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ORIGINAL RESEARCH

Association Between Suboptimal Health Status and Health-Related Productivity Loss in Primary Healthcare Workers in China: a Cross-Sectional Survey

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Objective: This study aimed to clarify the association between suboptimal health status and health-related productivity loss among primary healthcare workers in China.

Material and Methods: A field questionnaire survey was conducted with a multistage sampling among primary healthcare workers. The data on sub-health and health-related productivity loss were collected using the Sub-health Measurement Scale Version 1.0 and Work Productivity and Activity Impairment Questionnaire: General Health, respectively. Ordinary least squares regression was used to evaluate the association of the suboptimal health and health-related productivity loss. Subgroup analyses were performed by occupation (physician and nurse).

Results: Front-line primary healthcare workers (N = 1709) from 31 provinces in China responded to the survey. Of all participants, 73.43% experienced suboptimal health. The status of being in physical suboptimal health (Coef. = 0.050, $p < 0.001$, 95% CI = [0.031,0.070]) and mental suboptimal health (Coef. = 0.040, $p < 0.001$, 95% CI = [0.020,0.059]) status exerted significant effect on the extent of health-related productivity loss among primary healthcare workers in China. Nurses in social adaptation suboptimal health status (Coef. = 0.030, $p = 0.027$, 95% CI = [0.003,0.057]) had significant effect on health-related productivity loss.

Conclusion: The prevalence of suboptimal health is high among the respondents. Providing support for primary healthcare workers from bio-psycho-social aspects is an effective measure to promote their occupational health and improve their productivity.

Keywords: occupational health, productivity, presenteeism, healthcare workers, cross-sectional survey

Introduction

Health-related productivity loss (HRPL), the decrease in personal productivity due to health problems.[1] Healthcare workers are especially prone to HRPL due to their professional responsibility, dedication and irreplaceability.[2] The HRPL of healthcare workers may cause reduction in work efficiency and quality of medical services and may even harm the health of patients.[3] It is deemed that persisting with work in spite of illness is a sign of diligence and dedication in an Eastern cultural context. There are studies showing that the Chinese employees, including healthcare workers, have a strong sense of commitment and loyalty to organizations and therefore may in greater risk of suffering HRPL.[4,5]

Suboptimal health status (SHS) is a state of low-quality health in terms of physiology, psychology and social adaptation[6] and characterized by symptoms such as fatigue, pain, depression or stress. It is a non-disease and non-healthy state and may develop further into a disease state if not managed in time,[7] which has become a severe issue in many countries including China.[8–10]

Evidence from different countries suggests the association between health status and HRPL: good mental health was significantly and positively associated with productivity,[11] while poor physical health linked to HRPL.[12] It was also found that a range of health conditions, such as arthritis, asthma, back/neck pain, psychological distress diabetes and high

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cholesterol, had impact on employees' HRPL.[13] According to the human capital model,[14] an individual's productivity is directly proportional to his or her health status. As is shown in previous studies, health status is associated with lost productivity, and determinants of employees' productivity include mental health, physical health, job characteristics, organizational policies and presenteeism cultures.[15–18] Therefore, SHS, a low-quality health state in terms of physiology, psychology and social adaptation, would theoretically be associated with HRPL.

HRPL and SHS are common among healthcare workers. Primary healthcare workers (PHCWs) are the basic force in Chinese three-tier healthcare system. In 2015, the hierarchical diagnosis and treatment policy[19] was proposed by the State Council of the People's Republic of China to improve the utilization of primary healthcare institutions, which further increased the pressure on PHCWs.[20] However, the total number of PHCWs is still insufficient, which resulting in long working hours and heavy workload of them.[21] The intensity of their work increases the possibility of HRPL[22] and SHS.[23] Policies aimed at improving the productivity of PHCWs and ensuring their occupational health[24,25] have been issued separately in China, requiring the implementation of salary reform, paid leave and support from higher-level medical institutions. National Administration of Traditional Chinese Medicine and Shanghai Administration of Traditional Chinese Medicine also recommended that health risk assessment and specialized Chinese medicine interventions should be carried out for people in sub-health status.[26,27] The health state of PHCWs affects their productivity, clarifying the association between the SHS and HRPL of PHCWs is helpful to take measures to play the dual role of protecting occupational health of PHCWs and improving productivity, which is not only a core content of hierarchical diagnosis and treatment but also assure an equitable distribution of medical resources.[28]

A number of previous studies consistently show that healthcare workers with mental, physical, and chronic health conditions had higher rates of presenteeism.[29,30] Although it is shown in a qualitative study in Norway that nurses were confident that their suboptimal health issues did not significantly impact patient safety despite recognizing decrease in performance, such a statement was lacking in objective and quantitative evidence.[31] Literature review shows that studies on the association between the SHS and HRPL are rare. In the context of the current study, we aimed to assess the association between the SHS and HRPL of PHCWs through an empirical survey in primary healthcare institutions in China. The findings would offer reference for healthcare management in work quality and productivity improvement of PHCWs and may also be valuable to other developing or undeveloped countries. This study also has some significance for the promotion of PHCWs' health.

Method

Study Design and Participants

The survey was a cross-sectional study conducted in mainland China adopting a multistage sampling strategy. The flowchart was shown in Figure 1, and the steps were as follows:

(1) All of the 31 provincial administrative regions (including provinces, autonomous regions, and municipalities) in mainland China were included in the sampling. Cities in each provincial administrative region were evenly divided into three groups according to their 2020 per capita gross domestic product, thereby generating 93 groups.

(2) Within each group, two cities or districts not affected by the COVID-19 were selected using the random number method; thus, 186 cities or districts were selected. In each selected city or district, at least four primary healthcare institutions were surveyed by convenience based on the hospital administrators' permission to conduct the survey.

(3) In each surveyed primary healthcare institution, two participants were recommended by the hospital administrator(s) or another participant who completed the survey. The ratio of physicians to nurses in the survey was approximately 1:1.

The inclusion criteria were as follows: (1) full time and not currently suffering from diseases clearly diagnosed by secondary or higher medical institutions primary healthcare workers; (2) available and willing to participate in the study; and (3) able to sign the informed consent document. Primary healthcare workers in training (students on clerkships) were excluded.

Study Variables

Covariates

Gender, age, BMI, marital status, number of children, annual household income, education, technical title, years of practicing, and form of employment were included because these factors are potentially associated with health-related productivity loss.[32]

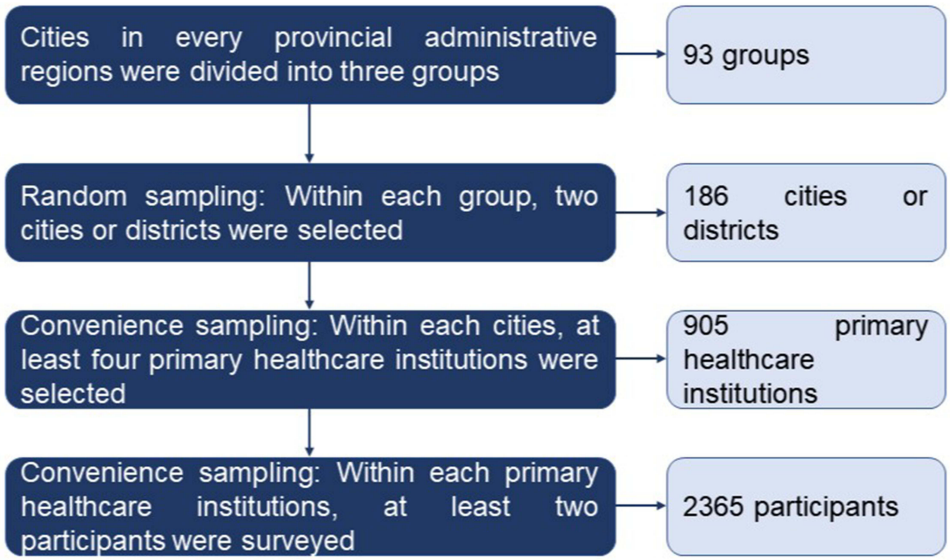

Figure 1 The flowchart of the multistage sampling strategy.

Suboptimal health status

The Suboptimal health Measurement Scale Version 1.0 (SHMS V1.0) was used to measure suboptimal health in this study.[6] The scale included 39 items on 3 dimensions: physical suboptimal health, mental suboptimal health and social adaptation suboptimal health. Respondents are required to evaluate their subjective feelings and expectations of their health status in the past four weeks using 5-point Likert items. Positive scoring items include question 1 (referred to as Q1) - Q3, Q13-Q19, and Q26-Q39, and these items are re-scored on the same scale as the original score, ranging from 1 to 5. Reverse scoring items include Q4-Q12, Q20-Q25, with re-scoring equal to 6 minus the original score. The sum of the scores of items in each subscale is the raw score of the subscale, and the sum of the scores of the three subscales is the raw score of the total scale, with higher scores meaning better health status. For comparison, these raw scores were converted to percentage in this study, and the transformed scores were used for analysis. Transformation score= (raw scores-theoretical minimum score)/(theoretical maximum score-theoretical minimum score)*100. SHMSV1.0 had good reliability and validity in a large sample population test in China.[33] According to the norm of the scale in Chinese urban residents, the participants were divided into three status: healthy, suboptimal health status, and diseased.[34]

Health-related productivity loss

Productivity loss due to health problems is usually measured with self-reporting tools.[35] The Chinese version of the Work Productivity and Activity Impairment Questionnaire: General Health (WPAI-GH2.0) was applied in this study. The questionnaire asked respondents to assess the impact of health problems on their work and daily activities. Moreover, the questionnaire consists of six questions (Q1-Q6) and the recall time frame is the past seven days. All items were scored according to the calculation rules specified by the questionnaire developers, with higher scores indicating greater productivity loss. Health-related productivity loss (%) = (Q2/(Q2+Q4)+((1-Q2/(Q2+Q4)))*(Q5/10)))*100%. The questionnaire has good validity and reliability.[36]

Data Collection

After explaining the aims, contents and ethical considerations of the study, a total of 538 undergraduate students majoring in pharmacy-related were recruited as data collecting volunteers and trained on accessing the potential participant, the contents of the face-to-face survey, basic research methodology, usage of research-related online system, and how to conduct the face-to-face interviews. The field survey was conducted during 1st August and 2nd September of 2021. After obtaining the administrators' consent, during the noon break of the hospital, the data collecting volunteers asked the potential participants for their basic information to determine whether they meet the study inclusion criteria and then conveyed the eligible participants with the purposes and requirements of the survey and checked their willingness to

participate. After those who were willing to participate signed the informed consent, a structured, anonymous and pre-coded questionnaire was used by each data collecting volunteers to conduct face-to-face surveys. The questionnaire did not involve any personal privacy, and the datasets generated during the current study were not publicly available.

The data collecting volunteers orally interviewed the participants with each item of the questionnaire and recorded their responses and then converted the data into electronic documents through an online survey system. The data collecting volunteers were required to assist only if the participants had any doubt on how to interpret any question from the questionnaire. The survey system allowed the users to set restrictions on format of responses and ensured the quality of the data. Quality control was accomplished by 19 postgraduates reviewing the uploaded documents and immediately returning those with data entry errors or damaged data. These problems could be corrected through return visits by data collecting volunteers when possible.

Data Analysis

Descriptive statistics were used to report the characteristics of the sample. The chi-square test was used for statistical evaluation of proportions, and Student's *t*-test was used for means. Ordinary least squares regression was used to assess the association between suboptimal health status and health-related productivity loss of primary healthcare workers in China, and presumptions of exogeneity of the independent variables, homoscedasticity and multicollinearity were verified using Durbin–Watson test, White's test and variance inflation factor, respectively (Supplementary File 1). Data included both continuous and categorial independent variables. To evaluate the robustness of the results, three independent variables, including physical suboptimal health, mental suboptimal health and social adaptation suboptimal health, were replaced by the overall suboptimal health into the regression model. The similarity of the results of two models could support the relative robustness of the final model. A p-value <0.05 was considered statistically significant. Stata 15.0 and SPSS 26.0 were used for data analysis.

Result

Overall, 1709 questionnaires were completed (response rate = 74.24%), including 799 questionnaires from physicians and 910 questionnaires from nurses. The other 656 questionnaires were excluded due to reasons such as not being collected or uploaded to the survey system, incomplete filling, or corrupted data files.

The main characteristics of all participants, as well as the Student's *t* test and chi-square test results are shown in Table 1. The mean age, annual household income and mean years of practicing as healthcare workers of physicians were

Table 1 The Main Characteristics of the Interviewed Primary Healthcare Workers

Item	N (%)			
	Physicians (799)	Nurse (910)	P	All (1709)
Age (mean, sd)	40.19(0.70)	32.61(8.01)	<0.001	36.16(9.16)
Years of practicing (mean, sd)	14.34(8.71)	8.962(7.19)	<0.001	11.48(8.38)
BMI (mean, sd)	22.65(3.75)	20.88(2.80)	<0.001	21.71(3.40)
Annual household income (mean, sd)	16.75(15.28)	13.07(8.88)	<0.001	14.79(12.43)
Health-related productivity loss (mean, sd)	0.112(0.18)	0.119(0.19)	0.4715	0.116(0.19)
Gender				
Male	398(49.81%)	46(5.05%)	<0.001	444(25.98%)
Female	401(50.19%)	864(94.95%)		1265(74.02%)
Marital status				
Unmarried	85(10.64%)	270(29.67%)	<0.001	355(20.77%)
Married	708(88.61%)	631(68.34%)		1339(78.35%)
Other (eg, divorced)	6(0.75%)	9(0.99%)		15(0.88%)

(*Continued*)

Table 1 (Continued).

Item	N (%)			
	Physicians (799)	Nurse (910)	P	All (1709)
Number of children				
Zero	110(13.77%)	333(36.59%)	<0.001	443(25.92%)
One	461(57.70%)	429(47.14%)		890(52.08%)
Two	209(26.16%)	138(15.16%)		347(20.30%)
Three or more	10(2.38%)	10(1.10%)		29(1.70%)
Education				
High school degree or below	57(7.13%)	100(10.99)	<0.001	157(9.19%)
Higher vocational degree	228(28.54%)	480(52.75%)		708(41.43%)
Undergraduate	421(52.69%)	319(35.05%)		740(43.30%)
Master	87(10.89%)	10(1.10%)		97(5.68%)
PhD	6(0.75%)	1(0.11%)		7(0.41%)
Technical title				
Primary title	324(40.55%)	703(77.25%)	<0.001	1027(60.09%)
Intermediate title	335(41.93%)	187(20.55%)		522(30.54%)
Deputy senior title	75(9.39%)	17(1.87%)		92(5.38%)
Senior title	24(3.00%)	3(0.33%)		27(1.58%)
None	41(5.13%)	0		41(2.40%)
Form of employment				
Contract workers	301(37.67%)	557(61.21%)	<0.001	858(50.20%)
Formal establishment	498(62.33%)	353(38.79%)		851(49.80%)
Physical status				
Health	231(28.91%)	289(31.76%)	0.233	520(30.43%)
Sub-health	527(65.96%)	565(62.09%)		1092(63.90%)
Disease	41(5.13%)	56(6.15%)		97(5.68%)
Mental status				
Health	187(23.40%)	223(24.51%)	0.159	410(23.99%)
Sub-health	581(72.72%)	635(69.78%)		1216(71.15%)
Disease	31(3.88%)	52(5.71%)		83(4.86%)
Social adaptation status				
Health	183(22.90%)	172(18.90%)	0.054	355(20.77%)
Sub-health	584(73.09%)	687(75.49%)		1271(74.37%)
Disease	32(4.01%)	51(5.60%)		83(4.86%)
General status				
Health	162(20.28%)	180(19.78%)	0.687	342(20.01%)
Sub-health	589(73.72%)	666(73.19%)		1255(73.43%)
Disease	48(6.01%)	64(7.03%)		112(6.55%)

significantly higher than that of nurses. In terms of gender, the largest number of participants was female (74.02%), especially among nurses, where the proportion of women was 94.95%. In terms of education background, the proportion of bachelor's degree in physicians (52.69%) was the highest, and the proportion of higher vocational degree in nurses (52.75%) was the highest. Overall, physicians had higher qualifications than nurses, and the difference was statistically significant.

The suboptimal health and health-related productivity loss of the interviewed PHCWs are also shown in Table 1. The raw score of HRPL and subhealth is shown in Supplementary Figure 1. The proportions of respondents in physical suboptimal health, mental suboptimal health, social adaptation suboptimal health, and overall suboptimal health status were 63.90%, 71.15%, 74.37%, and 73.43%, respectively. There are no significant differences in the composition of health status or HRPL scores between physicians and nurses.

The regression results are shown in Table 2. No independent variables were removed for suspected multicollinearity. The results were relatively robust between the models. In the subsequent sections, the original model is the focus of interpretation. Compared with healthy respondents, those in physical suboptimal health (Coef. = 0.050, p < 0.001, 95% CI = [0.058,0.172]) and mental suboptimal health (Coef. = 0.040, p < 0.001, 95% CI = [0.020,0.059]) status had significantly HRPL.

The regression results of the different occupation groups are shown in Table 3. As far as physicians are concerned, those in physical suboptimal health status (Coef. = 0.050, p = 0.001, 95% CI = [0.021,0.078]) and mental suboptimal health status (Coef. = 0.005, p = 0.024, 95% CI = [0.004,0.060]) had a higher HRPL than those in healthy status, and those with master degrees (Coef. = 0.068, p = 0.047, 95% CI = [0.001,0.136]) had significantly higher HRPL than those with high school

Table 2 The Regression Results of the Full Sample

	Original regression result[a]			Results of robustness test[b]		
	Coef.	**95% CI**	**p**	**Coef.**	**95% CI**	**p**
Physical status (ref=healthy)						
Diseased	0.115	[0.058,0.172]	<0.001**			
Sub-health	0.050	[0.031,0.070]	<0.001**			
Mental status (ref= healthy)						
Diseased	0.114	[0.049,0.179]	0.001**			
Sub-health	0.040	[0.020,0.059]	<0.001**			
Social adaptation status (ref= healthy)						
Diseased	0.066	[0.012,0.121]	0.017*			
Sub-health	0.018	[−0.002,0.038]	0.079			
General status (ref= healthy)						
Diseased				0.191	[0.147,0.236]	<0.001**
Sub-health				0.086	[0.070,0.102]	<0.001**
Gender (ref=male)						
Female	0.005	[−0.017,0.027]	0.658	0.001	[−0.021,0.023]	0.952
Age	0.002	[−0.000,0.004]	0.126	0.001	[−0.001,0.004]	0.209
Marriage status (ref=unmarried)						
Married	−0.008	[−0.058,0.041]	0.745	−0.008	[−0.058,0.042]	0.766
Others	0.017	[−0.114,0.147]	0.802	0.029	[−0.100,0.158]	0.662
Number of children (ref=none)						
One	−0.013	[−0.060,0.035]	0.598	−0.014	[−0.062,0.034]	0.566
Two	−0.042	[−0.091,0.008]	0.098	−0.038	[−0.088,0.012]	0.133
Three or more	−0.006	[−0.077,0.065]	0.866	−0.006	[−0.078,0.067]	0.875
Education (ref=high school degree or below)						
Higher vocational degree	0.010	[−0.022,0.042]	0.524	0.010	[−0.023,0.042]	0.555
Undergraduate	0.007	[−0.027,0.041]	0.702	0.006	[−0.028,0.040]	0.717
Master	0.045	[−0.009,0.098]	0.105	0.042	[−0.013,0.097]	0.134
PhD	0.159	[−0.080,0.399]	0.192	0.143	[−0.104,0.391]	0.256
Title(ref=junior)						
Middle	0.013	[−0.008,0.034]	0.219	0.015	[−0.006,0.037]	0.158
Deputy senior	0.002	[−0.040,0.043]	0.935	0.013	[−0.028,0.054]	0.528
Senior	−0.014	[−0.058,0.030]	0.527	−0.015	[−0.061,0.031]	0.521
None	−0.010	[−0.067,0.047]	0.728	−0.013	[−0.070,0.043]	0.639
Years of practicing	−0.001	[−0.003,0.001]	0.526	−0.001	[−0.003,0.002]	0.611
BMI	−0.001	[−0.003,0.002]	0.636	−0.001	[−0.003,0.002]	0.641
Annual household income	−0.000	[−0.001,0.000]	0.344	−0.000	[−0.001,0.000]	0.33
Employment form (ref=contract workers)						
Formal establishment	−0.010	[−0.028,0.007]	0.255	−0.012	[−0.030,0.006]	0.193

Notes: *p<0.05, **p<0.01. [a]F-test results of the original regression model: Prob>f: 0.0000, R-squared:0.0994, Root MSE: 0.17702. [b]F-test results of the model of robustness test:Prob>f: 0.0000, R-squared:0.0743, Root MSE:0.17925.

Table 3 The Regression Results of the Different Occupation Groups

	Physicians[a]			Nurses[b]		
	Coef.	95% CI	p	Coef.	95% CI	p
Physical status (ref=healthy)						
Diseased	0.143	[0.050,0.237]	0.003**	0.092	[0.021,0.163]	0.011*
Sub-health	0.050	[0.021,0.078]	0.001**	0.053	[0.022,0.081]	<0.001**
Mental status (ref= healthy)						
Diseased	0.166	[0.049,0.284]	0.000**	0.088	[0.011,0.165]	0.026*
Sub-health	0.032	[0.004,0.060]	0.024*	0.045	[0.017,0.072]	0.002**
Social adaptation status (ref= healthy)						
Diseased	0.046	[−0.047,0.139]	0.214	0.080	[0.013,0.148]	0.019*
Sub-health	0.005	[−0.025,0.037]	0.761	0.030	[0.003,0.057]	0.027*
Gender (ref=male)						
Female	0.010	[−0.015,0.034]	0.438	−0.042	[−0.120,0.033]	0.268
Age	0.001	[−0.002,0.004]	0.408	0.002	[−0.000,0.006]	0.174
Marriage status (ref=unmarried)						
Married	−0.076	[−0.172,0.021]	0.124	0.013	[−0.050,0.068]	0.729
Others	−0.159	[−0.298,-0.020]	0.025*	0.092	[−0.100,0.280]	0.336
Number of children (ref=none)						
One	0.028	[−0.058,0.114]	0.529	−0.026	[−0.083,0.032]	0.379
Two	−0.001	[−0.088,0.087]	0.987	−0.055	[−0.116,0.007]	0.081
Three or more	0.043	[−0.073,0.158]	0.469	−0.047	[−0.129,0.036]	0.265
Education (ref=high school degree or below)						
Higher vocational degree	0.025	[−0.021,0.071]	0.282	0.007	[−0.036,0.049]	0.761
Undergraduate	0.019	[−0.030,0.067]	0.455	0.003	[−0.044,0.050]	0.888
Master	0.068	[0.001,0.136]	0.047*	0.022	[−0.080,0.124]	0.669
PhD	0.211	[0.070,0.493]	0.141	0.000	[−0.062,0.061]	0.990
Title(ref=junior)						
Middle	0.019	[−0.010,0.048]	0.199	0.010	[−0.023,0.043]	0.539
Deputy senior	0.006	[−0.046,0.058]	0.812	−0.007	[−0.077,0.064]	0.847
Senior	−0.012	[−0.064,0.041]	0.669	0.025	[−0.028,0.078]	0.360
None	−0.015	[−0.069,0.039]	0.588			
Years of practicing	0.000	[−0.003,0.002]	0.829	−0.001	[−0.005,0.002]	0.429
BMI	−0.000	[−0.004,0.001]	0.290	0.001	[−0.004,0.005]	0.735
Annual household income	−0.000	[−0.001,0.000]	0.085	0.000	[−0.001,0.002]	0.689
Employment form (ref=contract workers)						
Formal establishment	−0.010	[−0.037,0.014]	0.362	−0.012	[−0.037,0.013]	0.346

Notes: *p<0.05, **p<0.01. [a]F-test results of the original regression model: Prob>f: 0.0000, R-squared:0.1322, Root MSE: 0.17364. [b]F-test results of the model of robustness test:Prob>f: 0.0000, R-squared:0.0962, Root MSE:0.17989.

degree or below. For nurses, compared with healthy respondents, respondents in physical suboptimal health status (Coef. = 0.053, p < 0.001, 95% CI = [0.022,0.081]), mental suboptimal health status (Coef. = 0.045, p = 0.002, 95% CI = [0.017,0.072]) and mental suboptimal health (Coef. = 0.030, p = 0.027, 95% CI = [0.003,0.057]) status had significantly higher HRPL.

Discussion

This study focused on the association between suboptimal health status and health-related productivity loss among primary healthcare workers in China. The sample in this survey had a similar distribution of gender, age, education and technical titles to those indicators of the national statistical information of primary healthcare workers in 2021, indicating the acceptable representativeness of the sample.[37]

Overall, the suboptimal health status was common among primary healthcare workers in China, which is similar to the survey of physicians in Quebec revealing their work overload regarding physical, mental, psychological, and relational/social aspects.[38] While the proportions of physicians in physical suboptimal health, mental suboptimal health, social adaptation suboptimal health, and general suboptimal health status were 65.96%, 72.72%, 73.09%, and 73.72%, respectively, the proportions of nurses in those suboptimal health statuses were 62.09%, 69.78%, 75.49%, and 73.19%, respectively. Such findings are basically consistent with the results of other researches in China.[39,40] As is indicated in this study, the physical and mental suboptimal health status had significant effects on the extent of health-related productivity loss of primary healthcare workers in China, and nurses in social adaptation suboptimal health status had significant effect on health-related productivity loss.

The health-related productivity loss of primary healthcare workers in the physical suboptimal health or worse physical health status was significantly higher compared to healthy status, which is consistent in physicians and nurses, suggesting that poor physical health status reduces productivity of primary healthcare workers. This is consistent with the findings for occupational populations that workers' health risks were significantly and positively associated with productivity loss.[41,42] A qualitative study in USA indicates that nurses recognized some illnesses impacted on their performance at work.[43] Physical suboptimal health of primary healthcare workers may limit their productivity for the following reasons: (1) Suboptimal health status was thought to be potentially associated with the progression of chronic diseases, and poor health would increase the risk of sick leave absenteeism and thus reduce productivity; (2) Health problems may impair the primary healthcare workers' ability to focus on work, reducing efficiency and productivity.[44] Physical disease status would cause more health-related productivity loss than healthy or physical suboptimal health status in primary healthcare workers, which was in line with the findings of previous researches.[3,45–47]

The regression results indicated that mental suboptimal health status significantly increased health-related productivity loss among primary healthcare workers, while the degradation of mental health further led to an increase in health-related productivity loss. Mental health was widely recognized as the primary factor affecting the advancement of work projects.[48] Healthcare workers were prone to physical and cognitive disorders such as job burnout, energy exhaustion, excessive fatigue, and passive avoidance and demoralization due to high responsibility, high intensity and work-life imbalance.[49,50] Previous studies show such problems as fatigue and job burnout are related to health-related productivity.[47] They would lead to a decrease in work motivation, job engagement and job satisfaction, resulting in a loss of productivity.

Outcomes of studies may vary with different culture (such as collectivism in Asia vs individualism in the United States and Europe),[51] as is indicated that individual, team and organizational productivity and effectiveness were significantly associated with leadership styles,[52] while organization culture and leadership style were not significantly associated with nurse productivity in another study.[53] This study suggests that social adaptation suboptimal health status had no significant effect on HRPL of PHCWs. Chinese culture is characterized by collectivism, which in turn may shape Chinese healthcare workers' work values and strengthened their organizational commitment.[54] This may be a protective factor for healthcare workers' productivity, mitigating to some extent the effects of social adaptation suboptimal health. During the acute phase of the COVID-19 outbreak, the restrictions of social distancing and lockdown prevented primary healthcare workers from effectively utilizing their support systems, most healthcare workers were often able to adapt to situations over time,[55] thus minor social adjustment disorders did not have a significant impact on productivity.

In terms of regression results by occupation, social adaptation suboptimal health status of physicians had no significant effect on HRPL, while this effect was statistically significant among nurses. Such a difference may be explained by the resilience. Resilient healthcare workers would seem more likely to deal more effectively with adverse situation and, also, tend to have more optimism as well as better regulation of emotions.[56] Previous studies found that female healthcare workers tend to develop greater physical and emotional stress during COVID-19, and physicians had a higher resilience compared to nurses due to general medical knowledge, education, and training for swift respond to emergencies.[57–60] Therefore, physicians are better at dealing with poor social adaptation and feelings of isolation, which mitigates the HRPL.

Suboptimal health was a potential risk factor for disease, so it seemed to be economical to focus health management on suboptimal health status that was still at low risk. Physical suboptimal health, mental suboptimal health and other workplace-related factors (such as low material benefits, low job support, etc.) of primary healthcare workers negatively affected their productivity. We can manage psychosocial factors, personal health issues, and organizational factors to

improve the overall health of primary healthcare workers in a sustainable and integrated manner. Measures such as conducting daily mental counseling, building a harmonious organizational culture, strengthening leadership care, training resilience, and performing physical exercise can be considered in order to effectively manage the health of primary healthcare workers and promote their productivity improvement.

This study had some limitations. First, we did not repeatedly measure the association between suboptimal health status and health-related productivity loss in primary healthcare workers over time, and thus may ignore the bias caused by the time factor. Second, this study carried out a strict multistage sampling design, but due to the impact of COVID-19 at the time of the survey, individual cities were unable to conduct field research, which may cause sample bias. For this issue, this study selected cities with similar economic levels in the same city group to conduct research, and the socio-demographic information of the sample was relatively consistent with the socio-demographic information of primary healthcare workers in national statistics. In addition, there were no scales that directly measured the impact of suboptimal health status on productivity. WPAI-GH asked about health problems and its impact on productivity, rather than suboptimal health status and its impact on productivity. We assume that the two concepts behave in a similar way in analyzing their association with productivity.

Conclusion

Our study suggests that the prevalence of suboptimal health is high among primary healthcare workers. It revealed that physical suboptimal health and mental suboptimal health of primary healthcare workers are significantly and positively related to HRPL, and social adaptation suboptimal health is significantly associated with HRPL among nurses. Therefore, it is critical to implement appropriate and effective practice approaches for healthcare workers, such as providing psychological counseling, providing adequate social support, implementing health risk assessment interventions and paid leave. More social support should be given to nurses. These approaches may play a significant role in developing administrative policies and interventions to promote healthcare workers' occupational safety and health, improve productivity and equip themselves with enough resilience.

Data Sharing Statement

Data are available on reasonable request. The datasets used and analyzed during the current study are not publicly available but are available from the corresponding author on reasonable request.

Ethical Considerations

This study was approved by the Ethics Committee of China Pharmaceutical University (ID: CPU2019015), and it was conducted in accordance with the Declaration of Helsinki.

Consent to Participate

Verbal informed consent was obtained from all individual participants included in the study.

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Author Contributions

Both authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

The authors report no conflicts of interest in this work.

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