

Effective resources for improving mental health among Chinese underground coal miners: Perceived organizational support and psychological capital

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Abstract: Effective resources for improving mental health among Chinese underground coal miners: Perceived organizational support and psychological capital: Li Liu, *et al.* Department of Social Medicine, School of Public Health, China Medical University, P.R. China—**Objectives:** This study aimed to examine the potential effects of perceived organizational support (POS) and psychological capital (PsyCap) on combating depressive and anxious symptoms among Chinese underground coal miners. **Methods:** A cross-sectional survey was conducted in a coal-mining population in northeast China. The Center for Epidemiologic Studies Depression (CES-D) Scale, the Zung Self-Rating Anxiety Scale (SAS), the Survey of Perceived Organizational Support (SPOS) scale and the Psychological Capital Questionnaire (PCQ), which measure depressive and anxious symptoms, POS and PsyCap were distributed to 2,500 underground coal miners (1,925 effective respondents). Hierarchical linear regression was performed to examine the associations of POS and PsyCap (self-efficacy, hope, resilience and optimism) with depressive and anxious symptoms and the moderating roles of PsyCap and its components. The mediating roles of PsyCap and its components were examined using asymptotic and resampling strategies. **Results:** The mean levels of depressive and anxious symptoms were 19.91 and 49.69, respectively. POS, PsyCap, hope, resilience, optimism and POS × PsyCap were negatively associated with depressive symptoms. POS, PsyCap, resilience, POS × PsyCap and POS × resilience were negatively associated with anxious symptoms. PsyCap, hope, resilience and optimism partially mediated the association between POS and depressive symptoms. PsyCap and resilience partially mediated

the association between POS and anxious symptoms. **Conclusions:** POS, PsyCap, hope, resilience and optimism could be effective resources for reducing depressive and anxious symptoms. PsyCap, hope, resilience and optimism act as moderators and mediators in the associations of POS with depressive and anxious symptoms. Managers should promote supportive settings and investment in PsyCap to improve workers' mental health.

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Key words: Anxious symptoms, Depressive symptoms, Perceived organizational support, Psychological capital, Underground coal miners

Underground coal mining remains one of the most dangerous occupations worldwide. Underground coal miners have to work in a confined space and perform multiple tasks, and they always face a variety of threats from physical agents, such as noise, vibration, temperature, humidity, and radiation. Additionally, many occupational psychosocial risk factors (e.g., job stress, insufficient social support, interpersonal conflict, work-life interference, and threat perception) are caused by poor production organization and management in underground coal mining^{1,2}. The safety and health of underground miners are threatened seriously by their complex working conditions.

However, most previous studies mainly focused on physical health of underground miners, and very few studies have paid attention to mental health in this population. Existing research on the mining workforce indicate that they suffer severe mental health problems, especially depression and anxiety^{3–5}. Underground coal miners were found to suffer from more severe mental health problems than surface workers from the same coal mine⁵. Thus, more attention should be paid to protection of the mental health of underground miners. China possesses the

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second largest coal reserves globally and is the largest coal producer in the world. Over 95% of the coal produced is from underground mining. Thus, there are about six million underground coal miners in China at present⁶. According to the Law of the People's Republic of China (PRC) on Safety in Mines, underground working environments and arrangements have been optimized and improved significantly, but the various occupational psychosocial factors mentioned above will tend to negatively affect the mental health of underground coal miners over the long term.

In addition, depression and anxiety are the most common mental health problems in workplaces worldwide. In view of their high prevalence and extensive adverse effects across occupations and countries, they may be prone to result in low productivity and job performance due to high rates of absenteeism, presenteeism and turnover intention^{7,8}, and they may even increase the probability of accidents and occupational injury in underground mines. Therefore, exploration of potentially effective resources for coping with depression and anxiety among underground coal miners is urgently needed to promote their overall health and production safety.

However, underground miners are generally regarded to be deficient in effective coping resources for depression and anxiety. These resources refer to the basic ways in which individuals handle occupational stress, which is the most important risk factor for mental health problems in workplaces, such as self-adjustment, rational coping, social support, and sufficient recreation. In China, sufficient organizational support may be an important coping resource because of the relatively stable working and living environments of underground coal miners. First of all, the external physical environment in the process of underground coal mining cannot be changed and avoided for virtually all underground miners. Second, in view of production safety, there are strict monitoring and management systems for underground coal mining, which facilitate the routinization and standardization of production and operations performed by underground coal miners⁹. In addition, two main types of coal mining communities have been established in China, which are known as mining cities/towns and mining camps. These are communities that house coal miners mainly, and many coal mining communities are situated in remote areas¹⁰. In these communities, migration rarely occurs among most coal miners. The effects of institutionalized management in coal mines also have the potential to permeate the family and social lives of miners. As a result, family and social lives tend to be simple and stable among underground coal miners^{11,12}. According to organizational support

theory, perceived organizational support (POS) is the degree to which employees believe that their organizations value their contributions, care about their well-being and fulfill socioeconomic needs¹³. There are many positive work and mental health outcomes of POS, such as improving organizational commitment, job satisfaction and job engagement and performance and reducing occupational stress, burnout, depression, and anxiety^{14,15}. Often, both external and internal factors play a role in causing depression and anxiety. As an external resource, the protective role of POS on mental health is bound to be affected by some internal factors. With the rise of positive psychology, psychological capital (PsyCap) has become an important internal resource for positive work behaviors and occupational health outcomes. PsyCap refers to some positive psychological states, including self-efficacy, hope, resilience and optimism, manifested in one's growth and development process, which is considered a higher-order core psychological construct beyond human capital and social capital. PsyCap can be measured, developed, and effectively managed¹⁶. Previous studies indicated that workers with high PsyCap reported high organizational commitment, job satisfaction and performance, and well-being¹⁶⁻¹⁸. Also, those workers reported low levels of burnout and depressive and anxious symptoms¹⁹⁻²¹.

The effectiveness of organizational interventions in improving mental health relies on a clear understanding of the inherent relationships among coping resources and mental health problems. On the one hand, PsyCap may play a moderating role on the relationships of POS with depression and anxiety. A moderator affects the direction and/or strength of the relationship between an independent variable and a dependent variable. On the other hand, PsyCap may act as a mediator in the relationships of POS with depression and anxiety. A mediator explains the mechanism that determines how and why a certain relationship exists. Although the positive effects of POS and PsyCap on worker mental health and the mediating role of PsyCap in the relationship between POS and depressive symptoms have been confirmed²⁰, integrated studies on the inherent relationships among positive resources and mental health problems are still limited. To our knowledge, among underground coal miners, the positive roles of POS and PsyCap in combating depression and anxiety and whether or not PsyCap moderates and/or mediates these relationships have not been confirmed. Clarifying the roles of PsyCap in the relationship between POS and mental health problems is of practical and theoretical importance. Moreover, analysis of the positive effects of self-efficacy, hope, resilience and optimism should be carried out in order to identify key components

for PsyCap development because each component is conceptually distinct.

The present study aimed to verify the following three assumptions among Chinese underground coal miners: (1) POS, PsyCap and the components of PsyCap (self-efficacy, hope, resilience and optimism) are negatively associated with depressive and anxious symptoms, (2) PsyCap and its components act as moderators of the associations of POS with depressive and anxious symptoms, and (3) POS is positively associated with PsyCap and its components, and so PsyCap and its components also act as mediators of the associations of POS with depressive and anxious symptoms.

Subjects and Methods

Study subjects and data collection

During the period of July–August 2013, a cross-sectional survey was conducted in a coal-mining population in northeast China. About 50% of the underground miners from each department of six selected coal mines were cluster sampled (in total 2,500 underground miners). All these underground miners were male. After a brief description of the study was given to these participants, their written informed consent was obtained. Then, a set of self-administered questionnaires was directly distributed to the underground miners, and they completed these questionnaires anonymously after their scheduled shifts with the help of trained investigators. There was no interference by the investigators in the process of completing questionnaires. Missing data concerning any item within these questionnaires were excluded from the final analysis. Complete responses were obtained from 1,925 individuals (response rate: 77.0%). The study was approved by the Committee on Human Experimentation of China Medical University, and the study procedures were in accordance with ethical standards.

Measurements

Depressive symptoms were measured with the Chinese version of the Center for Epidemiologic Studies Depression (CES-D) Scale²². It consists of 20 items, and each item has 4 responses that describe the frequency of respondents' feelings in the past week ranging from 0 "rarely or none of the time (less than 1 day)" to 3 "most or all of the time (5 to 7 days)". The summed CES-D score ranges from 0 to 60, and higher scores indicate increased severity of depressive symptoms. Due to its good reliability and validity, the CES-D scale has been used widely across occupational groups in China^{3, 20, 23, 24}. In the present study, Cronbach's alpha coefficient for the CES-D scale was 0.89.

Anxious symptoms were assessed with the Chinese version of the Zung Self-Rating Anxiety Scale (SAS)²⁵. This scale has both good reliability and validity among various Chinese occupational populations^{21, 26}. The SAS is composed of 20 items with 4 responses: (1) never, (2) rarely/sometimes, (3) frequently, and (4) always. The raw score was standardized according to the formula: standard score = $\text{int}(1.25 \times \text{raw score})$. A higher summed score represents more severe anxious symptoms. In this study, Cronbach's alpha for the Zung SAS was 0.86.

POS was assessed using the Survey of Perceived Organizational Support (SPOS) scale¹³. The scale consists of 9 items that mainly concern the organization's valuation and well-being of employees. Each item has 7 responses with categories ranging from 1 "strongly disagree" to 7 "strongly agree". Higher average scores for the SPOS scale indicate higher POS levels. Also, this scale has been extensively applied and validated among Chinese occupational groups^{20, 27}. In this study, Cronbach's alpha for the POS scale was 0.85.

The Chinese version of the Psychological Capital Questionnaire (PCQ) was used to measure PsyCap¹⁶. The PCQ consists of 24 items and 4 subscales: self-efficacy (6 items), hope (6 items), resilience (6 items) and optimism (6 items). Each item has 6 responses with categories ranging from 1 "strongly disagree" to 6 "strongly agree". Higher average scores for the total scale and each subscale indicate greater PsyCap, self-efficacy, hope, resilience and optimism. The PCQ has been demonstrated to have adequate reliability and validity across occupational groups in China^{19–21}. For the total scale, Cronbach's alpha was 0.94 in this study. Cronbach's alpha coefficients for self-efficacy, hope, resilience and optimism subscales were 0.88, 0.86, 0.86, and 0.80, respectively.

Demographics including age (yr), marital status, education and presence of chronic disease were collected in this study. Marital status was categorized as single/divorced/widowed/separated or married/cohabiting. Education was categorized as junior high school or under, senior high school/technical secondary school and junior college or above. If the respondent had ever been diagnosed with any common chronic disease (e.g., hypertension, hyperlipidemia, gastritis, arthritis, hepatic steatosis, and diabetes), presence of "chronic disease" was considered to be "yes".

Working characteristics including job rank, monthly income (RMB, yuan) and weekly working time (h) were collected in this study. Job rank was categorized as head miner and staff miner. Monthly income was categorized as $\leq 3,000$ yuan, 3,001–5,000 yuan and $> 5,000$ yuan. Weekly working time was collected as

a continuous variable.

Statistic analysis

The P-P-plot and K-S tests were used to verify the normal distribution of continuous variables before the data analyses were conducted. Group differences of continuous variables were examined by Student's *t*-test or one-way ANOVA. Correlations among continuous variables were examined using Pearson's correlation analyses. Univariate analyses were carried out firstly to determine independent variables that were associated with depressive and anxious symptoms with adjustment for age, marital status, education, chronic disease, job rank, monthly income and weekly working time. Then, significant variables were added in the hierarchical linear regression models performed to examine the associations of POS, PsyCap and the components of PsyCap with depressive and anxious symptoms and explore the moderating roles of PsyCap and its components in the associations of POS with depressive and anxious symptoms. In Block 1, demographic and working characteristics were added. The dummy variables of marital status, education, chronic disease, job rank and monthly income were set, respectively, because they were categorical variables. In these analyses, "single/divorced/widowed/separated", "junior high school or under", participants with chronic disease diagnosis (yes), "head miner" and "monthly income \leq 3,000 yuan" were set as the reference groups. POS was added in Block 2. There were two models (Model 3A and Model 3B) in Block 3. PsyCap was added in Model 3A, and self-efficacy, hope, resilience and optimism were added in Model 3B. Also, there were two models (Model 4A and Model 4B) in Block 4. The product of POS and PsyCap was added in Model 4A, and the products of POS with self-efficacy, hope, resilience and optimism were added in Model 4B. The hypothesis of the moderator is supported if the interaction is significant.

Asymptotic and resampling strategies were executed to explore the mediating roles (indicated by $a*b$ product) of PsyCap and its four components on the associations of POS with depressive and anxious symptoms, respectively²⁸. In these analyses, POS was modeled as independent variable, and depressive and anxious symptoms were modeled as dependent variables, respectively; PsyCap and its components were modeled as mediators, and demographic and working characteristics were modeled as covariates. The bootstrap estimate was based on 5,000 bootstrap samples. A bias-corrected and accelerated 95% confidence interval (BCa 95% CI) for each $a*b$ product excluding 0 indicates a significant mediating role²⁸.

All study variables were centralized before analysis to account for differences in scale scores. Moreover,

multicollinearity was checked by tolerance and variance inflation factor (VIF). All analyses were conducted using SPSS for Windows, Ver. 13.0. Statistical significance was defined as $p < 0.05$ (two-tailed).

Results

Participant characteristics and distributions of study variables

Demographic and working characteristics of participants and distributions of study variables in categorical items are shown in Table 1. Among our subjects, 82.6% were married/cohabiting, and they reported higher POS, PsyCap, self-efficacy, resilience and optimism and lower depressive symptoms than those single/divorced/widowed/separated subjects. The percentage of participants with at least a senior high school/technical secondary school education was 50.2%. Educational level significantly affected all study variables except depressive symptoms. Participants with at least one chronic disease (36.5%) only reported higher anxious symptoms than healthy subjects. Head miners (17.8%) reported higher POS, PsyCap, self-efficacy, hope, resilience and optimism than staff miners, and 76.8% of our subjects earned a monthly income of more than 3,000 (yuan, RMB). Monthly income had a significant influence on all study variables except anxious symptoms.

Correlations among continuous variables

Correlations among continuous variables are presented in Table 2. The mean levels of depressive and anxious symptoms were 19.91 (SD=9.97) and 49.69 (SD=11.34), respectively. Both depressive and anxious symptoms were negatively correlated with POS, PsyCap, self-efficacy, hope, resilience and optimism. POS was positively correlated with PsyCap and its components. The average age of the sample was 40.07 years (SD=9.18). Our subjects worked 49.99 hours (SD=10.27) per week on average. POS, PsyCap, self-efficacy, hope, resilience and optimism were slightly and positively correlated with age. Weekly working time was negatively correlated with POS and positively correlated with depressive and anxious symptoms but only slightly. Given the significant influence of these demographic and working characteristics on dependent variables and hypothetical moderators and/or mediators, they were modeled as covariates in subsequent analyses.

Associations of POS, PsyCap and the components of PsyCap with depressive and anxious symptoms and moderating roles of PsyCap and its components

All independent variables including POS, PsyCap, self-efficacy, hope, resilience and optimism were

Table 1. Participant characteristics and the distributions of study variables in categorical items

Characteristics	N (%)	POS	PsyCap	Self-efficacy	Hope	Resilience	Optimism	CES-D	SAS
		Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Marital status									
Married/Cohabiting	1,590 (82.6)	4.81** (1.14)	4.30* (0.78)	4.29* (0.90)	4.28 (0.88)	4.31* (0.89)	4.32* (0.93)	19.62 (9.96)	49.53 (11.35)
Single/Divorced/ Widowed/Separated	335 (17.4)	4.53 (1.11)	4.19 (0.80)	4.18 (0.95)	4.21 (0.88)	4.17 (0.88)	4.21 (0.94)	21.28** (9.94)	50.46 (11.25)
Education									
Junior high school or under	959 (49.8)	4.82 (1.09)	4.25 (0.76)	4.24 (0.89)	4.24 (0.85)	4.25 (0.86)	4.29 (0.92)	20.30 (9.85)	50.49** (10.99)
Senior high school/ Technical secondary school	714 (37.1)	4.64 (1.15)	4.24 (0.81)	4.23 (0.94)	4.23 (0.91)	4.22 (0.93)	4.28 (0.95)	19.86 (10.01)	49.33 (11.71)
Junior college or above	252 (13.1)	4.89** (1.23)	4.51** (0.77)	4.54** (0.90)	4.46** (0.88)	4.60** (0.83)	4.44* (0.94)	18.61 (10.22)	47.71 (11.30)
Chronic disease									
Yes	702 (36.5)	4.83 (1.16)	4.28 (0.77)	4.27 (0.89)	4.27 (0.87)	4.30 (0.88)	4.29 (0.94)	20.43 (10.09)	50.46* (11.12)
No	1223 (63.5)	4.72 (1.12)	4.28 (0.79)	4.27 (0.92)	4.26 (0.88)	4.28 (0.90)	4.31 (0.93)	19.61 (9.90)	49.25 (11.44)
Job rank									
Head miner	343 (17.8)	5.08** (1.19)	4.41** (0.79)	4.38* (0.91)	4.41** (0.85)	4.41** (0.86)	4.44** (0.90)	19.18 (10.15)	48.99 (11.25)
Staff miner	1,582 (82.2)	4.69 (1.11)	4.25 (0.78)	4.25 (0.91)	4.23 (0.88)	4.26 (0.89)	4.27 (0.94)	20.07 (9.93)	49.85 (11.35)
Monthly income (RMB)									
≤3,000 yuan	447 (23.2)	4.63 (1.16)	4.23 (0.77)	4.23 (0.91)	4.23 (0.86)	4.19 (0.91)	4.28 (0.93)	20.10 (10.07)	49.11 (11.48)
3,001–5,000 yuan	1162 (60.4)	4.73 (1.11)	4.23 (0.78)	4.22 (0.90)	4.21 (0.88)	4.24 (0.88)	4.25 (0.94)	20.21* (9.84)	50.08 (11.28)
>5,000 yuan	316 (16.4)	5.07** (1.16)	4.52** (0.78)	4.50** (0.93)	4.50** (0.85)	4.54** (0.84)	4.52** (0.88)	18.56 (10.24)	49.10 (11.31)

POS: perceived organizational support; PsyCap: psychological capital; CES-D: the Center for Epidemiologic Studies Depression Scale; SAS: the Self-Rating Anxiety Scale; SD: standard deviation; * $p < 0.05$; ** $p < 0.01$.

Table 2. Correlations among continuous variables

Variables	Mean (SD)	1	2	3	4	5	6	7	8
1. POS	4.76 (1.14)	—							
2. PsyCap	4.28 (0.79)	0.46**	—						
3. Self-efficacy	4.27 (0.91)	0.41**	0.87**	—					
4. Hope	4.26 (0.88)	0.44**	0.91**	0.73**	—				
5. Resilience	4.28 (0.89)	0.37**	0.88**	0.65**	0.74**	—			
6. Optimism	4.30 (0.93)	0.39**	0.81**	0.59**	0.65**	0.69**	—		
7. CES-D	19.91 (9.97)	-0.45**	-0.41**	-0.34**	-0.38**	-0.36**	-0.35**	—	
8. SAS	49.69 (11.34)	-0.37**	-0.30**	-0.24**	-0.28**	-0.28**	-0.27**	0.74**	—
9. Age (yr)	40.07 (9.18)	0.09**	0.06**	0.05*	0.05*	0.06**	0.07**	-0.04	-0.01
10. Weekly working time (h)	49.99 (10.27)	-0.06**	-0.03	-0.03	-0.02	-0.00	-0.04	0.06**	0.09**

SD: standard deviation; POS: perceived organizational support; PsyCap: psychological capital; CES-D: the Center for Epidemiologic Studies Depression Scale; SAS: the Self-Rating Anxiety Scale; * $p < 0.05$; ** $p < 0.01$.

associated with depressive and anxious symptoms in univariate analyses with adjustment for demographic and working characteristics. Thus, they were entered in the following hierarchical multiple regression models.

Hierarchical multiple regression analysis results for depressive symptoms as dependent variable are presented in Table 3. In this study, the VIFs of all factors were less than 3.5, suggesting that multicollinearity is not an issue in the estimates. POS was significantly and negatively associated with depressive symptoms in Block 2. In Block 3 Model 3A, both POS and PsyCap were significantly and negatively associated with depressive symptoms. In Block 3 Model 3B, POS, hope, resilience and optimism were significantly and negatively associated with depressive symptoms. In Block 4 Model 4A, the negative associations of POS, PsyCap, and the product of POS and PsyCap with depressive symptoms were significant. In Block 4 Model 4B, there was no significant

association of the products of POS and PsyCap's components with depressive symptoms. Thus, PsyCap negatively moderated the association between POS and depressive symptoms, but only as an integral construct.

The associations of POS, PsyCap and the components of PsyCap with anxious symptoms and the moderating roles of PsyCap and its components are presented in Table 4. POS was significantly and negatively associated with anxious symptoms in Block 2. In Block 3 Model 3A, both POS and PsyCap were significantly and negatively associated with anxious symptoms. In Block 3 Model 3B, POS and resilience were significantly and negatively associated with anxious symptoms. In Block 4 Model 4A, significant negative associations of POS, PsyCap and the product of POS and PsyCap with anxious symptoms were also found. In Block 4 Model 4B, in addition to POS and resilience, the product of POS and resilience was significantly and negatively associated with anxious

Table 3. Associations of POS, PsyCap and its components with depressive symptoms and moderating roles of PsyCap and its components

Variables	Block 1		Block 2		Block 3				Block 4			
					Model 3A		Model 3B		Model 4A		Model 4B	
	β	VIFs	β	VIFs	β	VIFs	β	VIFs	β	VIFs	β	VIFs
Age	-0.069*	1.945	-0.055	1.946	-0.031	1.959	-0.030	1.960	-0.031	1.959	-0.029	1.962
Marital status	-0.047	1.380	-0.027	1.382	-0.031	1.382	-0.031	1.385	-0.028	1.385	-0.029	1.389
Education 1	-0.067*	1.495	-0.083**	1.496	-0.066**	1.502	-0.066**	1.503	-0.063**	1.506	-0.062**	1.508
Education 2	-0.098**	1.449	-0.076**	1.452	-0.044	1.474	-0.044	1.485	-0.040	1.479	-0.040	1.490
Chronic disease	-0.050*	1.057	-0.061**	1.058	-0.054**	1.059	-0.054**	1.061	-0.053**	1.059	-0.053**	1.063
Job rank	0.014	1.139	-0.029	1.148	-0.027	1.148	-0.028	1.149	-0.026	1.149	-0.026	1.150
Monthly income 1	0.000	1.548	0.017	1.549	0.013	1.549	0.013	1.554	0.015	1.551	0.015	1.559
Monthly income 2	-0.048	1.772	0.002	1.784	0.015	1.788	0.015	1.791	0.016	1.789	0.016	1.798
Weekly working time	0.081**	1.102	0.039	1.111	0.034	1.111	0.034	1.112	0.037	1.114	0.036	1.118
POS			-0.454**	1.044	-0.342**	1.310	-0.344**	1.326	-0.333**	1.341	-0.334**	1.360
PsyCap					-0.247**	1.307			-0.261**	1.372		
Self-efficacy							-0.028	2.356			-0.029	2.548
Hope							-0.084*	3.091			-0.085*	3.371
Resilience							-0.093**	2.744			-0.099**	2.913
Optimism							-0.080**	2.167			-0.088**	2.339
POS × PsyCap									-0.056**	1.063		
POS × Self-efficacy											0.005	2.293
POS × Hope											-0.007	3.185
POS × Resilience											-0.039	2.996
POS × Optimism											-0.024	2.507
F	4.664**		53.522**		62.753**		49.645**		58.371**		39.226**	
R ²	0.021		0.219		0.265		0.267		0.268		0.270	
ΔR^2	0.021**		0.197**		0.047**		0.048**		0.003**		0.004	

POS: Perceived organizational support; PsyCap: Psychological capital; Marital status: married/cohabiting vs. single/divorced/widowed/separated; Education 1: senior high school/technical secondary school vs. junior high school or under; Education 2: junior college or above vs. junior high school or under; Chronic disease: no vs. yes; Job rank: staff miner vs. lead miner; Monthly income 1: 3,001–5,000 vs. ≤3,000; Monthly income 2: >5,000 vs. ≤3,000; * $p < 0.05$; ** $p < 0.01$.

symptoms. Thus, both PsyCap and resilience negatively moderated the association between POS and anxious symptoms.

In addition, the effects of POS on depressive and anxious symptoms in Block 3 were both reduced compared with that in Block 2, as indicated by smaller β coefficients. These results implied that PsyCap and its components could probably become mediators in the associations of POS with depressive and anxious symptoms.

Mediating roles of PsyCap and its components

The associations of POS with PsyCap and its components (a), $a*b$ (the associations of PsyCap and its components with depressive and anxious symptoms after controlling for POS) products, and BCa 95% CI for these products are presented in Table 5. POS was significantly and positively associated with PsyCap, self-efficacy, hope, resilience and optimism.

Because PsyCap, hope, resilience and optimism were significantly and negatively associated with depressive symptoms, significant mediating roles of PsyCap ($a*b=-0.111$, BCa 95% CI: $-0.136, -0.089$), hope ($a*b=-0.036$, BCa 95% CI: $-0.069, -0.005$), resilience ($a*b=-0.032$, BCa 95% CI: $-0.057, -0.009$) and optimism ($a*b=-0.030$, BCa 95% CI: $-0.053, -0.009$) in the association between POS and depressive symptoms were revealed. In addition, there were significant mediating roles of PsyCap ($a*b=-0.071$, BCa 95% CI: $-0.093, -0.049$) and resilience ($a*b=-0.038$, BCa 95% CI: $-0.063, -0.013$) in the association between POS and anxious symptoms because of the significant associations of PsyCap and resilience with anxious symptoms.

The proportion of total effects of POS on depressive and anxious symptoms by mediator role was calculated with the formula $(a*b)/\text{total effect}$. For depressive symptoms, the proportions of mediating roles of

Table 4. Associations of POS, PsyCap and its components with anxious symptoms and moderating roles of PsyCap and its components

Variables	Block 1 (β)	Block 2 (β)	Block 3 (β)		Block 4 (β)	
			Model 3A	Model 3B	Model 4A	Model 4B
Age	-0.077*	-0.066*	-0.051	-0.049	-0.050	-0.047
Marital status	-0.025	-0.009	-0.011	-0.011	-0.008	-0.008
Education 1	-0.092**	-0.105**	-0.095**	-0.095**	-0.091**	-0.090**
Education 2	-0.131**	-0.112**	-0.092**	-0.090**	-0.087**	-0.085**
Chronic disease	-0.056*	-0.065**	-0.061**	-0.061**	-0.060**	-0.061**
Job rank	0.027	-0.008	-0.007	-0.008	-0.006	-0.005
Monthly income 1	0.029	0.043	0.040	0.042	0.042	0.044
Monthly income 2	0.008	0.048	0.057*	0.058*	0.058*	0.059*
Weekly working time	0.100**	0.065**	0.062**	0.063**	0.066**	0.065**
POS		-0.375**	-0.304**	-0.308**	-0.291**	-0.296**
PsyCap			-0.157**		-0.175**	
Self-efficacy				0.020		0.029
Hope				-0.036		-0.049
Resilience				-0.110**		-0.123**
Optimism				-0.054		-0.055
POS \times PsyCap					-0.074**	
POS \times Self-efficacy						0.031
POS \times Hope						-0.045
POS \times Resilience						-0.070*
POS \times Optimism						0.004
F	5.759**	36.641**	38.028**	30.620**	36.061**	24.899**
R ²	0.026	0.161	0.179	0.183	0.185	0.190
ΔR^2	0.026**	0.134**	0.019**	0.023**	0.005**	0.007**

POS: Perceived organizational support; PsyCap: Psychological capital; Marital status: married/cohabiting vs. single/divorced/widowed/separated; Education 1: senior high school/technical secondary school vs. junior high school or under; Education 2: junior college or above vs. junior high school or under; Chronic disease: no vs. yes; Job rank: staff miner vs. lead miner; Monthly income 1: 3,001–5,000 vs. $\leq 3,000$; Monthly income 2: $>5,000$ vs. $\leq 3,000$; * $p < 0.05$; ** $p < 0.01$.

Table 5. Mediating roles of PsyCap and its components on the associations of POS with depressive and anxious symptoms

Mediators	a	Depressive symptoms	Anxious symptoms
		a*b (BCa 95% CI)	a*b (BCa 95% CI)
PsyCap	0.450**	-0.111* (-0.136, -0.089)	-0.071* (-0.093, -0.049)
Self-efficacy	0.398**	-0.011 (-0.038, 0.013)	0.008 (-0.020, 0.036)
Hope	0.432**	-0.036* (-0.069, -0.005)	-0.016 (-0.050, 0.021)
Resilience	0.347**	-0.032* (-0.057, -0.009)	-0.038* (-0.063, -0.013)
Optimism	0.383**	-0.030* (-0.053, -0.009)	-0.021 (-0.045, 0.002)

PsyCap: Psychological capital; POS: Perceived organizational support; BCa 95% CI: Bias-corrected and accelerated 95% confidence interval. a: Associations of POS with PsyCap and its components; b: Associations of PsyCap and its components with depressive and anxious symptoms after controlling for POS; a*b: Product of a and b. Age, marital status, education, chronic disease, job rank, monthly income, and weekly working time were covariates. * $p < 0.05$; ** $p < 0.01$.

PsyCap, hope, resilience and optimism were 24.4, 7.9, 7.0 and 6.6%, respectively. For anxious symptoms, the proportions of mediating roles of PsyCap and resilience were 18.9 and 10.1%, respectively.

Discussion

First of all, our findings indicated that underground coal miners are suffering seriously from depressive and anxious symptoms. The mean level of depressive symptoms was higher than that of other male occupational groups in China, such as correctional officers²⁰⁾ and a cross-occupational sample including teachers, foreign enterprise employees, managers, researchers, traffic police and community health workers from Shanghai²³⁾. This was consistent with the level of Chinese male doctors²⁴⁾. In comparison with studies using the same anxiety indicator, the standard score of our subjects was much higher than the anxious symptoms among male university teachers²⁹⁾ and correctional officers³⁰⁾ and even a little higher than the levels of male doctors²⁶⁾ and underground and surface coal miners¹¹⁾ in China. Unfortunately, comparison of the levels of depressive and anxious symptoms across countries could not be carried out because there is no study on the symptoms of depression and anxiety of underground coal miners using the same indicators in other countries to the best of our knowledge. Therefore, urgent efforts should be made to prevent and reduce these symptoms among Chinese underground miners.

Coping resources to deal with mental health problems should include both external and internal resources. External resources mainly come from three dimensions: family, organization and society. Specifically, for the coal miners who work and live in a mining community, their social networks tend to be simple and stable. Therefore, sufficient support from their respective organizations not only can help them

solve problems at work but also can guarantee their family well-being. The present study indicated that POS may be a highly effective resource that can help underground miners combat depression and anxiety. This result was consistent with previous studies in which other occupational groups from different countries with supportive organizations were more likely to show mental well-being^{15, 20)}.

The internal coping resources of mental health problems include ability, personality trait, coping style, and so on. PsyCap is an integrated resource, and it can be developed and managed in many ways. The results of the present study were consistent with those of many previous studies, which also suggested that PsyCap and its components (hope, resilience and optimism) could help underground coal miners deal with mental health problems. Hope, resilience and optimism had negative associations with depressive symptoms, and only resilience was negatively associated with anxious symptoms.

The moderating and mediating roles of PsyCap on/in relationships among many occupational psychological variables have been widely verified. PsyCap is a moderator of the relationships between work stress and job burnout, job satisfaction and performance, emotional labor and burnout and emotional labor and job satisfaction^{31–33)}. Also, PsyCap acts as a mediator of the relationships between work-family conflict and burnout, work stress and depressive symptoms, POS and depressive symptoms and POS and job performance^{19, 20, 34, 35)}. In this study, PsyCap had significant and negative moderating roles on the associations of POS with depressive and anxious symptoms. In other words, with the increase in the PsyCap level, the associations of POS with depressive and anxious symptoms decreased among Chinese underground coal miners. Also, resilience had a significant and negative moderating role on the association between POS

and anxious symptoms. For underground coal miners with higher resilience, anxious symptoms would be much less dependent on POS in the workplace. The purpose of testing the moderating role on the bivariate relationship between the independent and dependent variables is to determine the scope and limits of the existing relationship. In this study, the effect of POS was stronger for depressive symptoms than for anxious symptoms, which hinted that the association between POS and depressive symptoms might not be susceptible to the moderating roles of different moderator variables compared with the association between POS and anxious symptoms. Moreover, only resilience had a significant association with anxious symptoms among the four components of PsyCap, and the effect of resilience was stronger for anxious symptoms than for depressive symptoms in this study. In view of the abovementioned results, resilience had a significant moderating role with respect to the association between POS and anxious symptoms but not with respect to the association between POS and depressive symptoms in this study. Consistent with previous studies^{20, 21, 27, 35}, POS was significantly and positively associated with PsyCap and its four components in this study. Individuals who perceive high POS would feel confident and hopeful about their desired goals. POS can help recipients to get out of adversity and promote an optimistic explanatory style with respect to success. The underground coal miners who perceive more POS at work may be more likely to experience higher levels of PsyCap, which in turn may reduce their depressive and anxious symptoms. Among the PsyCap's components, hope, resilience and optimism slightly mediated the association between POS and depressive symptoms, and only resilience partially mediated the association between POS and anxious symptoms.

The results of the present study indicated that each PsyCap component has different effects on the association between POS and mental health. The causes of these differences may be the differences in the concepts of the PsyCap's components, as well as the etiological and symptomatic differences of depressive and anxious symptoms. Firstly, resilience refers to one's positive capacity to bounce back from adversity to attain success, and it can promote the utilization of all protective resources to achieve good adaptation and harmonious development¹⁶. Previous studies showed that the associations of resilience with depressive symptoms and mental health were higher than that of other PsyCap components among frontline correctional officers and college students^{20, 36}. The results of this study were consistent with those of previous studies. Moreover, there are some symptomatic differences between depressive and anxious symptoms, though

they frequently co-occur²¹. Depressive symptoms include sadness, hopelessness, worthlessness, suicidal thoughts or actions and anhedonia, whereas anxious symptoms include worry, fear, avoidance and sleep disruptions. Hope is defined as a positive motivational state directing perseverance towards goals and pathways. Optimism refers to an explanatory style regarding self-attribution for positive events¹⁶. As a result, hope and optimism were associated with depressive symptoms, whereas they were not associated with anxious symptoms in this study. It is important to identify the symptoms of mental health disorders to develop different prevention and treatment strategies. Self-efficacy is a positive belief in one's work ability to deal with challenging tasks¹⁶. In general, there is a relatively weak or indirect effect of work ability on mental health³⁷. Therefore, self-efficacy was correlated with depressive and anxious symptoms in the univariate correlation analysis in this study, but it was not associated with depressive and anxious symptoms after controlling for other factors.

However, several limitations must be mentioned. First, the study was a cross-sectional survey, and it was impossible to draw causal relations among study variables. The findings need to be confirmed in longitudinal studies. The second limitation is that the study sample comprised only underground coal miners from a coal-mining population in northeast China. A larger sample size and better response rate could provide a good representation of underground coal miners and contribute to the generalization of our findings. Third, the correlations among study variables might be affected by the unique use of self-report measures. We carried out some effective process control measures to reduce common-method bias, which included adopting measurement tools with high reliability and validity, setting up a measurement interval between independent and dependent variables, ensuring the anonymity of respondents, and assuring respondents that there were no right or wrong answers.

The findings from our study could help managers increase their understanding of the severity of depressive and anxious symptoms in this population and develop effective interventions for prevention and treatment according to the effects and different types of effects (direct, indirect, mediating and moderating effects) of POS, PsyCap and the components of PsyCap on depressive and anxious symptoms that were confirmed in this study. Effective strategies should be applied to improve the POS and PsyCap levels and further to relieve mental health problems. In particular, hope, resilience and optimism should be given more attention in PsyCap investment^{38, 39}. Previous studies have found that supportive settings

could improve the level of PsyCap. Employers or managers should establish supportive settings in workplaces, including providing adequate help, paying attention to employees and their contributions and caring about their well-being.

Conclusions

Chinese underground miners suffer from both depressive and anxious symptoms. POS and PsyCap could be effective resources for coping with them. PsyCap negatively moderates the association between POS and depressive symptoms. Both PsyCap and resilience negatively moderate the association between POS and anxious symptoms. In addition, PsyCap, hope, resilience and optimism partially mediate the association between POS and depressive symptoms. PsyCap and resilience partially mediate the association between POS and anxious symptoms. Therefore, managers should promote supportive settings and investment in PsyCap to improve the mental health of underground coal miners.

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