Objective: Lung cancer patients reported the highest incidence of psychological distress. It is extremely important to identify which patients at high risk for psychological distress. The study aims to develop and validate a predictive algorithm to identify lung cancer patients at high risk for psychological distress. Methods: This cross-sectional study identified the risk factors of psychological distress in lung cancer patients. Data on sociodemographic and clinical variables were collected from September 2018 to August 2019. Structural equation model (SEM) was conducted to determine the associations between all factors and psychological distress, and then construct a predictive algorithm. Coincidence rate was also calculated to validate this predictive algorithm. Results: Total 441 participants sent back validated questionnaires. After performing SEM analysis, educational level ($\beta = 0.151, P = 0.004$), residence ($\beta = 0.146, P = 0.016$), metastasis ($\beta = 0.136, P = 0.023$), pain degree ($\beta = 0.133, P = 0.005$), family history ($\beta = -0.107, P = 0.021$), and tumor, node, and metastasis stage ($\beta = -0.236, P < 0.001$) were independent predictors for psychological distress. The model built with these predictors showed an area under the curve of 0.693. A cutoff of 66 predicted clinically significant psychological distress with a sensitivity, specificity, positive predictive value, and negative predictive value of 65.41%, 66.90%, 28.33%, and 89.67%, respectively. The coincidence rate between predictive algorithm and distress thermometer was 64.63%. Conclusions: A validated, easy-to-use predictive algorithm was developed in this study, which can be used to identify patients at high risk of psychological distress with moderate accuracy.

Key words: Lung neoplasm, prediction model, psychological distress, structural equation model

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Introduction

According to the data released by the International Agency for Research on Cancer, lung cancer accounts for around 11.4% of new cancer cases and 18.0% of cancer-related deaths in 2020. Patients who were identified with lung cancer report significantly high detection rate of psychological distress mainly because of poor 5-year survival rate. Previous studies indicated that approximately 17.0%–73.0% lung cancer patients experienced clinically significant psychological distress worldwide. More importantly, compared to other types of cancers, lung cancer patients reported the highest incidence of psychological distress.

As a negative emotional state, psychological distress has been established to be associated with poor treatment adherence and physical symptoms. Meanwhile, there are some studies which found that psychological distress may enhance tumor growth and diminish effective treatment response, as well as decrease therapeutic effectiveness. As a result, lung cancer patients with clinically significant psychological distress reported poor quality of life and even higher mortality. Therefore, it is critical to early detect patients at high risk of psychological distress from overall lung cancer patients with a validated prediction tool.

Background

Accurately understanding risk factors of causing psychological distress and clarifying the correlations between psychological distress and various predictive factors is crucial for developing a reliable and robust prediction tool for early and accurately predicting the risk of psychological distress among lung cancer patients. To date, a great deal of studies have performed to investigate the predictive factors of developing psychological distress among cancer patients. Meanwhile, many studies have also been conducted in order to understand the predictive factors of psychological distress in lung cancer patients.

In 1999, Keller and Henrich investigated gender difference of psychological distress and found that female patients suffer from more serious psychological distress compared to male patients, which was supported by the study performed by Morrison et al. in 2017 and performed by Lv et al. in 2020. However, the gender difference of psychological distress in lung cancer patients has not yet been detected. Moreover, Lv et al. also found that educational level, medical insurance, residence, and occupational status were associated with psychological distress, which was partially consistent with the findings from another study in terms of educational level and occupational status. Meanwhile, Chambers et al. and Morrison et al. found an age difference of psychological distress, which was also detected in a study by Tian et al. Moreover, household income was also noted to be related to the occurrence of psychological distress. Previous studies also investigated the associations between various clinical variables and psychological distress except for sociodemographic characteristics. Carlson et al. found that advanced cancer patients with metastasis suffer from more serious psychological distress, which was also consistent with results found by Morrison et al. However, the role of metastasis in causing psychological distress was not determined in Lv et al.’s study. Family history, drinking history, and tumor stage were also found to be associated with psychological distress. Moreover, there are some studies which suggested that surgery, pain degree, and comorbidity were also the predictors of psychological distress.

Although various predictive factors of psychological distress among lung cancer patients have been examined, several conflicting conclusions were generated due to the inclusion of a limited number of potential predictors. Meanwhile, no study has investigated the predictive effect of combining established predictive factors on psychological distress. As a result, <10% of patients at high risk of psychological distress can be early detected. We therefore performed this study to first identify those predictive factors of psychological distress in lung cancer patients. Then, we set out to develop a predictive algorithm that may assist the clinical practitioners in identifying patients at high risk for psychological distress.

Methods

Study design

A cross-sectional descriptive study was performed to identify the risk factors of psychological distress and further develop a validated predictive algorithm of high-risk psychological distress in lung cancer patients based on optimal predictors. All results were presented in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology guidelines.

Participants

We developed the following criteria to recruit eligible participants according to previous studies: (a) adult patients with definitive lung cancer diagnosis and (b) having ability to independently complete questionnaires. We excluded those patients who were identified to have the psychiatric disorder and were therefore unable to cooperate with questionnaire survey or other types of cancer. We first estimated sample size based on the algorithm for cross-sectional survey design.
In this algorithm, \( \pi \) and \( \delta \) indicate the incidence and allowed error, respectively. We calculated an anticipated sample size of 384 after setting \( \alpha \) of 0.05, \( \pi \) of 0.5, and \( \delta \) of 0.5. Meanwhile, we also calculated a sample size of 190 according to the principle of minimum numbers needed to modeling the relationship between all variables and psychological distress with structural equation model (SEM). Theoretical sample size of 384 was determined eventually.

### Procedure

This study is strictly in accordance with the provisions of the Declaration of Helsinki. Moreover, the protocol of this study has been approved by the institute review board of all participated hospitals. All lung cancer patients who were admitted to the medical oncology and respiratory department of two tertiary hospitals and five secondary hospitals in Chongqing of China for further treatment were enrolled for questionnaire survey within 48 h of admission to ward. All participants fully understood aims and procedure of this study and patients' rights before participating in the survey. Meanwhile, participants were further informed that all questionnaires in this study will be completed anonymously, and collected data were just used to academic dissemination. We obtained oral or written informed consent from all participants before performing formal survey. Moreover, a pilot study suggested a feasibility of conducting the questionnaire survey, and then, all questionnaires were completed by patients in the formal survey. Data were collected by face to face in wards.

### Study variables

In this study, we mainly aimed to determine the optimal predictors of psychological distress in lung cancer patients from sociodemographic and clinical aspects. Therefore, after comprehensively reviewed published studies which investigated impact factors of psychological distress among cancer patients, especially lung cancer patients, the following sociodemographic variables were collected including gender, age, nationality, educational level, occupational status, marital status, payment method, residence, the quantity of children, household income, family history, smoking history, and drinking history. Meanwhile, we also collected the clinical variables as following: diagnosis duration, surgical history, metastasis, comorbidity, pain degree, and tumor, node, and metastasis (TNM) stage. All sociodemographic and clinical variables were collected used the standard sheet.

As the main outcome variable, psychological distress was measured with distress thermometer (DT), which was designed to have a 11-point scale (0 indicates no distress and 10 suggests extreme distress) in a thermometer format. The psychometric properties of DT have been extensively validated in various settings, and several studies consistently indicated 4 or above scores as the criteria of defining patients with clinically significant psychological distress. Certainly, this criterion of DT \( \geq 4 \) was also demonstrated to be applicable to Chinese cancer patients, with an area under the receiver operating characteristic curve of 0.885 in an empirical study.

### Statistical analysis

We used descriptive statistics including frequency and percentage to summarize participants' sociodemographic and clinical variables. Mean rank was calculated to express the score of psychological distress because of Kolmogorov–Smirnov test indicated a skew distribution. The mean rank of psychological distress between variables was first tested using univariate analysis prior to constructing the prediction model. However, we did not determine independent variables according to the results of univariate analysis, and all sociodemographic and clinical variables were included to modeling prediction structure. We calculated the following indices to evaluate the fitness of the overall model including the ratio of Chi-square (\( \chi^2 \)) to degrees of freedom (df), goodness-of-fit index (GFI), adjusted GFI (AGFI), comparative fit index (CFI), and root mean square error of approximation (RMSEA). According to Kline, model fit was regarded as good when a ratio of \( \chi^2/df \) is \( \leq 3 \). For GFI and AGFI, a value of more than indicates a good model fit. Moreover, CFI of \( \geq 0.90 \) and RMSEA of \( \leq 0.05 \) were also suggesting a good model fit. \( P < 0.05 \) indicated significance for all analyses. Data were analyzed with the Statistical Package for the Social Sciences (Chicago, IL, USA) and IBM AMOS 21.0 (Chicago, IL, USA).

### Results

#### Sample characteristics

We distributed 450 questionnaires during survey, and 441 valid questionnaires were received finally, with a validated response rate of 98.0%. The participants had a median age of 60.0 (interquartile range: 52.0–67.0) and most were male (71.4%) and Han nationality (98.6%). Most participants did not get adequate education (68.0%), and a significant number of participants were jobless (44.9%). Most participants got married (99.3%) and had medical insurance (97.3%), and more than half of them had no drinking history (53.7%) and diagnosis duration...
of <6 months (53.1%). In addition, most participants lived in urban (69.4%), had one or two children (99.4%), but no family history (87.8%) and no comorbidity (74.1%). However, most of these participants were at the advanced stage (85.7%) and most experienced metastasis (62.6%). Moreover, a minority of these participants experienced moderate-to-severe pain (19.0%), but most participants did not receive surgery (61.9%). The details of participants' characteristics are shown in Table 1.

**Influencing factors for psychological distress**

Univariate analysis suggested that eight variables including age, educational level, occupational status, household income, drinking history, diagnosis duration, family history, and TNM stage were substantially related to psychological distress. Younger participants experienced a higher level of psychological distress (\(P = 0.046\)), and participants having work also experienced significant psychological distress (\(P = 0.038\)). Participants who were from middle-income family had lower level psychological distress (\(P < 0.001\)), and participants who were newly diagnosed with lung cancer had the highest level of psychological distress (\(P = 0.001\)). Moreover, participants who were at the early stage reported a higher level of psychological distress (\(P < 0.001\)). Those participants with drinking history (\(P = 0.031\)) and without family history (\(P = 0.029\)) had a higher level of psychological distress. Meanwhile, higher educational level also caused the increasing of the level of psychological distress (\(P = 0.031\)). The details are shown in Table 1.

**Structural equation modeling of the factors predicting psychological distress**

We used SEM technique to further inveterate the association between sociodemographic and clinical variables and psychological distress in order to identify the independent predictive factors of psychological distress. We coded all variables to meet the requirement of performing structural equation modeling, and the coded information is summarized in Table 2. We used maximum likelihood to perform SEM for determining the predictive effect of each variable on psychological distress. The structural model of variables and psychological distress is displayed in Figure 1, and the regression weights of psychological distress and various variables are summarized in Table 3. Meanwhile, the correlations of all error variables are documented in Table 4. The results revealed that the structural model adequately fitted the data (\(\chi^2/df = 0.412\), GFI = 1.000, AGFI = 0.980, CFI = 1.000, and RMSEA = 0.000 [90% confidence interval, 0.000–0.073]).

Among those 19 paths, 13 paths did not achieve statistical significance, and the remaining 6 paths were statistically significant with all critical ratios of more than 2.0. Specifically, educational level (\(\beta = 0.151, P = 0.004\)), residence (\(\beta = 0.146, P = 0.016\)), metastasis (\(\beta = 0.136, P = 0.023\)), and pain degree (\(\beta = 0.133, P = 0.005\)) positively predicted psychological distress, however, family history (\(\beta = −0.107, P = 0.021\)) and TNM stage (\(\beta = −0.236, P < 0.001\)) negatively predicted psychological distress.

**Psychological distress predictive algorithm**

Based on the results from SEM analysis, we developed the following predictive algorithm of psychological distress: risk score = \((0.151 \times \text{educational level}) + (0.146 \times \text{residence}) + (0.136 \times \text{metastasis}) + (0.133 \times \text{pain degree}) − (0.107 \times \text{family history}) − (0.236 \times \text{TNM stage}) \times 100\), with an overall risk score distribution of −75–120. We calculated the risk score of each surveyed participant with the above predictive algorithm, and obtained an overall risk score distribution of −65–78. Then, we also calculated an area under the curve (AUC) of 0.693 for our predictive algorithm, which is depicted in Figure 2. Meanwhile, we also determined a cutoff value of −9, which was corresponding to a sensitivity of 65.4%, a specificity of 66.9%, a positive predictive value of 28.33%, and a negative predictive value of 89.66% when Youden's index got a maximum value of 0.323. Furthermore, in order to improve the feasibility of the predictive algorithm in clinical practice, we inserted a constant of 75 into the algorithm to eliminate negative risk score, and the user needed to do decimals to round up and round down numbers. Therefore, an updated predictive algorithm was constructed as following: risk score = 75 + \((0.151 \times \text{educational level}) + 0.146 \times \text{residence} + 0.136 \times \text{metastasis} + 0.133 \times \text{pain degree} − 0.107 \times \text{family history} − 0.236 \times \text{TNM stage}) \times 100\). As a result, the overall distribution of risk score was ranging from 0 to 195. Certainly, the cutoff value was also changed to be 66 eventually.

Next, we applied this predictive algorithm to our surveyed participants for further validating its predictive performance, and detected 51 participants at high risk from those 78 participants who were identified with clinically significant psychological distress with DT and 234 participants at low risk from 363 participants who were identified without clinically significant psychological distress with DT. Finally, a coincidence rate of 64.63% was achieved. Finally, 40.82% of participants were identified to get clinically significant psychological distress using our predictive algorithm.

**Discussion**

Psychological distress has been recognized as an important consequence of cancer diagnosis and treatment because
### Table 1: Comparison of psychological distress among 441 participants according to demographic and clinical variables

| Variable                     | Frequency | Proportion (%) | Mean rank of PS | Z or χ² | P       |
|------------------------------|-----------|----------------|-----------------|---------|---------|
| Gender                       |           |                |                 |         |         |
| Male                         | 315       | 71.4           | 219.51          | −0.479  | 0.632   |
| Female                       | 126       | 28.6           | 224.71          |         |         |
| Age (years)                  |           |                |                 |         |         |
| 18-39                        | 12        | 2.7            | 266.00          | 8.005   | 0.046   |
| 40-49                        | 57        | 12.9           | 249.26          |         |         |
| 50-59                        | 141       | 32.0           | 218.64          |         |         |
| ≥60                          | 231       | 52.4           | 213.13          |         |         |
| Nationality                  |           |                |                 |         |         |
| Han                          | 435       | 98.6           | 220.44          | −0.976  | 0.329   |
| Minority                     | 6         | 1.4            | 261.75          |         |         |
| Educational level            |           |                |                 |         |         |
| Primary                      | 120       | 27.2           | 215.34          | 8.891   | 0.031   |
| Junior high                  | 180       | 40.8           | 208.43          |         |         |
| Senior high                  | 84        | 19.1           | 243.55          |         |         |
| University                   | 57        | 12.9           | 228.42          |         |         |
| Occupational status          |           |                |                 |         |         |
| Not working                  | 198       | 44.9           | 217.48          | 6.560   | 0.038   |
| Working                      | 54        | 12.2           | 254.50          |         |         |
| Retired                      | 189       | 42.9           | 215.12          |         |         |
| Marital status               |           |                |                 |         |         |
| Married                      | 438       | 99.3           | 220.21          | 3.798   | 0.051   |
| Divorced/widowed             | 3         | 0.7            | 336.50          |         |         |
| Payment method               |           |                |                 |         |         |
| Medical insurance            | 429       | 97.3           | 221.58          | −0.703  | 0.482   |
| Private payment              | 12        | 2.7            | 200.38          |         |         |
| Residence                    |           |                |                 |         |         |
| Urban                        | 306       | 69.4           | 216.96          | −1.24   | 0.214   |
| Rural                        | 135       | 30.6           | 230.17          |         |         |
| Quantity of children         |           |                |                 |         |         |
| 0                            | 3         | 0.6            | 155.00          | 2.531   | 0.282   |
| 1                            | 234       | 53.1           | 216.23          |         |         |
| ≥2                           | 204       | 46.3           | 227.44          |         |         |
| Household income (rmb)       |           |                |                 |         |         |
| <20,000                      | 39        | 8.8            | 259.77          | 22.224  | <0.001  |
| 20,000-50,000                | 123       | 27.9           | 204.87          |         |         |
| 50,000-100,000               | 192       | 43.5           | 207.38          |         |         |
| >100,000                     | 87        | 19.8           | 256.48          |         |         |
| Diagnosis duration (month)   |           |                |                 |         |         |
| <1                           | 51        | 11.6           | 269.09          | 16.492  | 0.001   |
| 1-6                          | 183       | 41.5           | 211.85          |         |         |
| 7-12                         | 84        | 19.0           | 233.80          |         |         |
| >12                          | 123       | 27.9           | 205.93          |         |         |
| Family history               |           |                |                 |         |         |
| No                           | 387       | 87.8           | 224.99          | −2.177  | 0.029   |
| Yes                          | 54        | 12.2           | 192.42          |         |         |
| Smoking history              |           |                |                 |         |         |
| No                           | 159       | 36.1           | 218.00          | −0.459  | 0.646   |
| Yes                          | 282       | 63.9           | 222.69          |         |         |
| Drinking history             |           |                |                 |         |         |
| No                           | 237       | 53.7           | 211.18          | −2.157  | 0.031   |
| Yes                          | 204       | 46.3           | 232.40          |         |         |
| Surgery                      |           |                |                 |         |         |
| No                           | 273       | 61.9           | 216.76          | −1.102  | 0.270   |
| Yes                          | 168       | 38.1           | 227.89          |         |         |

Contd...
it was negatively associated with decreased therapeutic effectiveness, increased risk of morbidity and mortality, and poor quality of life.[24] Patients with lung cancer reported to have the highest incidence of psychological distress compared to other types of cancer.[8,17] Unfortunately, no validated screening tool specifically focused on lung cancer has been developed for early detection of patients at high risk of psychological distress although several studies have identified some risk factors of psychological distress.[3,6,16] In this study, a predictive algorithm with a moderate predictive accuracy (AUC = 0.693) was first developed and validated. Noteworthy, a cutoff value of 66 identified that 40.82% of lung cancer patients were at high risk of psychological distress, which was supported by results from several previous studies.[8,17,33]

In this study, total 19 risk factors were included for the final investigation, and younger age, higher educational level, working, extremely low or high household income, shorter diagnosis duration, no family history, drinking history, and advanced cancer stage were first identified as the risk factors of psychological distress. Furthermore, educational level, residence, family history, TNM stage, metastasis, and pain degree were included to develop predictive algorithm eventually, which were all reported previously to have predictive effects on psychological distress in lung cancer patients. However, the predictive role of other important risk factors, especially age and gender which have been identified previously to be the independent risk factor of psychological distress,[5,15,16,34] was not demonstrated. We therefore suggested performing more studies with larger sample size to further assess their association.

To our knowledge, several screening tools have been applied in practice for assessing the level of psychological distress in cancer patients.[24] Of these tools, DT and Hospital Anxiety and Depression Scale (HADS) were used most extensively. As an easy-to-use tool, DT has been recommended by the National Comprehensive Cancer Network to identify the level of psychological distress.[24] However, the cutoff value must be calculated again when DT was used for different types of cancer, in diverse cultural settings, and for different aims,[18,28,35-38] which may significantly increase the inaccuracy of psychological distress. Moreover, the accuracy of assessing psychological distress will be impaired because DT is marked subjectively

| Variable          | Frequency | Proportion (%) | Mean rank of PS | Z or χ² | P     |
|-------------------|-----------|----------------|-----------------|---------|-------|
| Metastasis        |           |                |                 |         |       |
| No                | 165       | 37.4           | 229.43          | −1.328  | 0.184 |
| Yes               | 276       | 62.6           | 215.96          |         |       |
| Comorbidity       |           |                |                 |         |       |
| No                | 327       | 74.1           | 225.78          | −1.649  | 0.099 |
| Yes               | 114       | 25.9           | 207.30          |         |       |
| Pain              |           |                |                 |         |       |
| No pain           | 183       | 41.5           | 207.33          | 7.323   | 0.062 |
| Mild              | 174       | 39.5           | 233.41          |         |       |
| Moderate          | 81        | 18.4           | 227.67          |         |       |
| Severe            | 3         | 0.06           | 155.00          |         |       |
| TNM stage         |           |                |                 |         |       |
| I                 | 42        | 9.5            | 247.79          | 62.803  | <0.001|
| II                | 21        | 4.8            | 387.07          |         |       |
| III               | 48        | 10.9           | 212.38          |         |       |
| IV                | 330       | 74.8           | 208.28          |         |       |

PS: Psychological distress; TNM: Tumor, node, and metastasis

| Variable                        | Coding                                      |
|---------------------------------|---------------------------------------------|
| Gender                          | 1=male, 2=female                            |
| Age                             | 1=18-39, 2=40-49, 3=50-59, 4=≥60           |
| Nationality                     | 1=Han nationality, 2=minority               |
| Educational level               | 1=primary, 2=junior high, 3=senior high, 4=university |
| Occupational status             | 0=not working, 1=working, 2=retired         |
| Marital status                  | 1=married, 2=divorced/widowed               |
| Payment method                  | 1=medical insurance, 2=private payment      |
| Residence                       | 1=urban, 2=rural                            |
| Quantity of children            | 0=childness, 1=1 child, 2=≥children         |
| Household income                | 1=<20,000; 2=20,000-50,000; 3=50,000-100,000; 4=>100,000 |
| Diagnosis duration              | 1=<1, 2=1-6, 3=7-12, 4=>12                  |
| Family history                  | 0=no, 1=yes                                 |
| Smoking history                 | 0=no, 1=yes                                 |
| Drinking history                | 0=no, 1=yes                                 |
| Surgery                         | 0=no, 1=yes                                 |
| Metastasis                      | 0=no, 1=yes                                 |
| Comorbidity                     | 0=no, 1=yes                                 |
| Pain degree                     | 0=no pain, 1=mild, 2=moderate, 3=severe     |
| TNM stage                       | 1=I, 2=II, 3=III, 4=IV                    |

TNM: Tumor, node, and metastasis
by participants. For the HADS, it was actually developed to measure the level of anxiety and depression in the hospital setting. The HADS was extensively utilized in identifying psychological distress because anxiety and depression were considered to be manifestations of psychological distress. However, it is a mistake to simply equate anxiety and depression with psychological distress, which was defined as a negative emotional state characterized by physical and/or emotional discomfort, pain, or anguish. Therefore, the HADS cannot adequately

Table 3: Regression weights of psychological distress and different demographic and clinical variables

| Pathway          | Standard estimate | SE  | CR  | P    |
|------------------|-------------------|-----|-----|------|
| Gender           | 0.022             | 0.178| 0.312| 0.755|
| Age              | −0.016            | 0.007| −0.280| 0.779|
| Nationality      | 0.009             | 0.439| 0.194| 0.846|
| Educational level| 0.151             | 0.060| 2.885| 0.004|
| Occupational status| 0.068        | 0.072| 1.126| 0.260|
| Marital status   | 0.021             | 0.631| 0.459| 0.646|
| Payment method   | −0.088            | 0.331| −1.837| 0.066|
| Residence        | 0.146             | 0.148| 2.411| 0.016|
| Quantity of children| 0.050         | 0.110| 0.992| 0.321|
| Household income | 0.010             | 0.071| 0.178| 0.859|
| Family history   | −0.107            | 0.158| −2.310| 0.021|
| Diagnosis duration| 0.001            | 0.058| 0.019| 0.985|
| Smoking history  | −0.028            | 0.174| −0.379| 0.705|
| Drinking history | 0.065             | 0.106| 1.379| 0.168|
| TNM stage        | −0.236            | 0.070| −3.973| <0.001|
| Surgery          | 0.059             | 0.105| 1.288| 0.198|
| Metastasis       | 0.136             | 0.139| 2.270| 0.023|
| Comorbidity      | −0.060            | 0.126| −1.214| 0.225|
| Pain degree      | 0.133             | 0.070| 2.783| 0.005|

PS: Psychological distress; SE: Standard error; CR: Critical ratio; TNM: Tumor, node, and metastasis
identify patients at high risk of psychological distress. According to the updated definition, we developed the initial predictive algorithm of psychological distress through including sociodemographic and clinical variables based on participants from seven different hospitals with different levels. Meanwhile, this predictive algorithm will objectively calculate the corresponding risk score after entering the value of each predictive factor. Therefore, compared to reported tools, our predictive algorithm has potential of objectively and accurately identifying participants at high risk of psychological distress.

Two main limitations in this study must be further interpreted. First, psychosocial factors were not included despite the fact that 19 sociodemographic and clinical factors have been considered. However, it remains an issue that inclusion of psychological factors may greatly decrease the feasibility of predictive algorithm because psychological states will be assessed with various complex questionnaires. Second, external validation was not performed after developing the predictive algorithm. However, we further evaluated the accuracy of our predictive algorithm through calculating the coincidence rate.

**Conclusions**

In this study, some important independent sociodemographic and clinical predictive factors for clinically significant psychological distress in lung cancer patients were identified, and a validated, easy-to-use predictive algorithm with fair predictive yield was developed.
Implications for practice

By applying this predictive algorithm, a considerable number of subjects at the clinically significant level for psychological distress who will benefit more from psychological intervention programs can be early and precisely identified. Therefore, the predictive algorithm has great potential as a validated screening measure for use in research, evaluating the effects of intervention programs designed to decrease the level of psychological distress among lung cancer patients through measuring accumulation of psychological distress.

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Conflicts of interest

There are no conflicts of interest.

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