

1 **The chain mediating role of social support and stigma in the**
2 **relationship between mindfulness and psychological distress**
3 **among Chinese lung cancer patients**

4
5 **Running title: Mindfulness againsts psychological distress**

6
7 **Hui Lei, MSN, RN^{1#}, Xu Tian, PhD, RN^{2,3#}, Yan-Fei Jin, PhD, RN², Ling Tang,**
8 **BSc, RN³, Wei-Qing Chen, MD^{3*}, Maria F. Jiménez-Herrera, PhD, RN^{2*}**

9 1. Department of Nursing, Wuchuan People's Hospital, Wuchuan, Guangdong
10 524500, P.R.China.

11 2. Nursing Faculty, Universitat Rovira i Virgili, Tarragona 43002, Spain.

12 3. Chongqing University Cancer Hospital, Chongqing 400030, P.R.China.

13
14 [#]Hui Lei and Xu Tian have contributed equally to this work as joint first author.

15
16 ***Corresponding to:**

17 Dr. Wei-Qing Chen, Department of Gastroenterology, Chongqing University Cancer
18 Hospital, School of Medicine, Chongqing University, Chongqing 400030, P.R.China.
19 Tel: +86 023 65079213. E-mail: CQCH_ChenWQ@163.com.

20 Dr. Maria F. Jiménez-Herrera, Nursing Faculty & Nursing Department, Universitat
21 Rovira i Virgili, Avinguda Catalunya, 35 43002 Tarragona, Spain. Tel: +34
22 977299426. E-mail: maria.jimenez@urv.cat.

23
24
25 Word counts: 2866.

26 Number of table: 4.

27 Number of figure: 1.

28 **ABSTRACT (242 words)**

29 **Purpose:** Psychological distress greatly impaired the psychological and physical
30 wellbeing of lung cancer patients. Identification of protective and risk factors is a
31 prerequisite of developing effective psychological treatment protocol. The study aims
32 to determine the relationship of mindfulness and psychological distress and further
33 clarify the mechanism of mindfulness againsts psychological distress through
34 perceived stigma and social support among Chinese lung cancer patients.

35

36 **Method:** A cross-sectional survey study involving 441 valid Chinese lung cancer
37 patients was conducted from September 2018 to August 2019. After all validated
38 questionnaires that measured psychological distress, level of mindfulness, social
39 support, and perceived stigma were returned by patients, we firstly performed
40 correlation analysis to assess the associations between mindfulness, social support,
41 perceived stigma, and psychological distress. Then structural equation modelling
42 analysis was conducted to further clarify the mediating effects of perceived stigma
43 and social support on the relationship between mindfulness and psychological
44 distress.

45

46 **Results:** According to our hypothesis and further modification, our revised model
47 adequately fits to data. Mindfulness ($\beta=-0.107, p=0.008$) and social support ($\beta=-$
48 $0.513, p<0.001$) had a direct effect on psychological distress. Meanwhile, mindfulness
49 had a direct effect on perceived stigma ($\beta=-0.185, p<0.001$), and perceived stigma had
50 a direct effect on social support ($\beta=-0.373, p<0.001$). Furthermore, mindfulness had
51 also the indirect effect on psychological distress through the chain mediating role of
52 stigma and social support among lung cancer patients.

53

54 **Conclusions:** Mindfulness has direct negative effect on psychological distress, and
55 has also indirectly negative psychological distress through impacting social support
56 and perceived stigma.

57

58 **Keywords:** lung cancer, psychological distress, mindfulness, social support,
59 perceived stigma, structural equation model

60 **1. Introduction**

61 According to the latest data, lung cancer was at the second rank for the incidence and
62 the first rank for mortality, accounting for 11.4% of new cancer cases and 18.0%
63 cancer-related deaths in 2020 worldwide, respectively[1]. Lung cancer patients have
64 been reported to suffer from clinically significant psychological distress because of
65 several factors such as a definitive diagnosis of lung cancer[2] and poor prognosis[3].
66 Meanwhile, compared to other types of cancers, lung cancer patients were even found
67 to have the highest detection rate of psychological distress[4], with an empirical
68 incidence of 17.0% to 73.0%[5-7].

69 Substantial evidence investigating the adverse consequences of psychological
70 distress had been accumulated to date. For example, studies demonstrated that
71 psychological distress deeply decreased patients' compliance with cancer treatment
72 and increased the risk of somatic symptoms[8]. Moreover, evidence published
73 recently even suggested that psychological distress may accelerate the growth of
74 tumor cells and decrease therapeutic effects[9], which may significantly reduce the
75 quality of life[7] and even increase mortality[10]. Considering these negative results,
76 it is critically important to identify potential protective and risk factors and further
77 clarify potential relationships of all factors in order to develop precise psychological
78 treatment protocol for psychological distress among lung cancer patients.

80 **2. Background**

81 Mindfulness refers to meditation practice cultivating present moment nonjudgmental
82 awareness[11]. As a positive psychological trait, the role of mindfulness in
83 psychological and mental wellbeing has been extensively investigated, indicating a
84 negative association between mindfulness and psychological distress[12], even among
85 general population[13]. Meanwhile, mindfulness-based interventions such as
86 mindfulness-based stress reduction (MBSR) have also been demonstrated to improve
87 psychological outcomes[14]. It is noted that the specific role of mindfulness in
88 affecting psychological outcomes among different populations may be changed[15].

89 What is exhilarating is that, however, a handful of studies revealed that mindfulness
90 was negatively related to psychological distress among lung cancer patients[16], and a
91 scatter of clinical trials also suggested a promising role of MBSR intervention in lung
92 cancer patients for the alleviation of psychological distress[17,18]. To date, there are
93 restricted data on the relationship between mindfulness and psychological distress in
94 lung cancer patients. More importantly, the mechanism of mindfulness in buffering
95 psychological distress has not yet been adequately clarified in lung cancer patients.

96 As a positive external source, the protective effects of social support on
97 psychological distress have been extensively demonstrated in previous studies[19,20].
98 Meanwhile, a negative association between social support and psychological distress
99 among lung cancer patients has also been shown in our previous study[21]. Moreover,
100 some studies also indicated that social support was positively associated with
101 mindfulness[22,23], and mindfulness-based interventions significantly improved
102 social support[24]. However, the associations between mindfulness, social support,
103 and psychological distress among lung cancer patients were not investigated, and
104 therefore it's unclear whether mindfulness can indirectly alleviate psychological
105 distress through strengthening social support among lung cancer patients.

106 Stigma refers to a negative emotional experience involving isolation, rejection,
107 degradation, and criticism owing to patients suffer from some undesirable diseases
108 such as lung cancer[25], which has been found to negatively impact many outcomes
109 in cancer patients. For example, evidence demonstrated stigma was positively related
110 to poorer quality of life (QoL) and psychological distress in lung cancer patients[26].
111 Meanwhile, stigma has also been found to significantly decrease the level of social
112 support of advanced lung cancer patients[27] and mindfulness of youth with
113 inflammatory bowel disease[28]. It is noteworthy that the relationship of mindfulness,
114 social support, and stigma in lung cancer patients had not been empirically tested.

115 As discussed above, in this study, we firstly determined the relationship of
116 mindfulness, social support, or perceived stigma and psychological distress, and then
117 we further clarified whether perceived stigma and social support played mediators in

118 the relationship between mindfulness and psychological distress among lung cancer
119 patients.

120

121 **3. Methods**

122 **3.1. Study design**

123 The present study was a cross-sectional, correlational, descriptive survey design.

124

125 **3.2. Participants**

126 We designed inclusion criteria according to the previous studies[5]: (a) adult patients
127 with definitive diagnosis of lung cancer and (b) having ability to clearly and
128 accurately read and write. We excluded those patients who were identified to have the
129 psychiatric disorder which was confirmed based on the medical information extracted
130 from electronic medical record system or other types of cancer or participated in
131 studies investigating the effects of psychological treatment or other survey studies
132 with similar study aims. Sample size was calculated using the formula for cross-
133 sectional survey design: $N = \left[\mu_{\alpha/2}^2 \pi(1-\pi) \right] / \delta^2$. In this formula, π and δ represent the
134 incidence and tolerance error respectively. Theoretical sample size of 384 was
135 determined eventually after α of 0.05, π of 0.5 and δ of 0.5 was defined, respectively.
136 Eligible lung cancer patients were recruited from 7 hospitals in Chongqing, China
137 from September 2018 to August 2019. All questionnaires were independently and
138 anonymously completed by patients. At the end of study, total 450 eligible lung
139 cancer patients were surveyed and 441 validated questionnaires were collected
140 eventually, with a validate response rate of 98.0%.

141

142 **3.3. Procedure**

143 This study is strictly in accordance with the provisions of the Declaration of Helsinki.
144 Moreover, the protocol of the current study has been approved by the Institutional
145 Review Board with an approval number of CUCH_P20180225. All eligible patients
146 were enrolled based on convenience sampling, and all participants fully understood

147 aims and procedure of this study and patients' rights before participating in the survey.
148 The principal investigator orally informed all eligible patients about the aims and
149 procedures of this study based on written research protocol before conducting the
150 formal survey. More importantly, the formal survey was conducted after all patients
151 gave informed consent orally. STROBE guideline (Strengthening the Reporting of
152 Observational Studies in Epidemiology) was utilized to guide us to report all data[29].

153

154 **3.4. Study variables**

155 **3.4.1. Demographic information**

156 In this study, the following sociodemographic and clinical variables were collected
157 with self-designed standard demographic information collection sheet including
158 gender, age, educational level, occupational status, marital status, family history of
159 lung cancer, smoking history, and alcohol consumption, time from diagnosis, surgical
160 history, metastasis, comorbidity, pain degree, and TNM stage.

161

162 **3.4.2. Psychological distress**

163 In the current survey study, distress thermometer (DT) was utilized to measure
164 psychological distress at 11-point thermometer scale from 0 to 10, and 0 and 10
165 indicates no distress and extreme distress, respectively[30]. DT was established to
166 have satisfactory reliability and validity, and its psychometric characteristics have also
167 been tested across diverse settings[31]. **Studies indicates that patients reporting a cut-**
168 **off of 4 would be considered to be clinically significant level of psychological**
169 **distress**[31,32]. The cut-off value of 4 was also extensively accepted for Chinese
170 cancer populations, with an area under the receiver operating characteristic curve of
171 0.885 in an empirical study[31].

172

173 **3.4.3. Mindfulness**

174 We used the Five Facet Mindfulness Questionnaire (FFMQ), which was designed by
175 Baer and colleagues in 2006[33], to measure the level of mindfulness. In the original

176 version, total 39 items were effectively pooled to assess mindfulness from five facets
177 including observing, describing, acting with awareness, nonjudging, and nonreacting
178 at 5-point Likert scale, with a total score of ranging 39 to 195[33]. In this study, we
179 used Chinese version of original FFMQ, which was translated and then validated by
180 Deng and colleagues in 2011 indicating an acceptable psychometric properties[34], to
181 measure the level of mindfulness among lung cancer patients.

182

183 **3.4.4. Social support**

184 In the present study, we used the 12-item Multidimensional Scale of Perceived Social
185 Support (MSPSS) to measure social support from three aspects including family,
186 friends and significant others[35]. Eligible lung cancer patients were asked to rate
187 each item at a 7-point Likert scale (1=very strongly disagree to 7=very strongly
188 agree), with an overall scores from 12 to 84. Previous study has tested the
189 psychological properties of MSPSS and reported that the coefficient alpha values of
190 subscales were ranging from 0.81 to 0.98[35]. The reliability of the Chinese version
191 of MSPSS was established to be 0.90[36].

192

193 **3.4.5. Perceived stigma**

194 Lung cancer stigma was measured with the Cataldo lung cancer stigma scale
195 (CLCSS)[25]. In the original version, a total of 31 items were pooled to measure four
196 aspects including stigma and shame, social isolation, discrimination, and smoking. All
197 items should be rated at 4-point Likert scale, with a total score from 31 to 124 and a
198 higher score indicating a higher level of perceived stigma. In 2017, the Chinese
199 version of CLCSS was translated by Yu and colleagues, reporting a Cronbach alpha of
200 0.932 for an overall scale and 0.799, 0.922, 0.863, and 0.803 for individual 4
201 subscales respectively[37].

202

203 **3.5. Statistical analysis**

204 For patients' sociodemographic and clinical variables, we used descriptive statistics to

205 express all. Numerical variables including age, the score of psychological distress,
206 mindfulness, social support, and perceived stigma were expressed as median with
207 interquartile rang (IQR) because of all did not follow normal distribution according to
208 the results from Kolmogorov–Smirnov test. Meanwhile, Spearman rank correlation
209 analysis was conducted to determine the correlation matrix among psychological
210 distress, mindfulness, social support, and perceived stigma. The following indices
211 were calculated in order to evaluate the fitness of the overall model: the ratio of Chi-
212 square (χ^2) to degrees of freedom (df), comparative fit index (CFI), goodness of fit
213 index (GFI), adjusted GFI (AGFI), Tucker-Lewis index (TLI), incremental fit index
214 (IFI), and root-mean-square error of approximation (RMSEA). Model fit was
215 regarded as good when a ratio of χ^2/df was equal to or less than 3. For GFI and AGFI,
216 a value of more than 0.90 indicates a good model fit. Moreover, CFI of ≥ 0.90 and
217 RMSEA of < 0.05 were also suggesting a good model fit. Moreover, bootstrap test
218 was also used to test a mediating effect of social support and perceived stigma in the
219 relationship between mindfulness and psychological distress. A $p < 0.05$ indicated
220 significance for all analyses. Dada was analysed with the Statistical Package for the
221 Social Sciences (Chicago, Illinois, USA) and IBM AMOS 21.0 (Chicago, Illinois,
222 USA).

223

224 **4. Results**

225 **4.1. Sample characteristics**

226 Total 450 questionnaires were distributed during survey, and 441 valid questionnaires
227 were received finally, with an effective response rate of 98.0%. Details of 441
228 Chinese lung cancer patients' socio-demographic and clinical were presented in Table
229 1. The participants had a median age of 60.0 (IQR: 52.0–67.0) and most were male
230 (71.4%). Most participants did not get adequate education (68.0%), and a significant
231 number of participants were unemployed (44.9%). Most participants were married
232 (99.3%) and had medical insurance (97.3%), and more than half of them had no

233 drinking history (53.7%) and diagnosis duration of less than 6 months (53.1%). In
234 addition, most participants had no family history of lung cancer (87.8%) and no
235 comorbidity (74.1%). However, most of these participants were at the advanced stage
236 (85.7%) and most experienced metastasis (62.6%). Moreover, a minority of these
237 participants experienced moderate to severe pain (19.0%), but most participants did
238 not receive surgery (61.9%).

239

240 **4.2. Correlation matrix of psychological distress, mindfulness, social support,** 241 **and perceived stigma**

242 The score of psychological distress, mindfulness, social support, and perceived stigma
243 was 2 (2-3), 117 (111-123), 66 (61-70), and 98 (84-107), respectively. Among 441
244 lung cancer patients who returned valid questionnaires, 78 patients were confirmed to
245 achieve a clinically significant level of psychological distress, indicating an incidence
246 of 17.7%. Table 2 documented the results of correlation analyses of psychological
247 distress, mindfulness, social support, and perceived stigma. The results of the
248 Spearman rank correlation analyses showed all variables were significantly correlated
249 with one another.

250

251 **4.3. Structural equation modeling of the association of psychological distress,** 252 **mindfulness, social support, and perceived stigma**

253 Structural equation modeling (SEM) with maximum likelihood was used to analyze
254 the route correlations. We firstly constructed the structure of all variables according to
255 the results of correlation analyses. However, the relationship between perceived
256 stigma and psychological distress did not get statistically significant. We therefore
257 eliminated the direct route to good fit the structural model which was presented in
258 Figure 1 ($\chi^2/df = 1.201$, CFI = 0.999, GFI = 0.999, AGFI = 0.986, TLI = 0.995, IFI =
259 0.999, RMSEA = 0.021 [0.000 to 0.130]). Corresponding numerical results were
260 summarized in Table 3.

261 As illustrated, mindfulness ($\beta = -0.107$, $p = 0.008$) and social support ($\beta = -0.513$,

262 $p<0.001$) had direct negative effects on psychological distress. The direct pathway
263 from mindfulness to perceived stigma ($\beta=-0.185, p<0.001$) was statistically
264 significant. Meanwhile, the direct pathway from perceived stigma to social support
265 ($\beta=-0.373, p<0.001$) was also statistically significant. The results from bootstrap test
266 for significance of indirect pathways are summarized in Table 4. The results indicated
267 that the indirect pathways between mindfulness and psychological distress through
268 chain mediating effect of perceived stigma and social support were statistically
269 significant ($B=-0.048, 95\% \text{ CI } [-0.102 \text{ to } 0.000], p=0.048$). Overall, the total effect of
270 mindfulness in againtsing psychological distress was -0.155 . Furthermore,
271 mindfulness had only an indirect positive effect on social support through route of
272 perceived stigma ($B=0.069, 95\% \text{ CI } [0.037 \text{ to } 0.105], p=0.001$). Meanwhile,
273 perceived stigma had only indirect positive effect on psychological distress through
274 social support ($B=0.191, 95\% \text{ CI } [0.240 \text{ to } 0.149], p<0.001$). The results suggested
275 that perceived stigma and social support play a chain mediating role in the
276 relationship between mindfulness and psychological distress among Chinese lung
277 cancer patients.

278

279 **5. Discussion**

280 Psychological distress was extensively regarded as an important negative
281 psychological consequence of diagnosis of cancer and anti-cancer, which has been
282 demonstrated to be negatively related to poor treatment effectiveness, increased risk
283 of morbidity and mortality, and poor quality of life[30]. The incidence of
284 psychological distress among lung cancer patients was detected to be highest
285 compared to other types of cancer[4]. Therefore, it is imperative to identify protective
286 and risk factors in order to further develop precise psychological treatment protocol
287 for psychological distress among lung cancer patients. In this cross-sectional
288 descriptive study, we revealed a relatively lower detection rate of psychological
289 distress among lung cancer (17.7%), possible reasons such as higher proportion of
290 advanced lung cancer patients and usage of DT have been deeply discussed in our

291 previous study[21]. Meanwhile, we determined mindfulness and social support had
292 direct positive effects on psychological distress as protective factors among lung
293 cancer patients. Meanwhile, perceived stigma indirectly and negatively impacted
294 psychological distress through reducing social support. Furthermore, mindfulness also
295 alleviated psychological distress via the only chain mediating route between perceived
296 stigma and social support due to the direct route between mindfulness and social
297 support was not statistically significant.

298 Mindfulness is a positive psychological trait of regulating awareness and
299 attention through meditation practice in which thoughts, feelings, and physical
300 sensations are observed and then accepted at present moment non-judgmentally[38].
301 Mindfulness has been found to be beneficial for improving adverse psychological
302 outcomes through effective self-designed regulation and keeping positive emotional
303 status[14]. For example, studies revealed that self-reported mindfulness skills were
304 related to less psychological distress in cancer patients[39] and less perceived stigma
305 in other populations[28], which were further demonstrated in our current study.

306 Social support was also listed as an important variable in this study. As one of the
307 most common positive external sources coping with negative psychological events,
308 social support has been extensively cited as a protective source on psychosocial
309 adjustment[40]. Previous studies have demonstrated that social support plays a curial
310 role in predicting psychological distress[41]. One study focusing on breast cancer
311 patients also suggested that a higher level of social support was the association with
312 higher benefit when a critical threshold of social support was reached[41]. In this
313 study, we also demonstrated the direct negative correlation between social support and
314 psychological distress, which were consistent with previous studies[41]. However, in
315 this study, the role of social support in the relationship between mindfulness and
316 psychological distress was not determined due to the direct effect of mindfulness on
317 social support was not significant. Nevertheless, mindfulness was demonstrated to
318 have an indirect effect on social support via mediating route of perceived stigma, and
319 further negatively influence psychological distress. Cancer stigma has been

320 extensively regarded as a stressor[42,43]. Previous studies consistently suggested that
321 lung cancer stigma impeded patients to seek external supports[44], such as medical
322 help-seeking behavior[45]. Therefore, nursing practitioners should design more
323 support elements into mindfulness-based intervention protocols in order to
324 significantly reduce the impact of perceived stigma on social support and further
325 enhance the protective effect of mindfulness on psychological distress.

326 A few limitations in the current study must be further interpreted. First, the
327 nature of the cross-sectional, observational, descriptive design limits the ability of
328 interpreting causal interference between the mindfulness, social support, and
329 perceived stigma. Although we proposed the theoretical model according to previous
330 studies, the findings in our study should also be interpreted cautiously. Additional
331 studies with longitudinal or experimental designs should be conducted to establish our
332 findings. Second, all eligible lung cancer patients were enrolled based on convenience
333 sampling, which impaired the representativeness of the sample. Therefore, we suggest
334 future studies with random sampling method to further demonstrate the relationships
335 of all variables. Third, the level of psychological distress, mindfulness, social support,
336 and perceived stigma was measured with self-reported questionnaires, and thus
337 inflation in results can not be neglected due to subjective bias from patients. We
338 therefore suggest designing more studies with physiological assessment and
339 ecological momentary assessment. Forth, the relationships revealed in the current
340 study may be specific to all lung cancer patients regardless of cancer treatment
341 modalities and the level of symptom burden and not applicable to other populations.
342 Additional studies with samples of greater diversity should be performed to determine
343 these relationships. Fifth, DT was selected to measure the level of psychological
344 distress in the present study, however as a self-answered scale at grade evaluation, it
345 can not separate the risk of psychological distress and the accumulated level of
346 psychological distress. Therefore, further study should be designed to develop an
347 instrument of measuring the risk of psychological distress based on objective
348 variables. Sixth, demographic characteristics such as marital status may have an

349 impact on the levels of social support and perceived stigma, the generalizability of our
350 findings may be limited because of we did not further investigate the role of
351 demographic characteristics on targeted variables such as social support.

352

353 **6. Conclusion**

354 In conclusion, to our knowledge, this is the first study that investigated the
355 associations between mindfulness, social support, perceived stigma, and
356 psychological distress among lung cancer patients. As expected, through conducting
357 investigation among 441 lung cancer patients, this study showed that mindfulness
358 have direct negative impact on psychological distress, and social support and
359 perceived stigma mediated the relationship between mindfulness and psychological
360 distress. It suggested that clinicians and nursing professionals may enhance the
361 positive effects of mindfulness-based intervention protocol through involving more
362 social support elements on perceived stigma in psychological treatments, and further
363 lessen psychological distress finally.

364

365 **7. Clinical implications**

366 This study enhanced our understanding on the associations between mindfulness,
367 social support, perceived stigma and psychological distress in lung cancer patients.
368 From our current findings, practitioners may enhance the benefits of mindfulness-
369 based intervention protocol involving social support elements through alleviating the
370 level of perceived stigma of lung cancer patients and eventually reduce the adverse
371 consequences caused by psychological distress.

372

373 **Author Declaration**

374 **Funding:** This study was supported by Grant from the Technological Innovation and
375 Demonstrational Application Project of Chongqing Science and Technology Bureau
376 (project no. cstc2018jscx-msybX0030) and Chongqing Natural Science Foundation
377 (project no. cstc2018jcyjAX0737s). The founder had no role in the design and

378 conduct of the study; collection, management, analysis, and interpretation of the data;
379 preparation, review, or approval of the manuscript; and decision to submit the
380 manuscript for publication.

381 **Conflict of interest:** No conflict of interest was reported.

382 **Availability of data and materials:** The datasets used and/or analysed during the
383 current study are available from the corresponding author on reasonable request.

384 **Author contributions:** Xu Tian had full access to all of the data in the study and are
385 held responsible for the integrity of the data and accuracy of the data analysis.

386 Concept and design: Hui Lei, Xu Tian and Maria F. Jiménez-Herrera. Acquisition,
387 analysis, or interpretation of data: Hui Lei, Xu Tian, Yan-Fei Jin, and Ling Tang.

388 Drafting of the manuscript: Hui Lei, Xu Tian and Hui Chen. Critical revision of the
389 manuscript for important intellectual content: Wei-Qing Chen and Maria F. Jiménez-

390 Herrera. Statistical analysis: Lei Hui and Xu Tian. Obtaining funding: Xu Tian.

391 Administrative, technical, or material support: Wei-Qing Chen. Supervision: Maria F.
392 Jiménez-Herrera.

393 **Ethics approval:** Not applicable.

394 **Consent to participate:** Not applicable.

395 **Consent for publication:** Not applicable.

396 **Acknowledgments:** The research team gratefully acknowledges the supervisors of
397 the hospitals and the 441 lung cancer patients who voluntarily participated in the
398 study, as well as the experts and members of the group for their help and advice.

399 **References**

- 400 1. Sung H, Ferlay J, Siegel RL, Laversanne M, Soerjomataram I, Jemal A, Bray F
401 (2021) Global cancer statistics 2020: GLOBOCAN estimates of incidence and
402 mortality worldwide for 36 cancers in 185 countries. *CA: a cancer journal for*
403 *clinicians*. doi:10.3322/caac.21660
- 404 2. Brocken P, Prins JB, Dekhuijzen PN, van der Heijden HF (2012) The faster the
405 better?—A systematic review on distress in the diagnostic phase of suspected cancer,
406 and the influence of rapid diagnostic pathways. *Psychooncology* 21 (1):1-10.
407 doi:10.1002/pon.1929
- 408 3. Goldstraw P, Chansky K, Crowley J, Rami-Porta R, Asamura H, Eberhardt WE,
409 Nicholson AG, Groome P, Mitchell A, Bolejack V (2016) The IASLC Lung Cancer
410 Staging Project: Proposals for Revision of the TNM Stage Groupings in the
411 Forthcoming (Eighth) Edition of the TNM Classification for Lung Cancer. *Journal of*
412 *thoracic oncology : official publication of the International Association for the Study*
413 *of Lung Cancer* 11 (1):39-51. doi:10.1016/j.jtho.2015.09.009
- 414 4. Zabora J, BrintzenhofeSzoc K, Curbow B, Hooker C, Piantadosi S (2001) The
415 prevalence of psychological distress by cancer site. *Psycho-oncology* 10 (1):19-28.
416 doi:10.1002/1099-1611(200101/02)10:1<19::aid-pon501>3.0.co;2-6
- 417 5. Tian X, Jin YF, Chen H, Tang L, Jimenez-Herrera MF (2021) Relationships among
418 Social Support, Coping Style, Perceived Stress, and Psychological Distress in Chinese
419 Lung Cancer Patients. *Asia-Pacific Journal of Oncology Nursing* 8 (2):172-179.
420 doi:10.4103/apjon.apjon_59_20
- 421 6. Lynch J, Goodhart F, Saunders Y, O'Connor SJ (2010) Screening for psychological
422 distress in patients with lung cancer: results of a clinical audit evaluating the use of
423 the patient Distress Thermometer. *Supportive care in cancer : official journal of the*
424 *Multinational Association of Supportive Care in Cancer* 19 (2):193-202.
425 doi:10.1007/s00520-009-0799-8
- 426 7. Chambers SK, Baade P, Youl P, Aitken J, Occhipinti S, Vinod S, Valery PC, Garvey
427 G, Fong KM, Ball D, Zorbas H, Dunn J, O'Connell DL (2015) Psychological distress

428 and quality of life in lung cancer: the role of health-related stigma, illness appraisals
429 and social constraints. *Psycho-oncology* 24 (11):1569-1577. doi:10.1002/pon.3829

430 8. Yee MK, Sereika SM, Bender CM, Brufsky AM, Connolly MC, Rosenzweig MQ
431 (2017) Symptom incidence, distress, cancer-related distress, and adherence to
432 chemotherapy among African American women with breast cancer. *Cancer* 123
433 (11):2061-2069. doi:10.1002/cncr.30575

434 9. Zhang Y, Zanos P, Jackson IL, Zhang X, Zhu X, Gould T, Vujaskovic Z (2020)
435 Psychological stress enhances tumor growth and diminishes radiation response in
436 preclinical model of lung cancer. *Radiotherapy and oncology : journal of the*
437 *European Society for Therapeutic Radiology and Oncology* 146:126-135.
438 doi:10.1016/j.radonc.2020.02.004

439 10. Hamer M, Chida Y, Molloy GJ (2009) Psychological distress and cancer mortality.
440 *Journal of psychosomatic research* 66 (3):255-258.
441 doi:10.1016/j.jpsychores.2008.11.002

442 11. Kabat-Zinn J (2003) Mindfulness-Based Interventions in Context: Past, Present,
443 and Future. *Clinical Psychology: Science and Practice* 10 (2):144-156.
444 doi:<https://doi.org/10.1093/clipsy.bpg016>

445 12. Kashiwazaki Y, Takebayashi Y, Murakami M (2020) Relationships between
446 radiation risk perception and health anxiety, and contribution of mindfulness to
447 alleviating psychological distress after the Fukushima accident: Cross-sectional study
448 using a path model. *PloS one* 15 (7):e0235517. doi:10.1371/journal.pone.0235517

449 13. Freudenthaler L, Turba JD, Tran US (2017) Emotion Regulation Mediates the
450 Associations of Mindfulness on Symptoms of Depression and Anxiety in the General
451 Population. *Mindfulness (N Y)* 8 (5):1339-1344. doi:10.1007/s12671-017-0709-y

452 14. Ludwig DS, Kabat-Zinn J (2008) Mindfulness in Medicine. *JAMA* 300 (11):1350-
453 1352. doi:10.1001/jama.300.11.1350

454 15. Galante J, Friedrich C, Dawson AF, Modrego-Alarcón M, Gebbing P, Delgado-
455 Suárez I, Gupta R, Dean L, Dalglish T, White IR, Jones PB (2021) Mindfulness-
456 based programmes for mental health promotion in adults in nonclinical settings: A

457 systematic review and meta-analysis of randomised controlled trials. *PLoS medicine*
458 18 (1):e1003481. doi:10.1371/journal.pmed.1003481

459 16. Cho D, Kim S, Durrani S, Liao Z, Milbury K (2020) Associations Between
460 Spirituality, Mindfulness, and Psychological Symptoms Among Advanced Lung
461 Cancer Patients and Their Spousal Caregivers. *Journal of pain and symptom*
462 *management*. doi:10.1016/j.jpainsymman.2020.10.001

463 17. van den Hurk DG, Schellekens MP, Molema J, Speckens AE, van der Drift MA
464 (2015) Mindfulness-Based Stress Reduction for lung cancer patients and their
465 partners: Results of a mixed methods pilot study. *Palliative medicine* 29 (7):652-660.
466 doi:10.1177/0269216315572720

467 18. Schellekens MPJ, van den Hurk DGM, Prins JB, Donders ART, Molema J,
468 Dekhuijzen R, van der Drift MA, Speckens AEM (2017) Mindfulness-based stress
469 reduction added to care as usual for lung cancer patients and/or their partners: A
470 multicentre randomized controlled trial. *Psycho-Oncology* 26 (12):2118-2126.
471 doi:<https://doi.org/10.1002/pon.4430>

472 19. Teixeira RJ, Pereira MG (2013) Psychological morbidity, burden, and the
473 mediating effect of social support in adult children caregivers of oncological patients
474 undergoing chemotherapy. *Psychooncology* 22 (7):1587-1593. doi:10.1002/pon.3173

475 20. Demirtepe-Saygili D, Bozo O (2011) Perceived social support as a moderator of
476 the relationship between caregiver well-being indicators and psychological symptoms.
477 *Journal of health psychology* 16 (7):1091-1100. doi:10.1177/1359105311399486

478 21. Tian X, Jin Y, Chen H, Tang L, Jim, #233, nez-Herrera M (2021) Relationships
479 among Social Support, Coping Style, Perceived Stress, and Psychological Distress in
480 Chinese Lung Cancer Patients. *Asia-Pacific Journal of Oncology Nursing* 8 (2):172-
481 179. doi:10.4103/apjon.apjon_59_20

482 22. Hsu T, Forestell CA (2021) Mindfulness, depression, and emotional eating: The
483 moderating role of nonjudging of inner experience. *Appetite* 160:105089.
484 doi:10.1016/j.appet.2020.105089

485 23. Sanchez Hernandez H, Urizar GG, Jr., Yim IS (2019) The influence of

486 mindfulness and social support on stress reactivity during pregnancy. *Stress and*
487 *health : journal of the International Society for the Investigation of Stress* 35 (3):330-
488 340. doi:10.1002/smi.2865

489 24. Schellekens MPJ, Tamagawa R, Labelle LE, Speca M, Stephen J, Drysdale E,
490 Sample S, Pickering B, Dirkse D, Savage LL, Carlson LE (2017) Mindfulness-Based
491 Cancer Recovery (MBCR) versus Supportive Expressive Group Therapy (SET) for
492 distressed breast cancer survivors: evaluating mindfulness and social support as
493 mediators. *Journal of behavioral medicine* 40 (3):414-422. doi:10.1007/s10865-016-
494 9799-6

495 25. Cataldo JK, Slaughter R, Jahan TM, Pongquan VL, Hwang WJ (2011) Measuring
496 stigma in people with lung cancer: psychometric testing of the cataldo lung cancer
497 stigma scale. *Oncology nursing forum* 38 (1):E46-54. doi:10.1188/11.onf.e46-e54

498 26. Chambers SK, Dunn J, Occhipinti S, Hughes S, Baade P, Sinclair S, Aitken J,
499 Youl P, O'Connell DL (2012) A systematic review of the impact of stigma and
500 nihilism on lung cancer outcomes. *BMC cancer* 12:184. doi:10.1186/1471-2407-12-
501 184

502 27. Johnson LA, Schreier AM, Swanson M, Moye JP, Ridner S (2019) Stigma and
503 Quality of Life in Patients With Advanced Lung Cancer. *Oncology nursing forum* 46
504 (3):318-328. doi:10.1188/19.onf.318-328

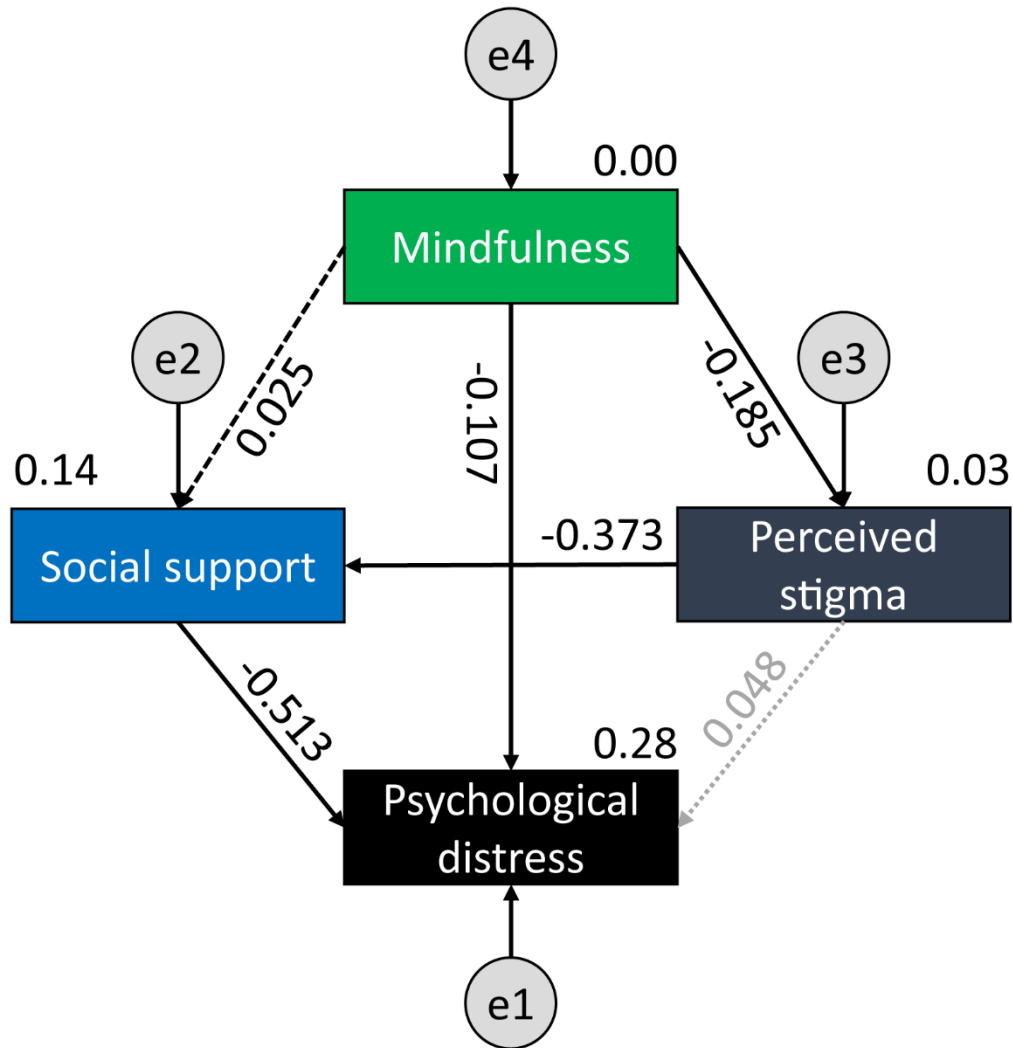
505 28. Gamwell KL, Roberts CM, Espeleta HC, Baudino MN, Hommel KA, Grunow JE,
506 Jacobs NJ, Gillaspay SR, Mullins LL, Chaney JM (2020) Perceived stigma, illness
507 uncertainty, and depressive symptoms in youth with inflammatory bowel disease: The
508 moderating effect of mindfulness. *Psychology, health & medicine* 25 (9):1037-1048.
509 doi:10.1080/13548506.2020.1714062

510 29. von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP
511 (2014) The Strengthening the Reporting of Observational Studies in Epidemiology
512 (STROBE) Statement: guidelines for reporting observational studies. *International*
513 *journal of surgery (London, England)* 12 (12):1495-1499.
514 doi:10.1016/j.ijssu.2014.07.013

- 515 30. Riba MB, Donovan KA, Andersen B, Braun I, Breitbart WS, Brewer BW,
516 Buchmann LO, Clark MM, Collins M, Corbett C, Fleishman S, Garcia S, Greenberg
517 DB, Handzo RGF, Hoofring L, Huang CH, Lally R, Martin S, McGuffey L, Mitchell
518 W, Morrison LJ, Pailer M, Paresh O, Parnes F, Pazar JP, Ralston L, Salman J,
519 Shannon-Dudley MM, Valentine AD, McMillian NR, Darlow SD (2019) Distress
520 Management, Version 3.2019, NCCN Clinical Practice Guidelines in Oncology.
521 Journal of the National Comprehensive Cancer Network : JNCCN 17 (10):1229-1249.
522 doi:10.6004/jnccn.2019.0048
- 523 31. Hong J, Wei Z, Wang W (2015) Preoperative psychological distress, coping and
524 quality of life in Chinese patients with newly diagnosed gastric cancer. Journal of
525 clinical nursing 24 (17-18):2439-2447. doi:10.1111/jocn.12816
- 526 32. Donovan KA, Grassi L, McGinty HL, Jacobsen PB (2014) Validation of the
527 distress thermometer worldwide: state of the science. Psycho-oncology 23 (3):241-
528 250. doi:10.1002/pon.3430
- 529 33. Baer RA, Smith GT, Hopkins J, Krietemeyer J, Toney L (2006) Using self-report
530 assessment methods to explore facets of mindfulness. Assessment 13 (1):27-45.
531 doi:10.1177/1073191105283504
- 532 34. Deng YQ, Liu XH, Rodriguez MA, Xia CY (2011) The Five Facet Mindfulness
533 Questionnaire: Psychometric Properties of the Chinese Version. Mindfulness 2
534 (2):123-128
- 535 35. Zimet GD, Powell SS, Farley GK, Werkman S, Berkoff KA (1990) Psychometric
536 characteristics of the Multidimensional Scale of Perceived Social Support. Journal of
537 personality assessment 55 (3-4):610-617. doi:10.1080/00223891.1990.9674095
- 538 36. Yang J, Li S, Zheng Y (2009) Predictors of depression in Chinese community-
539 dwelling people with type 2 diabetes. Journal of clinical nursing 18 (9):1295-1304.
540 doi:10.1111/j.1365-2702.2008.02703.x
- 541 37. Yu Y, Wang L, Zhang M, Du YH, Bai Y, Liu JE (2017) Psychometric evaluation of
542 the Chinese version of the Cataldo Lung Cancer Stigma Scale (CLCSS). Chin J
543 Nurs 52 (5):636-640. doi:10.3761/j.issn.0254-1769.2017.05.029

- 544 38. Bishop SR, Lau M, Shapiro S, Carlson L, Anderson ND, Carmody J, Segal ZV,
545 Abbey S, Speca M, Velting D, Devins G (2004) Mindfulness: A Proposed Operational
546 Definition. *Clinical Psychology: Science and Practice* 11 (3):230-241.
547 doi:<https://doi.org/10.1093/clipsy.bph077>
- 548 39. Huang HP, He M, Wang HY, Zhou M (2016) A meta-analysis of the benefits of
549 mindfulness-based stress reduction (MBSR) on psychological function among breast
550 cancer (BC) survivors. *Breast cancer (Tokyo, Japan)* 23 (4):568-576.
551 doi:10.1007/s12282-015-0604-0
- 552 40. Schulz U, Schwarzer R (2004) Long-Term Effects of Spousal Support on Coping
553 with Cancer After Surgery. *Journal of Social and Clinical Psychology* 23 (5):716-732.
554 doi:10.1521/jscp.23.5.716.50746
- 555 41. Mallinckrodt B, Armer JM, Heppner PP (2012) A threshold model of social
556 support, adjustment, and distress after breast cancer treatment. *Journal of counseling*
557 *psychology* 59 (1):150-160. doi:10.1037/a0026549
- 558 42. Chapple A, Ziebland S, McPherson A (2004) Stigma, shame, and blame
559 experienced by patients with lung cancer: qualitative study. *BMJ (Clinical research*
560 *ed)* 328 (7454):1470. doi:10.1136/bmj.38111.639734.7C
- 561 43. Kang NE, Kim HY, Kim JY, Kim SR (2020) Relationship between cancer stigma,
562 social support, coping strategies and psychosocial adjustment among breast cancer
563 survivors. *Journal of clinical nursing* 29 (21-22):4368-4378. doi:10.1111/jocn.15475
- 564 44. Brown Johnson CG, Brodsky JL, Cataldo JK (2014) Lung cancer stigma, anxiety,
565 depression, and quality of life. *Journal of psychosocial oncology* 32 (1):59-73.
566 doi:10.1080/07347332.2013.855963
- 567 45. Carter-Harris L, Hermann CP, Schreiber J, Weaver MT, Rawl SM (2014) Lung
568 cancer stigma predicts timing of medical help-seeking behavior. *Oncology nursing*
569 *forum* 41 (3):E203-210. doi:10.1188/14.onf.e203-e210
- 570

571 **Figure legends**



$\chi^2/df = 1.201$, CFI = 0.999, GFI = 0.999, AGFI = 0.986,
 TLI = 0.995, IFI = 0.999, RMSEA = 0.021 (0.000, 0.130)

572

573

Figure 1. Structural routes of mindfulness, social support, perceived stigma, and

574

psychological distress among 441 Chinese lung cancer patients. Grey dotted arrow

575

indicates the unconnected direct route between perceived stigma and psychological

576

distress resulted from no statistical significance. Black solid arrow indicates

577

statistically significant direct route, and black dotted arrow represents no statistical

578

significance. Values are standardized coefficients for direct paths.

Table 1. Socio-demographic and clinical characteristics of 441 Chinese lung cancer patients.

Characteristic	Percentage, %
Age: Median (IQR)	60.0 (52.0–67.0) yrs
Gender	
Male	71.4%
Female	28.6%
Educational level	
Primary	27.2%
Junior high	40.8%
Senior high	19.1%
University	12.9%
Occupational status	
Not working	44.9%
Working	12.2%
Retired	42.9%
Marital status	
Married	99.3%
Divorced/Widowed	0.7%
Time from diagnosis, month	
<1	11.6%
1-6	41.5%
7-12	19.0%
>12	27.9%
Family history of lung cancer	
No	87.8%
Yes	12.2%
Smoking history	
No	36.1%
Yes	63.9%
Alcohol consumption	
No	53.7%
Yes	46.3%
Surgery	
No	61.9%
Yes	38.1%
Metastasis	
No	37.4%
Yes	62.6%
Co-morbidity	
No	74.1%
Yes	25.9%
Pain	
No pain	41.5%
Mild	39.5%
Moderate	18.4%
Severe	0.06%
TNM stage	
I	9.5%
II	4.8%
III	10.9%
IV	74.8%

Table 2. Spearman correlation coefficient of study variables ($n = 441$).

Variables	Score, median (IQR)	Psychological distress	Perceived stigma	Social support	Mindfulness
Psychological distress	2 (2 – 3)	1			
Perceived stigma	98 (84 – 107)	0.340**	1		
Social support	66 (61 – 70)	-0.444**	-0.392**	1	
Mindfulness	117 (111 – 123)	-0.152**	-0.237**	0.122*	1

* $P < 0.05$, ** $P < 0.01$. IQR, interquartile rang.

Variables	Mindfulness			Perceived stigma		Social support
	Perceived stigma	Social support	Psychological distress	Social support	Psychological distress	Psychological distress
Total effects	-0.185**	0.094	-0.155*	-0.373**	n.a.	-0.513**
Direct effects	-0.185**	0.025	-0.107*	-0.373**	n.a.	-0.513**
Indirect effects	0.000	0.069**	-0.048*	0.000	0.191**	0.000

* $P < 0.05$, ** $P < 0.01$. n.a., not applicable.

Table 4. Bias-corrected bootstrap test for all analyzed direct and indirect pathways.		
Direct pathway	Bootstrap estimate (95% CI)	<i>P</i> value
psychological distress ← mindfulness	-0.107 (-0.195 to -0.017)	0.022
perceived stigma ← mindfulness	-0.185 (-0.098 to -0.272)	0.001
social support ← perceived stigma	-0.373 (-0.302 to -0.439)	0.001
psychological distress ← social support	-0.513 (-0.588 to -0.437)	0.001
social support ← mindfulness	0.025 (-0.004 to 0.192)	0.061
Indirect pathway	Bootstrap estimate (95% CI)	<i>P</i> value
psychological distress ← mindfulness	-0.048 (-0.102 to 0.000)	0.048
social support ← mindfulness	0.069 (0.037 to 0.105)	0.001
psychological distress ← perceived stigma	0.191 (0.240 to 0.149)	<0.001

CI, confidence interval.