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RESEARCH ARTICLE

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Ability and utility of the Physician Well-Being Index to identify distress among Chinese physicians

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ABSTRACT

Background: Despite the high prevalence of mental stress among physicians, reliable screening tools are scarce. This study aimed to evaluate the capability of the Physician Well-Being Index (PWBI) in identifying distress and adverse consequences among Chinese physicians.

Methods: This cross-sectional online survey recruited 2803 physicians from Southern Mainland China *via* snowball sampling between October and December 2020. Data on socio-demographic characteristics, the PWBI, mental distress (including quality of life [QOL], burnout, sleepiness, fatigue and suicidal ideation) and adverse outcomes (medical errors and turnover intention) were collected. Chi-square tests and logistic regression were used for data analysis.

Results: Seven items of the PWBI (emotional exhaustion, depression, stress, poor mental and physical QOL, low work meaning and dissatisfaction with work-life integration) were independently associated with low QOL (all $p<0.05$). Physicians with lower QOL were more likely to endorse each item (OR: 1.76-5.86) and less likely to have favourable index scores (all $p<0.001$). Assuming a prevalence of 29.2% for low QOL, the PWBI could reduce the post-test probability to 6.9% or increase it to 70.8%. Physicians scoring ≥4 on the PWBI were at increased risk (likelihood ratio >1) for experiencing various mental distress, with sensitivity exceeding 80% in detecting burnout, depression, high stress and anxiety. Additionally, the PWBI score helped stratify physicians' likelihood of reporting medical errors and turnover intention.

Conclusions: This study provides preliminary insights into the validity and utility of the 9-item PWBI as a screening tool for assessing distress and well-being among Chinese physicians, helping identify those at higher risk of medical errors or turnover. However, these findings should be interpreted with caution due to the limited sample size.

HIGHLIGHTS

1. Physicians with lower quality of life were more likely to endorse these items on the PWBI.
2. The PWBI was effective in stratifying physicians' likelihood of experiencing mental distress.
3. The PWBI effectively predicted the likelihood of physicians reporting recent medical errors and their turnover intention.

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1. Introduction

In recent years, the well-being of physicians has become a global concern [1–3]. Subjective well-being encompasses various dimensions, including positive affect, life satisfaction, fulfillment, positive functioning, and the absence of negative emotions [4]. The COVID-19 pandemic has further underscored the importance of promoting well-being among healthcare professionals [5,6], with the World Health Organization expressing concerns about the potential adverse consequences for the affected physicians [7]. Psychological distress (such as anxiety, depression, burnout, fatigue and stress) of healthcare professionals

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manifests as emotional suffering arising from workplace stressors and unaddressed needs in their daily lives [8,9]. Not only does it lead to a range of adverse personal and professional consequences, including poor quality of life (QOL) [10], suicide [11], medical malpractice [12] and physician turnover [13], but it also has detrimental impacts on both the quality of patient care and the healthcare systems [3,14–16]. Consistent with the prevalence of psychological distress reported in other countries [17–19], approximately one-third of Chinese physicians exhibit symptoms of depression and anxiety [10], with over half suffering from burnout [1]. However, physicians often lack awareness of their distress or are reluctant to acknowledge it, which makes them hesitate to seek support [9,20]. Given these concerns, it is critical to explore effective and practical approaches for the early identification of mental distress and provide support accordingly to promote the well-being of physicians.

Screening tools such as the 9-item Patient Health Questionnaire (PHQ-9) and the Maslach Burnout Inventory (MBI) are commonly used to assess psychological distress [9]. While these instruments are reliable for evaluating specific mental health concerns, they may fail to capture other dimensions of distress when used in isolation [21]. Well-being is a complex and multidimensional construct and the absence of distress in any one area, as measured by these tools, does not necessarily reflect overall well-being [22]. Additionally, these tools have several limitations, including their length, complexity, difficulty in data analysis and inability to predict occupational outcomes, such as medical errors or intent to leave the job [20,23,24]. Specifically, the PHQ-9 primarily assesses depression as a clinical disorder rather than stress responses, making it less suitable for screening within the physician population [22]. While the MBI focuses on exhaustion, depersonalization and personal accomplishment, it overlooks other important aspects of physician burnout, such as a sense of meaning in work and work-life integration [25]. Moreover, the high cost associated with administering the MBI may limit its accessibility and widespread use. These limitations highlight the need for a more comprehensive, valid and reliable tool to systematically screen for psychological distress among physicians.

To address these concerns, Dyrbye et al. [20] developed the Physician Well-Being Index (PWBI), a brief and reliable self-assessment tool designed to identify physicians experiencing significant distress and in need of intervention. The PWBI assesses distress across multiple dimensions, including fatigue, depression, burnout, stress and mental/physical QOL in medical professionals. Initially consisting of 7 items, the PWBI was later expanded to 9 items to better detect distress and identify physicians with high levels of well-being [26,27]. This instrument was validated using a sample of 6,880 physicians in the US [26–28]. Detailed information regarding the content, rating scale and interpretation of the PWBI are presented in the subsection of measures below.

Although the validity of the 9-item PWBI has been evaluated in the United States and several other countries [9,27], it has not yet gained widespread usage. Its effectiveness in assessing distress within the Chinese physician population remains unclear. To address this gap, we conducted an online cross-sectional survey to evaluate the ability and utility of the PWBI in identifying distress among Chinese physicians, including fatigue, burnout, depression, anxiety, sleepiness, stress, somatic symptoms and suicidal ideation. Additionally, we assessed its capacity to identify physicians at increased risk for adverse personal outcomes (such as low QOL) and professional outcomes (such as medical errors or turnover intentions). Finally, we established appropriate thresholds for predicting an increased risk of distress and related negative outcomes.

2. Methods

2.1. Study design and participants

We conducted a cross-sectional online survey in Southern Mainland China using a structured questionnaire on the Wenjuanxing platform (www.wjx.cn), a popular Chinese online survey site, between October and December 2020. Participants meeting the following criteria were recruited *via* snowball sampling: (1) Chinese, aged 18-65 years old; (2) able to understand Chinese and willing to participate in the survey; and (3) having been working as physicians in Chinese hospitals for a minimum of one year, regardless of their specialty. Medical students and doctors working abroad were excluded. This online survey only allowed one response per device and provided no incentives. The questionnaire included a wide range of occupation options, covering both healthcare roles (such as physicians, nurses and other healthcare workers) and non-medical professions. This comprehensive list ensured that participants had no clear incentive to misrepresent themselves as physicians. Additionally, we incorporated a trap question, 'When is the Chinese national day?' to identify and exclude invalid responses. We also excluded responses that appeared completely implausible, such as those reporting an unrealistically high number of monthly shifts (e.g. more than 30

shifts per month), excessive weekly working hours (e.g. over 120 h per week), or inconsistencies between age and years of clinical experience (e.g. a 25-year-old claiming 10 years of experience). The study was approved by the ethics committee of the Second Xiangya Hospital of Central South University (JY20200326), and all participants provided written informed consent.

2.2. Sample size

A sample size of 2261 produces a two-sided 95% confidence interval (CI) with a width of 0.020 when the sample proportion is 0.36, based on 36% of Chinese physicians reporting low QOL in a previous study [29]. Assuming a 90% validity rate for the questionnaire, the required final sample size is approximately 2513. The sample size calculation was performed using PASS 15.0.5.

2.3. Measures

2.3.1. Socio-demographic information

The online survey consisted of four sections. Section 1 focused on the respondents' socio-demographic information, including age, gender, marital status, level of education, professional title, years of clinical experience, weekly working hours, the number of night shifts or weekend shifts per month, monthly disposable income and hospital level.

2.3.2. Physician Well-Being Index

Section 2 of the questionnaire focused specifically on the expanded version of the PWBI (a total of 9 items), which included inquiries about satisfaction with work-life balance and the perception of meaning in work [20,26,27]. The first seven items covered various manifestations of burnout (emotional exhaustion and depersonalization), depression, fatigue or sleepiness, stress, poor mental QOL and poor physical QOL. Participants were asked to respond to these items with 'yes' or 'no', and each answer of 'yes' was assigned one point. All nine questions evaluated the participants' status over the past month. For the eighth item, participants were asked to rate the meaning of their work using a 7-point Likert scale, ranging from 'strongly disagree' to 'strongly agree', in response to the statement 'The work I do is meaningful to me'. The responses were classified into three levels: 'low level' (+1 point) for responses option of 1 or 2, 'neutral level' (0 point) for responses option of 3 to 5 and 'high level' (–1 point) for responses option of 6 or 7. The ninth item assessed participants' work-life balance using the question: 'My work schedule leave me enough time for my personal/family life (satisfaction with work–life integration)'. The responses to this question were classified as follows: 'high' (–1 point) for strong agreement or agreement with the statement, 'neutral' (0 point) for neutral response and 'low' (+1 point) for disagreement or strong disagreement.

The original English version of PWBI and guidelines for its use in research (the Well-being Index Research document) were provided by the Mayo Clinic [20,26], which also authorized the first translation of PWBI into Chinese. The English PWBI was translated into Chinese through a three-stage process, following Sperber's recommendations for translating instruments for cross-cultural research [30]. First, the PWBI was translated from the original English version into Chinese by two native Chinese-speaking psychiatrists working independently of each other with particular attention to its human fluency and cultural issues. After that, they agreed on a final common translation. Second, the Simplified Chinese version of PWBI was back-translated by an English-Chinese bilingual psychiatrist who did not know the wording of the original English version of the PWBI. The two English versions were then compared item by item, and minor discrepancies were addressed and corrected in the Chinese version, according to the consensus of these translators. Finally, the revised version was tested among fifteen physicians, and minor changes were made to develop a final version. In this study, the internal consistency of the PWBI was fair, with a Cronbach's α coefficient of 0.73.

2.3.3. Mental distress

Section 3 focused on participants' mental distress, including overall QOL, burnout, depression, excessive daytime sleepiness, level of fatigue, perceived stress, anxiety, somatic symptoms and suicidal ideation.

Quality of life and fatigue. Consistent with previous research [20,27,28], we used single-item linear analogue self-assessment (LASA) questions to evaluate overall QOL and fatigue. This instrument measures overall QOL and fatigue in the past week on a 0 to 10 scale, with response anchors ranging from 'worst possible' (0) to 'best possible' (10). Physicians with a score of at least 0.5 standard deviations below the group's sex-matched mean were regarded as having low QOL or extreme fatigue [31]. The two scales have been well-validated and widely used among medical staff [27,32–35].

Burnout was assessed using the single-item measure, which includes questions on emotional exhaustion ('How often do you feel burned out from work?')

and depersonalization ('How often do you feel you have become more callous toward people since you took this job?'). The responses were rated on a 7-point Likert scale, ranging from 'never' to 'every day'. Physicians reporting emotional exhaustion or depersonalization at least weekly were considered as experiencing burnout [36]. These two single items have been confirmed to have strong factorial validity and were widely used in burnout research among medical staff [17,37–41].

Depression and anxiety. We assessed depressive and anxiety symptoms using the Chinese version of the PHQ-9[42] and the Chinese version of the 7-item Generalized Anxiety Disorder Scale (GAD-7) [43], respectively. Both scales have good reliability and validity and were widely used among Chinese healthcare workers [42–45]. Participants rated their depressive and anxiety symptoms on a 4-point Likert scale from 0 (not at all) to 3 (almost every day), with higher scores indicating more severe mental distress. Consistent with previous studies [46], we employed a cut-off of 10 to identify clinically relevant depressive and anxiety symptoms.

Excessive daytime sleepiness or dozing propensity was assessed using the Mandarin version of the Epworth Sleepiness Scale (ESS), which was proven acceptable, reliable and valid [47]. All items in this scale are rated on a 4-point scale; its total score ranges from 0 to 24, with higher scores indicating greater daytime sleepiness and a score over 10 indicating excessive daytime sleepiness.

Perceived stress was evaluated using the Chinese version of the PSS-10, demonstrating adequate psychometric properties [48,49]. Each item was rated on a 5-point scale (0 = never to 4 = very often), with higher scores indicating higher levels of perceived stress. The total score ranges from 0 to 40, with a score of 19 or higher indicating a high level of perceived pressure.

Somatic symptoms. The Chinese version of the 15-item Patient Health Questionnaire (PHQ-15), which exhibited satisfactory reliability and validity, was utilized to screen somatic symptoms and evaluate their severity [50,51]. It encompasses inquiries about fifteen specific somatic symptoms, including fatigue, gastrointestinal discomforts, musculoskeletal pain and cardiopulmonary symptoms. Participants were asked to rate the intensity of their symptoms over the past four weeks on a 3-point Likert scale (0 = not bothered at all, 1 = bothered a little and 2 = bothered a lot). The total score ranged from 0 to 30, with higher scores indicating higher severity of somatic symptoms. In this study, participants with a score of 10 or more were regarded as having somatic symptoms.

Suicidal ideation. A single-item question from the US National Comorbidity Survey [52] was used to assess the one-year suicidal ideation: 'In the past 12 months, have you seriously considered attempting suicide?' Participants were required to respond with a 'yes' or 'no'. This question has been used extensively to assess suicidal ideation in other studies of medical professionals [27,28,53–55] and the general population [56,57].

2.3.4. Adverse consequences

Section 4 was used to collect detailed information about the adverse consequences experienced by the participants, such as medical errors, intention to leave and considerations of transitioning to non-medical careers.

In this section, intention to leave was assessed with a standard question that asks respondents to indicate the likelihood of leaving their current institution within the next two years, with 5 Likert scale response options from '1 = none' to '5 = definitely'. This previously developed measure has been validated and widely used among physicians [27,58–60]. Consistent with previous reports [34,58,59], responses of moderate likelihood and above (≥ 3) were classified as 'intent to leave'. Those who reported intention to leave their jobs were further inquired about their actions and intentions, which included engagement in other medical practices, transitioning to non-clinical roles, completely exiting the healthcare industry, retiring, or exploring other possibilities. Responses were documented for participants considering the possibility of 'completely leaving the healthcare industry and pursuing a different career'. Additionally, consistent with numerous previous studies [12,27,34,35], we used a self-report measure to screen for medical errors. Participants were asked, 'Are you concerned that you have made any medical errors within the last three months?' with binary response options 'Yes' and 'No'.

2.4. Statistical analysis

The normality of variables was tested using the quantile-quantile (Q-Q) plot and Kolmogorow-Smironov test [61]. Non-normally distributed continuous variables were presented as medians and interquartile ranges (IQR, 1st quartile, 3rd quartile). Pearson's chi-square test was used as appropriate to determine the univariate odds ratio (OR), post-test probabilities and likelihood ratios (LR) associated with the PWBI scores for the outcomes of interest. The Mann-Whitney U rank sum test was used to compare the mean PWBI

scores between groups. Moreover, receiver operating characteristic (ROC) curves were generated to assess the outcomes of interest, and important metrics such as the area under the ROC curves (AUC), optimal threshold, sensitivity, specificity and Youden's index were calculated. Spearman's correlation coefficient was used to examine the correlation between the total PWBI score and distress or adverse consequences. Logistic regression analysis was conducted to identify items in PWBI that independently predicted low QOL. All the statistical analyses were conducted using SPSS 26.0; all tests were two-tailed, and the significance level was set at $p < 0.05$.

3. Results

3.1. Demographic characteristics, mental distress and adverse consequences

A total of 3071 physicians participated in this online survey, with 2803 responses (91.3%) deemed eligible for subsequent analyses (Table 1). The median age of participants was 35 years (IQR, 29-40), and more than half were female (1788, 63.8%). The majority of respondents were married, comprising over two-thirds of the sample ($n = 2002$, 71.4%), and 869 physicians (31.0%) held a master's degree or higher. The median number of weekly working hours was 48 (IQR, 40-60), and the median number of night or weekend shifts per month was 4 (IQR, 2-8). Most participants worked in tertiary hospitals (1599, 57.0%), followed by secondary hospitals (734, 26.2%). Furthermore, 1269 physicians (45.3%) held a junior professional title or lower, and their median clinical experience was ten years (IQR, 4-17) (Table 1).

The median QOL score was 7 (IQR, 5-8); 817 physicians (29.1%) reported to have a low QOL, and 964 (34.4%) reported a high QOL. Regarding burnout, 27.0% of the physicians reported at least one symptom of burnout. More than one-fifth (23.3%) exhibited a moderate or higher likelihood of leaving their current job within the next two years for reasons other than retirement. This included 12.1% of the participants intending to leave the healthcare profession

Table 1. Demographic characteristics of participants.

Variables	No. (%)[a] or Median (IQR)[b]		
	All participants ($n = 2803$)	Individuals with low QOL ($n = 817$)	Individuals without low QOL ($n = 1986$)
Age[b]	35 (29, 40)	34 (29, 40)	35 (30, 41)
Gender[a]			
Male	1015 (36.2)	281 (34.4)	734 (37.0)
Female	1788 (63.8)	536 (65.6)	1252 (63.0)
Partnership status[a]			
Single	705 (25.2)	253 (31.0)	452 (22.8)
Married	2002 (71.4)	529 (64.7)	1473 (74.2)
Divorced or widowed	96 (3.4)	35 (4.3)	61 (3.1)
Education level[a]			
Associate degree or vocational diploma	328 (11.7)	11.4 (14.0)	214 (10.8)
Bachelor's degree	1606 (57.3)	453 (55.4)	1153 (58.1)
Master's degree	573 (20.4)	168 (20.6)	405 (20.4)
Doctoral degree	296 (10.6)	82 (10.0)	214 (10.8)
Professional title[a]			
Junior profession title and below	1269 (45.3)	414 (50.7)	855 (43.1)
Intermediate professional title	862 (30.8)	250 (30.6)	612 (30.8)
Senior professional title	672 (20.4)	153 (18.7)	519 (26.1)
Years of clinical experience[b]	10 (4, 17)	9 (4, 15)	10 (5, 18)
Hours worked per week[b]	48 (40, 60)	50 (40, 60)	48 (40, 56)
No. of shifts per month[b,c]	4 (2, 8)	5 (2, 10)	4 (2, 8)
Monthly disposable income, CNY[a,d]			
>6367	735 (26.2)	178 (21.8)	557 (28.0)
3271-6366	628 (22.4)	175 (21.4)	453 (22.8)
2087-3270	454 (16.2)	132 (16.2)	322 (16.2)
1311-2086	421 (15.0)	131 (16.0)	290 (14.6)
616-1310	350 (12.5)	113 (13.8)	237 (11.9)
≤615	215 (7.7)	88 (10.8)	127 (6.4)
Hospital level[a,*]			
Primary hospital or below	470 (16.8)	157 (19.2)	313 (15.8)
Second-class hospital	734 (26.2)	211 (25.8)	523 (26.3)
Tertiary hospital	1599 (57.0)	449 (55.0)	1150 (57.9)

[a]Categorical variables, expressed as the number and percentage of study participants.
[b]Continuous variables, presented as medians and interquartile ranges (IQR, 1st quartile, 3rd quartile).
[c]Number of night shifts or weekend shifts per month.
[d]Annual income in RMB, excluding all necessary expenses.
[*]Tertiary hospitals offer advanced technology and skilled professionals, providing high-quality care, education, research and treatment. As hospital levels decrease, their scale, facilities and technology also diminish.

pursuing a non-medical career. Alarmingly, over one-fifth (20.4%) of the participants reported having suicidal thoughts within the past year, and 21.9% admitted to making a medical error within the past three months. Among physicians, 26.0%, 13.2%, 34.9%, 34.3%, 50.9% and 28.2% experienced depression symptoms, anxiety symptoms, somatic symptoms, high perceived stress, excessive daytime sleepiness and high fatigue, respectively. The median PWBI score was 3 (IQR, 3-5), and the distribution of physicians across different PWBI scores is presented in Figure S1.

3.2. Ability to detect mental distress

Physicians who reported lower QOL were more likely to endorse each item in the PWBI (Table 2). They also exhibited less favourable index scores, with a median score of 5 compared to 2 for those with higher QOL ($p < 0.001$) (Table S1). The stepwise logistic regression analysis revealed that, except for the second item concerning emotional hardening and the fourth item related to falling asleep while sitting inactive in a public place, all the remaining seven items in PWBI appeared to be independently and significantly predictive of low QOL ($p < 0.05$), with OR ranging from 1.27 to 2.73 (Table 3). Most of the items in PWBI demonstrated a sensitivity of ≥75.9%, with specificity ranging from 42.3% to 90.5% for detecting distress in their respective domains (Table S2).

As the summative PWBI score increased, the OR of low QOL ranged from 0.04 for individuals with a score of −2 to 11.52 for those with a score of 9 (lower scores are more favourable) (Table 2). Furthermore, a significant correlation was found between the total PWBI score and low QOL, with a correlation coefficient of 0.587 ($p < 0.001$) (Table S3). With an initial prevalence of low QOL of 29.15%, the PWBI was found to have the potential to either reduce the post-test probability of low QOL to 6.93% or increase it to 70.83% (Table 4). The PWBI demonstrated good discriminative performance for low QOL, with an area under the ROC curve of 0.77 (95% CI, 0.75-0.79). When the optimal threshold was set at 4, the PWBI achieved a sensitivity of 77.1% and a specificity of 63.3% (Table 5).

Physicians experiencing mental distress had significantly less favourable scores on PWBI (all $p < 0.001$) (Table S1). The increase in PWBI score was also associated with increased odds of experiencing burnout (OR for the most favourable score: 0.05; OR for the least favourable score: 20.66), depression (0.08; 9.38), excessive daytime sleepiness (0.26; 7.29), high levels of fatigue (0.39; 6.18), high levels of perceived stress (0.02; 14.59), anxiety (0.06; 9.63), somatic symptoms (0.20; 3.45) and recent suicidal ideation (0.11; 3.49). A

Table 2. Physician well-being Index items endorsed by physicians with or without low quality of life.

Item	No. (%) endorsing item		
	Physicians with low QOL ($n = 817$)	Physicians without low QOL ($n = 1986$)	OR (95% CI)[a]
1. Feel burned out from work (burnout: emotional exhaustion)	636 (77.8%)	907 (45.7%)	4.18 (3.47, 5.04)
2. Work hardening me emotionally (burnout: depersonalization)	562 (68.8%)	830 (41.8%)	3.07 (2.58, 3.65)
3. Feel down, depressed, or hopeless (depression)	544 (66.6%)	514 (25.9%)	5.71 (4.78, 6.81)
4. Fallen asleep while sitting inactive in a public place (fatigue or sleepiness)	214 (26.2%)	333 (16.8%)	1.76 (1.45, 2.14)
5. Tasks piling up and feel overwhelmed (stress)	621 (76.0%)	1023 (51.5%)	2.98 (2.48, 3.58)
6. Bothered by emotional problems (poor mental QOL)	726 (88.9%)	1145 (57.7%)	5.86 (4.63, 7.42)
7. Physical health interfering with daily work (poor physical QOL)	501 (61.3%)	626 (31.5%)	3.44 (2.91, 4.08)
8. Meaning in work, low level[b]	76 (9.3%)	70 (3.5%)	2.81 (2.01, 3.93)
4. Satisfaction with work–life integration, low[c]	561 (68.7%)	913 (46.0%)	2.58 (2.17, 3.06)
PWBI score			
−2 (most favourable)	2 (0.2%)	107 (5.4%)	0.04 (0.01, 0.18)
−1	5 (0.6%)	137 (6.9%)	0.08 (0.03, 0.20)
0	16 (2.0%)	225 (11.3%)	0.16 (0.09, 0.26)
1	32 (3.9%)	270 (13.6%)	0.26 (0.18, 0.38)
2	56 (6.9%)	257 (12.9%)	0.50 (0.37, 0.67)
3	76 (9.3%)	261 (13.1%)	0.68 (0.52, 0.89)*
4	110 (13.5%)	233 (11.7%)	1.17 (0.92, 1.49)§
5	117 (14.3%)	219 (11.0%)	1.35 (1.06, 1.72)†
6	146 (17.9%)	150 (7.6%)	2.66 (2.09, 3.40)
7	172 (21.1%)	92 (4.6%)	5.49 (4.20, 7.18)
8	71 (8.7%)	32 (1.6%)	5.81 (3.80, 8.90)
9 (least favourable)	14 (1.7%)	3 (0.2%)	11.52 (3.30, 40.21)

CI = confidence interval; OR = odds ratio; QOL = quality of life; SD = standard deviation; PWBI = Physician Well-Being Index. All analyses were performed using Pearson's Chi-squared test.

*$p = 0.005$.

§$p = 0.204$.

†$p = 0.015$, all other $p < 0.001$.

[a]Odds ratio represents risk of low QOL in group of individuals that endorsed the item relative to the referent group.

[b]This group consisted of individuals who reported a low level of meaning in their work (responses of 1 or 2 on the 7-point Likert scale).

[c]This group included individuals who expressed low satisfaction with work-life integration (selecting 'disagree' or 'strongly disagree').

Table 3. Identification of independent predictive items for low quality of life in the Physician Well-Being Index using stepwise logistic regression analysis.

Item	β	OR (95% CI)	P value
1	0.48	1.61 (1.29, 2.02)	<0.001
2	Not included	–	–
3	1.00	2.73 (2.22, 3.35)	<0.001
4	Not included	–	–
5	0.24	1.27 (1.02, 1.58)	0.031
6	0.78	2.17 (1.66, 2.84)	<0.001
7	0.54	1.71 (1.41, 2.08)	<0.001
8*	0.29	1.34 (1.13, 1.60)	0.001
9**	0.33	1.39 (1.22, 1.59)	<0.001

OR = odds ratio.
*The referent group consisted of individuals who reported high or neutral levels of meaning in their work (responses ranging from 3 to 7 on the 7-point Likert scale).
**The referent group included individuals who expressed high satisfaction with work-life integration (selecting 'agree' or 'strongly agree') as well as those with a neutral stance.

significant correlation was observed between the total PWBI score and all types of mental distress, with correlation coefficients ranging from 0.266 to 0.649 (all $p < 0.001$) (Table S3).

Considering the initial prevalence rates as pretest probabilities, the PWBI had varying effects on post-test probabilities. With regard to burnout, it decreased the probability from 27.01% to 4.66% or increased it to 73.33%. In terms of depression, it lowered the probability from 26.04% to 3.73% or increased it to 70.84%. For high levels of fatigue, it reduced the probability from 28.22% to 14.46% or increased it to 61.66%. Similarly, the post-test probabilities for anxiety and somatic symptoms (the pretest probabilities of which were 13.20% and 34.89%, respectively) either decreased

Table 4. Efficacy of the Physician Well-Being Index for identifying low quality of life and other distress or adverse consequences among physicians.

PWBI	Low QOL		Burnout		Depression		High fatigue		High perceived stress	
score	LR[a]	Prob. %[b]	LR	Prob. %	LR	Prob. %	LR	Prob. %	LR	Prob. %
≤1	0.18 (0.14, 0.23)	6.93	0.13 (0.10, 0.18)	4.66	0.11 (0.08, 0.15)	3.73	0.43 (0.36, 0.52)	14.46	0.15 (0.11, 0.19)	7.26
2	0.53 (0.40, 0.70)	17.89	0.42 (0.31, 0.57)	13.42	0.33 (0.24, 0.48)	10.41	0.62 (0.47, 0.80)	19.60	0.36 (0.26, 0.48)	15.81
3	0.71 (0.56, 0.90)	22.55	0.57 (0.44, 0.75)	17.51	0.64 (0.49, 0.83)	18.39	0.75 (0.59, 0.96)	22.77	0.59 (0.46, 0.75)	23.54
4	1.15 (0.93, 1.42)	32.07	1.16 (0.94, 1.44)	30.03	1.04 (0.83, 1.30)	26.81	1.22 (0.99, 1.50)	32.42	1.32 (1.08, 1.62)	40.78
5	1.30 (1.05, 1.60)	34.82	1.37 (1.11, 1.69)	33.63	1.48 (1.20, 1.82)	34.26	1.31 (1.06, 1.61)	33.99	1.51 (1.23, 1.84)	44.07
6	2.37 (1.91, 2.93)	49.32	2.63 (2.13, 3.25)	49.32	2.62 (2.12, 3.24)	47.99	1.76 (1.42, 2.18)	40.90	3.06 (2.45, 3.82)	61.49
7	4.54 (3.58, 5.78)	65.15	4.81 (3.79, 6.09)	64.02	5.31 (4.18, 6.74)	65.16	2.06 (1.64, 2.58)	44.75	6.24 (4.75, 8.21)	76.50
≥8	5.90 (4.02, 8.68)	70.83	7.43 (5.00, 11.04)	73.33	6.90 (4.70, 10.13)	70.84	4.09 (2.86, 5.86)	61.66	12.46 (7.40, 20.97)	86.67
PWBI	Anxiety		Somatic symptoms		Suicidal ideation		Medical errors		Intent to leave	
score	LR	Prob. %	LR	Prob. %	LR	Prob. %	LR	Prob. %	LR	Prob. %
≤1	0.12 (0.07, 0.20)	1.79	0.26 (0.21, 0.32)	12.23	0.41 (0.33, 0.51)	9.53	0.57 (0.48, 0.69)	13.78	0.38 (0.31, 0.47)	10.33
2	0.31 (0.18, 0.52)	4.50	0.63 (0.49, 0.80)	25.24	0.52 (0.37, 0.73)	11.79	0.93 (0.72, 1.21)	20.69	0.57 (0.42, 0.77)	14.70
3	0.57 (0.39, 0.84)	7.98	0.75 (0.60, 0.94)	28.67	0.86 (0.66, 1.12)	18.10	0.84 (0.65, 1.08)	19.07	0.71 (0.55, 0.93)	17.80
4	1.04 (0.78, 1.39)	13.66	1.30 (1.07, 1.59)	41.06	0.84 (0.65, 1.09)	17.75	1.07 (0.84, 1.35)	23.08	1.00 (0.79, 1.27)	23.32
5	1.02 (0.76, 1.36)	13.43	1.42 (1.16, 1.73)	43.21	1.30 (1.03, 1.63)	25.04	1.30 (1.04, 1.63)	26.72	1.34 (1.08, 1.67)	28.87
6	1.85 (1.44, 2.38)	21.96	2.45 (1.97, 3.04)	56.76	1.57 (1.24, 1.98)	28.75	1.23 (0.96, 1.57)	25.65	1.76 (1.41, 2.20)	34.80
7	4.07 (3.26, 5.09)	38.23	3.43 (2.70, 4.36)	64.77	2.96 (2.36, 3.71)	43.20	1.81 (1.43, 2.30)	33.67	2.59 (2.06, 3.24)	43.94
≥8	5.95 (4.23, 8.37)	47.50	3.73 (2.57, 5.41)	66.65	3.29 (2.33, 4.66)	45.81	1.85 (1.28, 2.67)	34.16	4.31 (3.04, 6.12)	56.67

[a]LR = likelihood ratio, LR indicates the likelihood ratio associated with the exact score.
[b]Prob = probability, posttest probability was calculated using an estimated prevalence of 29.15% for low QOL, 27.01% for burnout, 26.04% for depression symptoms, 28.22% for high fatigue, 34.28% for high perceived stress, 13.20% for anxiety symptoms, 34.89% for somatic symptoms, 20.44% for suicidal ideation, 21.91% for medical errors and 23.26% for intent to leave as the pretest probability.

Table 5. Diagnostic value and optimal threshold of the physician well-being Index in identifying distress or adverse consequences.

Distress or negative consequences	AUC (95% CI)	Optimal threshold[a]	Sensitivity (%)[b]	Specificity (%)[b]	Youden's index[b]
Low quality of life	0.77 (0.75, 0.79)	4	77.1	63.3	0.40
Burnout	0.80 (0.78, 0.82)	4	81.8	63.8	0.46
Depression	0.81 (0.79, 0.83)	4	83.0	63.7	0.47
Excessive daytime sleepiness	0.66 (0.64, 0.68)	4	60.2	63.7	0.24
High fatigue	0.67 (0.65, 0.70)	4	68.0	59.2	0.27
High perceived stress	0.82 (0.80, 0.83)	4	80.7	68.3	0.49
Anxiety	0.79 (0.77, 0.82)	4	85.1	57.1	0.42
Somatic symptoms	0.74 (0.72, 0.76)	4	72.1	64.2	0.36
Suicidal ideation	0.69 (0.67, 0.71)	5	59.0	69.6	0.29
Medical errors	0.61 (0.58, 0.63)	4	61.1	55.0	0.16
Intent to leave	0.70 (0.68, 0.72)	4	71.2	58.4	0.29
Leaving for a non-medical careers	0.66 (0.63, 0.69)	4	70.1	54.5	0.25

[a]The threshold that yielded the highest Youden's Index (sensitivity + specificity − 1) was considered the optimal threshold.
[b]Sensitivity, specificity and Youden's Index were three metrics obtained at the optimal threshold value.
AUC = area under the ROC curves; CI = confidence interval.

to 1.79% and 12.23% or increased to 47.50% and 66.65%, respectively. Furthermore, suicidal ideation had an initial pretest probability of 20.44%, and the PWBI could lower the post-test probability to 9.53% or increase it to 45.81% (Table 4).

For the identification of burnout, depression, excessive daytime sleepiness, high levels of fatigue, high levels of perceived stress, anxiety, somatic symptoms and recent suicidal ideation, the area under the ROC curve was 0.80 (95% CI, 0.78-0.82), 0.81 (0.79-0.83), 0.66 (0.64-0.68), 0.67 (0.65-0.70), 0.82 (0.80-0.83), 0.79 (0.77-0.82), 0.74 (0.72-0.76) and 0.69 (0.67-0.71), respectively (Table 5).

3.3. Ability to detect adverse consequences

Physicians who reported a medical error during the past three months (median 4 vs. 3, $p < 0.001$) and expressed their intention to leave their current job within the next two years (5 vs. 3, $p < 0.001$) exhibited less favourable scores on PWBI (Table S1). It was found that less favourable PWBI scores were associated with an increased likelihood of making medical errors (OR for the most favourable score: 0.39; OR for the least favourable score: 1.91), having the intention to leave their current jobs (0.22; 8.05) and pursuing a non-medical career (0.13; 5.19). A significant correlation was observed between the total PWBI score and the three adverse consequences, with correlation coefficients ranging from 0.154 to 0.292 (all $p < 0.001$) (Table S3). Regarding recent medical errors, assuming an estimated prevalence of 21.91% as the pretest probability, the PWBI score lowered the post-test probability to 13.78% or increased it to 34.16%. Finally, using an estimated prevalence of 23.26% for the intention to leave the current job within the next two years for non-retirement reasons, the PWBI could decrease the post-test probability to 10.33% or increase it to 56.67% (Table 4). For medical errors, intention to leave, and pursuit of non-medical careers, the area under the ROC curve for the PWBI was 0.61 (0.58, 0.63), 0.70 (0.68, 0.72) and 0.66 (0.63, 0.69), respectively (Table 5).

3.4. Threshold scores to identify physicians at risk

In the present study, physicians with a PWBI score of 4 or higher were found to be at an increased risk (LR > 1) of various mental distress or negative outcomes, such as low QOL, burnout, depression, excessive daytime sleepiness, fatigue, high stress, anxiety, somatic symptoms, suicidal ideation, medical errors and intention to leave their current job (Table 4). However, a PWBI score of 5 or higher was found specifically indicative of an increased risk (LR > 1) of suicidal ideation. To determine the optimal threshold, we evaluated the maximum sum of sensitivity and specificity, which shows the greatest diagnostic value. It was determined that the optimal threshold of PWBI score to identify all types of mental distress or adverse consequences other than suicidal ideation was 4 and that the optimal threshold to identify suicidal ideation specifically was 5 (Table 5). With a threshold of 4, the sensitivity of PWBI in identifying burnout, depression, high stress, anxiety and the intention to leave the current job was 81.8%, 83.0%, 80.7%, 85.1% and 71.2%, respectively. The corresponding specificity was 63.8%, 63.7%, 68.3%, 57.1% and 58.4%, respectively. Therefore, a score of 4 or higher on PWBI may be indicative of a higher risk of distress or adverse consequences, while a score of 5 or greater may indicate severe distress or suicidal ideation.

4. Discussion

In this cross-sectional study, we explored the validity and applicability of the 9-item PWBI among Chinese physicians, which helps expand its application in assessing the well-being of Chinese healthcare workers. Our study revealed several key findings: (1) all items in the PWBI demonstrated favourable sensitivity and specificity in detecting distress within their corresponding domains, and seven of the nine items were independently associated with low QOL; (2) physicians reporting lower QOL were more likely to endorse each PWBI item and scored less favourably; (3) In addition to identifying physicians who might be experiencing mental distress, the PWBI also proved effective in identifying physicians whose level of distress increased the risk of adverse consequences, including medical errors and intentions to leave their current job; (4) the PWBI was found to have a high diagnostic value in identifying distress or adverse consequences; (5) physicians with a PWBI score of 4 or higher might be at an increased risk (LR > 1) of experiencing various mental distress or adverse consequences, and the posterior probability of these outcomes might also significantly improve with the increase of PWBI scores. These findings strongly supported PWBI as a efficacy screening tool to stratify distress in different domains among physicians.

The present study revealed a high prevalence of distress among Chinese physicians, with a significant number considering changing their profession. This finding aligns with previous research in China [46,62,63]. Therefore, effective screening tools are crucial for healthcare professionals' health management,

helping to identify early distress signs and enabling timely intervention to reduce distress and other negative outcomes.

Our findings align with several prior studies conducted in the United States on physicians and nurses, which have shown that healthcare professionals experiencing distress—such as low QOL, extreme fatigue, recent suicidal ideation, or burnout—tend to score lower on the PWBI [20,23,26,27]. In addition, Dyrbye and Shanafelt et al. has developed other scales to assess the well-being of different populations, such as the Medical Student Well-Being Index (MSWBI) [64,65] and the Resident Well-Being Index (RSWBI) [28]. These scales have also indicated associations between the PWBI scores and low QOL, fatigue, burnout and recent suicidal ideation among medical students, residents and research fellows [66]. Therefore, the PWBI may be a useful tool for identifying distress in healthcare professionals in China, helping to guide further interventions and prevent adverse consequences.

The PWBI is a concise, efficient and comprehensive assessment tool that goes beyond job satisfaction only and evaluates distress in multiple dimensions, including burnout, depression, QOL, stress and fatigue; it also helps stratify individuals with different levels of well-being [20]. As it only needs one to two minutes to complete, the PWBI can be administered every month without difficulty. Such a frequency allows the dynamic monitoring of the overall well-being of physicians. Furthermore, the PWBI offers a quantifiable metric for well-being, thereby allowing healthcare organizations to monitor changes, assess the effectiveness of interventions and improve physician satisfaction and retention rates. In addition, its simplicity of use and reflection of personal and professional outcomes may further support its wide application by individuals and healthcare organizations. Prior studies have found that healthcare professionals may not have an accurate perception of their own well-being [9,20,67]; therefore, using PWBI and comparing the scores against national benchmarks may provide a reference for self-improvement of individuals and interventions of healthcare organizations [67].

The PWBI can be used as a self-assessment tool and a screening tool. The primary purpose is to identify individuals whose distress levels may affect their professional performance, and it can also estimate the risk of severe distress among physicians. For example, assuming a prevalence of 29.2% for low overall QOL, the exact score on the PWBI can reduce the probability of low QOL to 1.8% (PWBI score of ≤1) or increase it to 47.5% (PWBI score of ≥8). At a threshold score of 4 (5 for suicide ideation), the PWBI showed a specificity ranging from 54.5% to 69.6% and a sensitivity ranging from 59.0% to 85.1%. Moreover, the area under the ROC curve for PWBI was 0.61-0.82 when identifying distress. The above findings suggest that, with a threshold score of 4, the diagnostic ability of PWBI is comparable to other well-established and widely used screening instruments, such as the PHQ-9[42] and GAD-7[43].

This study has several limitations. Firstly, the representativeness of our findings may have been influenced by the use of online snowball sampling, which could introduce selection bias. Additionally, the relatively small sample size may not fully reflect the physician population in Southern Mainland China. Secondly, due to the cross-sectional design of this study, the predictive validity of the PWBI cannot be assessed. This design limits our ability to draw causal inferences and does not account for temporal changes or dynamic interactions between variables that may affect the results. Future research employing longitudinal approaches is needed to overcome these limitations and strengthen the evaluation of the PWBI's predictive validity. Thirdly, standardized tools often focus on different time frames, such as 'during the past week' for QOL and fatigue, and 'in the last 12 months' for suicidal ideation. In contrast, the PWBI was specifically designed to assess physicians' well-being over the past month. Despite these differences in time frames, the PWBI has demonstrated a strong correlation between its items and the distress measured by standardized tools. Additionally, compared to traditional assessment tools, the PWBI offers several strengths, including ease of implementation, comprehensive reports, inclusion of non-professional factors (unlike scales such as the MBI), and low cost of administration. Despite some limitations, our study highlights the strong correlation between PWBI scores and adverse outcomes, indicating that the PWBI could be an effective tool for identifying distress among Chinese physicians and providing valuable guidance for improving their well-being.

5. Conclusion

In conclusion, this study provides preliminary insights into the validity and utility of the 9-item PWBI for assessing distress and well-being among Chinese physicians. The PWBI shows potential as a screening tool to identify Chinese physicians at higher risk of making medical errors or turnover intentions. However, these findings should be interpreted with caution due to the study's focus on a specific demographic and its small sample size. Further comprehensive and longitudinal

investigations are necessary to establish the predictive validity of the PWBI across different contexts. Additionally, the tool's cross-cultural applicability remains uncertain, as the study did not include analysis of other cultural or demographic groups. Future research should prioritize evaluating the validity and reliability of the PWBI in diverse populations. In the meantime, healthcare institutions should consider implementing targeted support systems and providing resources aimed at enhancing physicians' well-being and job satisfaction within their unique work environments.

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Authors' contributions

Qiuxia Wu, Yi-Yuan Tang and Tieqiao Liu provided the design and supervision for this study. Qianjin Wang, Manyun Li, Yuzhu Hao, Li He and Yunfei Wang were responsible for data collection. Data analysis and interpretation were performed by Min Wu, Xin Wang, Huixue Xu, Xiaoyu Zhang, Qijian Deng, Winson Fuzun Yang and Yueheng Liu. Zejun Li prepared the initial draft of the manuscript and critically revised it by Pu Peng, Qiuxia Wu and Yi-Yuan Tang. All co-authors revised and agreed to publish the final version of the manuscript.

Ethics approval and consent to participate

The study was approved by the ethics committee of the Second Xiangya Hospital of Central South University (JY20200326), and written informed consent was obtained from all participants. The study adhered to the principles stated in the 'Declaration of Helsinki'.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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Data availability statement

The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request.

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