1.69	0.26
Gender: male, ref.: female	−0.90	0.81	0.41	0.08–2.00	0.27
Family situation: not the only child, ref.: only-child	**−2.08**	**0.48**	**0.13**	**0.05–0.32**	**0.00**
Education level: associate degree and below, ref.: master's degree and above	1.16	1.21	3.20	0.30–34.38	0.34
Education level: bachelor's degree, ref.: master's degree and above	0.82	1.15	2.26	0.24–21.43	0.48
Marital status: without a spouse, ref.: with a spouse	−0.33	0.47	0.72	0.28–1.81	0.48
Professional titles: nurse practitioner, ref.: chief nurse	−0.24	0.98	0.79	0.12–5.38	0.81
professional titles: supervisor nurse, ref.: chief nurse	0.24	0.78	1.27	0.27–5.87	0.76

TABLE 3 (Continued)

	B	Std. error	Odds ratio	95% confidence interval	p
Years of nursing experience (years): less than 5, ref.: more than 15	−1.31	1.05	0.27	0.03–2.12	0.21
Years of nursing experience (years): 5–9, ref.: more than 15	−1.40	0.92	0.25	0.04–1.48	0.13
Years of nursing experience (years):10–15, ref.: more than 15	−0.41	0.69	0.66	0.17–2.56	0.55

et al., 2021). These results suggest that nurses in this subgroup have greater enthusiasm for work and are more absorbed in their work and enjoy it. These results support the notion that some frontline nurses show more positive emotional and cognitive states at work than others. A qualitative study on the work experience of frontline nurses revealed that some nurses expressed positivity even if they were exhausted and they still endeavoured to treat patients, whilst others reported that saving the life of critical patients and addressing urgent tasks in an orderly manner gave them a strong sense of accomplishment (Tan et al., 2020). Although these studies revealed a positive, fulfilling, work-related state in some frontline nurses, additional in-depth studies are needed to fully elucidate how and why these nurses could maintain high work engagement under extreme pressure.

Demographic predictors of profile membership include age and family status. For example, nurses less than or equal to 35 years old were more likely to be in the 'low work engagement' group. This result was consistent with the findings of previous studies (Allande-Cussó et al., 2021; Lyu et al., 2020; Saito et al., 2018). For example, a study amongst Japanese nurses in long-term care hospitals found that older age is associated with higher levels of work engagement (Saito et al., 2018). When working in the infection ward, nurses need to deal with high-intensity rescue work and rapidly changing and unpredictable disease conditions of patients. The increased personal competencies that are gained as one's age and more experience in handling multiple and simultaneous tasks provide older nurses with more experience in dealing with urgent demands (Kim & Kang, 2017). This experience contributes to work efficiency and performance and leads to higher levels of work engagement. Nurses who were the only children (i.e., no brothers or sisters) were less likely to be in the 'high work engagement' group. However, without theoretical and empirical evidence, we cannot deduce a causal relationship between being an only child and poor work engagement. If we hypothesize that there is a causal relationship, one possible reason is those frontline nurses who were only children may feel greater stress and anxiety whilst working because if they contract the coronavirus and die of the disease, no one can take care of their parents. Additionally, increased psychological distress may have an adverse impact on their work engagement and performance (Tomietto et al., 2019).

One work-related predictor of profile membership is the professional title of the individual. For example, compared with chief nurses, nurse practitioners are more likely to be in the 'low work engagement' group. A higher proportion of nursing practitioners in the 'low work engagement' group may be explained by their responsibility in caring for infected patients. Nurse practitioners who are responsible for infected patients have more direct interactions with patients than chief nurses who guide the formulation of nursing plans and coordinate the deployment of nursing staff. A close and prolonged exposure to infected patients is associated with a higher risk of virus infection (Bani-Issa et al., 2021). Furthermore, the psychological distress caused by an increased risk of infection decreases one's willingness to work and work satisfaction and increases chronic fatigue (Galehdar et al., 2020; Luo et al., 2020). Additionally, nurse practitioners have fewer years of working experience than supervisory nurses and chief nurses, which may impact the work engagement of nurses.

Demographic and work-related factors, such as gender, years of work experience as a nurse, education level and marital status, did not significantly differ amongst these four profiles. Some findings were inconsistent with studies in which more years of work experience and being unmarried were associated with higher levels of work engagement (Sun & Pan, 2008; Wan et al., 2018). This difference may be due to the nature of the work. COVID-19 is a lethal respiratory infectious disease and when caring for infected COVID-19 patients, nurses not only need to have intensive care and respiratory infectious disease care experience but also need to know how to use first aid equipment such as ventilators. Some nurses have years of work experience but are incapable of taking care of critical patients and using critical equipment. As for marital status, married nurses need to take on more family responsibilities, which can take up much time and energy and result in less work engagement (Wan et al., 2018). However, during the pandemic, both married and unmarried frontline nurses have experienced work–family conflicts because they may lose contact with family whilst working in an isolation ward, even when they are eager to take care of their families.

Nursing managers or policymakers should pay attention to nurses in profile one and profile two and tailor interventions to enhance their work engagement. For nurses in the 'low work engagement' group, in addition to providing them with sufficient protective equipment, nurse managers should organize targeted training for nurses who lack experience in caring for infected and critical patients. Training content should include knowledge of the prevention, diagnosis and treatment of COVID-19; methods of prevention and control of infectious disease; knowledge of

respiratory intensive care; and methods of using mechanical ventilation and first aid devices. The training component could include theoretical explanations, scenario simulations and actual combat drills. During the pandemic, making videos for online training or organizing learning through live webcasts may be more appropriate. For nurses in the 'high vigour-low dedication and absorption' group, managers should optimize scheduling to relieve suffocation and chest tightness caused by wearing protective equipment and meet the normal physiological needs of nurses whilst considering the rational utilization of protective materials. Nursing managers should arrange professional psychologists to regularly assess the psychological status of frontline nurses and provide psychological counselling or set up a special platform for consultations with nurses in need. Finally, they should keep nurses in contact with their families who can provide nurses with emotional support.

5.1 | Study limitations

There are several limitations of this study that should be acknowledged. Participants in this study were recruited via snowball sampling. This sampling method may introduce selection bias and decrease the representativeness of the study sample. Future studies should utilize random sampling to improve the representativeness of the study sample. The study is a cross-sectional study and identification of causal relationships between variables may not be possible. Therefore, further longitudinal studies are recommended to follow up the trajectory of work engagement amongst nurses with the development of the pandemic. Besides, 94.4% of the participants are female, which may introduce gender bias. The gender imbalance may relate to the sex ratios amongst Chinese nurses (female:male = 32:1) (Zhang & Tu, 2020). Future studies should include more male nurses to decrease gender bias.

6 | CONCLUSION

In summary, obvious classification features of work engagement were found amongst frontline supporting nurses, and the four-profile model was optimal as follows: 'low work engagement,' 'high vigour-low dedication and absorption,' 'moderate work engagement' and 'high work engagement.' Approximately 43.9% of frontline supporting nurses were in the first two profiles. Thus, nurse administrators should provide emotional, material and organizational support for frontline nurses to improve their work engagement. Overall, the enhancement of work engagement in nurses is critically important for the quality of care for patients affected by COVID-19.

ORCID

Mengmeng Lyu https://orcid.org/0000-0003-2736-3605
Juan Li https://orcid.org/0000-0003-3820-3877
Jingping Zhang https://orcid.org/0000-0002-7800-9617

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