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Research on the status and associated factors of fatigue and professional identity among CDC workers in China

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1 # Research on the status and associated factors of fatigue and

2 # professional identity among CDC workers in China

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28

1   **Abstract**

2   **Objective** To assess the current status and investigate the related factors of fatigue and

3   professional identity among China CDC workers.

4   **Design** A cross-sectional design.

5   **Setting** CDC workers belonging to the Liaoning CDC system were enrolled and

6   workers engaged in administrative work was excluded.

7   **Participants** 1,020 CDC workers.

8   **Primary outcome measures** Fatigue scores and Professional identity scores.

9   **Secondary outcome measures** Post-competence scores, Respect scores, Occupational

10 stress scores, Resilience scores and Self-efficacy scores.

11 **Results:** The average score for fatigue and professional identity was 8.23, 38.88,

12 respectively. Factors including public respect (β =-0.129, $P<0.01$), resilience (β=-0.104,

13 $P<0.05$), and self-efficacy (β=-0.22, $P<0.01$) were negatively connected with fatigue.

14 Educational background (bachelor vs junior college or below) (β=0.105, $P<0.01$),

15 (master or above vs junior college or below) (β=0.092, $P<0.05$), workplace (county vs

16 district) (β=0.067, $P<0.05$), (city vs district) (β=0.085, $P<0.05$), fighting the COVID-

17 19 on the frontline (β=0.059, $P<0.05$), and occupational stress (β=0.166, $P<0.01$) were

18 positively correlated with fatigue. Educational background (bachelor vs junior college

19 or below) (β=-0.097, $P<0.01$), (master or above vs junior college or below) (β=-0.114,

20 $P<0.01$), workplace (city vs district) (β=-0.114, $P<0.01$), fighting the COVID-19 on the

21 frontline (β=-0.047, $P<0.05$), and occupational stress (β=-0.105, $P<0.01$) were

22 negatively associated with professional identity. Factors including post-competence

23 (β=0.362, $P<0.01$), public respect (general vs low) (β=0.219, $P<0.01$), (high vs low)

24 (β=0.288, $P<0.01$), resilience (β=0.097, $P<0.05$), and self-efficacy (β=0.113, $P<0.01$)

25 were positively connected with professional identity.

26 **Conclusion:** The fatigue among CDC workers was at a higher level, level of CDC

27 workers' professional identity was high, and administrators should take measures to

28 alleviate fatigue and maintain professional identity. In addition, methods aiming to

29 attenuate occupational stress, and improve resilience and self-efficacy should be

30 immediately put into action.

1   **Key words** Fatigue; Professional identity; Influencing factor; CDC worker

2   **Word count** 3,586

3   **Strengths and limitations of this study**

4   ● This study is the first study to assess the status of fatigue and professional identity

5   among CDC workers in China.

6   ● This study is the first to explore the psychological factors affecting fatigue and

7   professional identity among CDC workers.

8   ● Due to this is a cross-sectional survey, no causal relationship can be drawn between

9   the variables.

10   ● Participants in this study should be enrolled from widely regions of the country.

Introduction

12   The 2019 coronavirus disease (COVID-19) has caused numerous confirmed or

13   dead cases, leading to billions of economic losses and adverse effects on people's

14   normal lives and induces widely psychological problems within general people and

15   occupational groups [1, 2]. WHO has declared it as a Global pandemic[3]. New

16   coronavirus variants have been deriving, and the impacts on people's health would exist.

17   Previous studies have confirmed that during public health emergencies, both

18   general people and professional groups will suffer from a wide range of adverse psycho-

19   social impacts, especially for frontline workers fighting against the pandemic [1, 4].

20   Centers for Disease Control and Prevention (CDC), an official public health department,

21   offers public health services, including promoting health knowledge as well as disease

22   surveillance and prevention. During pandemic, CDC workers in China have

23   implemented various measures to prevent and control the disease, including the

24   epidemiological investigation of patients and close contacts, collection and examination

25   of specimens, giving effective prevention strategies timely, surveillance of high-risk

26   populations, etc. However, these workers are also burdened with various psychological

27   and physical pressures, but compared with studies on medical staff in this regard [2, 5],

28   far less concerning those occupational group's physical and mental health has been

29   conducted.

1   Fatigue, in medical, is a self-recognized state in which individual experiences

2   undermined labor ability for overwhelming physical and mental work demands, and

3   feels persistent tiredness and weakness, which can't be alleviated by rest [6]. Fatigue

4   exerts both psychological and physiological influences on person's health [7]. For

5   professional groups, fatigue can induce negative mood, lower work efficiency, and

6   cause human errors and physical problems [8]. Studies have found that the higher

7   prevalence and severity of fatigue among healthcare workers were higher, pose an

8   adverse impact on medical service provision and patients' satisfaction [9, 10], and at the

9   early stage of the COVID-19, researchers identified the prevalence of healthcare

10   worker's fatigue vary from 69% to 72.2%, and influencing factors include fear of

11   infection, sleep difficulty and depression, etc. [2, 4]. However, investigations on the

12   current situation and factors of fatigue among CDC workers have been rare.

13   Professional identity is defined as the combination of a worker's knowledge, skills,

14   values and behaviors with his or her own unique identity and core values [11]. Workers

15   usually take professional identity for self-assessment over the matching level of

16   themselves and the job the engaged. Professional identity can be seen as a psychological

17   resource, highly relative to worker's performance and job satisfaction; can relieve

18   workers' burnout and reduce their turnover intention to maintain the stability of the

19   workplace, which has been verified among healthcare staff [12, 13]. It has been confirmed

20   that during the COVID-19, professional identity can effectively moderate the influence

21   of pandemics on staff's job burnout [14]. Thus, it's necessary to identify the state of

22   professional identity, and explore influencing factors among CDC workers.

23   Competency means personal's qualities and behaviors traits affecting individual's

24   productivity and performance [15]. Post-competency refers to the ability to complete

25   assigned work efficiently. Higher post competency means the higher work efficiency

26   and work performance [16], which means less possibilities of burnout. The Job

27   Demands-Resources model (JDR) [17] points out that there is a balance between job

28   demands and possessed resources by employees. Once the demands outweigh the

29   resources, and the employee's competence can't meet the work's needs, burnout and

30   stress arise, and ultimately lead to fatigue and a decline in professional identity.

1 Therefore, CDC workers' post-competence may be an influencing factor for their

2 fatigue and professional identity.

3 Respect, is defined as the feeling of being highly valued, esteemed, or the

4 satisfaction of being held in honor, and it can be seen as an optimistic side of life [18]. It

5 has been found that being respected is an important factor for worker's job satisfaction,

6 and is significantly associated with their organization commitment and retention [19, 20].

7 Maslow's Hierarchy of Needs points out that respect is one of the five needs associated

8 with individual's self-actualization, employee's job satisfaction and performance [21, 22].

9 Therefore, we believe that respect is an influencing factor of fatigue and professional

10 identity, and being respected may reduce the occurrence of fatigue and enhance CDC

11 workers' professional identity.

12 With rapid social and economic development, people tend to have higher demands

13 for keeping their health, causing occupational stress prevalent in China, especially

14 among healthcare workers [23]. Occupational stress refers to a psychological state, and

15 based on the classical occupational stress model of Effort Reward Imbalance (ERI),

16 which proposed by professor Siegrist based on the reciprocity principle [24],

17 occupational stress was caused by the imbalance between extrinsic effort and reward.

18 ERI model argues that workers under the imbalanced extrinsic effort and reward would

19 experience a failed social reciprocity that evokes occupational stress. There have been

20 number of studies on the influence of occupational stress on fatigue and professional

21 identity among profession groups [25, 26]. While, the relationships between occupational

22 stress and CDC workers' fatigue and professional identity still keep vague.

23 From the perspective of the conversation of recourse (COR) theory, when

24 employees' internal and external resources are insufficient or they feel resources are

25 deficient, they will experience occupational stress, which will further lead to fatigue

26 [27]. Owing to the development of positive psychology, scholars have put much attention

27 to the effect of positive psychological resources (e.g., resilience, self-efficacy, hope,

28 and optimism) on fatigue [23]. Resilience refers to the ability that individuals adopt to

29 cope with stress in a healthy way, during which tasks can be completed efficiently with

30 minimal psychological and physical cost. Those with higher resilience can quickly

recover from challenges and become stronger [28]. Self-efficacy signifies individuals' perceived ability to succeed and complete tasks [29]. Studies among healthcare staffs have confirmed a close link among self-efficacy, resilience and fatigue and professional identity, they played a positive role in relieving fatigue and maintaining professional identity [23, 30]. Therefore, for CDC worker, resilience and self-efficacy may have the same effect on their fatigue and professional identity.

As aforementioned, during the fight against the COVID-19 pandemic, CDC workers as the professional responder to control the pandemic, may undertake a greater deal of psychological burden. However, studies on their psychological health are insufficient. This study aims to explore the status and influencing factors of CDC worker's fatigue and professional identity. By our study, some evidence-based suggestions can be provided to maintain CDC worker's mental health.

Methods

Study design and settings

This cross-sectional survey was conducted in Liaoning province in China, from Sep 7-18, 2020. After communicating with and receiving support from CDC managers, a digital questionnaire was delivered through the Wenjuanxing platform to a CDC worker belonging to the Liaoning province CDC system.

Study participants

CDC worker belonging to the Liaoning province CDC system were recruited and workers engaged in administrative work was excluded from this study. A total of 1,020 valid questionnaires were collected, with an effective response rate of 83.2%.

Patients and Public involvement

No patients or public persons were involved in this study.

Measurement of demographic and job characteristics

Age (years), gender, marital status and educational background were set as demographic variables. Age was divided into ≤30years, 31-40 years, 41-50 years, and >50 years. Gender. Marital status was divided into: "single/divorced/widowed/separated" and "married/cohabited". Educational

background was divided into three: "junior college or lower", "bachelor" and "master or higher". Job characteristics including monthly income (RMB, yuan) which was classified as: ≤3000 yuan, 3000－4000 yuan, 4001－5000 yuan and >5000 yuan; workplace includes district, county and city; serving years was classified as ≤ 10years, 11-20 years, and >20 years; weekly work time(hours) was categorized as "≤40h /week" and ">40h/week"; whether having occupational subsidy and whether fighting the COVID-19 in the frontline.

Measurement of fatigue

The Chinese vision of the Chalder Fatigue Scale (CFS) was used to assess the level of fatigue of CDC workers [31]. This scale includes 14 items and two dimensions: physical fatigue (8 items) and mental fatigue (6 items). The answer for each item was designed as dichotomization: 0 (no symptom) and 1 (have symptom). The sum of the CFS score ranges from 0 to14. The higher the CFS score, the more severe the fatigue. The CFS has been widely used among Chinese healthcare staff with good reliability and validity [32]. Cronbach's α coefficient of CFS in this study was 0.938.

Measurement of professional identity

The Chinese vision Occupational Identity Scale (OIS) was used to assess professional identity [33]. It comprises of 10 items, and all items are scored from 1 (absolutely inconsistent) to 5 (absolutely consistent). Then, the scores would be summed to indicate the level of professional identity: the higher the sum the higher level of professional identity. The Chinese vision Occupational Identity Scale, has been widely used among Chinese occupational groups with good reliability and validity [34]. Cronbach's α coefficient of scale in this study was 0.949.

Measurement of post-competence and respect

The assessment of CDC worker's post-competence adopts self-compiled questions, based on the instructions from the Association of Schools of Public Health in the European Region (ASPHER) and the Council on Linkages Between Academia and Public Health Practice (Council on Linkages) [35, 36]. These questions were used to evaluate CDC worker's mastery of their professional knowledge, public health emergency knowledge as well as communication and cooperation. 3 self- rated items

1 were included with each was estimated from 0(none) to 7(have a good commander of

2 it). Respect was measured by a single item (Please rate the level of public recognition

3 and respect the work you do: low, general and high).

Measurement of occupational stress

5 The Chinese vision Effort-reward Imbalance questionnaire (ERI)'s subscale of

6 extrinsic effort and reward was used to measure CDC worker's occupational stress [37,

7 38]. The effort/reward ratio (ERR) = $(11 \times \text{effort})/ (6 \times \text{reward})$ represent the

8 occupational stress. Item for extrinsic effort and reward are rated by a 5-point Likert-

9 type scale, from 1 (not stressful) to 5 (very stressful). When ERR>1, the occupational

10 stress exists. The Chinese version of the ERI has been widely used among Chinese

11 occupational groups with good reliability and validity [23]. In this study, Cronbach's α

12 coefficients for the extrinsic effort and reward subscales were 0.879, 0.898, respectively.

Measurement of resilience and self-efficacy

14 CDC worker's resilience and self-efficacy were measured by the Psychological

15 Capital Questionnaire (PCQ) [39] which has 24 items and four components (self-efficacy,

16 hope, resilience, and optimism), and each item was scored from 1 (strong disagreement)

17 to 6 (strong agreement). Higher total scores mean higher level of Psychological Capital

18 and its components. The Chinese vision PCQ has been widely applied among Chinese

19 people and has shown satisfactory reliability and validity [23]. In this study, the

20 Cronbach's α coefficients for resilience and self-efficacy subscales were 0.919 and 0.94,

21 respectively.

Statistical analysis

23 The demographic and job variables were described with mean, standard deviation

24 (SD), number (n), and percentage (%). Group differences of continuous variables were

25 analyzed with *t*-test or one-way ANOVA. Hierarchical multiple regression (HMR)

26 analysis was conducted to identify the influencing factors. Variables were entered as

27 follows: step 1, input demographic and job characteristics with statistically significant

28 differences in fatigue and professional identity at *t*-test or one-way ANOVA; step 2,

29 competence and respect were added; step 3, occupational stress, resilience and self-

30 efficacy were entered. In this study, SPSS 21.0 (IBM, Asia Analytics Shanghai) was

1   used for statistical analysis. A two-tailed $p < 0.05$ was considered statistically

2   significant.

Results

Descriptive statistics.

5   The average score of fatigue and professional identity for CDC workers were 8.23

6   and 38.88 respectively. Results of univariate analyses are shown in table1. Workers

7   aged 31-40 years had higher level of fatigue ($P<0.01$), while those aged 21-30 showed

8   higher professional identity ($P<0.01$). Female CDC workers have higher professional

9   identity than male ($P=0.016$); but there was no statistical difference for fatigue by

10   gender. CDC workers who were married or cohabiting, indicated higher fatigue

11   levels($P=0.016$) and lower professional identity ($P<0.01$). Participants with higher

12   levels of education tend to be fatigued ($P<0.01$) and had lower professional identity

13   ($P<0.01$). As for job characteristics, we found significant difference in fatigue and

14   professional identity, among CDC workers for the variables of workplace grade, weekly

15   work time, receipt of occupational allowance and fighting the COVID-19 on the

16   frontline, respectively ($P<0.01$). Professional identity differs across serving years, but

17   fatigue isn't statistically different in terms of the same variable. CDC workers who

18   perceived low public recognition and respect for their work, had higher levels of fatigue

19   ($P<0.01$) and lower professional identity ($P<0.01$).

Table 1 Univariate analysis result (n = 1020)

Variables	N (%)	Fatigue			Professional identity		
		Mean ± SD	F/t	P-value	Mean ± SD	F/t	P-value
Age (years)			9.35	<0.01		12.307	<0.01
21-30	162 (15.9%)	7.03±3.952			41.31±8.139		
31-40	370 (36.3%)	8.79±3.409			37.21±8.542		
41-50	320 (31.4%)	8.35±3.411			39.2±7.164		
＞50	168 (16.5%)	7.93±3.634			39.57±6.337		
Gender			1.704	0.089		-2.417	0.016
Male	282 (27.6%)	8.53±3.4			37.88±8.367		
Female	738 (72.4%)	8.12±3.648			39.26±7.613		
Marital status			-2.428	0.016		2.603	<0.01

Category	N (%)	Value 1	Statistic 1	p 1	Value 2	Statistic 2	p 2
Unmarried/divorced/separated/widowed	229 (22.5%)	7.7±3.857			40.06±8.578		
Married/cohabiting	791 (77.5%)	8.39±3.488			38.53±7.596		
Educational background			8.463	<0.01		14.983	<0.01
Junior college or below	219 (21.5%)	7.39±3.843			41.16±6.557		
Bachelor	648 (63.5%)	8.39±3.509			38.6±7.782		
Master or above	153 (15%)	8.76±3.33			36.76±9.014		
Monthly income (RMB)			6.554	<0.01		7.667	<0.01
≤3000	215 (21.1%)	7.39±3.871			41.06±8.009		
3001-4000	394 (38.6%)	8.48±3.507			38.27±8.184		
4001-5000	258 (25.3%)	8.16±3.564			38.51±7.538		
>5000	153 (15%)	8.9±3.181			38±6.689		
Workplace			13.777	<0.01		30.57	<0.01
City	403 (39.5%)	8.89±3.286			40.63±7.616		
County	207 (20.3%)	8.22±3.434			39.8±7.267		
District	410 (40.2%)	7.6±3.824			36.62±7.837		
Serving years			2.327	0.098		15.403	<0.001
≤10	457 (44.8%)	8.09±3.742			39.71±7.901		
11-20	252 (24.7%)	8.65±3.333			36.52±8.473		
>20	311 (30.5%)	8.11±3.528			39.56±6.822		
Weekly work time (hours)			-2.997	<0.01		2.915	<0.01
≤40h/week	676 (66.3%)	8±3.672			39.38±7.743		
>40h/week	344 (33.7%)	8.69±3.364			37.88±7.969		
Occupational subsidy			4.128	<0.01		-5.641	<0.01
No	417 (40.9%)	7.67±3.821			40.52±7.407		
Yes	603 (50.1%)	8.62±3.358			37.74±7.95		
Fighting the COVID-19 on the frontline			4.298	<0.01		-4.458	<0.01
No	655 (64.2%)	7.89±3.735			39.71±7.426		
Yes	365(35.8%)	8.85±3.21			37.37±8.358		
Respect			26.601	<0.01		92.708	<0.01
Low	256(25.1%)	9.48±2.781			34.26±8.977		
General	575(56.4%)	8.02±3.682			39.34±6.708		
High	189 (18.5%)	7.2±3.797			43.71±5.837		

1

2   **Correlations of continue variables**

1   Table 2 shows the correlations among age, post-competence, occupational stress,

2   resilience, self-efficacy, professional identity and fatigue. As the table shows, post

3   competence was negatively correlated with fatigue, while positively correlated with

4   professional identity. For psychological factors, occupational stress was positively

5   correlated with fatigue, but resilience professional identity and self-efficacy were

6   negatively correlated with fatigue. Resilience professional identity and self-efficacy

7   were positively correlated with professional identity, while occupational stress was

8   negatively connected with it.

Table 2 Correlations among continue variables.

	Mean ± SD	1	2	3	4	5	6	7
1.Age	40.42±9.32	1						
2.Post-competence	18.15±2.30	-0.02	1					
3.ERR	1.32±0.63	0.119**	-0.022	1				
4.Resilience	29.04±4.36	-0.037	0.535**	0.012	1			
5.Self-efficacy	29.23±4.47	-0.065*	0.521**	-0.02	0.824**	1		
6.Professional identity	38.88±7.85	-0.038	0.547**	-0.187**	0.445**	0.444**	1	
7.Fatigue	8.23±3.58	0.059	-0.205**	0.226**	-0.313**	-0.338**	-0.373**	1

9   *Note*: □ *P< 0.05.* □□ *P< 0.01 (two-tailed).*

10   **Influencing factors of fatigue**

11   The results of the analysis of factors influencing fatigue are displayed in table 3.

12   The variance inflation factor (VIF)s of all independent variables in this analysis were

13   less than 10, which means that collinearity didn't affect the results. A total of 21.7% of

14   variance was interpreted by the final model. The improvement model fits caused by

15   each step (R^2 changes) were 7%, 5.8% and 8.9% respectively. In the final model, public

16   respect (general vs low, and high vs low) (both β =-0.129, $P<0.01$), resilience (β=-0.104,

17   $P<0.05$), and self-efficacy (β=-0.22, $P<0.01$) were significantly and negatively

18   connected with fatigue. Educational background (bachelor vs junior college or below)

19   (β=0.105, $P<0.01$), (master or above vs junior college or below) (β=0.092, $P<0.05$),

20   workplace grade (county vs district) (β=0.067, $P<0.05$), workplace (city vs district)

21   (β=0.085, $P<0.05$), fighting the COVID-19 on the frontline (β=0.059, $P<0.05$), and

22   occupational stress (β=0.166, $P<0.01$) were significantly and positively correlated with

23   fatigue.

Table 3 Hierarchical multiple regression results of fatigue

Variables	Step1		Step2		Step3	
	β	VIF	β	VIF	β	VIF
Age (years)	0.059	2.776	0.064	2.779	0.027	2.801
Marital status	0.027	1.225	0.02	1.227	0.02	1.228
Education1	0.131**	1.952	0.121**	1.953	0.105**	1.966
Education2	0.102*	2.044	0.099*	2.044	0.092*	2.046
Income1	0.073	2.208	0.059	2.228	0.038	2.242
Income2	0.012	2.85	0.012	2.87	-0.001	2.881
Income3	0.051	3.012	0.063	3.031	0.058	3.039
Workplace1	0.077*	1.273	0.087**	1.278	0.067*	1.302
Workplace2	0.111**	1.439	0.093**	1.444	0.085*	1.453
Weekly work time (hours)	0.065*	1.037	0.053	1.043	0.024	1.087
Occupational subsidy	0.062	1.227	-0.039	1.236	-0.03	1.238
Fighting the COVID-19 on the frontline	0.091**	1.049	0.076*	1.059	0.059*	1.073
Post-competence			-0.151**	1.063	0.009	1.474
Respect1			-0.171**	1.502	-0.129**	1.538
Respect2			-0.182**	1.514	-0.129**	1.55
ERR					0.166**	1.143
Resilience					-0.104*	3.326
Self-efficacy					-0.22**	3.263
F	6.268**		9.789**		15.393**	
Adjusted R^2	0.058		0.115		0.203	
ΔR^2	0.07		0.058		0.089	

Note: Marital status, married/cohabiting vs unmarried/ divorced/separated/widowed; Education1, bachelor vs junior college or lower; Education2, master or higher vs junior college or lower; Income1, 3001–4000yuan vs ≤3000yuan; Income2, 4001–5000yuan vs ≤3000yuan; Income3, >5000yuan vs ≤3000yuan; Workplace1, county vs district; Workplace2, city vs district; Weekly work time (hours), >40h/week vs ≤40h/week; Occupational subsidy, yes vs no; Working on frontline to defeat the COVID-19, yes vs no; Respect1, general vs bad; Respect2, good vs bad; ERR: Effort/Reward Ratio. □ *P< 0.05*. □□ *P< 0.01 (two-tailed)*.

Influencing factors of professional identity

The hierarchical multiple regression analysis results in table 4 indicate that, post-competence (β=0.362, *P*<0.01), public respect (general vs low) (β=0.219, *P*<0.01), (high vs low) (β=0.288, *P*<0.01), resilience (β=0.097, *P*<0.05), and self-efficacy (β=0.113, *P*<0.01) were significantly and positively connected with professional identity. Educational background (bachelor vs junior college or below) (β=-0.097, *P*<0.01), (master or above vs junior college or below) (β=-0.114, *P*<0.01), workplace

1   (city vs district) (β=-0.114, P<0.01), fighting the COVID-19 on the frontline (β=-0.047,

2   P<0.05), and occupational stress (β=-0.105, P<0.01) were significantly and negatively

3   associated with professional identity. The VIFs of all independent variables in this

4   analysis were less than 10, meaning that collinearity didn't affect the results. Finally,

5   the final model explained 47.6% variance of professional identity, the R^2 changes for

6   step1, step2 and step3 were 10.6%, 33.3% and 3.6% respectively.

Table 4 Hierarchical multiple regression results of professional identity

Variables	Step1		Step2		Step3	
	β	VIF	β	VIF	β	VIF
Age (years)	-0.028	4.075	-0.034	4.08	0.001	4.123
Gender	0.053	1.088	0.019	1.1	0.017	1.124
Marital status	-0.022	1.227	0	1.229	0	1.23
Education1	-0.131**	1.968	-0.106**	1.97	-0.097**	1.985
Education2	-0.128**	2.12	-0.116**	2.121	-0.114**	2.126
Income1	-0.108*	2.236	-0.059	2.256	-0.046	2.27
Income2	-0.083	2.992	-0.068	3.014	-0.058	3.023
Income3	-0.066	3.196	-0.079	3.217	-0.073	3.223
Workplace1	-0.037	1.295	-0.059*	1.301	-0.046	1.321
Workplace2	-0.164**	1.472	-0.13**	1.476	-0.122**	1.487
Serving years	0.027	3.367	0.024	3.368	0.006	3.387
Weekly work time (hours)	-0.049	1.041	-0.03	1.045	-0.012	1.088
Occupational subsidy	-0.091**	1.242	-0.041	1.251	-0.034	1.253
Fighting the COVID-19 on the frontline	-0.082**	1.073	-0.059*	1.08	-0.047*	1.09
Post-competence			0.466**	1.066	0.362**	1.486
Respect1			0.246**	1.51	0.219**	1.544
Respect2			0.322**	1.514	0.288**	1.551
ERR					-0.105**	1.163
Resilience					0.097*	3.342
Self-efficacy					0.113**	3.268
F	8.534**		46.199**		45.326**	
Adjusted R^2	0.094		0.43		0.465	
ΔR^2	0.106		0.333		0.036	

7   *Note*: Gender, female vs male; Marital status, married/cohabiting vs unmarried/

8   divorced/separated/widowed; Education1, bachelor vs junior college or lower; Education2, master

9   or higher vs junior college or lower; Income1, 3001–4000yuan vs ≤3000yuan; Income2, 4001–

10 5000yuan vs ≤3000yuan; Income3, >5000yuan vs ≤3000yuan; Workplace1, county vs district;

11 Workplace2, city vs district; Weekly work time (hours), >40h/week vs ≤40h/week; Occupational subsidy,

12 yes vs no; Working on frontline to defeat the COVID-19, yes vs no; Respect1, general vs bad; Respect2,

1   good vs bad; ERR: Effort/Reward Ratio. □$P< 0.05$. □□ $P< 0.01$ *(two-tailed)*.

2   Discussion

3   The results of this study demonstrated that CDC workers had higher levels of

4   fatigue and professional identity than healthcare workers [13, 40], suggesting that

5   measures to attenuate CDC workers' fatigue, and maintain worker's professional

6   identity should be implemented immediately.

7   In this study, we found that CDC worker's educational background, workplace,

8   experience of fighting the COVID-19 on the frontline, and occupational stress were

9   positively associated with fatigue. In terms of educational background, workers with

10   higher education were more likely to be fatigue than those with junior college or lower

11   educational level, which is consistent with previous studies [23, 40]. The reason for this

12   may be that they are assigned with important or urgent works, that are more energy and

13   resources consuming to complete tasks. Based on the COR theory [27], once employees'

14   resources insufficient, they are vulnerable to fatigue. As for the workplace, compared

15   with CDC workers who work at district level, the county and municipal CDC staffs are

16   vulnerable to fatigue, possibly due to workload difference. Staffs at municipal level

17   undertake the responsibility for the health of the people of the entire city (city was

18   comprised by county and district). Besides, the urbanization and public infrastructure

19   is more developed than county, so county staffs need to invest more energy to complete

20   the same tasks as those at district level. Thus, CDC administrators need to pay attention

21   to staffs' fatigue belonging to city and county level. Workers fighting the COVID-19

22   on the frontline are vulnerable to fatigue, which is consistent with previous studies [4,

23   41]. Therefore, CDC managers should provide material and moral support to protect

24   them from fatigue. We found occupational stress was positively connected with fatigue

25   which is in line with previous study [25]. As an important role in preventing and

26   controlling pandemic, CDC workers put much time and energy into keeping their duty.

27   While their salaries and benefits are yet to be improved, and psychological energy is

28   being depleted faster than it can be replenished, occupational stress will occur and cause

29   fatigue. CDC managers should establish a rationalized workload and reward system,

30   and provide timely support, to reduce occupational stress and alleviate fatigue.

1　　　This research found that respect, resilience and self-efficacy were negatively

2　associated with fatigue. Consistent with former study that respect can alleviate job-

3　related negative consequences [42], public respect is negatively connected with CDC

4　worker's fatigue, which can be explained that respect is one of a person's fundamental

5　needs and study has found it associated with worker's satisfaction and performance,

6　Therefore, CDC administrators need to take measures to raise people's recognition and

7　respect for CDC workers. Resilience and self-efficacy as positive psychology resources

8　were negatively associated with fatigue, this is consistent with results among healthcare

9　workers [23]. Previous studies have confirmed that, special training programs

10　(mindfulness intervention, resilience enhancement project, psychological capital

11　intervention) can effectively improve employee's resilience and self-efficacy, and

12　relieve job-related negative consequences [43-45]. Therefore, CDC managers can take the

13　aforementioned measures to enhance their workers' resilience and alleviate fatigue.

14　　　As for professional identity, we found that, post-competence, respect, resilience

15　and self-efficacy are its protective factors. Post-competence as an indicator of how well

16　of a person is suited to his or her job, is positively associated with professional identity.

17　Previous study has confirmed that, professional competence is positively associated

18　with employees' professional identity, and is related to the development of professional

19　identity [46]. Therefore, taking measures to improve CDC workers' professional

20　competence can be a way to promote professional identity. Respect is positively

21　associated with professional identity, which supports our hypothesis, and studies have

22　found that respect was negatively related to burnout and positively associated with job

23　satisfaction and retention [20, 42]. Therefore, finding ways to foster general people

24　recognition and respect for CDC work should be given top priority for CDC

25　administrators' work. With Resilience and self-efficacy positively related to

26　professional identity, which is consistent with former studies [30, 47], workers with higher

27　levels of resilience and self-efficacy, tend to possess more energy and wiliness to adjust

28　their emotions and perceptions. It has confirmed that resilience and self-efficacy could

29　be developed by professional training [44, 45]. In this study we adopt resilience and self-

30　efficacy from the psychological capital background, and previous study has indicated

1 resilience and self-efficacy can be improved by psychological capital intervention [43],

2 so interventions based on the psychological capital training model can be utilized to

3 enhance resilience and self-efficacy to increase professional identity.

4 This study showed that educational background, workplace, fighting the COVID-

5 19 on the frontline, and occupational stress were negatively associated with

6 professional identity, in this study. For educational background, CDC workers with

7 higher levels tend to experience lower professional identity, which is different from

8 former studies [13, 47]. This could be that in CDC workers with higher education levels

9 tend to be assigned more workloads responsibilities, thus inducing work stress and

10 lowering professional identity. CDC workers in cities, compared with those in district

11 levels, were inclined to have a lower professional identity, which can be explained by

12 the fact that city CDC workers are responsible for the health of the entire city, so their

13 workload are heavier, and they are more vulnerable to work stress than those work on

14 the district level. Inconsistent with former studies [48], CDC workers fighting on the

15 frontline to defeat COVID-19 have a higher professional identity, which may be

16 because, after the successful control of early the COVID-19 outbreaks, in China,

17 occasional localized outbreaks caused by mutated strains of the virus need CDC

18 workers to keep alarm at all time, ultimately leading to burnout, and professional

19 identity [49]. A negative relationship between occupational stress and professional

20 identity was also identified, which was similar to previous study [50]. In the fight against

21 the COVID-19, CDC worker have been under much stress, and they may expand more

22 physical and psychological energy to counteract occupational stress, causing fatigue

23 and burnout, and leading to lower professional identity. Based on the ERI model and

24 the COR theory [24, 27], CDC administrators should rationalize work tasks, establish a

25 scientific performance evaluation and reward distribution system, and offer

26 interventions to improve workers' mental health, to reduce occupational stress level.

27 **Conclusions**

28 China CDC workers have undertaken s great deal of works to fight the COVID-

29 19 pandemic, their fatigue levels are high, workers' professional identity should be

1   maintained and enhanced. General public respect, occupational stress, resilience and

2   self-efficacy all influence workers' fatigue and professional identity. Administrators

3   need to strive to raise the level of public recognition respect for CDC work, rationalize

4   work assignments to reduce work stress, and implement psychological capital

5   interventions to improve CDC workers' resilience and self-efficacy.

6   There are some limitations needs to be illustrated in this study. This study belongs

7   to cross-sectional study, any causal-relationship conclusions can't be drawn among

8   variables in this study. Longitudinal research should be conducted in the future to

9   address this limitation. Secondly, this survey was performed via internet platform,

10   which may cause some response bias. Nevertheless, this study extends the field of

11   research on the mental health of occupational populations, and the mental health of

12   CDC employees also requires attention.

13 **Ethics approval and consent to participate**

14   This study has been reviewed and approved by the Committee on Human

15   Experimentation of China Medical University. All participants volunteered to enroll in

16   this research and the informed consent was received by them. All information gathered

17   from the subjects were kept confidential and anonymous to protect participant's privacy.

18 **Competing interests**

19   The authors declare that they have no competing interests

20 **Author's contribution**

21   Qi Cui: Formal analysis, Investigation, Writing-original draft, Writing-review &
22 editing. Li Liu: Methodology, Writing-review & editing. Zejun Hao: Writing-review &
23 editing. Mengyao Li: Investigation, Writing-review & editing.   Chunli Liu: Writing-
24 review & editing. Chenxin Yang: Investigation. Qiuling Zhang: investigation. Hui Wu:
25 Conceptualization, Data curation, Funding acquisition, Methodology, Project
26 administration, Supervision.

27 **Data availability statement**

28   The datasets used and/or analyzed during the current study are available from the

29   corresponding author on reasonable request.

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36

Reporting checklist for cross sectional study.

Based on the STROBE cross sectional guidelines.

Instructions to authors

Complete this checklist by entering the page numbers from your manuscript where readers will find each of the items listed below.

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In your methods section, say that you used the STROBE cross sectionalreporting guidelines, and cite them as:

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		Reporting Item	Page Number
Title and abstract			
Title	#1a	Indicate the study's design with a commonly used term in the title or the abstract	1
Abstract	#1b	Provide in the abstract an informative and balanced summary	2

of what was done and what was found

Introduction

Background / rationale	#2	Explain the scientific background and rationale for the investigation being reported	3-6
Objectives	#3	State specific objectives, including any prespecified hypotheses	6

Methods

Study design	#4	Present key elements of study design early in the paper	6
Setting	#5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Eligibility criteria	#6a	Give the eligibility criteria, and the sources and methods of selection of participants.	6
	#7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6
Data sources / measurement	#8	For each variable of interest give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group. Give information separately for for exposed and unexposed groups if applicable.	6
Bias	#9	Describe any efforts to address potential sources of bias	6
Study size	#10	Explain how the study size was arrived at	6

Quantitative variables	#11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen, and why	6-8
Statistical methods	#12a	Describe all statistical methods, including those used to control for confounding	8
Statistical methods	#12b	Describe any methods used to examine subgroups and interactions	8
Statistical methods	#12c	Explain how missing data were addressed	8
Statistical methods	#12d	If applicable, describe analytical methods taking account of sampling strategy	8
Statistical methods	#12e	Describe any sensitivity analyses	8

Results

Participants	#13a	Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed. Give information separately for for exposed and unexposed groups if applicable.	8-9
Participants	#13b	Give reasons for non-participation at each stage	8
Participants	#13c	Consider use of a flow diagram	8-9
Descriptive data	#14a	Give characteristics of study participants (eg demographic,	8-9

clinical, social) and information on exposures and potential confounders. Give information separately for exposed and unexposed groups if applicable.

Descriptive data	#14b	Indicate number of participants with missing data for each variable of interest	8
Outcome data	#15	Report numbers of outcome events or summary measures. Give information separately for exposed and unexposed groups if applicable.	8
Main results	#16a	Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	10
Main results	#16b	Report category boundaries when continuous variables were categorized	11
Main results	#16c	If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	12
Other analyses	#17	Report other analyses done—e.g., analyses of subgroups and interactions, and sensitivity analyses	13

Discussion

| Key results | #18 | Summarise key results with reference to study objectives | 13-16 |
| Limitations | #19 | Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias. | 16 |

| Interpretation | #20 | Give a cautious overall interpretation considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence. | 16 |
| Generalisability | #21 | Discuss the generalisability (external validity) of the study results | 16 |

Other Information

| Funding | #22 | Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based | 17 |

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Research on the influencing factors of fatigue and professional identity among CDC workers in China：an online cross-sectional study

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1 **Research on the influencing factors of fatigue and professional identity**

2 **among CDC workers in China: an online cross-sectional study**

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28

1 **Abstract**

2 **Objective** This study aimed to investigate the current status and the influencing factors

3 of fatigue and professional identity among China CDC workers.

4 **Design** A cross-sectional design.

5 **Setting** CDC workers employed by the Liaoning CDC system were enrolled

6 (administrative staffs were excluded).

7 **Participants** 1,020 CDC workers.

8 **Primary outcome measures** Fatigue scores and Professional identity scores.

9 **Secondary outcome measures** Post competency scores, Respect scores, Occupational

10 stress scores, Resilience scores and Self-efficacy scores.

11 **Results:** The average scores of fatigue and professional identity were 8.23, 38.88,

12 respectively. Factors including perceived public respect (β =-0.129, P<0.01), resilience

13 (β=-0.104, P<0.05), and self-efficacy (β=-0.22, P<0.01) were negatively connected

14 with fatigue. Educational background (bachelor vs junior college or below) (β=0.105,

15 P<0.01), (master or above vs junior college or below) (β=0.092, P<0.05), workplace

16 (county vs district) (β=0.067, P<0.05), (city vs district) (β=0.085, P<0.05), fighting the

17 COVID-19 on the frontline (β=0.059, P<0.05), and occupational stress (β=0.166,

18 P<0.01) were positively correlated with fatigue. Educational background (bachelor vs

19 junior college or below) (β=-0.097, P<0.01), (master or above vs junior college or

20 below) (β=-0.114, P<0.01), workplace (city vs district) (β=-0.114, P<0.01), fighting the

21 COVID-19 on the frontline (β=-0.047, P<0.05), and occupational stress (β=-0.105,

22 P<0.01) were negatively associated with professional identity. Factors including post

23 competency (β=0.362, P<0.01), perceived public respect (general vs low) (β=0.219,

24 P<0.01), (high vs low) (β=0.288, P<0.01), resilience (β=0.097, P<0.05), and self-

25 efficacy (β=0.113, P<0.01) were positively connected with professional identity.

26 **Conclusion:** The fatigue among CDC workers was at a higher level, level of CDC

27 workers' professional identity was high, and administrators should take measures to

28 alleviate fatigue and maintain professional identity. In addition, methods aiming to

29 attenuate occupational stress, and improve resilience and self-efficacy should be

30 immediately put into action.

1 **Key words** Fatigue; Professional identity; Influencing factor; CDC worker

2 **Word count** 4,008

3 **Strengths and limitations of this study**

4 ● The independent samples *t*-test, one-way ANOVA, and hierarchical multiple

5 regression analysis was conducted to identify CDC workers fatigue and

6 professional identity's influencing factors.

7 ● An online survey method was used to collect samples, to maximize sample size.

8 ● Due to this study is a cross-sectional survey, no causal relationship can be drawn

9 between the variables.

10 ● Participants in this study should be enrolled from widely regions of the country.

11 **Introduction**

12 The 2019 coronavirus disease (COVID-19) has caused heavy economic losses,

13 disrupted people's normal lives and induced widely psychological problems within the

14 general population and occupational groups [1, 2]. WHO has declared it as a Global

15 pandemic[3]. New coronavirus variants have been deriving, and the impacts on people's

16 health would exist.

17 During public health emergencies, people have suffered from a wide range of

18 adverse psycho-social impacts, and this situation is even critical among frontline

19 workers fighting against the pandemic [1, 4]. Centers for Disease Control and Prevention

20 (CDC) offers various public health services, ranging from promoting health knowledge

21 to disease surveillance and prevention. During the pandemic, CDC workers in China

22 have implemented various measures to prevent and control the diseases, including the

23 epidemiological investigation of patients and close contacts, collection and examination

24 of specimens, giving timely prevention strategies, and surveillance of high-risk

25 populations, etc. CDC workers are subjected to various psychological and physical

26 pressures; however, compared with studies covering medical staff in this regard [2, 5],

27 few has been conducted concerning the occupational group's physical and mental

28 health.

29 Fatigue, in medical, is a self-recognized state in which an individual experiences

1   undermined labor ability for overwhelming physical and mental work demands, and

2   feels persistent tiredness and weakness, which can't be alleviated by rest [6]. Fatigue

3   influences both psychological and physiological influences on person's health [7]. For

4   professional groups, fatigue is associated with negative mood, lower work efficiency,

5   and cause human errors and physical problems [8]. Healthcare workers have higher

6   prevalence and more severe fatigue symptoms, which poses an adverse impact on health

7   workers health, medical service provision and patients' satisfaction [9, 10]. Studies

8   surveyed during the early stage of the pandemic have identified the prevalence of

9   healthcare worker's fatigue varying from 69% to 72.2%, and reported the influencing

10   factors including fear of infection, sleep difficulty and psychological factors. [2, 4].

11   However, investigations on the status quo and the influencing factors of fatigue among

12   CDC workers have been rare.

13   Professional identity is defined as the combination of a worker's knowledge, skills,

14   values and behaviors with his or her own unique identity and core values [11]. Workers

15   usually take professional identity for self-assessment over the matching level of

16   themselves and the job the engaged. For health care staff, professional identity is

17   conducive to worker's performance and job satisfaction, relieves workers' burnout and

18   reduces their turnover intention [12, 13]. It has been confirmed that during the COVID-

19   19, professional identity can effectively moderate the influence of pandemics on staff's

20   job burnout [14]. Thus, identifying the state of professional identity and exploring

21   influencing factors can provide advice on maintaining the mental health of CDC staff.

22   Competency depicts personal's qualities and behaviors traits affecting individual's

23   productivity and performance [15]. Post competency refers to the ability to complete

24   assigned work efficiently. The higher post competency leads to the higher work

25   efficiency and better work performance [16], which reduces the possibilities of burnout.

26   The Job Demands-Resources model (JDR) [17] points out that there is a balance between

27   job demands and possessed resources by employees. posits once the job-demands

28   outweigh the resources possessed by the employees, burnout and stress will arise, which

29   ultimately leads to fatigue and the declined professional identity. Staff with higher post

30   competency demonstrates a good command of professional knowledge and skills, have

1   a deep understanding of the profession they engaged, handle work demands effectively,

2   and thus, were less likely influenced by fatigue. Therefore, we assume that CDC

3   workers' post competency may be an influencing factor for their fatigue and

4   professional identity.

5   Respect, is defined as the feeling of being highly valued, esteemed, or the

6   satisfaction of being held in honor, and it can be seen as an optimistic side of life [18].

7   Being respected contributes to job satisfaction, and is significantly associated with their

8   organization commitment and retention [19, 20]. Maslow's Hierarchy of Needs points out

9   that gaining respect is one of the five needs fulfilling an individual's self-actualization,

10   and enhancing employee's job satisfaction and performance [21, 22]. Therefore, being

11   respected is a protective factor for the mental health of occupational people. We assume

12   that being respected is an influencing factor of CDC workers' fatigue and professional

13   identity, and being respected may reduce the occurrence of fatigue and enhance

14   professional identity.

15   With the rapid social and economic development, competition is becoming more

16   intense among the professional groups, causing occupational stress prevalent in China,

17   meanwhile, people have higher demands for keeping their health, leading to healthcare

18   workers are more vulnerable to occupational stress[23]. According to the classical model

19   of Effort Reward Imbalance (ERI) proposed by professor Siegrist based on the

20   reciprocity principle [24], occupational stress was caused by the imbalance between

21   extrinsic effort and reward. ERI model argues that workers under the imbalanced

22   extrinsic effort and reward would experience a failed social reciprocity that evokes

23   occupational stress. There have been a number of studies on the influence of

24   occupational stress on fatigue and professional identity among professional groups [25,

25   26]. CDC staffs as professionals in pandemic prevention and control, needs to keep

26   constant vigilance in responding to possible outbreak situations, and are subject to

27   occupational stress. Based on existing results, it is supposed that, for CDC workers,

28   higher occupational stress will induce higher fatigue and lower professional identity.

29   From the perspective of the conversation of recourse (COR) theory, when

30   employees' internal and external resources are insufficient or they feel resources are

1   deficient, they will experience occupational stress, which will further lead to fatigue

2   [27]. Owing to the development of positive psychology, scholars have put much attention

3   to the effect of positive psychological resources (e.g., resilience, self-efficacy, hope,

4   and optimism) on fatigue [23]. Resilience refers to the ability that individuals adopt to

5   cope with stress in a healthy way, during which tasks can be completed efficiently with

6   minimal psychological and physical cost. Those with higher resilience can quickly

7   recover from challenges and become stronger [28]. Self-efficacy signifies individuals'

8   perceived ability to succeed and complete tasks [29]. Studies among professional groups

9   have confirmed a close link among self-efficacy, resilience with fatigue and

10   professional identity, and that they played a positive role in relieving fatigue and

11   maintaining professional identity [23, 30]. Therefore, for CDC worker, resilience and self-

12   efficacy may have an effect on their fatigue and professional identity, with higher

13   resilience, self-efficacy or both, can mitigate fatigue and strengthen professional

14   identity.

15   As aforementioned, during the fight against the COVID-19 pandemic, CDC

16   workers as the professional responder to control the pandemic, have undertaken a

17   greater deal of psychological burden. However, studies on their psychological health

18   are insufficient. This study aimed to explore the status quo and the influencing factors

19   of CDC worker's fatigue and professional identity. By our study, some evidence-based

20   suggestions can be provided to maintain CDC worker's mental health.

21   **Methods**

22   **Study design and settings**

23   This cross-sectional survey was conducted in Liaoning province in China, from

24   Sep 7-18, 2020. After communicating with and receiving support from CDC managers,

25   a digital questionnaire was delivered through the Wenjuanxing platform to a CDC

26   worker belonging to the Liaoning province CDC system.

27   **Study participants**

28   CDC worker belonging to the Liaoning province CDC system were recruited and

29   workers engaged in administrative work was excluded from this study. A total of 1,020

1   valid questionnaires were collected, with an effective response rate of 83.2%.

2   **Patients and Public involvement**

3   No patients or public persons were involved in this study.

4   **Measurement of demographic and job characteristics**

5   Age (years), gender, marital status and educational background were set as

6   demographic variables. Age was collected as: ≤30years, 31-40 years, 41-50 years,

7   and >50 years. Gender. Marital status was divided into:

8   "single/divorced/widowed/separated" and "married/cohabited". Educational

9   background was divided into three: "junior college or lower", "bachelor" and

10   "master or higher". Job characteristics including personal monthly income (RMB,¥)

11   which was classified as: ≤¥3000 (≤US \$438.69), ¥3001–¥4000 (US \$438.83 -

12   \$584.92), ¥4001–¥5000 (US \$585.06 - \$731.14) and >¥5000 (> US \$731.14);

13   workplace includes district, county and city; serving years was classified as ≤10years,

14   11-20 years, and >20 years; weekly work time(hours) was categorized as "≤40h

15   /week" and ">40h/week"; whether having occupational allowance and whether

16   fighting the COVID-19 in the frontline.

17   **Measurement of fatigue**

18   The Chinese vision of the Chalder Fatigue Scale (CFS) was used to assess the level

19   of fatigue of CDC workers [31]. This scale includes 14 items and two dimensions:

20   physical fatigue (8 items) and mental fatigue (6 items). The answer for each item was

21   designed as dichotomization: 0 (no symptom) and 1 (have symptom). The sum of the

22   CFS score ranges from 0 to14. The higher the CFS score, the more severe the fatigue.

23   The CFS has been widely used among Chinese healthcare staff with good reliability

24   and validity [32]. Cronbach's α coefficient of CFS in this study was 0.938.

25   **Measurement of professional identity**

26   The Chinese vision Occupational Identity Scale (OIS) was used to assess

27   professional identity [33]. It comprises of 10 items, and all items are scored from 1

28   (absolutely inconsistent) to 5 (absolutely consistent). Then, the scores would be

29   summed to indicate the level of professional identity: the higher the sum the higher

30   level of professional identity. The Chinese vision Occupational Identity Scale, has been

1 widely used among Chinese occupational groups with good reliability and validity [34].

2 Cronbach's α coefficient of scale in this study was 0.949.

Measurement of post competency and respect

4 The assessment of CDC worker's post competency adopts self-compiled questions,

5 based on the instructions from the Association of Schools of Public Health in the

6 European Region (ASPHER) and the Council on Linkages Between Academia and

7 Public Health Practice (Council on Linkages) [35, 36]. Three self-administrated questions

8 were used to evaluate CDC worker's mastery of their professional knowledge, public

9 health emergency knowledge as well as communication and cooperation: a. Please rate

10 the level of your knowledge about public health expertise (epidemiology, preventive

11 medicine, health education, laws and regulations, etc.); b. Please rate the level of your

12 knowledge of public health emergencies (classification and grading of public health

13 emergencies, corresponding emergency response criteria and skills, etc.); c. Please rate

14 your teamwork and communication skills (with superiors, colleagues and the public).

15 Each was estimated from 0(none) to 7(have a good command of it), the scores would

16 be summed to indicate the level of post competency: the higher the sum the higher post

17 competency. Respect was measured by a single item (Please rate the level of public

18 recognition and respect the work you do: low, general and high).

Measurement of occupational stress

20 The Chinese vision Effort-reward Imbalance questionnaire (ERI)'s subscale of

21 extrinsic effort and reward was used to measure CDC worker's occupational stress [37,

22 38]. The effort/reward ratio (ERR) = $(11 \times$ effort)$/ (6 \times$ reward) represent the

23 occupational stress. Item for extrinsic effort and reward are rated by a 5-point Likert-

24 type scale, from 1 (not stressful) to 5 (very stressful). When ERR>1, the occupational

25 stress exists. The Chinese version of the ERI has been widely used among Chinese

26 occupational groups with good reliability and validity [23]. In this study, Cronbach's α

27 coefficients for the extrinsic effort and reward subscales were 0.879, 0.898, respectively.

Measurement of resilience and self-efficacy

29 CDC worker's resilience and self-efficacy were measured by the Psychological

30 Capital Questionnaire (PCQ) [39] which has 24 items and four components (self-efficacy,

1 hope, resilience, and optimism), and each item was scored from 1 (strong disagreement)

2 to 6 (strong agreement). Higher total scores mean higher level of Psychological Capital

3 and its components. The Chinese vision PCQ has been widely applied among Chinese

4 people and has shown satisfactory reliability and validity [23]. In this study, the

5 Cronbach's α coefficients for resilience and self-efficacy subscales were 0.919 and 0.94,

6 respectively.

7 **Statistical analysis**

8 The demographic and job variables were described with mean, standard deviation

9 (SD), number (n), and percentage (%). Group differences of continuous variables were

10 analyzed with *t*-test or one-way ANOVA. Hierarchical multiple regression (HMR)

11 analysis was conducted to identify the influencing factors. Variables were entered as

12 follows: step 1, input demographic and job characteristics with statistically significant

13 differences in fatigue and professional identity at *t*-test or one-way ANOVA; step 2,

14 competence and respect were added; step 3, occupational stress, resilience and self-

15 efficacy were entered. In this study, SPSS 21.0 (IBM, Asia Analytics Shanghai) was

16 used for statistical analysis. A two-tailed $p < 0.05$ was considered statistically

17 significant.

18 **Results**

19 **Descriptive statistics.**

20 The average score of fatigue and professional identity for CDC workers were 8.23

21 and 38.88 respectively. Results of univariate analyses are shown in table1. Workers

22 aged 31-40 years had higher level of fatigue ($P<0.01$), while those aged 21-30 showed

23 higher professional identity ($P<0.01$). Female CDC workers have higher professional

24 identity than male ($P=0.016$); but there was no statistical difference for fatigue by

25 gender. CDC workers who were married or cohabiting, indicated higher fatigue

26 levels($P=0.016$) and lower professional identity ($P<0.01$). Participants with higher

27 levels of education tend to be fatigued ($P<0.01$) and had lower professional identity

28 ($P<0.01$). As for job characteristics, we found significant difference in fatigue and

29 professional identity, among CDC workers for the variables of workplace grade, weekly

1   work time, receipt of occupational allowance and fighting the COVID-19 on the

2   frontline, respectively ($P<0.01$). Professional identity differs across serving years, but

3   fatigue isn't statistically different in terms of the same variable. CDC workers who

4   perceived low public recognition and respect for their work, had higher levels of fatigue

5   ($P<0.01$) and lower professional identity ($P<0.01$).

Table 1 Univariate analysis result (n = 1020)

Variables	N (%)	Fatigue			Professional identity		
		Mean ± SD	F/t	P-value	Mean ± SD	F/t	P-value
Age (years)			9.35	<0.01		12.307	<0.01
21-30	162 (15.9%)	7.03±3.952			41.31±8.139		
31-40	370 (36.3%)	8.79±3.409			37.21±8.542		
41-50	320 (31.4%)	8.35±3.411			39.2±7.164		
>50	168 (16.5%)	7.93±3.634			39.57±6.337		
Gender			1.704	0.089		-2.417	0.016
Male	282 (27.6%)	8.53±3.4			37.88±8.367		
Female	738 (72.4%)	8.12±3.648			39.26±7.613		
Marital status			-2.428	0.016		2.603	<0.01
Unmarried/ divorced/separated/widowed	229 (22.5%)	7.7±3.857			40.06±8.578		
Married/cohabiting	791 (77.5%)	8.39±3.488			38.53±7.596		
Educational background			8.463	<0.01		14.983	<0.01
Junior college or below	219 (21.5%)	7.39±3.843			41.16±6.557		
Bachelor	648 (63.5%)	8.39±3.509			38.6±7.782		
Master or above	153 (15%)	8.76±3.33			36.76±9.014		
Personal monthly income (¥)			6.554	<0.01		7.667	<0.01
≤3000	215 (21.1%)	7.39±3.871			41.06±8.009		
3001-4000	394 (38.6%)	8.48±3.507			38.27±8.184		
4001-5000	258 (25.3%)	8.16±3.564			38.51±7.538		
>5000	153 (15%)	8.9±3.181			38±6.689		
Workplace			13.777	<0.01		30.57	<0.01
City	403 (39.5%)	8.89±3.286			40.63±7.616		
County	207 (20.3%)	8.22±3.434			39.8±7.267		
District	410 (40.2%)	7.6±3.824			36.62±7.837		
Serving years			2.327	0.098		15.403	<0.001
≤10	457 (44.8%)	8.09±3.742			39.71±7.901		
11-20	252 (24.7%)	8.65±3.333			36.52±8.473		
>20	311 (30.5%)	8.11±3.528			39.56±6.822		

Weekly work time (hours)			-2.997	<0.01			2.915	<0.01
≤40h/week	676 (66.3%)	8±3.672			39.38±7.743			
>40h/week	344 (33.7%)	8.69±3.364			37.88±7.969			
Occupational allowance			4.128	<0.01			-5.641	<0.01
No	417 (40.9%)	7.67±3.821			40.52±7.407			
Yes	603 (50.1%)	8.62±3.358			37.74±7.95			
Fighting the COVID-19 on the frontline			4.298	<0.01			-4.458	<0.01
No	655 (64.2%)	7.89±3.735			39.71±7.426			
Yes	365(35.8%)	8.85±3.21			37.37±8.358			
Respect			26.601	<0.01			92.708	<0.01
Low	256(25.1%)	9.48±2.781			34.26±8.977			
General	575(56.4%)	8.02±3.682			39.34±6.708			
High	189 (18.5%)	7.2±3.797			43.71±5.837			

1   *Note*: 1 ¥ = US \$0.146 (9/7/2020)

Correlations of continue variables

3   Table 2 shows the correlations among age, post-competence, occupational stress, resilience, self-efficacy, professional identity and fatigue. As the table shows, post-competence was negatively correlated with fatigue, while positively correlated with professional identity. For psychological factors, occupational stress was positively correlated with fatigue, but resilience and self-efficacy were negatively correlated with fatigue. Resilience and self-efficacy were positively correlated with professional identity, while occupational stress was negatively connected with it.

Table 2 Correlations among continue variables.

	Mean ± SD	1	2	3	4	5	6	7
1.Age	40.42±9.32	1						
2.Post competency	18.15±2.30	-0.02	1					
3.ERR	1.32±0.63	0.119**	-0.022	1				
4.Resilience	29.04±4.36	-0.037	0.535**	0.012	1			
5.Self-efficacy	29.23±4.47	-0.065*	0.521**	-0.02	0.824**	1		
6.Professional identity	38.88±7.85	-0.038	0.547**	-0.187**	0.445**	0.444**	1	
7.Fatigue	8.23±3.58	0.059	-0.205**	0.226**	-0.313**	-0.338**	-0.373**	1

10   *Note*: □ $P< 0.05$. □□ $P< 0.01$ (two-tailed).

Influencing factors of fatigue

12   The results of the analysis of factors influencing fatigue are displayed in table 3.

13   The variance inflation factor (VIF)s of all independent variables in this analysis were

1 less than 10, which means that collinearity didn't affect the results. A total of 21.7% of

2 variance was interpreted by the final model. The improvement model fits caused by

3 each step (R^2 changes) were 7%, 5.8% and 8.9% respectively. In the final model,

4 perceived public respect (general vs low, and high vs low) (both β =-0.129, $P<0.01$),

5 resilience (β=-0.104, $P<0.05$), and self-efficacy (β=-0.22, $P<0.01$) were significantly

6 and negatively connected with fatigue. Educational background (bachelor vs junior

7 college or below) (β=0.105, $P<0.01$), (master or above vs junior college or below)

8 (β=0.092, $P<0.05$), workplace grade (county vs district) (β=0.067, $P<0.05$), workplace

9 (city vs district) (β=0.085, $P<0.05$), fighting the COVID-19 on the frontline (β=0.059,

10 $P<0.05$), and occupational stress (β=0.166, $P<0.01$) were significantly and positively

11 correlated with fatigue.

Table 3 Hierarchical multiple regression results of fatigue

Variables	Step1		Step2		Step3	
	β	VIF	β	VIF	β	VIF
Age (years)	0.059	2.776	0.064	2.779	0.027	2.801
Marital status	0.027	1.225	0.02	1.227	0.02	1.228
Education1	0.131**	1.952	0.121**	1.953	0.105**	1.966
Education2	0.102*	2.044	0.099*	2.044	0.092*	2.046
Income1	0.073	2.208	0.059	2.228	0.038	2.242
Income2	0.012	2.85	0.012	2.87	-0.001	2.881
Income3	0.051	3.012	0.063	3.031	0.058	3.039
Workplace1	0.077*	1.273	0.087**	1.278	0.067*	1.302
Workplace2	0.111**	1.439	0.093**	1.444	0.085*	1.453
Weekly work time (hours)	0.065*	1.037	0.053	1.043	0.024	1.087
Occupational allowance	0.062	1.227	-0.039	1.236	-0.03	1.238
Fighting the COVID-19 on the frontline	0.091**	1.049	0.076*	1.059	0.059*	1.073
Post competency			-0.151**	1.063	0.009	1.474
Respect1			-0.171**	1.502	-0.129**	1.538
Respect2			-0.182**	1.514	-0.129**	1.55
ERR					0.166**	1.143
Resilience					-0.104*	3.326
Self-efficacy					-0.22**	3.263
F	6.268**		9.789**		15.393**	
Adjusted R^2	0.058		0.115		0.203	
ΔR^2	0.07		0.058		0.089	

12 *Note*: Marital status, married/cohabiting vs unmarried/ divorced/separated/widowed; Education1,

bachelor vs junior college or lower; Education2, master or higher vs junior college or lower; Income1, ¥3001–¥4000 vs ≤¥3000; Income2, ¥4001–¥5000 vs ≤¥3000; Income3, >¥5000 vs ≤¥3000; 1 ¥ = US $0.146 (9/7/2020); Workplace1, county vs district; Workplace2, city vs district; Weekly work time (hours), >40h/week vs ≤40h/week; Occupational allowance, yes vs no; Working on frontline to defeat the COVID-19, yes vs no; Respect1, general vs low; Respect2, good vs low; ERR: Effort/Reward Ratio. □ $P< 0.05$. □□ $P< 0.01$ (two-tailed).

Influencing factors of professional identity

The hierarchical multiple regression analysis results in table 4 indicate that, post competency (β=0.362, $P<0.01$), perceived public respect (general vs low) (β=0.219, $P<0.01$), (high vs low) (β=0.288, $P<0.01$), resilience (β=0.097, $P<0.05$), and self-efficacy (β=0.113, $P<0.01$) were significantly and positively connected with professional identity. Educational background (bachelor vs junior college or below) (β=-0.097, $P<0.01$), (master or above vs junior college or below) (β=-0.114, $P<0.01$), workplace (city vs district) (β=-0.114, $P<0.01$), fighting the COVID-19 on the frontline (β=-0.047, $P<0.05$), and occupational stress (β=-0.105, $P<0.01$) were significantly and negatively associated with professional identity. The VIFs of all independent variables in this analysis were less than 10, meaning that collinearity didn't affect the results. Finally, the final model explained 47.6% variance of professional identity, the R^2 changes for step1, step2 and step3 were 10.6%, 33.3% and 3.6% respectively.

Table 4 Hierarchical multiple regression results of professional identity

Variables	Step1		Step2		Step3	
	β	VIF	β	VIF	β	VIF
Age (years)	-0.028	4.075	-0.034	4.08	0.001	4.123
Gender	0.053	1.088	0.019	1.1	0.017	1.124
Marital status	-0.022	1.227	0	1.229	0	1.23
Education1	-0.131**	1.968	-0.106**	1.97	-0.097**	1.985
Education2	-0.128**	2.12	-0.116**	2.121	-0.114**	2.126
Income1	-0.108*	2.236	-0.059	2.256	-0.046	2.27
Income2	-0.083	2.992	-0.068	3.014	-0.058	3.023
Income3	-0.066	3.196	-0.079	3.217	-0.073	3.223
Workplace1	-0.037	1.295	-0.059*	1.301	-0.046	1.321
Workplace2	-0.164**	1.472	-0.13**	1.476	-0.122**	1.487
Serving years	0.027	3.367	0.024	3.368	0.006	3.387
Weekly work time (hours)	-0.049	1.041	-0.03	1.045	-0.012	1.088
Occupational allowance	-0.091**	1.242	-0.041	1.251	-0.034	1.253
Fighting the COVID-19 on the frontline	-0.082**	1.073	-0.059*	1.08	-0.047*	1.09

Post competency			0.466**	1.066	0.362**	1.486
Respect1			0.246**	1.51	0.219**	1.544
Respect2			0.322**	1.514	0.288**	1.551
ERR					-0.105**	1.163
Resilience					0.097*	3.342
Self-efficacy					0.113**	3.268
F	8.534**		46.199**		45.326**	
Adjusted R^2	0.094		0.43		0.465	
ΔR^2	0.106		0.333		0.036	

1 *Note*: Gender, female vs male; Marital status, married/cohabiting vs unmarried/
2 divorced/separated/widowed; Education1, bachelor vs junior college or lower; Education2, master
3 or higher vs junior college or lower; Income1, ¥3001–¥4000 vs ≤¥3000; Income2, ¥4001–¥5000 vs
4 ≤¥3000; Income3, >¥5000 vs ≤¥3000; 1 ¥ = US $0.146 (9/7/2020); Workplace1, county vs district;
5 Workplace2, city vs district; Weekly work time (hours), >40h/week vs ≤40h/week; Occupational
6 allowance, yes vs no; Working on frontline to defeat the COVID-19, yes vs no; Respect1, general vs
7 low; Respect2, good vs low; ERR: Effort/Reward Ratio. $P< 0.05$. $P< 0.01$ (two-tailed).

8 **Discussion**

9 The results of this study demonstrated that CDC workers had higher levels of
10 fatigue and professional identity than healthcare workers [13, 40], suggesting that
11 measures to attenuate CDC workers' fatigue, and maintain worker's professional
12 identity should be implemented immediately.

13 In this study, we found that CDC worker's educational background, workplace,
14 experience of fighting the COVID-19 on the frontline, and occupational stress were
15 positively associated with fatigue. In terms of educational background, workers with
16 higher education were more likely to be fatigued than those with junior college or lower
17 educational level, which is consistent with previous studies [23, 40]. The reason for this
18 may be that they are assigned with important or urgent work that consumes more energy
19 and resources consuming to complete. Based on the COR theory [27], once employees'
20 resources insufficient, they are vulnerable to fatigue. As for the workplace, compared
21 with CDC workers who work at district level, the county and municipal CDC staff are
22 vulnerable to fatigue, possibly due to workload differences. Staff at municipal level
23 undertake the responsibility for the health of the people of the entire city (city was
24 comprised by counties and districts). Besides, the urbanization and public infrastructure
25 of district is more developed than county, so county staffs need to invest more energy

1 to complete the same tasks as those at district level. Thus, CDC administrators need to

2 pay attention to staffs' fatigue belonging to city and county CDC. For educational

3 background and workplace grade factor, CDC managers need to recruit more staff with

4 higher educational level, as well as shorter duty time through increasing the frequency

5 of shifts to attenuate workload and fatigue.

6   Workers fighting the COVID-19 on the frontline are vulnerable to fatigue, which

7 is consistent with previous studies [4, 41]. CDC managers should provide material and

8 moral support to protect them from being fatigued by providing them with paid vacation,

9 counselling and incentive payment. We found occupational stress was positively

10 connected with fatigue which is in line with previous study [25]. Playing an important

11 role in preventing and controlling the pandemic, CDC workers have spent much time

12 and energy in keeping their duties. While the psychological energy is being depleted

13 faster than it can be replenished, occupational stress will occur and cause fatigue. Thus,

14 CDC managers should establish a rationalized workload and reward system, and

15 provide timely support to reduce occupational stress and alleviate fatigue.

16   This research found that perceived public respect, resilience and self-efficacy were

17 negatively associated with fatigue. Consistent with former finding that respect can

18 alleviate job-related negative consequences [42], perceived public respect is negatively

19 connected with CDC worker's fatigue, which can be explained by that respect is one of

20 a person's fundamental needs and is associated with a worker's satisfaction and

21 performance. CDC administrators can use the new media to promote the role of CDC

22 work in epidemic prevention and control, to raise people's recognition and respect for

23 CDC workers. Resilience and self-efficacy as positive psychology resources were

24 negatively associated with fatigue, this is consistent with the results among healthcare

25 workers [23]. Previous studies have confirmed that, special training programs

26 (mindfulness intervention, resilience enhancement project, psychological capital

27 intervention) can effectively improve employee's resilience and self-efficacy, and

28 relieve job-related negative consequences [43-45]. For the intervention approach, given

29 the features of the work of CDC staffs, the intervention can be delivered online. CDC

30 managers can take the aforementioned information to develop interventions that cater

1 to CDC staff to enhance their workers' resilience and self-efficacy to alleviate fatigue.

2 As for professional identity, we found that post competency, perceived public

3 respect, resilience and self-efficacy are the protective factors. Post competency as an

4 indicator of the extent to which a person fits the job, is positively associated with

5 professional identity. Professional competence is positively associated with employees'

6 professional identity[46]. Therefore, taking measures such as providing training in

7 professional knowledge and skills, and taking material and psychological incentives to

8 stimulate active learning to improve CDC workers' professional competence, can be a

9 way to promote professional identity. Respect is positively associated with professional

10 identity, which supports our hypothesis. Studies have found that respect is negatively

11 associated with burnout and positively relates to job satisfaction and retention [20, 42].

12 So, to foster general people recognition and respect for CDC work via traditional and

13 online media should be CDC administrators' priority. Resilience and self-efficacy are

14 positively related to professional identity, which concurs with former results [30, 47], that

15 workers with higher levels of resilience and self-efficacy tend to possess more energy

16 and willingness to adjust their emotions and perceptions. Resilience and self-efficacy

17 could be developed by professional training[44, 45]. In this study we adopt resilience and

18 self-efficacy from the psychological capital background. Previous study has indicated

19 resilience and self-efficacy can be improved by psychological capital intervention [43],

20 so interventions based on the psychological capital training model can be utilized to

21 enhance resilience and self-efficacy to increase professional identity.

22 This study showed that educational background, workplace, fighting the COVID-

23 19 on the frontline, and occupational stress were negatively associated with

24 professional identity. CDC workers with better educational background tend to

25 experience lower professional identity, which is different from former studies[13, 47].

26 This could be that the work of prevention and control of diseases requires a high level

27 of knowledge and skills, and workers with higher education tend to be assigned with

28 more workloads and responsibilities, resulting in more fatigue and less professional

29 identity. CDC administrators can ease the workload of staff with higher education by

30 upgrading the professional competence of existing staff to take on more work to

1 maintain professional identity of higher educational staffs. CDC workers in cities,
2 compared with those in district levels, were inclined to have a lower professional
3 identity, which can be explained by the fact that city CDC workers' workloads are
4 heavier than those under the district level, so they are more vulnerable to work stress.
5 CDC managers can deploy human resources across the whole city to enhance the
6 manpower of the municipal CDC, and relieve the work pressure of municipal CDC staff
7 and enhance their professional identity.

8 Inconsistent with former studies [48], CDC workers fighting on the frontline to
9 defeat COVID-19 have a lower professional identity, which may be because after the
10 successful control during the early phase of COVID-19 pandemic in China, occasional
11 localized outbreaks caused by mutated strains of the virus requires CDC workers to
12 keep alarmed at all time to address the pandemic, ultimately leading to burnout and
13 lower professional identity [49]. So, before the new recruited workers are qualified for
14 the job demands, CDC managers can alleviate burnout and keep professional identity
15 by shorter duty time and increase shifts frequent. A negative relationship between
16 occupational stress and professional identity was identified, which was similar to
17 previous study [50]. In the fight against the COVID-19, CDC worker have been under
18 much stress, and they have to expand much physical and psychological energy to
19 counteract occupational stress, leading to lower professional identity. Based on the ERI
20 model and the COR theory [24, 27], CDC administrators should rationalize work
21 assignments, establish a scientific performance evaluation and reward distribution
22 mechanism, and offer interventions to reduce occupational stress level, and maintain
23 CDC workers' professional identity.

Conclusions

25 CDC workers in China have undertaken a great deal of work to fight the COVID-
26 19 pandemic. Their fatigue levels are high, and workers' professional identity should
27 be maintained and enhanced. General public respect, occupational stress, resilience and
28 self-efficacy all influence workers' fatigue and professional identity. Administrators
29 need to strive to raise the level of public recognition respect for CDC work, rationalize

1   work assignments to reduce work stress, and implement psychological capital

2   interventions to improve CDC workers' resilience and self-efficacy.

3   There are some limitations that need to be illustrated in this study. This study

4   belongs to a cross-sectional study, and any causal-relationship conclusions can't be

5   drawn among variables in this study. Longitudinal research should be conducted in the

6   future to address this limitation. Secondly, this survey was performed via internet

7   platform, which may cause some response bias. Nevertheless, this study extends the

8   field of research on the mental health of occupational population, and the mental health

9   of CDC employees also requires attention.

10 **Ethics approval and consent to participate**

11   This study has been reviewed and approved by the Committee on Human

12 Experimentation of China Medical University. All participants volunteered to enroll in

13 this research and the informed consent was received by them. All information gathered

14 from the subjects were kept confidential and anonymous to protect participant's privacy.

15 **Competing interests**

16   The authors declare that they have no competing interests

17 **Author's contribution**

18   Qi Cui: Formal analysis, Investigation, Writing-original draft, Writing-review &
19 editing. Li Liu: Methodology, Writing-review & editing. Zejun Hao: Writing-review &
20 editing. Mengyao Li: Investigation, Writing-review & editing.   Chunli Liu: Writing-
21 review & editing. Chenxin Yang: Investigation. Qiuling Zhang: investigation. Hui Wu:
22 Conceptualization, Data curation, Funding acquisition, Methodology, Project
23 administration, Supervision.

24 **Data availability statement**

25   The datasets used and/or analyzed during the current study are available from the

26 corresponding author on reasonable request.

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1   questionnaires to the subject

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Reporting checklist for cross sectional study.

Based on the STROBE cross sectional guidelines.

Instructions to authors

Complete this checklist by entering the page numbers from your manuscript where readers will find each of the items listed below.

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		Reporting Item	Page Number
Title and abstract			
Title	#1a	Indicate the study's design with a commonly used term in the title or the abstract	1
Abstract	#1b	Provide in the abstract an informative and balanced summary	2

of what was done and what was found

Introduction

Background / rationale	#2	Explain the scientific background and rationale for the investigation being reported	3-6
Objectives	#3	State specific objectives, including any prespecified hypotheses	6

Methods

Study design	#4	Present key elements of study design early in the paper	6
Setting	#5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Eligibility criteria	#6a	Give the eligibility criteria, and the sources and methods of selection of participants.	6
	#7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6
Data sources / measurement	#8	For each variable of interest give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group. Give information separately for for exposed and unexposed groups if applicable.	6
Bias	#9	Describe any efforts to address potential sources of bias	6
Study size	#10	Explain how the study size was arrived at	6

Quantitative variables	#11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen, and why	6-8
Statistical methods	#12a	Describe all statistical methods, including those used to control for confounding	8
Statistical methods	#12b	Describe any methods used to examine subgroups and interactions	8
Statistical methods	#12c	Explain how missing data were addressed	8
Statistical methods	#12d	If applicable, describe analytical methods taking account of sampling strategy	8
Statistical methods	#12e	Describe any sensitivity analyses	8

Results

Participants	#13a	Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed. Give information separately for for exposed and unexposed groups if applicable.	8-9
Participants	#13b	Give reasons for non-participation at each stage	8
Participants	#13c	Consider use of a flow diagram	8-9
Descriptive data	#14a	Give characteristics of study participants (eg demographic,	8-9

clinical, social) and information on exposures and potential

confounders. Give information separately for exposed and

unexposed groups if applicable.

Descriptive data	#14b	Indicate number of participants with missing data for each variable of interest	8
Outcome data	#15	Report numbers of outcome events or summary measures. Give information separately for exposed and unexposed groups if applicable.	8
Main results	#16a	Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	10
Main results	#16b	Report category boundaries when continuous variables were categorized	11
Main results	#16c	If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	12
Other analyses	#17	Report other analyses done—e.g., analyses of subgroups and interactions, and sensitivity analyses	13

Discussion

Key results	#18	Summarise key results with reference to study objectives	13-16
Limitations	#19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias.	16

| Interpretation | #20 | Give a cautious overall interpretation considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence. | 16 |
| Generalisability | #21 | Discuss the generalisability (external validity) of the study results | 16 |

Other Information

| Funding | #22 | Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based | 17 |

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1 **Research on the influencing factors of fatigue and professional identity**

2 **among CDC workers in China ： an online cross-sectional study**

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1   **Abstract**

2   **Objective** This study aimed to investigate the status quo and the influencing factors of

3   fatigue and professional identity among the CDC workers in China during the pandemic.

4   **Design** A cross-sectional design.

5   **Setting** CDC workers employed by the Liaoning CDC system were enrolled

6   (administrative staffs were excluded).

7   **Participants** 1,020 CDC workers.

8   **Primary outcome measures** Fatigue scores and Professional identity scores.

9   **Secondary outcome measures** Post competency scores, Respect scores, Occupational

10   stress scores, Resilience scores and Self-efficacy scores.

11   **Results:** The average scores of fatigue and professional identity were 8.23, 38.88,

12   respectively. Factors including perceived public respect (β =-0.129, P<0.01), resilience

13   (β=-0.104, P<0.05), and self-efficacy (β=-0.22, P<0.01) were negatively associated

14   with fatigue. Educational background (bachelor vs junior college or below) (β=0.105,

15   P<0.01), (master or above vs junior college or below) (β=0.092, P<0.05), workplace

16   (county vs district) (β=0.067, P<0.05), (city vs district) (β=0.085, P<0.05), fighting the

17   COVID-19 on the frontline (β=0.059, P<0.05), and occupational stress (β=0.166,

18   P<0.01) were positively correlated with fatigue. Educational background (bachelor vs

19   junior college or below) (β=-0.097, P<0.01), (master or above vs junior college or

20   below) (β=-0.114, P<0.01), workplace (city vs district) (β=-0.114, P<0.01), fighting the

21   COVID-19 on the frontline (β=-0.047, P<0.05), and occupational stress (β=-0.105,

22   P<0.01) were negatively associated with professional identity. Factors including post

23   competency (β=0.362, P<0.01), perceived public respect (general vs low) (β=0.219,

24   P<0.01), (high vs low) (β=0.288, P<0.01), resilience (β=0.097, P<0.05), and self-

25   efficacy (β=0.113, P<0.01) were positively connected with professional identity.

26   **Conclusion:** The fatigue among the CDC workers was at a higher level. The level of

27   professional identity was high, and administrators should take measures to alleviate

28   fatigue and maintain professional identity. In addition, methods aiming to attenuate

29   occupational stress, and improve resilience and self-efficacy should be immediately put

30   into action.

1   **Key words** Fatigue; Professional identity; Influencing factor; CDC worker

2   **Word count** 3,616

3   **Strengths and limitations of this study**

4   ● The independent samples *t*-test, one-way ANOVA and hierarchical multiple

5   regression analysis were conducted to identify the influencing factors of fatigue

6   and professional identity.

7   ● An online survey method was used to collect samples with a big sample size.

8   ● This is a cross-sectional survey no causal relationship can be drawn among the

9   variables.

10   ● Participants in this study should be enrolled across the country.

Introduction

12   The 2019 coronavirus disease (COVID-19) has caused heavy economic losses and

13   psychological problems within the whole population including the occupational

14   groups.[1 2] WHO has declared it as a Global pandemic.[3] However, new coronavirus

15   variants are constantly deriving, and the pandemic impacts would continue to exist.

16   During public health emergencies, people have suffered from a wide range of

17   adverse psycho-social impacts, and this situation is even worse among the frontline

18   medical staff who have taken great responsibilities during the pandemic.[1 4] Centers for

19   Disease Control and Prevention (CDC) serves the public by publicizing the health

20   knowledge and conducting disease surveillance and prevention, etc. During the

21   pandemic, CDC workers in China have undertaken the responsibilities of

22   epidemiological investigation of the patients and close contacts, specimen collection

23   and examination, and surveillance of high-risk populations, etc.; therefore, they are

24   subjected to various psychological and physical pressures. However, compared with

25   the extant studies covering medical staff in this regard,[2 5] few have been conducted

26   concerning the mental health status of the occupational group.

27   Fatigue is a self-recognized state in which an individual experiences undermined

28   labor ability for overwhelming physical and mental work demands, and feels persistent

29   tiredness and weakness, which can't be alleviated by taking a rest.[6] Fatigue is

1 significantly associated with an individual's both physical and mental health.[7] Among

2 the professional staff, fatigue intrigues negative mood, lowers work efficiency and leads

3 to human errors and physical problems.[8] Healthcare workers are observed with severe

4 symptoms of fatigue, which adversely impact their health status and the quality of the

5 provided medical service.[9] [10] The prevalence of fatigue among the health care workers

6 under the pandemic varies from 69% to 72.2%, and studies have concluded the

7 influencing factors of fear of infection, sleep difficulty and psychological factors.[2] [4]

8 However, similar findings concerning the CDC workers during the same period have

9 been rarely reported and the influencing factors remain less discovered.

10 Professional identity refers to the combination of a worker's knowledge, skills,

11 values and behaviors with his or her own unique identity and core values.[11] Workers

12 usually take professional identity for self-assessment over the matching level of

13 themselves and the job they are engaged. Among health care staff, professional identity

14 is conducive to enhancing their work performance and job satisfaction and reduces their

15 turnover intention.[12] [13] During the COVID-19 pandemic, professional identity could

16 effectively relieve their job burnout symptoms.[14] Thus, research on professional

17 identity is beneficial for maintaining the mental health of CDC staff.

18 Competency depicts the personal qualities and behavioral traits affecting an

19 individual's productivity and performance.[15] Post competency refers to the ability to

20 complete assigned work efficiently. The higher post competency contributes to the

21 higher work efficiency and better work performance,[16] which reduces the possibilities

22 of burnout. The Job Demands-Resources model (JDR) points out that there is a

23 psychological need to maintain the balance between job demands and the resources

24 possessed by the employees,[17] and once the balance breaks, burnout and stress arise,

25 which ultimately leads to fatigue and the declined professional identity. Staff with

26 higher post competency have adequate professional knowledge and skills and handle

27 work demands effectively. Thus, such individuals are less prone to fatigue.

28 Aforementioned, we assume that post competency might influence the levels of fatigue

29 and professional identity of the CDC workers.

30 Respect, which is seen as an optimistic side of life, describes the feeling of being

1 highly valued, esteemed, or the satisfaction of being held in honor.[18] Maslow's

2 Hierarchy of Needs advocates that the satisfied need for respect is critical for achieving

3 self-actualization,[19] and the sense of being respected in the workplace contributes to job

4 satisfaction and is associated with organization commitment and retention.[20]

5 Considering these, we assume that the higher degree of being respected may reduce the

6 occurrence of fatigue and enhance professional identity.

7 Due to the intense competition within the organization and the higher demands for

8 good health from the general population, healthcare workers in China are more

9 vulnerable to occupational stress.[21] According to the classical model of Effort Reward

10 Imbalance (ERI), occupational stress is caused by the imbalance between extrinsic

11 effort and reward, and workers as such would experience a failed social reciprocity that

12 evokes occupational stress.[22] During the pandemic, CDC staff are on duty to keep

13 constant vigilance in response of outbreaks. This gives them more occupational stress

14 which relates to fatigue and professional identity.[23] [24] Accordingly, among CDC

15 workers, higher occupational stress level has bigger chance to induce more fatigue and

16 less professional identity.

17 According to the Conservation of Recourse (COR) theory, when the internal and

18 external resources are insufficient or the employees feel deficient resources, they will

19 experience occupational stress and fatigue.[25] Scholars have noted the effects of positive

20 psychological resources (e.g., resilience, self-efficacy, hope, and optimism) on

21 attenuating the severity of fatigue.[21] Resilience refers to the ability that individuals

22 adopt to cope with stress in a healthy way, during which tasks can be completed

23 efficiently with minimal psychological and physical cost.[26] Resilient people can quickly

24 sort out the solution to tackle the challenges and restore the mental health. Self-efficacy

25 signifies an individual's perceived ability to succeed and complete the tasks.[27] Studies

26 have identified the roles of self-efficacy and resilience for relieving fatigue and

27 maintaining the professional identity.[21] [28] Therefore, for CDC workers, we

28 hypothesized that resilience and self-efficacy would reduce the level fatigue and

29 enhance professional identity.

30 CDC workers have undertaken great psychological burden during the pandemic;

1 however, findings on their mental health status are insufficiently reported. This study

2 aimed to investigate the status quo and the influencing factors of fatigue and

3 professional identity of the CDC workers. With the obtained findings, some evidence-

4 based suggestions would be formulated to support the psychological wellbeing of the

5 CDC workers.

Methods

Study design and settings

8   This cross-sectional survey was conducted in Liaoning province in China, from

9 Sep 7-18, 2020. After communicating with and receiving support from CDC managers,

10 a digital questionnaire was delivered through the Wenjuanxing platform to the CDC

11 workers belonging to the Liaoning provincial CDC system.

Study participants

13   CDC workers belonging to the Liaoning provincial CDC system were recruited

14 and workers engaged in administrative work were excluded from this study. A total of

15 1,020 valid questionnaires were collected, with an effective response rate of 83.2%.

Patients and Public involvement

17   No patients or public persons were involved in this study.

Measurement of demographic and job characteristics

19   Age (years), gender, marital status and educational background were set as

20 demographic variables. Age was collected as: ≤30years, 31-40 years, 41-50 years,

21 and >50 years. Gender. Marital status was divided into:

22 "single/divorced/widowed/separated" and "married/cohabited". Educational

23 background was divided into three: "junior college or lower", "bachelor" and

24 "master or higher". Job characteristics including personal monthly income (RMB,￥)

25 which was classified as: ≤￥3000 (≤US $438.69), ￥3001－￥4000 (US $438.83 -

26 $584.92), ￥4001－￥5000 (US $585.06 - $731.14) and >￥5000 (＞US $731.14);

27 workplace includes district, county and city; serving years was classified as ≤10years,

28 11-20 years, and >20 years; weekly work time(hours) was categorized as "≤40h

29 /week" and ">40h/week"; whether having occupational allowance and whether

1   fighting the COVID-19 in the frontline.

2   **Measurement of fatigue**

3   The Chinese vision of the Chalder Fatigue Scale (CFS) was used to assess the level

4   of fatigue of CDC workers.[29] This scale includes 14 items and two dimensions: physical

5   fatigue (8 items) and mental fatigue (6 items). The answer for each item was designed

6   as dichotomization: 0 (no symptom) and 1 (have symptom). The sum of the CFS score

7   ranges from 0 to14. The higher the CFS score is, the more severe the fatigue is. The

8   CFS has been widely used among Chinese healthcare staff with good reliability and

9   validity.[21 30] Cronbach's α coefficient of CFS in this study was 0.938.

10   **Measurement of professional identity**

11   The Chinese vision Occupational Identity Scale (OIS) was used to assess

12   professional identity.[31] It comprises of 10 items, and all items are scored from 1

13   (absolutely inconsistent) to 5 (absolutely consistent). Then, the scores would be

14   summed to indicate the level of professional identity: the higher the sum the higher

15   level of professional identity. The Chinese vision Occupational Identity Scale has been

16   widely used among Chinese occupational groups with good reliability and validity.[12 32]

17   Cronbach's α coefficient of scale in this study was 0.949.

18   **Measurement of post competency and respect**

19   The assessment of CDC worker's post competency adopts self-compiled questions,

20   based on the instructions from the Association of Schools of Public Health in the

21   European Region (ASPHER) and the Council on Linkages Between Academia and

22   Public Health Practice (Council on Linkages).[33 34] Three self-administered questions

23   were used to evaluate CDC worker's mastery of their professional knowledge, public

24   health emergency knowledge as well as communication and cooperation: a. Please rate

25   the level of your knowledge about public health expertise (epidemiology, preventive

26   medicine, health education, laws and regulations, etc.); b. Please rate the level of your

27   knowledge of public health emergencies (classification and grading of public health

28   emergencies, corresponding emergency response criteria and skills, etc.); c. Please rate

29   your teamwork and communication skills (with superiors, colleagues and the public).

30   Each was estimated from 0(none) to 7(have a good command of it), the scores would

1   be summed to indicate the level of post competency: the higher the sum the higher post

2   competency. Respect was measured by a single item (Please rate the level of public

3   recognition and respect the work you do: low, general and high).

Measurement of occupational stress

5   The Chinese vision Effort-reward Imbalance questionnaire (ERI)'s subscale of

6   extrinsic effort and reward was used to measure CDC worker's occupational stress.[35 36]

7   The effort/reward ratio (ERR) = $(11 \times \text{effort})/ (6 \times \text{reward})$ represent the occupational

8   stress. Item for extrinsic effort and reward are rated by a 5-point Likert-type scale, from

9   1 (not stressful) to 5 (very stressful). When ERR>1, the occupational stress exists. The

10   Chinese version of the ERI has been widely used among Chinese occupational groups

11   with good reliability and validity.[21 30] In this study, Cronbach's α coefficients for the

12   extrinsic effort and reward subscales were 0.879, 0.898, respectively.

Measurement of resilience and self-efficacy

14   CDC worker's resilience and self-efficacy were measured by the Psychological

15   Capital Questionnaire (PCQ) which has 24 items and four components (self-efficacy,

16   hope, resilience, and optimism), and each item was scored from 1 (strong disagreement)

17   to 6 (strong agreement).[37] Higher total scores mean higher level of Psychological

18   Capital and its components. The Chinese vision PCQ has been widely applied among

19   Chinese people and has shown satisfactory reliability and validity.[12 38] In this study, the

20   Cronbach's α coefficients for resilience and self-efficacy subscales were 0.919 and 0.94,

21   respectively.

Statistical analysis

23   The demographic and job variables were described with mean, standard deviation

24   (SD), number (n), and percentage (%). Group differences of continuous variables were

25   analyzed with *t*-test or one-way ANOVA. Hierarchical multiple regression (HMR)

26   analysis was conducted to identify the influencing factors. Variables were entered as

27   follows: step 1, input demographic and job characteristics with statistically significant

28   differences in fatigue and professional identity at *t*-test or one-way ANOVA; step 2,

29   competence and respect were added; step 3, occupational stress, resilience and self-

30   efficacy were entered. In this study, SPSS 21.0 (IBM, Asia Analytics Shanghai) was

1   used for statistical analysis. A two-tailed $p < 0.05$ was considered statistically

2   significant.

3 Results

4 Descriptive statistics.

5   The average score of fatigue and professional identity for CDC workers were 8.23

6   and 38.88 respectively. Results of univariate analyses are shown in table1. Workers

7   aged 31-40 years had higher level of fatigue ($P<0.01$), while those aged 21-30 showed

8   higher professional identity ($P<0.01$). Female CDC workers had higher professional

9   identity than male ($P=0.016$); but there was no statistical difference for fatigue by

10   gender. CDC workers, who were married or cohabiting, indicated higher fatigue

11   levels($P=0.016$) and lower professional identity ($P<0.01$). Participants with higher

12   levels of education tended to be fatigued ($P<0.01$) and had lower professional identity

13   ($P<0.01$). As for job characteristics, we found significant differences in fatigue and

14   professional identity among CDC workers for the variables of workplace grade, weekly

15   work time, receipt of occupational allowance and fighting the COVID-19 on the

16   frontline, respectively ($P<0.01$). Professional identity differed across serving years, but

17   fatigue wasn't statistically different in terms of the same variable. CDC workers who

18   perceived low public recognition and respect for their work, had higher levels of fatigue

19   ($P<0.01$) and lower professional identity ($P<0.01$).

Table 1 Univariate analysis result (n = 1020)

Variables	N (%)	Fatigue			Professional identity		
		Mean ± SD	F/t	P-value	Mean ± SD	F/t	P-value
Age (years)			9.35	<0.01		12.307	<0.01
21-30	162 (15.9%)	7.03±3.952			41.31±8.139		
31-40	370 (36.3%)	8.79±3.409			37.21±8.542		
41-50	320 (31.4%)	8.35±3.411			39.2±7.164		
＞50	168 (16.5%)	7.93±3.634			39.57±6.337		
Gender			1.704	0.089		-2.417	0.016
Male	282 (27.6%)	8.53±3.4			37.88±8.367		
Female	738 (72.4%)	8.12±3.648			39.26±7.613		
Marital status			-2.428	0.016		2.603	<0.01
Unmarried/ divorced/separated/widowed	229 (22.5%)	7.7±3.857			40.06±8.578		

Married/cohabiting	791 (77.5%)	8.39±3.488			38.53±7.596		
Educational background			8.463	<0.01		14.983	<0.01
Junior college or below	219 (21.5%)	7.39±3.843			41.16±6.557		
Bachelor	648 (63.5%)	8.39±3.509			38.6±7.782		
Master or above	153 (15%)	8.76±3.33			36.76±9.014		
Personal monthly income (¥)			6.554	<0.01		7.667	<0.01
≤3000	215 (21.1%)	7.39±3.871			41.06±8.009		
3001-4000	394 (38.6%)	8.48±3.507			38.27±8.184		
4001-5000	258 (25.3%)	8.16±3.564			38.51±7.538		
>5000	153 (15%)	8.9±3.181			38±6.689		
Workplace			13.777	<0.01		30.57	<0.01
City	403 (39.5%)	8.89±3.286			40.63±7.616		
County	207 (20.3%)	8.22±3.434			39.8±7.267		
District	410 (40.2%)	7.6±3.824			36.62±7.837		
Serving years			2.327	0.098		15.403	<0.001
≤10	457 (44.8%)	8.09±3.742			39.71±7.901		
11-20	252 (24.7%)	8.65±3.333			36.52±8.473		
>20	311 (30.5%)	8.11±3.528			39.56±6.822		
Weekly work time (hours)			-2.997	<0.01		2.915	<0.01
≤40h/week	676 (66.3%)	8±3.672			39.38±7.743		
>40h/week	344 (33.7%)	8.69±3.364			37.88±7.969		
Occupational allowance			4.128	<0.01		-5.641	<0.01
No	417 (40.9%)	7.67±3.821			40.52±7.407		
Yes	603 (50.1%)	8.62±3.358			37.74±7.95		
Fighting the COVID-19 on the frontline			4.298	<0.01		-4.458	<0.01
No	655 (64.2%)	7.89±3.735			39.71±7.426		
Yes	365(35.8%)	8.85±3.21			37.37±8.358		
Respect			26.601	<0.01		92.708	<0.01
Low	256(25.1%)	9.48±2.781			34.26±8.977		
General	575(56.4%)	8.02±3.682			39.34±6.708		
High	189 (18.5%)	7.2±3.797			43.71±5.837		

1   *Note*: 1 ¥ = US $0.146 (9/7/2020)

2

3 **Correlations of continue variables**

4   Table 2 shows the correlations among age, post-competence, occupational stress,

5   resilience, self-efficacy, professional identity and fatigue. As the table shows, post-

1 competence was negatively correlated with fatigue, while positively correlated with

2 professional identity. For psychological factors, occupational stress was positively

3 correlated with fatigue, but resilience and self-efficacy were negatively correlated with

4 fatigue. Resilience and self-efficacy were positively correlated with professional

5 identity, while occupational stress was negatively connected with it.

Table 2 Correlations among continue variables.

	Mean ± SD	1	2	3	4	5	6	7
1.Age	40.42±9.32	1						
2.Post competency	18.15±2.30	-0.02	1					
3.ERR	1.32±0.63	0.119**	-0.022	1				
4.Resilience	29.04±4.36	-0.037	0.535**	0.012	1			
5.Self-efficacy	29.23±4.47	-0.065*	0.521**	-0.02	0.824**	1		
6.Professional identity	38.88±7.85	-0.038	0.547**	-0.187**	0.445**	0.444**	1	
7.Fatigue	8.23±3.58	0.059	-0.205**	0.226**	-0.313**	-0.338**	-0.373**	1

6 *Note*: □ *P< 0.05.* □□ *P< 0.01 (two-tailed).*

7 **Influencing factors of fatigue**

8 The results of the analysis of factors influencing fatigue are displayed in table 3.

9 The variance inflation factor (VIF)s of all independent variables in this analysis were

10 less than 10, which means that collinearity didn't affect the results. A total of 21.7% of

11 variance was interpreted by the final model. The improvement model fits caused by

12 each step (R^2 changes) were 7%, 5.8% and 8.9% respectively. In the final model,

13 perceived public respect (general vs low, and high vs low) (both β =-0.129, $P<0.01$),

14 resilience (β=-0.104, $P<0.05$), and self-efficacy (β=-0.22, $P<0.01$) were significantly

15 and negatively connected with fatigue. Educational background (bachelor vs junior

16 college or below) (β=0.105, $P<0.01$), (master or above vs junior college or below)

17 (β=0.092, $P<0.05$), workplace grade (county vs district) (β=0.067, $P<0.05$), workplace

18 (city vs district) (β=0.085, $P<0.05$), fighting the COVID-19 on the frontline (β=0.059,

19 $P<0.05$), and occupational stress (β=0.166, $P<0.01$) were significantly and positively

20 correlated with fatigue.

Table 3 Hierarchical multiple regression results of fatigue

Variables	Step1		Step2		Step3	
	β	VIF	β	VIF	β	VIF
Age (years)	0.059	2.776	0.064	2.779	0.027	2.801
Marital status	0.027	1.225	0.02	1.227	0.02	1.228

Education1	0.131**	1.952	0.121**	1.953	0.105**	1.966
Education2	0.102*	2.044	0.099*	2.044	0.092*	2.046
Income1	0.073	2.208	0.059	2.228	0.038	2.242
Income2	0.012	2.85	0.012	2.87	-0.001	2.881
Income3	0.051	3.012	0.063	3.031	0.058	3.039
Workplace1	0.077*	1.273	0.087**	1.278	0.067*	1.302
Workplace2	0.111**	1.439	0.093**	1.444	0.085*	1.453
Weekly work time (hours)	0.065*	1.037	0.053	1.043	0.024	1.087
Occupational allowance	0.062	1.227	-0.039	1.236	-0.03	1.238
Fighting the COVID-19 on the frontline	0.091**	1.049	0.076*	1.059	0.059*	1.073
Post competency			-0.151**	1.063	0.009	1.474
Respect1			-0.171**	1.502	-0.129**	1.538
Respect2			-0.182**	1.514	-0.129**	1.55
ERR					0.166**	1.143
Resilience					-0.104*	3.326
Self-efficacy					-0.22**	3.263
F	6.268**		9.789**		15.393**	
Adjusted R^2	0.058		0.115		0.203	
ΔR^2	0.07		0.058		0.089	

1 *Note*: Marital status, married/cohabiting vs unmarried/ divorced/separated/widowed; Education1,
2 bachelor vs junior college or lower; Education2, master or higher vs junior college or lower;
3 Income1, ¥3001–¥4000 vs ≤¥3000; Income2, ¥4001–¥5000 vs ≤¥3000; Income3, >¥5000 vs ≤¥3000; 1
4 ¥ = US $0.146 (9/7/2020); Workplace1, county vs district; Workplace2, city vs district; Weekly work
5 time (hours), >40h/week vs ≤40h/week; Occupational allowance, yes vs no; Working on frontline to
6 defeat the COVID-19, yes vs no; Respect1, general vs low; Respect2, good vs low; ERR: Effort/Reward
7 Ratio. □ *P< 0.05*. □□ *P< 0.01 (two-tailed)*.

8 **Influencing factors of professional identity**

9   The results of the hierarchical multiple regression analysis are shown in table 4.

10 The results indicated that post competency (β=0.362, $P<0.01$), perceived public respect

11 (general vs low) (β=0.219, $P<0.01$), (high vs low) (β=0.288, $P<0.01$), resilience

12 (β=0.097, $P<0.05$), and self-efficacy (β=0.113, $P<0.01$) were significantly and

13 positively connected with professional identity. Educational background (bachelor vs

14 junior college or below) (β=-0.097, $P<0.01$), (master or above vs junior college or

15 below) (β=-0.114, $P<0.01$), workplace (city vs district) (β=-0.114, $P<0.01$), fighting the

16 COVID-19 on the frontline (β=-0.047, $P<0.05$), and occupational stress (β=-0.105,

17 $P<0.01$) were significantly and negatively associated with professional identity. The

18 VIFs of all independent variables in this analysis were less than 10, meaning that

1 collinearity didn't affect the results. Finally, the final model explained 47.6% variance

2 of professional identity, the R^2 changes for step1, step2 and step3 were 10.6%, 33.3%

3 and 3.6% respectively.

Table 4 Hierarchical multiple regression results of professional identity

Variables	Step1		Step2		Step3	
	β	VIF	β	VIF	β	VIF
Age (years)	-0.028	4.075	-0.034	4.08	0.001	4.123
Gender	0.053	1.088	0.019	1.1	0.017	1.124
Marital status	-0.022	1.227	0	1.229	0	1.23
Education1	-0.131**	1.968	-0.106**	1.97	-0.097**	1.985
Education2	-0.128**	2.12	-0.116**	2.121	-0.114**	2.126
Income1	-0.108*	2.236	-0.059	2.256	-0.046	2.27
Income2	-0.083	2.992	-0.068	3.014	-0.058	3.023
Income3	-0.066	3.196	-0.079	3.217	-0.073	3.223
Workplace1	-0.037	1.295	-0.059*	1.301	-0.046	1.321
Workplace2	-0.164**	1.472	-0.13**	1.476	-0.122**	1.487
Serving years	0.027	3.367	0.024	3.368	0.006	3.387
Weekly work time (hours)	-0.049	1.041	-0.03	1.045	-0.012	1.088
Occupational allowance	-0.091**	1.242	-0.041	1.251	-0.034	1.253
Fighting the COVID-19 on the frontline	-0.082**	1.073	-0.059*	1.08	-0.047*	1.09
Post competency			0.466**	1.066	0.362**	1.486
Respect1			0.246**	1.51	0.219**	1.544
Respect2			0.322**	1.514	0.288**	1.551
ERR					-0.105**	1.163
Resilience					0.097*	3.342
Self-efficacy					0.113**	3.268
F	8.534**		46.199**		45.326**	
Adjusted R^2	0.094		0.43		0.465	
ΔR^2	0.106		0.333		0.036	

4 *Note*: Gender, female vs male; Marital status, married/cohabiting vs unmarried/
5 divorced/separated/widowed; Education1, bachelor vs junior college or lower; Education2, master
6 or higher vs junior college or lower; Income1, ¥3001–¥4000 vs ≤¥3000; Income2, ¥4001–¥5000 vs
7 ≤¥3000; Income3, >¥5000 vs ≤¥3000; 1 ¥ = US $0.146 (9/7/2020); Workplace1, county vs district;
8 Workplace2, city vs district; Weekly work time (hours), >40h/week vs ≤40h/week; Occupational
9 allowance, yes vs no; Working on frontline to defeat the COVID-19, yes vs no; Respect1, general vs
10 low; Respect2, good vs low; ERR: Effort/Reward Ratio. □*P< 0.05.* □□ *P< 0.01 (two-tailed).*

11 **Discussion**

12 　　The current study revealed that compared with healthcare workers, CDC workers

1 had higher level of fatigue and professional identity.[12][39] In this sense, measures to

2 alleviate fatigue and maintain professional identity should be implemented immediately.

3   The study found that educational background, workplace, experience of fighting

4 the COVID-19 on the frontline, and occupational stress were positively associated with

5 fatigue. Workers with higher education were more likely to be fatigued than those with

6 junior college or lower educational level, which is consistent with previous studies.[21][38]

7 During the pandemic, the CDC workers are assigned with the work that consumes more

8 resources to complete and this situation breaks the balance between the work demand

9 and the possessed resources. Based on the COR theory, once employees' resources

10 become insufficient, they are vulnerable to fatigue.[25] As for the workplace, compared

11 with those working at the district level, the county and municipal CDC staff had more

12 fatigue, a possible consequence of workload differences between the two levels. Staff

13 at the municipal level are responsible for the health wellbeing of the people of the entire

14 city (a city is comprised of several counties and districts). Besides, the facilities of the

15 county level are less developed, so staff working at the county level need to invest more

16 energy to complete the same tasks than those at the district level. For educational

17 background and workplace grade factor, CDC managers should recruit staff with higher

18 educational level and apply more frequent rotations to attenuate the level of fatigue.

19   Workers on the frontline of COVID-19 containment are vulnerable to fatigue,

20 which is consistent with previous studies.[4][40] CDC managers could support the

21 employees to keep away fatigue by applying paid vacation, counselling and incentive

22 payments. We found occupational stress was positively connected with fatigue which

23 is in line with previous study.[21] CDC workers have spent much time and energy in

24 keeping their duties during the pandemic. While the psychological energy depletes

25 faster than it is replenished, occupational stress would occur and fatigue would entail.

26 Thus, CDC managers should assign the work rationally and provide timely support to

27 reduce occupational stress and alleviate fatigue.

28   This research found that perceived public respect, resilience and self-efficacy were

29 negatively associated with fatigue. Concurring with the previous result,[41] perceived

30 public respect negatively related to fatigue, which can be explained by that respect

1   constitutes a fundamental psychological need and determines a worker's job

2   satisfaction and performance. With this finding, CDC administrators can use the new

3   media to publicize the contributions made by the CDC workers in epidemic prevention

4   and control, and raise public recognition and respect. Resilience and self-efficacy were

5   negatively associated with fatigue and they are consistent with the results obtained in

6   the healthcare workers.[21] Special training programs (mindfulness intervention,

7   resilience enhancement project, psychological capital intervention) have been found to

8   effectively improve an employee's resilience and self-efficacy.[42-44] CDC managers can

9   take the aforementioned information to develop interventions that cater to CDC staff to

10   enhance their levels of resilience and self-efficacy.

11   As for professional identity, we found that post competency, perceived public

12   respect, resilience and self-efficacy were the protective factors. Post competency,

13   which describes the extent to which a person fits the job, was positively associated with

14   professional identity and this supports the previous result.[45] Considering these findings,

15   measures for training professional knowledge and stimulating active learning could be

16   taken to improve professional competence. Meanwhile, professional identity would be

17   enhanced as well. Respect was positively associated with professional identity, which

18   supports our hypothesis. Respect is negatively associated with burnout and positively

19   relates to job satisfaction and retention.[41 46] Accordingly, CDC administrators could use

20   both traditional and online media to enhance the recognition and respect for CDC

21   workers. Resilience and self-efficacy were positively related to professional identity,

22   which concur with the former results,[28 47] that workers with higher levels of resilience

23   and self-efficacy tend to possess more energy and willingness to adjust their emotions

24   and perceptions. Previous study has indicated resilience and self-efficacy can be

25   improved by psychological capital intervention;[42] therefore, interventions in this regard

26   can be utilized to increase professional identity.

27   This study showed that educational background, workplace, fighting the COVID-

28   19 on the frontline, and occupational stress were negatively associated with

29   professional identity. CDC workers with better educational background tended to

30   experience lower professional identity, which is different from the former studies.[12 47]

1 In the workplace, employees with better educational background tend to be assigned

2 with critical workloads and responsibilities, and this scenario results in more fatigue

3 and lower professional identity. This issue could be solved by upgrading the

4 professional competence of existing staff to take on more work and this would help to

5 maintain the professional identity with better educational background. CDC workers in

6 cities, compared with those at district level, were inclined to have a lower professional

7 identity, which can be explained by that city CDC workers are assigned with heavier

8 workloads than those at the district level and they have more work stress. A proper

9 personnel assignment is needed to improve the manpower of the municipal CDC, so

10 that the work pressure would be relived and the professional identity would be enhanced.

11 Inconsistent with former studies,[48] CDC workers fighting on the frontline to defeat

12 COVID-19 have a lower professional identity. With the successful control during the

13 early phase of the pandemic, occasional outbreaks caused by mutated strains of the

14 virus require CDC workers to keep cautious at all time, and this lowers their level of

15 professional identity.[49] Therefore, substitutes who sustain the duties are needed, and in

16 this way, the level of professional identity could be maintained. A negative relationship

17 between occupational stress and professional identity was identified, which is similar

18 to previous study.[50] CDC workers have been under great stress during the pandemic

19 and much physical and psychological energy is needed to get rid of this situation. The

20 consequence is that the professional identity is lowered. Based on the ERI model and

21 the COR theory,[22 25] CDC administrators should rationalize work assignments, establish

22 a scientific evaluation system, and offer interventions to reduce the stress level and to

23 maintain the professional identity.

Conclusions

25 CDC workers in China have undertaken a great deal of work to control the

26 COVID-19 pandemic. They have more fatigue symptoms, and level of professional

27 identity needs to be enhanced. Public respect, occupational stress, resilience, and self-

28 efficacy influence fatigue and professional identity. With these findings, administrators

29 should raise the level of public recognition of the CDC's contribution, rationalize work

1   assignments, and implement psychological capital interventions to improve resilience

2   and self-efficacy of the CDC workers.

3   There are some limitations that need to be illustrated in this study. This study

4   belongs to a cross-sectional study, and any causal-relationship conclusions can't be

5   drawn among variables in this study. Longitudinal research should be conducted in the

6   future to address this limitation. Secondly, this survey was performed via internet

7   platform, which may cause some response bias. Nevertheless, this study extends the

8   field of research on the mental health of occupational population, and the mental health

9   of CDC employees also requires attention.

10 **Ethics approval and consent to participate**

11 This study has been reviewed and approved by the Committee on Human

12 Experimentation of China Medical University (YD2020018). All participants

13 volunteered to enroll in this research and the informed consent was received by them.

14 All information gathered from the subjects were kept confidential and anonymous to

15 protect participant's privacy.

16 **Competing interests**

17 The authors declare that they have no competing interests

18 **Author's contribution**

19 Qi Cui: Formal analysis, Investigation, Writing-original draft, Writing-review &
20 editing. Li Liu: Methodology, Writing-review & editing. Zejun Hao: Writing-review &
21 editing. Mengyao Li: Investigation, Writing-review & editing.   Chunli Liu: Writing-
22 review & editing. Chenxin Yang: Investigation. Qiuling Zhang: investigation. Hui Wu:
23 Conceptualization, Data curation, Funding acquisition, Methodology, Project
24 administration, Supervision.

25 **Data availability statement**

26 The datasets used and/or analyzed during the current study are available from the

27 corresponding author on reasonable request.

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2 questionnaires to the subject

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31

32

Reporting checklist for cross sectional study.

Based on the STROBE cross sectional guidelines.

Instructions to authors

Complete this checklist by entering the page numbers from your manuscript where readers will find each of the items listed below.

Your article may not currently address all the items on the checklist. Please modify your text to include the missing information. If you are certain that an item does not apply, please write "n/a" and provide a short explanation.

Upload your completed checklist as an extra file when you submit to a journal.

In your methods section, say that you used the STROBE cross sectionalreporting guidelines, and cite them as:

von Elm E, Altman DG, Egger M, Pocock SJ, Gotzsche PC, Vandenbroucke JP. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement: guidelines for reporting observational studies.

		Reporting Item	Page Number
Title and abstract			
Title	#1a	Indicate the study's design with a commonly used term in the title or the abstract	1
Abstract	#1b	Provide in the abstract an informative and balanced summary	2

of what was done and what was found

Introduction

| Background / rationale | #2 | Explain the scientific background and rationale for the investigation being reported | 3-6 |
| Objectives | #3 | State specific objectives, including any prespecified hypotheses | 5 |

Methods

Study design	#4	Present key elements of study design early in the paper	6
Setting	#5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Eligibility criteria	#6a	Give the eligibility criteria, and the sources and methods of selection of participants.	6
	#7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6
Data sources / measurement	#8	For each variable of interest give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group. Give information separately for for exposed and unexposed groups if applicable.	6
Bias	#9	Describe any efforts to address potential sources of bias	6
Study size	#10	Explain how the study size was arrived at	6

Quantitative variables	#11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen, and why	6-8
Statistical methods	#12a	Describe all statistical methods, including those used to control for confounding	8
Statistical methods	#12b	Describe any methods used to examine subgroups and interactions	8
Statistical methods	#12c	Explain how missing data were addressed	8
Statistical methods	#12d	If applicable, describe analytical methods taking account of sampling strategy	8
Statistical methods	#12e	Describe any sensitivity analyses	8

Results

Participants	#13a	Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed. Give information separately for for exposed and unexposed groups if applicable.	9
Participants	#13b	Give reasons for non-participation at each stage	9
Participants	#13c	Consider use of a flow diagram	9
Descriptive data	#14a	Give characteristics of study participants (eg demographic,	9

clinical, social) and information on exposures and potential

confounders. Give information separately for exposed and

unexposed groups if applicable.

Descriptive data	#14b	Indicate number of participants with missing data for each variable of interest	9
Outcome data	#15	Report numbers of outcome events or summary measures. Give information separately for exposed and unexposed groups if applicable.	9
Main results	#16a	Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	10
Main results	#16b	Report category boundaries when continuous variables were categorized	11
Main results	#16c	If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	12
Other analyses	#17	Report other analyses done—e.g., analyses of subgroups and interactions, and sensitivity analyses	13

Discussion

Key results	#18	Summarise key results with reference to study objectives	13-16
Limitations	#19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias.	17

Interpretation	#20	Give a cautious overall interpretation considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence.	17
Generalisability	#21	Discuss the generalisability (external validity) of the study results	17

Other Information

Funding	#22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	17

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