ORIGINAL ARTICLE

Optimal communication associated with lower risk of acute traumatic stress after lung cancer diagnosis

Hronn Hardardottir[1,2] · Thor Aspelund[2] · Jianwei Zhu[2,3,4] · Katja Fall[5,6] · Arna Hauksdottir[2] · Fang Fang[6] ·
Donghao Lu[2,3,7,8] · Christer Janson[9] · Steinn Jonsson[1,10] · Heiddis Valdimarsdottir[11,12] ·
Unnur A. Valdimarsdottir[2,3,7]

Abstract

Purpose The aim of this study was to assess the role of the patient's background and perceived healthcare-related factors in symptoms of acute stress after lung cancer diagnosis.

Methods The study population consisted of 89 individuals referred for diagnostic work-up at Landspitali National University Hospital in Iceland and subsequently diagnosed with lung cancer. Before diagnosis, the patients completed questionnaires on sociodemographic characteristics, pre-diagnostic distress (Hospital Anxiety and Depression Scale), social support, and resilience. At a median of 16 days after diagnosis, the patients reported symptoms of acute stress on the Impact of Event Scale-Revised (IES-R) and experience of communication and support from healthcare professionals and family during the diagnostic period.

Results Patients were on average 68 years and 52% reported high levels of post-diagnostic acute stress (IES-R > 23) while 24% reported symptoms suggestive of clinical significance (IES-R > 32). Prior history of cancer ($\beta = 6.7$, 95% CI: 0.1 to 13.3) and pre-diagnostic distress were associated with higher levels of post-diagnostic acute stress ($\beta = 8.8$, 95% CI: 2.7 to 14.9), while high educational level ($\beta = -7.9$, 95% CI: −14.8 to −1.1) was associated with lower levels. Controlling for the abovementioned factors, the patients' perception of optimal doctor-patient ($\beta = -9.1$, 95% CI: −14.9 to −3.3) and family communication ($\beta = -8.6$, 95% CI: −14.3 to −2.9) was inversely associated with levels of post-diagnostic acute stress after lung cancer diagnosis.

Conclusions A high proportion of patients with newly diagnosed lung cancer experience high levels of acute traumatic stress of potential clinical significance. Efforts to improve doctor-patient and family communication may mitigate the risk of these adverse symptoms.

Keywords Post-diagnostic acute stress · Doctor-patient communication · Lung cancer diagnosis · Posttraumatic stress disorder (PTSD) · Prospective cohort study

✉ Hronn Hardardottir
  hronnh@landspitali.is

1 Department of Respiratory Medicine, Landspitali University Hospital, Reykjavik, Iceland

2 Centre of Public Health Sciences, Faculty of Medicine, University of Iceland, Reykjavik, Iceland

3 Department of Medical Epidemiology & Biostatistics, Karolinska Institutet, Stockholm, Sweden

4 Department of Orthopedic Surgery, West China Hospital, West China Medical School, Sichuan University, Chengdu 610000, Sichuan Province, China

5 Clinical Epidemiology and Biostatistics, School of Medical Sciences, Örebro University, Örebro, Sweden

6 Institute of Environmental Medicine, Karolinska Institutet, Stockholm, Sweden

7 Department of Epidemiology, Harvard T.H. Chan School of Public Health, Boston, MA, USA

8 Channing Division of Network Medicine, Brigham and Women's Hospital, Harvard Medical School, Boston, MA, USA

9 Respiratory, Allergy and Sleep Research, Department of Medical Sciences, Uppsala University, Uppsala, Sweden

10 Department of Medicine, Faculty of Medicine, University of Iceland, Reykjavik, Iceland

11 Department of Psychology, Reykjavík University, Reykjavik, Iceland

12 Mount Sinai School of Medicine, New York, NY, USA

Introduction

Receiving a cancer diagnosis may induce a significant psychological and biological stress response [1–6] with documented immediate risks of extreme outcomes including suicide and cardiovascular deaths [7]. Evidence indicates that as many as 19–62% of cancer patients experience clinically significant levels of cancer-related stress, especially patients facing a poor prognosis, e.g., lung cancer [1, 8]. This patient group experiences a range of other psychological symptoms, including acute stress, anxiety, and depression as well as post-traumatic stress [9], which may also impact social, occupational, or other important areas of function [10]. Early detection of acute stress symptoms in cancer patients is critical as these symptoms have been linked with poorer mental and physical health [10], including increased cancer symptom burden [1, 3], decreased compliance with medical care [11], prolonged hospital stay [12], decreased quality of life [3, 9, 13], and even reduced overall survival [2, 14, 15].

Mounting evidence suggests that a history of psychological morbidity is associated with the risk of severe mental stress after cancer diagnosis [10, 16, 17]. Resilience or adaptive coping styles have also been associated with more adaptive responses after cancer diagnosis [18], while divergent results have been obtained regarding the role of social support in stress levels after a diagnosis of cancer [18–21].

Data are scarce on the association between both the doctor-patient communication and patient-family communication on patient acute stress levels after lung cancer diagnosis. Yet the communication between healthcare professionals and cancer patients has been suggested as an important contributor to patients' well-being and medical outcomes [13, 22]. Current guidelines suggest that physicians should communicate in a straightforward and patient-centered way to reduce mismatch of understanding and meet patients' satisfaction and preferences [23]. Nevertheless, patients often report dissatisfaction with the amount and nature of information they receive about their disease and prognosis as well as choices in its management [24, 25]. Moreover, several studies using various methodologies suggest that poor communication with healthcare professionals and family plays a role in psychosocial stress levels and quality of life among cancer patients [26]. Meanwhile, to our knowledge, no studies have been performed specifically on the role of doctor-patient communication and family communication in patients' stress levels shortly after diagnosis of lung cancer and most of the existing literature on stress-related psychological symptoms by cancer patients is when cancer therapy is already established and possibly biased of therapy-related features.

With this background, the present study aimed to determine the prevalence of acute stress symptoms shortly after lung cancer diagnosis, and explore the role of the patient's background and healthcare-related factors (e.g., doctor-patient communication) on the acute stress levels after the diagnosis.

Methods

Procedure and study population

The LUCASS (LUng CAncer, Stress, and Survival) study is a prospective cohort study of the psycho-biologic stress response of patients going through a diagnostic work-up for suspected lung cancer. The measurements include a comprehensive self-assessment of psychological stress with ascertainment of various biomarkers and detailed documentation of the patient's background, clinical factors, and disease course. The data collection is ongoing in Uppsala region, Sweden, while completed nationwide in Iceland. The data used for this study are from the nationwide Icelandic study arm. Eligible were all individuals 18 to 86 years old referred to Landspitali University Hospital in Iceland with clinical and/or radiographic changes suggestive of lung cancer. They went through a diagnostic work-up, leading to a definite lung cancer diagnosis and staging during a 24-h diagnostic work-up or within a few days thereafter. Between March 15, 2015, and March 31, 2018, we recruited 166 patients of whom 130 received a diagnosis of lung cancer. This analysis is confined to the 89 patients diagnosed with lung cancer who completed questionnaires (e.g., IES-R) after the lung cancer diagnosis but before any treatment was given (see flow chart of the study population in Supplementary Figure 1).

The lung cancer diagnosis was in all cases based on pathological diagnosis of non-small cell carcinoma (NSCLC) or small cell carcinoma (SCLC) respectively. Patients with carcinoid tumors ($n = 3$) were excluded because of rarity and the predominantly benign nature of carcinoid tumors. The date of the lung cancer diagnosis was defined as the date of the first report of the pathology diagnosis, either from cytology or histologic results. All patients were clinically staged after diagnosis of lung cancer according to TNM classification system (the seventh edition) both for NSCLC and SCLC [27].

All patients referred to Landspitali University Hospital in Iceland for a diagnostic work-up for suspected lung cancer were given verbal and written information about the study at the first hospital visit and informed consent was obtained from all participating patients before any study material was collected.

Approval for the study was granted by the National Bioethics Committee, Iceland (VSNb201460025/03.07).

Questionnaire assessment

Questionnaire assessment was integrated with the clinical assessments at two time-points, i.e., during the diagnostic work-

up and at a follow-up visit shortly after lung cancer diagnosis but before any treatment. Patients had the option to complete the questionnaires at home and then bring them back to the hospital or complete them during their clinical assessment visits.

Assessments before diagnosis

The patients completed a questionnaire consisting of self-reports of age, education, marital status, work, financial status, and smoking. We considered patients having a history of psychologic morbidity if they responded "yes" to ever have suffered from depression or anxiety for 2 weeks or longer or had ever been treated for psychiatric symptoms. Nurse-led assessment of clinical measures and detailed prior medical history was recorded including prior history of any cancer diagnosis.

The 14-item Hospital Anxiety and Depression Scale (HADS) [28] was used to measure pre-diagnostic distress, anxiety, and depression during the diagnostic work-up [29]. In accordance to guidelines, we used HADS-T scores ≥ 13 as indicating mental distress of potential clinical significance [29].

We used 7 modified items from the Berkman-Syme Social Network Index (SNI) as a composite measure of social support and connections [30, 31]. To evaluate social support from family and friends, the following five questions were asked: "Is there someone available to you whom you can count on to listen to you when you need to talk?", "Is there someone available to give you good advice about a problem?", "Is there someone available to you who shows you love and affection?", "Can you count on anyone to provide you with emotional support (talking over problems or helping you make a difficult decision)", and "Do you have as much contact as you would like with someone you feel close to, someone in whom you can trust and confide?". Having two or fewer friends or family members was categorized as 0, whereas having three or more was categorized as 1, for each item. In addition, marital status and group activities were included in the final SNI scores with total range from 0 to 7. Low social support reflects scores of 0–2 and high support scores of 3–7.

We measured resilience with the 10-item version of the Connor-Davidson Resilience Scale (CD-RISC-10) [32]. The total score ranges from 0 to 40, a higher score indicates a higher level of resilience.

Assessments after diagnosis

We used the Impact of Event Scale-Revised (IES-R) to assess symptoms of post-diagnostic acute stress specifically in response to the lung cancer diagnosis [33]. IES-R is a 22-item scale with three subscales of intrusion (8 items), avoidance (8 items), and hyperarousal (6 items) and total score range of 0–88. The IES-R scale measures the patients' response to trauma, in this case being diagnosed with lung cancer, and

according to previous practice a cutoff of 24 was used to indicate high levels of post-diagnostic acute stress [34] and a cutoff point of 33 to indicate post-diagnostic acute stress of potential clinical significance [35].

Experience of healthcare factors was assessed after diagnosis with the following questions:

A. Doctor-patient communication was assessed with "How did you experience the information you got from your doctor on the lung cancer diagnosis/disease process/prognosis," rated from 1 ("very unclear/I did not understand anything") to 5 ("very clear/I understood everything"); and "How well did you understand the information you got from your doctor on the lung cancer diagnosis," rated from 0 ("I did not understand anything") to 6 ("I understood it completely"). Responses of 5 and 5–6 respectively were considered optimal doctor-patient communication, otherwise suboptimal.

B. Support from the healthcare professionals was assessed with "When the lung cancer diagnosis was confirmed how did you experience the support of the healthcare staff," rated from 0 ("very insufficient") to 6 ("very good"). Responses of 5–6 were considered optimal healthcare-related support, otherwise suboptimal.

C. Family communication was assessed with "How happy are you with the conversation you have had with your spouse/family/friends about your feelings around the lung cancer diagnosis," rated from 0 ("not appropriate, I have not had such conversation") to 3 ("very happy"). Responses of 3 were considered optimal family communication, otherwise suboptimal.

D. Preparedness for the lung cancer diagnosis: "Were you prepared for receiving this diagnosis," rated from 0 ("not at all prepared") to 6 ("completely prepared"). If rated 5–6, it was assessed as optimal, otherwise suboptimal.

Information about the responsible physician was not documented but majority of the study participants were seen by one of four physicians responsible for lung cancer diagnostic track at Landspitali Hospital.

Statistical analysis

We used summary statistics to describe the demographic and clinical characteristics of the study population. We calculated the proportion of individuals above varying threshold levels on IES-R and assessed their univariate association to demographic and clinical characteristics using the chi-squared or Fischer exact test. A median split of 28.0 on the CD-RISC-10 was used to classify individuals as low and high resilience. We then used multiple linear regression models to determine the association between demographic and clinical characteristics and IES-R acute stress score, and to assess the association

between care-related factors (e.g., doctor-patient communication, healthcare-related support, family communication) and IES-R acute stress scores. Covariates included in the multiple regression models were all factors statistically significant in prior age- and sex-adjusted models.

Individuals with more than 25% missing data in multi-item measures (IES-R, HADS, SNI, and CD-RISC) were removed from further analysis. We used predictive mean matching to impute missing data when less than 25% (Supplemental Table 2) [36]. When the measure of HADS, SNI, or CD-RISC was not available at the assessment before diagnosis for lung cancer, the measure at the assessment after the lung cancer diagnosis was used instead.

Statistical significance was set at level 0.05. We performed all statistical analyses in R, version 3.5.1 (2018-07-02) [37].

Results

Patients and clinical characteristics

A total of 89 patients diagnosed with lung cancer completed the IES-R questionnaire after lung cancer diagnosis, thereof 76 patients participating in both assessments (Supplementary Figure 1). This analytic sample ($N = 89$) did not differ to non-completers ($N = 37$) on any of the tested background characteristics (Supplementary Table 1).

Fifty-two percent of the participants were female. The mean age of participants was 68 years (SD 7.2) but women were younger than men (66 (SD 7.2) vs 70 (SD 6.7) years old; $p = 0.007$). The median time interval from pathological diagnosis of lung cancer to the post-diagnostic assessment was 16 days (ICR = 18 days, range: 0–153 days) with all patients except three responding the post-diagnostic questionnaire within 2 months after diagnosis. Nineteen patients had a history of cancer, thereof 5 with lung cancer and 14 had been diagnosed more than 5 years ago.

The characteristics of the study participants are displayed in Table 1 tabulated by acute stress levels on IES-R. The mean IES-R score of the total patient group was 25.1 (SD 13.2, range: 1.0–61.0). More than half of the patients (51.6%) reported significant post-diagnostic acute stress (> 23 on IES-R) and 23.6% had acute stress symptoms suggestive of clinical significance (> 32 on IES-R).

Factors associated with post-diagnostic acute stress after lung cancer diagnosis

The results from univariate regression analysis of the IES-R acute stress score on baseline characteristics are shown in Table 2. The following factors were found to be associated with IES-R acute stress score: history of psychological morbidity ($\beta = 7.5$, $p = 0.007$, 95% CI: 2.1 to 13.0), history of

cancer ($\beta = 8.4$, $p = 0.013$, 95% CI: 1.8 to 15.0) and pre-diagnostic distress measured with HADS-T ($\beta = 8.0$, $p = <0.001$, 95% CI: 3.7 to 12.3) were associated with higher IES-R levels while, high educational level ($\beta = -8.4$, $p = 0.015$, 95% CI: -15.2 to -1.7) and higher resilience ($\beta = -5.9$, $p = 0.036$, 95% CI: -11.3 to -0.4) was associated lower levels of acute stress after lung cancer diagnosis.

The results from the multiple regression analysis are shown in Table 3. The analysis included all covariates statistically significant from the univariate analysis. After additional adjustment, we found that pre-diagnostic distress (HADS-T) was still associated with higher levels of post-diagnostic acute stress ($\beta = 8.8$, $p = 0.005$, 95% CI: 2.7 to 14.9) as was history of cancer ($\beta = 6.7$, $p = 0.046$, 95% CI: 0.1 to 13.3), and high educational level was associated with lower risk of acute stress ($\beta = -7.9$, $p = 0.024$, 95% CI: -14.8 to -1.1) after lung cancer diagnosis.

Healthcare-related factors and acute stress after lung cancer diagnosis

Table 4 shows the results from the multiple regression analysis to assess the association between the patients' experience of healthcare-related factors and acute traumatic stress after lung cancer diagnosis. After controlling for significant clinical and background covariates, the perception of optimal doctor-patient communication was (compared to suboptimal) associated with lower levels of post-diagnostic acute stress (IES-R mean 15.9 vs. 28.7, respectively; $\beta = -9.1$, $p = 0.003$, 95% CI: -14.9 to -3.3) as was the perception of optimal family communication ($\beta = -8.6$, $p = 0.005$, 95% CI: -14.3 to -2.9). The perception of optimal support from the healthcare professionals and preparedness for the lung cancer diagnosis were not statistically associated with levels of post-diagnostic acute stress on IES-R. A history of cancer remained a significant risk factor for higher acute stress levels after lung cancer diagnosis in this adjusted model ($\beta = 8.6$, $p = 0.015$, 95% CI: 1.9 to 15.3) (Supplemental Table 3).

Discussion

Manifested by the high levels of acute traumatic stress symptoms among newly diagnosed lung cancer patients, the findings of this study confirm that receiving a diagnosis of lung cancer is a severely stressful event. More than half of the total patient group had high levels of post-diagnostic acute stress, and almost a quarter of them reported symptom levels suggestive of clinical significance (IES-R > 32). Importantly, our data suggest that potentially modifiable factors, including doctor-patient communication as well as patient-family communication, may be associated with reduced risk of acute stress among patients receiving a diagnosis of lung cancer.

Table 1 Baseline characteristics of study participants, by levels of post-diagnostic acute stress (IES-R)

	All N (%)	Low levels of post-diagnostic acute stress (IES-R score < 24) N (%)	High levels of post-diagnostic acute stress (IES-R score 24–32) N (%)	Post-diagnostic acute stress of clinical significance (IES-R score > 32) N (%)	p^1
Overall	89	43 (48.3)	25 (28.1)	21 (23.6)	
Age at diagnosis					0.594
65 years and under	27 (30.3)	13 (30.2)	8 (32.0)	6 (28.6)	
66–70 years	25 (28.1)	9 (20.9)	8 (32.0)	8 (38.1)	
70 years and above	37 (41.6)	21 (48.8)	9 (36.0)	7 (33.3)	
Sex					0.091
Male	43 (70.1)	22 (69.0)	15 (70.8)	6 (28.6)	
Female	46 (51.7)	21 (48.8)	10 (40.0)	15 (71.4)	
Civil status					0.977
Single/divorced/widowed	26 (29.9)	13 (31.0)	7 (29.2)	6 (28.6)	
Married/partnered	61 (70.1)	29 (69.0)	17 (70.8)	15 (71.4)	
Educational level					0.392
Primary	34 (39.1)	14 (33.3)	8 (33.3)	12 (57.1)	
Secondary	27 (31.0)	14 (33.3)	9 (37.5)	4 (19.0)	
University	26 (29.9)	14 (33.3)	7 (29.2)	5 (23.8)	
Occupation					0.579
Working	34 (38.6)	19 (44.2)	8 (33.3)	7 (33.3)	
Unemployed/retired	54 (61.4)	24 (55.8)	16 (66.7)	14 (66.7)	
Financial status					0.058
Very good/good	33 (37.9)	20 (46.5)	4 (17.4)	9 (42.9)	
Enough/bad	54 (62.1)	23 (53.5)	19 (82.6)	12 (57.1)	
Smoking status					0.444
Never	8 (9.1)	6 (14.0)	1 (4.2)	1 (4.8)	
Stopped	41 (46.6)	18 (41.9)	14 (58.3)	9 (42.9)	
Current	39 (44.3)	19 (44.2)	9 (37.5)	11 (52.4)	
Lung cancer type					0.690
NSCLC	81 (91.0)	39 (90.7)	22 (88.0)	20 (95.2)	
SCLC	8 (9.0)	4 (9.3)	3 (12.0)	1 (4.8)	
Lung cancer stage					0.844
I–II	33 (37.5)	17 (40.5)	9 (36.0)	7 (33.3)	
III–IV	55 (62.5)	25 (59.5)	16 (64.0)	14 (66.7)	
History of psychologic morbidity					0.030
No	39 (43.8)	25 (58.1)	8 (32.0)	6 (28.6)	
Yes	50 (56.2)	18 (41.9)	17 (68.0)	15 (71.4)	
History of cancer					0.016
No	70 (78.7)	38 (88.4)	20 (80.0)	12 (57.1)	
Yes	19 (21.3)	5 (11.6)	5 (20.0)	9 (42.9)	
HADS score					
HADS-T (mean (SD))	9.79 (6.19)	7.51 (4.51)	10.48 (5.6)	13.62 (7.8)	0.001
HADS-T < 13	67 (75.3)	38 (88.4)	18 (72.0)	11 (52.4)	0.007
HADS-T ≥ 13	22 (24.7)	5 (11.6)	7 (28.0)	10 (47.6)	
Social support[2]					0.891
Low	15 (17.2)	8 (19.0)	4 (16.7)	3 (14.3)	
High	72 (82.8)	34 (81.0)	20 (83.3)	18 (85.7)	
Resilience[3]					0.035
Low	46 (51.7)	17 (39.5)	18 (72.0)	11 (52.4)	

Table 1 (continued)

	All N (%)	Low levels of post-diagnostic acute stress (IES-R score < 24) N (%)	High levels of post-diagnostic acute stress (IES-R score 24–32) N (%)	Post-diagnostic acute stress of clinical significance (IES-R score > 32) N (%)	p^1
High	43 (48.3)	26 (60.5)	7 (28.0)	10 (47.6)	

IES-R Impact of Event Scale-Revised, *HADS* Hospital Anxiety and Depression Scale, *HADS-T* Hospital Anxiety and Depression Scale-Total score

[1] *p* values based on chi-square test or Fisher's exact test when expected cell counts less than 5

[2] Social support was measured by the Berkman-Syme Social Network Index (SNI)

[3] Resilience was measured by the Connor-Davidson Resilience Scale (CD-RISC-10)

The present study adds to the existing literature indicating that patients experience severe stress during the first weeks after receiving a lung cancer diagnosis. In a large study of 4496 cancer patients, psychiatric disorders were estimated on average to be present among 35.1% of patients across 14 cancer sites with lung cancer patients having the highest prevalence (43.4%) [1]. Graves et al. detected significant stress symptoms in up to 62% of patients with lung cancer first seen in a multidisciplinary lung cancer program with around 40% of patients still undergoing clinical work-up for suggestive lung cancer lesions or symptoms [8]. Brocken et al. measured patients' distress levels in a rapid versus stepwise diagnostic program and confirmed high stress levels during the course of the diagnostic evaluation, with a peak during the first weeks after the diagnostic work-up of lung cancer [4]. Their findings suggest that patients experienced less stress symptoms in a rapid diagnostic program or similar to the one that our study population went through.

The literature of cancer-related traumatic stress indicates varying prevalence depending on the method of assessment. Most studies present posttraumatic stress (PTS) with various measures and timespan from the cancer diagnosis. In this study, we report acute stress symptoms at a median of 16 days after lung cancer diagnosis and all but three participants finalizing the questionnaire within 2 months of the diagnosis. A meta-analysis with pooled data of self-reported posttraumatic stress disorder (PTSD) measures in mainly breast cancer patients at any time after diagnosis shows the prevalence of clinically significant symptom levels ranged from 7.3 to 13.8% [38]. Dougall et al. were among the first to report symptoms of PTS in newly diagnosed lung cancer patients who were already receiving therapy, at a median of 103 days from the diagnosis (range: 15–667 days), suggesting a prevalence of threshold and subthreshold posttraumatic symptoms of 31.5% persisting in the coming months with 30.9% and 21%, 2 and 4 months later [9]. These findings are in line with the results of our study of acute traumatic stress after newly diagnosed lung cancer suggesting that more than half of the patients have high stress levels and 23.6% surpassing the threshold of stress symptoms within clinical significant range

(IES-R > 32) but also indicating persisting stress symptoms throughout months after the diagnosis.

Collectively, these findings indicate that screening for mental health symptoms after diagnosis of lung cancer should be considered and the importance of an established psychologic support system in the acute oncologic setting for a significant proportion of the population as well as refined referral system to psychiatry on indications [39].

Our results on risk factors for symptoms of acute stress following lung cancer diagnosis are further supported by previous research that has found that pre-existing psychological problems [10, 16, 40], cancer type [1], advanced illness and poor prognosis [20, 41], emotional problems [3], and prior life stressors [16, 20] are predictors of severe stress symptoms and PTSD symptomatology after cancer diagnosis.

In the present study, previous history of cancer was associated with acute traumatic stress symptoms in newly diagnosed lung cancer patients. Most post-cancer studies on acute stress and PTSD exclude patients with prior history of cancer, but with the improvements in cancer detection and therapy in the recent years, the number of cancer survivors is increasing with around one in six patients being diagnosed with second malignancy [42], justifying therefore their inclusion in the present study. Contrary to previous studies linking female sex [3] and younger age [18, 38, 41] to higher stress levels, we did not observe age differences in post-diagnostic acute stress symptoms which may be due to a narrow age span of our study population. In line with our findings, previous studies have suggested that a higher educational level is associated with lower stress degree in cancer patients [20, 41]. In contrast to our findings, social support has been linked to stress levels in cancer patients in multiple studies [8, 20], yet in line with the findings of Swartzman et al. [43], we found that quality family communication at lung cancer diagnosis is associated with lower post-diagnostic stress levels.

To our knowledge, the present study is the first study to directly address the association between doctor-patient communication and severe post-diagnostic stress in patients after a recent lung cancer diagnosis. We found that patients experiencing lower quality of the doctor-patient communication, i.e., suboptimal

Table 2 Symptoms of post-diagnostic acute stress (IES-R) by baseline characteristics of study participants

	IES-R score	Estimate[1]	p[2]	95% CI	
	(Mean (SD))			Lower bound	Upper bound
Age at diagnosis					
65 years and younger	25.22 (11.06)	Ref			
66–70 years	27.24 (15.48)	2.0	0.586	− 5.3	9.4
Above 70 years	23.51 (13.22)	− 1.7	0.613	− 8.4	5.0
Sex					
Male	23.23 (10.32)	Ref			
Female	26.80 (15.40)	3.6	0.205	− 2.0	9.1
Civil status					
Single/divorced/widowed	23.96 (12.90)	Ref			
Married/partnered	25.61 (13.60)	1.6	0.602	− 4.6	7.9
Educational level					
Primary	29.47 (15.01)	Ref			
Secondary	23.56 (10.35)	− 5.9	0.081	− 12.6	0.7
University	21.04 (12.57)	− 8.4	0.015	− 15.2	− 1.7
Occupation					
Unemployed/retired	25.63 (13.75)	Ref			
Working	24.33 (12.55)	− 1.6	0.586	− 7.4	4.2
Financial status					
Bad/enough	25.61 (12.34)	Ref			
Good/very good	24.06 (15.08)	− 1.5	0.603	− 7.5	4.4
Smoking status					
Never	16.88 (13.30)	Ref			
Stopped	25.32 (11.15)	8.4	0.102	− 1.7	18.6
Current	26.36 (15.02)	9.5	0.015	− 0.7	19.7
Lung cancer type					
Non-small cell	25.54 (13.44)	Ref			
Small cell	20.38 (10.57)	− 5.2	0.295	− 14.9	4.6
Lung cancer stage					
I–II	24.24 (13.96)	Ref			
III–IV	25.82 (12.89)	1.6	0.592	− 4.2	7.4
History of psychologic morbidity					
No	20.85 (12.16)	Ref			
Yes	28.38 (13.23)	7.5	0.007	2.1	13.0
History of cancer					
No	23.29 (12.36)	Ref			
Yes	31.68 (14.59)	8.4	0.013	1.8	15.0
HADS-T score					
< 13	22.28 (11.86)	Ref			
≥ 13	33.59 (13.84)	8.0	<0.001	3.7	12.3
Social support[3]					
Low	24.27 (13.21)	Ref			
High	25.29 (13.46)	1.0	0.788	− 6.5	8.6
Resilience[4]					
Low	27.91 (13.23)	Ref			
High	22.05 (12.72)	− 5.9	0.036	− 11.3	− 0.4

IES-R Impact of Events Scale-Revised, *CI* confidence interval, *HADS-T* Hospital Anxiety and Depression Scale-Total score

[1] Estimated effect size (β value) of baseline characteristics, from univariate regression analysis

[2] p values for test of correlation

[3] Social support was measured by the Berkman-Syme Social Network Index (SNI)

[4] Resilience was measured by the Connor-Davidson Resilience Scale (CD-RISC-10)

delivery of information on the lung cancer diagnosis, disease course, and prognosis, presented with higher post-diagnostic stress level scores when controlling for other relevant covariates. A study including cancer patients with various cancer sites and different cancer stages suggested that the patients' preferences in this scenario are on clinical competence and patient-centered communication, a clear and direct communication. In line with our findings, this study suggested that higher stress levels are associated with the bad news being delivered without considering the patients' preferences [44]. Schofield et al. demonstrate that the communication practice of direct information on the cancer diagnosis among melanoma patients and the preparedness

Table 3 Estimated mean difference in levels of post-diagnostic acute stress on IES-R from multiple regression analysis

	Estimate[1]	p[2]	95% CI	
			Lower bound	Higher bound
Age at diagnosis, years	− 0.1	0.678	− 0.5	0.3
Sex				
Male	Ref			
Female	− 1.4	0.618	− 7.2	4.3
Educational level				
Basic	Ref			
Middle	− 5.2	0.106	− 11.6	1.1
High	− 7.9	0.024	− 14.8	− 1.1
History of psychologic morbidity				
No	Ref			
Yes	5.4	0.057	− 0.2	11.0
History of cancer				
No	Ref			
Yes	6.7	0.046	0.1	13.3
HADS-T score				
< 13	Ref			
≥ 13	8.8	0.005	2.7	14.9
Resilience[3]				
Low	Ref			
High	− 1.4	0.643	− 7.6	4.7

Multiple regression analysis, adjusted for age, sex, educational level, history of cancer, history of psychologic morbidity, resilience, and HADS-T (total) score

[1] Estimated effect size (β value) of baseline characteristics, from multiple regression analysis

[2] p values for effect size (β value) of baseline characteristics, from multiple regression analysis

[3] Resilience was measured by the Connor-Davidson Resilience Scale (CD-RISC-10)

IES-R Impact of Events Scale-Revised, *CI* confidence interval, *HADS-T* Hospital Anxiety and Depression Scale-Total score

for the diagnosis is associated with higher patient satisfaction and lower anxiety [22]. On the other hand, a Chinese study reported an association between awareness of cancer diagnosis and prognosis and higher initial stress levels and poorer quality of life among stage IV lung cancer patients during first-line therapy [45]. In our study, we found that the perception of suboptimal communication with the spouse, family, and friends about feelings related the lung cancer diagnosis was associated with elevated stress levels but we did not detect significant association of acute stress symptoms to how prepared the patient was for the lung cancer diagnosis, as shown in Table 4. It is further possible that a gap in the communication between the patient and responsible physician may contribute to lower quality in the family communication [46]. In this study, we assessed patients' perceived healthcare-related factors in symptoms of acute stress after lung cancer diagnosis but not the communication method of an individual healthcare provider. But it is important to remember that communication skills based on patients' preferences in the oncologic setting has shown to have significant impact on patients' psychological health [47].

Further studies are needed for understanding patients' responses to communications in the healthcare and the role of background factors such as resilience in patients' perceived understanding of doctor-patient conversation.

This study leverages validated measurements on post-diagnostic acute stress symptoms in a well-defined population of newly diagnosed patients with lung cancer before any treatment is given, with a range of prospectively collected covariates that have been accounted for in the analysis. The diagnostic process is standardized for all patients although individual differences, both among patients and healthcare professionals, will inevitably occur. Limitations of the study pertain

Table 4 Estimated mean difference in levels of post-diagnostic acute stress on IES-R by different healthcare-related factors from multiple regression analysis

	IES-R score		Estimate[1]	p[2]	95% CI	
	Mean (SD)	N (%)			Lower bound	Higher bound
Doctor-patient communication						
Suboptimal	28.7 (13.1)	54 (60.7)	Ref			
Optimal	15.9 (8.8)	23 (25.8)	− 9.1	0.003	− 14.9	− 3.3
Support from the healthcare professionals						
Suboptimal	25.6 (14.1)	69 (77.5)	Ref			
Optimal	22.1 (10.2)	13 (14.6)	− 2.2	0.538	− 9.1	4.7
Family communication						
Suboptimal	33.6 (13.4)	27 (30.3)	Ref			
Optimal	21.5 (11.8)	57 (64.0)	− 8.6	0.005	− 14.3	− 2.9
Preparedness for the lung cancer diagnosis						
Unprepared	29.4 (14.7)	41 (46.1)	Ref			
Prepared	21.8 (11.0)	43 (48.3)	− 2.1	0.483	− 7.8	3.6

Multiple regression analysis, adjusted for age, sex, educational level, history of cancer, history of psychologic morbidity, resilience, and HADS-Total

[1] Estimated effect size (β value) of baseline characteristics, from multiple regression analysis

[2] p values for effect size (β value) of baseline characteristics, from multiple regression analysis

IES-R Impact of Events Scale-Revised, *CI* confidence interval, *N* number of patients (%)

to relatively small sample size, primarily due to the fragile population that in some cases was too ill or stressed to participate in the second wave of the study. It is indeed possible that the patients experiencing the highest levels of post-diagnostic stress did not make it to the second assessment. This would yield an underestimated degree of post-diagnostic stress levels in this study and restricted our ability to analyze cases with stress levels of clinical significance. Secondly, lack of validation of some key measures, including the social support and care-related factors, may contribute to measurement error. However, such a measurement error would though unlikely be associated with the outcome, and thus result in attenuation of the observed associations. Finally, the study population is limited to newly diagnosed lung cancer patients within a specialized, fast diagnostic track in Iceland and the results may therefore not be readily generalized to other populations.

Conclusion

Our data demonstrate that a high proportion of patients newly diagnosed with lung cancer experience high levels of acute traumatic stress of potential clinical significance. Furthermore, the quality of communication between patient and doctors and family members may be associated with lower risks of post-diagnostic acute stress among patients with lung cancer. These findings motivate increased awareness and surveillance of mental health issues in this fragile group of patients and the importance of an established psychologic support system in the acute oncologic setting.

Abbreviations *CD-RISC-10,* Connor-Davidson Resilience Scale, the 10-item version; *HADS,* Hospital Anxiety and Depression Scale; *HADS-T,* Hospital Anxiety and Depression Scale-Total score; *IES-R,* Impact of Event Scale-Revised; *LUCASS,* LUng CAncer, Survival, and Stress study; *NSCLC,* Non-small cell lung cancer; *PTS,* Posttraumatic stress; *PTSD,* Posttraumatic stress disorder; *SCLC,* Small cell lung cancer; *SNI,* The Berkman-Syme Social Network Index; *TNM,* Tumor, node, and metastasis staging system

Data Availability The authors have full access to the primary data and can make the data available to the journal or interested researchers upon the approval of the National Bioethics Committee of Iceland.

Declarations

Ethics approval Approval for the study was granted by the National Bioethics Committee, Iceland (VSNb201460025/03.07).

Consent to participate Informed consent was obtained from all participating patients before any study material was collected.

Consent for publication Participants of the study signed an informed consent regarding publishing their data.

Conflict of interest The authors declare no competing interests.

References

1. Zabora J, BrintzenhofeSzoc K, Curbow B, Hooker C, Piantadosi S (2001) *The prevalence of psychological distress by cancer site.* Psychooncology **10**(1):19–28. https://doi.org/10.1002/1099-1611(200101/02)10:1<19::aid-pon501>3.0.co;2-6

2. Batty GD, Russ TC, Stamatakis E, Kivimäki M (2017) *Psychological distress in relation to site specific cancer mortality: pooling of unpublished data from 16 prospective cohort studies.* Bmj **356**:j108. https://doi.org/10.1136/bmj.j108

3. Morrison EJ, Novotny PJ, Sloan JA, Yang P, Patten CA, Ruddy KJ, Clark MM (2017) *Emotional problems, quality of life, and symptom burden in patients with lung cancer.* Clin Lung Cancer **18**(5):497–503. https://doi.org/10.1016/j.cllc.2017.02.008

4. Brocken P, van der Heijden EHFM, Oud KTM, Bootsma G, Groen HJM, Donders ART, Dekhuijzen PNR, Prins JB (2015) *Distress in suspected lung cancer patients following rapid and standard diagnostic programs: a prospective observational study.* Psychooncology **24**(4):433–441. https://doi.org/10.1002/pon.3660

5. Thaker PH, Han LY, Kamat AA, Arevalo JM, Takahashi R, Lu C, Jennings NB, Armaiz-Pena G, Bankson JA, Ravoori M, Merritt WM, Lin YG, Mangala LS, Kim TJ, Coleman RL, Landen CN, Li Y, Felix E, Sanguino AM, Newman RA, Lloyd M, Gershenson DM, Kundra V, Lopez-Berestein G, Lutgendorf SK, Cole SW, Sood AK (2006) *Chronic stress promotes tumor growth and angiogenesis in a mouse model of ovarian carcinoma.* Nat Med **12**(8):939–944. https://doi.org/10.1038/nm1447

6. Lu D, Andersson TML, Fall K, Hultman CM, Czene K, Valdimarsdóttir U, Fang F (2016) *Clinical diagnosis of mental disorders immediately before and after cancer diagnosis: a nationwide matched cohort study in Sweden.* JAMA Oncol **2**(9):1188–1196. https://doi.org/10.1001/jamaoncol.2016.0483

7. Fang F, Fall K, Mittleman MA, Sparén P, Ye W, Adami HO, Valdimarsdóttir U (2012) *Suicide and cardiovascular death after a cancer diagnosis.* N Engl J Med **366**(14):1310–1318. https://doi.org/10.1056/NEJMoa1110307

8. Graves KD, Arnold SM, Love CL, Kirsh KL, Moore PG, Passik SD (2007) *Distress screening in a multidisciplinary lung cancer clinic: prevalence and predictors of clinically significant distress.* Lung

Cancer **55**(2):215–224. https://doi.org/10.1016/j.lungcan.2006.10.001

9. Dougall AL et al (2017) *Posttraumatic symptoms, quality of life, and survival among lung cancer patients*. J Appl Biobehav Res **22**(3). https://doi.org/10.1111/jabr.12065

10. Hegel MT, Moore CP, Collins ED, Kearing S, Gillock KL, Riggs RL, Clay KF, Ahles TA (2006) *Distress, psychiatric syndromes, and impairment of function in women with newly diagnosed breast cancer*. Cancer **107**(12):2924–2931. https://doi.org/10.1002/cncr.22335

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

12. Prieto JM, Blanch J, Atala J, Carreras E, Rovira M, Cirera E, Gastó C (2002) *Psychiatric morbidity and impact on hospital length of stay among hematologic cancer patients receiving stem-cell transplantation*. J Clin Oncol **20**(7):1907–1917. https://doi.org/10.1200/jco.2002.07.101

13. Ong LM et al (2000) *Doctor-patient communication and cancer patients' quality of life and satisfaction*. Patient Educ Couns **41**(2):145–156. https://doi.org/10.1016/s0738-3991(99)00108-1

14. Lu D, Andrae B, Valdimarsdóttir U, Sundström K, Fall K, Sparén P, Fang F (2019) *Psychological distress is associated with cancer-specific mortality among patients with cervical cancer*. Cancer Res **79**:3965–3972. https://doi.org/10.1158/0008-5472.can-19-0116

15. Zhu J, Fang F, Sjölander A, Fall K, Adami HO, Valdimarsdóttir U (2017) *First-onset mental disorders after cancer diagnosis and cancer-specific mortality: a nationwide cohort study*. Ann Oncol **28**(8):1964–1969. https://doi.org/10.1093/annonc/mdx265

16. Wachen JS, Patidar SM, Mulligan EA, Naik AD, Moye J (2014) *Cancer-related PTSD symptoms in a veteran sample: association with age, combat PTSD, and quality of life*. Psychooncology **23**(8):921–927. https://doi.org/10.1002/pon.3494

17. Montazeri A, Milroy R, Hole D, McEwen J, Gillis CR (1998) *Anxiety and depression in patients with lung cancer before and after diagnosis: findings from a population in Glasgow, Scotland*. J Epidemiol Community Health **52**(3):203–204. https://doi.org/10.1136/jech.52.3.203

18. Matzka M, Mayer H, Köck-Hódi S, Moses-Passini C, Dubey C, Jahn P, Schneeweiss S, Eicher M (2016) *Relationship between resilience, psychological distress and physical activity in cancer patients: a cross-sectional observation study*. PLoS One **11**(4):e0154496. https://doi.org/10.1371/journal.pone.0154496

19. Mallinckrodt B, Armer JM, Heppner PP (2012) *A threshold model of social support, adjustment, and distress after breast cancer treatment*. J Couns Psychol **59**(1):150–160. https://doi.org/10.1037/a0026549

20. Andrykowski MA, Cordova MJ (1998) *Factors associated with PTSD symptoms following treatment for breast cancer: test of the Andersen model*. J Trauma Stress **11**(2):189–203. https://doi.org/10.1023/a:1024490718043

21. Arnaboldi P, Lucchiari C, Santoro L, Sangalli C, Luini A, Pravettoni G (2014) *PTSD symptoms as a consequence of breast cancer diagnosis: clinical implications*. Springerplus **3**:392. https://doi.org/10.1186/2193-1801-3-392

22. Schofield PE, Butow PN, Thompson JF, Tattersall MHN, Beeney LJ, Dunn SM (2003) *Psychological responses of patients receiving a diagnosis of cancer*. Ann Oncol **14**(1):48–56. https://doi.org/10.1093/annonc/mdg010

23. Gilligan T, Coyle N, Frankel RM, Berry DL, Bohlke K, Epstein RM, Finlay E, Jackson VA, Lathan CS, Loprinzi CL, Nguyen LH, Seigel C, Baile WF (2017) *Patient-clinician communication: American Society of Clinical Oncology Consensus Guideline*. J Clin Oncol **35**(31):3618–3632. https://doi.org/10.1200/jco.2017.75.2311

24. Lobb EA et al (1999) *Communicating prognosis in early breast cancer: do women understand the language used?* Med J Aust **171**(6):290–294. https://doi.org/10.5694/j.1326-5377.2000.tb123923.x

25. Hack TF, Ruether JD, Pickles T, Bultz BD, Chateau D, Degner LF (2012) *Behind closed doors II: systematic analysis of prostate cancer patients' primary treatment consultations with radiation oncologists and predictors of satisfaction with communication*. Psychooncology **21**(8):809–817. https://doi.org/10.1002/pon.1984

26. Thorne SE, Bultz BD, Baile WF (2005) *Is there a cost to poor communication in cancer care?: a critical review of the literature*. Psychooncology **14**(10):875–884; discussion 885-6. https://doi.org/10.1002/pon.947

27. Vallieres E et al (2009) *The IASLC Lung Cancer Staging Project: proposals regarding the relevance of TNM in the pathologic staging of small cell lung cancer in the forthcoming (seventh) edition of the TNM classification for lung cancer*. J Thorac Oncol **4**(9):1049–1059. https://doi.org/10.1097/JTO.0b013e3181b27799

28. Zigmond AS, Snaith RP (1983) *The hospital anxiety and depression scale*. Acta Psychiatr Scand **67**(6):361–370. https://doi.org/10.1111/j.1600-0447.1983.tb09716.x

29. Singer S, Kuhnt S, Götze H, Hauss J, Hinz A, Liebmann A, Krauß O, Lehmann A, Schwarz R (2009) *Hospital anxiety and depression scale cutoff scores for cancer patients in acute care*. Br J Cancer **100**(6):908–912. https://doi.org/10.1038/sj.bjc.6604952

30. Berkman LF, Syme SL (1979) *Social networks, host resistance, and mortality: a nine-year follow-up study of Alameda County residents*. Am J Epidemiol **109**(2):186–204. https://doi.org/10.1093/oxfordjournals.aje.a112674

31. Loucks EB et al (2006) *Social networks and inflammatory markers in the Framingham Heart Study*. J Biosoc Sci **38**(6):835–842. https://doi.org/10.1017/s0021932005001203

32. Campbell-Sills L, Stein MB (2007) *Psychometric analysis and refinement of the Connor-Davidson Resilience Scale (CD-RISC): validation of a 10-item measure of resilience*. J Trauma Stress **20**(6):1019–1028. https://doi.org/10.1002/jts.20271

33. Weiss DS, Marmar CR (1997) *The Impact of Event Scale-Revised*. In: Wilson JP, Keane TM (eds) *Assessing psychological trauma and PTSD*, vol 399-411. The Guilford Press, New York

34. Asukai N et al (2002) *Reliability and validity of the Japanese-language version of the Impact of Event Scale-Revised (IES-R-J): four studies of different traumatic events*. J Nerv Ment Dis **190**(3):175–182. https://doi.org/10.1097/00005053-200203000-00006

35. Creamer M, Bell R, Failla S (2003) *Psychometric properties of the Impact of Event Scale - Revised*. Behav Res Ther **41**(12):1489–1496. https://doi.org/10.1016/j.brat.2003.07.010

36. van Buuren S, Groothuis-Oudshoorn OK (2011) *Mice: multivariate imputation by chained equation in R*. Journal of Statistical Software **45**(3):1–67. https://doi.org/10.18637/jss.v045.i03

37. R Core Team (2014) *R: A language and environment for statistical computing*. R Foundation for Statistical Computing, Vienna

38. Abbey G, Thompson SBN, Hickish T, Heathcote D (2015) *A meta-analysis of prevalence rates and moderating factors for cancer-related post-traumatic stress disorder*. Psychooncology **24**(4):371–381. https://doi.org/10.1002/pon.3654

39. Jacobsen PB, Norton WE (2019) *The role of implementation science in improving distress assessment and management in oncology: a commentary on "Screening for psychosocial distress among patients with cancer: implications for clinical practice, healthcare policy, and dissemination to enhance cancer survivorship"*. Transl Behav Med **9**(2):292–295. https://doi.org/10.1093/tbm/ibz022

40. Akechi T, Okamura H, Nishiwaki Y, Uchitomi Y (2001) *Psychiatric disorders and associated and predictive factors in patients with unresectable nonsmall cell lung carcinoma: a longitudinal study.*

Cancer **92**(10):2609–2622. https://doi.org/10.1002/1097-0142(20011115)92:10<2609::aid-cncr1614>3.0.co;2-k

41. Cordova MJ, Riba MB, Spiegel D (2017) *Post-traumatic stress disorder and cancer*. Lancet Psychiatry **4**(4):330–338. https://doi.org/10.1016/s2215-0366(17)30014-7

42. Wood ME, Vogel V, Ng A, Foxhall L, Goodwin P, Travis LB (2012) *Second malignant neoplasms: assessment and strategies for risk reduction*. J Clin Oncol **30**(30):3734–3745. https://doi.org/10.1200/jco.2012.41.8681

43. Swartzman S, Sani F, Munro AJ (2017) *The role of social support, family identification, and family constraints in predicting posttraumatic stress after cancer*. Psychooncology **26**(9):1330–1335. https://doi.org/10.1002/pon.4304

44. Gebhardt C, Gorba C, Oechsle K, Vehling S, Koch U, Mehnert A (2017) *Breaking bad news to cancer patients: content, communication preferences and psychological distress*. Psychother Psychosom Med Psychol **67**(7):312–321. https://doi.org/10.1055/s-0043-113628

45. Yanwei L et al (2017) *A double-edged sword: should stage IV non-small cell lung cancer patients be informed of their cancer diagnosis?* Eur J Cancer Care (Engl) **26**(6). https://doi.org/10.1111/ecc.12665

46. Penalba V, Deshields TL, Klinkenberg D (2019) *Gaps in communication between cancer patients and healthcare providers: symptom distress and patients' intentions to disclose*. Support Care Cancer **27**(6):2039–2047. https://doi.org/10.1007/s00520-018-4442-4

47. Fujimori M, Shirai Y, Asai M, Kubota K, Katsumata N, Uchitomi Y (2014) *Effect of communication skills training program for oncologists based on patient preferences for communication when receiving bad news: a randomized controlled trial*. J Clin Oncol **32**(20):2166–2172. https://doi.org/10.1200/jco.2013.51.2756