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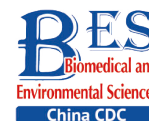
Insomnia Burden among Informal Caregivers of Hospitalized Lung Cancer Patients and Its Influencing Factors[*]

LI Chun Yan[1,&], SONG Yu Jian[2,3,&], ZHAO Lan[4], DENG Mu Hong[4], LI Rui Xin[4], ZHANG Xiao Ling[4], LI Qiong Xuan[2], SHI Ying[2], LUAN Heng Yu[2], SUN Yuan Yuan[2], HU Yi[4], and SAI Xiao Yong[2,#]

1. Department of Respiratory, The First Medical Center of PLA General Hospital, Beijing 100853, China;
2. Department of Statistics and Epidemiology, The Graduate School of the Chinese PLA General Hospital, Beijing 100853, China; 3. Department of Disease Prevention, Marine Police Hospital, Jiaxing 314000, Zhejiang, China; 4. Department of Internal Oncology, The First Medical Center of PLA General Hospital, Beijing 100853, China

Abstract

Objective   This study aimed to reveal the insomnia burden and relevant influencing factors among informal caregivers (ICs) of hospitalized patients with lung cancer.

Methods   A cross-sectional study on ICs of hospitalized patients with lung cancer was conducted from December 31, 2020 to December 31, 2021. ICs' burden was assessed using the Caregiver Reaction Assessment (CRA), Hospital Anxiety and Depression Scale (HADS), and Insomnia Severity Index (ISI). Linear and logistic regression models were used to identify the influencing factors.

Results   Among 289 ICs of hospitalized patients with lung cancer, 83 (28.72%), 53 (18.34%), and 14 (4.84%) ICs experienced mild, moderate, and severe insomnia, respectively. The scores concerning self-esteem, lack of family support, financial problems, disturbed schedule, and health problems were 4.32 ± 0.53, 2.24 ± 0.79, 2.84 ± 1.14, 3.63 ± 0.77, and 2.44 ± 0.95, respectively. ICs with higher Activities of Daily Living Scale (ADLS) scores were associated with a lower risk of insomnia, with an odd ratio (*OR*) and 95% confidence interval (*CI*) of 0.940 (0.898–0.983). Among the ICs, female gender (*OR* = 2.597), alcohol consumption (*OR* = 3.745), underlying medical conditions (*OR* = 11.765), long-term caregiving experience (*OR* = 37.037), and higher monthly expenses (*OR* = 5.714) were associated with a high risk of insomnia.

Conclusion   Of the hospitalized patients with lung cancer, 51.9% experienced insomnia. Patients' ADL, ICs gender, alcohol consumption, underlying medical conditions, caregiving duration, and monthly expenses were influencing factors. Therefore, prompt screening and early intervention for ICs of patients with lung cancer is necessary.

Key words: Informal caregivers; Insomnia; Risk factors; Cross-sectional study; Lung cancer

INTRODUCTION

Lung cancer is one of the leading causes of death, with long-term patient suffering, a heavy disease burden, and high costs among the Chinese population[1]. As patients with lung cancer are frequently hospitalized, caregivers play an important role in their survival[2]. Among caregivers, most are informal caregivers (ICs). Generally, ICs are individuals who provide unpaid assistance to older or dependent people and have a social connection with them, including a spouse, parent, child, other relative, neighbor, friend, or someone who is not a blood relative[3]. Previous studies indicated that cancer is one of the top five diseases requiring informal care[4]. ICs of patients with cancer face tremendous physical and psychological stress, duties, and responsibilities[5].

Identifying factors that would influence caregivers of patients with lung cancer is crucial for improving the patients' survival time and reducing the disease and economic burden on society as a whole[6]. However, to date, evidence regarding the burden experienced by ICs of patients with lung cancer in China is lacking. Owing to the growing burden faced by ICs, early prevention and control of ICs' burden has become a crucial topic. Few studies on the factors influencing IC burden have been conducted in China[7,8].

Therefore, there is an urgent need to identify the specific factors that strongly influence the ICs of hospitalized lung cancer patients to improve their health condition, provide effective interventions, and assist them to better support patients with lung cancer.

MATERIALS AND METHODS

Participants

A cross-sectional survey was used to facilitate sampling. Patients with lung cancer were located through medical record system queries and ICs of hospitalized patients with lung cancer in the inpatient ward of the Department of Oncology, Chinese People's Liberation Army (PLA) General Hospital, between December 31, 2020 and December 31, 2021, were selected for the questionnaire survey.

The inclusion criteria were as follows: (1) provided written informed consent; (2) cared for patients with cancer diagnosis confirmed by pathology or cellular testing; (3) cared for patients

during hospitalization; and (4) were the patients' partners, parents, children, or friends.

The exclusion criteria were as follows: (1) had an employment relationship with patients with cancer; (2) were aged < 18 years; (3) did not wish to participate in the survey; (4) could not understand the contents of the survey; or (5) did not complete the questionnaire.

Diagnostic criteria for lung cancer[9]: lung cancer diagnosis was based on pathological diagnostic criteria. A confirmed diagnosis of lung cancer should not be made without clear pathological findings; at least the biopsy site should be selected, and a sufficient amount of tissue should be obtained for microscopic examination. Notably, a large number of specimens are required for auxiliary immunohistochemistry and genetic analyses.

Research Indicators

Demographic and Caregiving Characteristics of ICs

Demographic information included the patient's household members, cancer type, gender, age, Activities of Daily Living (ADL) score, patient's time of cancer diagnosis, IC's relationship with patients, marital status, patient's gender, patient's age, education level, employment status, smoking and drinking status, underlying health problems, and economic status.

Caregiving status included whether the ICs provided full-time care, lived with the patient, duration of caregiving, number of caregiving hours per day, medical expenses of caregiving, and occurrence of acute events during caregiving.

The Activities of Daily Living Scale (ADLS) is the standardized scale used for evaluating cancer patients' physical function. It is divided into the Basic Activities of Daily Living Scale (BADLS) and the Instrumental Activities of Daily Living Scale (IADLS). The BADLS comprises six items: eating, bathing, ambulating, dressing, getting in and out of bed, and toileting. The IADLS comprises eight items: managing finances, making phone calls, housekeeping, shopping, preparing meals, managing transportation, managing medication, and doing laundry. Scoring was based on domestic and international scoring criteria[10]. Participants were scored from 0 to 3 points depending on whether they were completely independent, needed help, had some difficulty, or were completely dependent, respectively. Higher scores indicate a lower ability to perform daily living activities.

Outcome Measures

IC Sleep The Insomnia Severity Index (ISI)[11] was

used to assess sleep quality in ICs of patients with cancer. The ISI consists of seven items, with five options for each item, and scores range from 0 to 4. The scores of the seven items were tallied, with higher total scores indicating more severe insomnia in ICs of patients with cancer. The participants were categorized into four groups based on their total score, with 0–7 indicating no insomnia, 8–14 indicating mild insomnia, 15–21 indicating moderate insomnia, and 22–28 indicating severe insomnia; the scale was suitable for evaluating the participant's sleep situation for the preceding two weeks[12]. The Chinese version of the ISI has good psychometric properties and can be used as a screening tool for insomnia and as an assessment tool for determining its severity[13].

Survey Methods and Quality Control

The on-site survey was conducted by four uniformly trained investigators and data were collected as responses to electronic questionnaires. For those who were unable to respond independently (e.g., older adults and individuals with poor vision), the investigator read each sentence and recorded the participants' responses. Consent was obtained from all ICs before completing the surveys. The investigators had clinical backgrounds and strong communication skills and adopted standardized survey procedures and administration of questionnaire content to ensure survey quality.

Statistical Methods

Electronic questionnaires were administered and the data were double-checked by two researchers. Descriptive statistics and statistical analyses were conducted using SPSS (version 23.0; license number: 6b4543b2xxxxf3c69a68). The quantitative data were expressed as mean ± standard deviation ($\bar{x} \pm s$) or median (M) and interquartile range (IQR), whereas the qualitative data were expressed as percentages. A chi-squared test was performed for comparative analysis of the qualitative data. If the expected value was less than five and greater than one, a continuity-corrected chi-squared test was performed; if the expected value was less than one, Fisher's exact probability test was performed. The Mann–Whitney U test, independent samples t-test, and analysis of variance (ANOVA) were used for the comparative analysis of the quantitative data. If the assumption of homogeneity of variance was not met, corrected one-way ANOVA (Welch's ANOVA) was performed. Regarding pairwise comparisons of continuous variables after the ANOVA, the Tukey–Kramer test

was used if the variances were equal, whereas the Games–Howell test was used if the variances were unequal.

When exploring the factors influencing the burdens faced by ICs of patients with lung cancer, the full model approach was employed for multivariate linear regression and logistic regression, and multicollinearity was assessed using the variance inflation factor (VIF). When performing the multivariate linear regression, a scatter plot was used to determine the linear relationship between the independent and dependent variables. The independence between variables was determined based on expertise. The normality and homogeneity of variances were assessed using residual plots. In the multivariate logistic regression analysis, the test of parallel lines was performed for ordinal dependent variables. If the test was not satisfied, multinomial variables were used[9]. If certain ordinal or nominal categories contained too few samples, they were combined according to the nature of the dependent variable, and binomial logistic regression analysis was performed.

Data analyses were performed using SPSS software. R software (v4.1.2, R Foundation for Statistical Computing, Vienna, Austria) and R Studio (v1.4.1103, Integrated Development for R, Boston, MA, USA) were used to plot the nomogram for ICs' burden.

RESULTS

Demographics of ICs

A total of 289 ICs of patients with lung cancer were included in the final analysis, of whom 67 reported insomnia (Figure 1). Their ages ranged from 20 to 85 years, and female ICs outnumbered male ICs (58.8% *vs.* 41.2%, respectively). Of the ICs, 91.0% were married and 46.7% had an undergraduate degree or above. Most ICs were
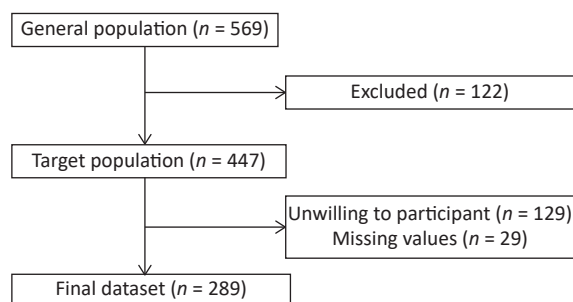

Figure 1. Screening flowchart.

children or spouses, with proportions of 40.8% and 48.8%, respectively. Regarding employment status, 39.8% were full-time workers and 37.4% were retired. The percentages of ICs who smoked or consumed alcohol were 30.4% and 27.7%, respectively (Table 1).

Table 1. Basic characteristics of lung cancer patients' ICs

Variables	Both (n = 289)	Male (n = 119)	Female (n = 170)	$T/\chi^2/Z$	P value	Insomnia (n = 67)	Non-insomnia (n = 222)	$T/\chi^2/Z$	P value
Age, years, $\bar{x} \pm s$	49.44 ± 12.52	47.16 ± 12.31	51.04 ± 12.46	2.615	0.009	52.96 ± 12.66	48.38 ± 12.31	−2.649	0.009
BADLs (P_{25}, P_{75})	0 (0, 2.5)	0 (0, 3)	0.5 (0, 2.25)	−2.133	0.033	1 (0, 4)	0 (0, 2)	−3.029	0.003
IADLs (P_{25}, P_{75})	2 (0, 7)	2 (0, 8)	3 (0,7)	−0.634	0.526	4 (0, 10)	2 (0, 6)	−2.552	0.012
Years diagnosed with Cancer (P_{25}, P_{75})	2 (2, 2)	2 (1, 2)	2 (2,2.25)	−1.694	0.09	2 (2, 3)	2 (2 ,2)	−1.065	0.288
ICs characteristics									
Education, n				6.221	0.013			1.070	0.301
University and above	135	69	66			35	100		
High school and below	154	101	53			32	122		
Marriage, n				2.396	0.122			0.976	0.323
Married	263	112	151			63	22		
Other	26	7	19			4	200		
Smoking, n				112.095	0.000			0.180	0.671
Yes	88	77	11			19	69		
No	201	42	159			48	153		
Alcohol consumption, n				73.343	0.000			0.205	0.651
Yes	80	65	15			20	60		
No	209	54	155			47	162		
Underlying condition, n				4.951	0.027			37.207	< 0.001
Yes	100	50	50			44	56		
No	189	69	120			23	166		
Acute events, n				1.664	0.197			2.987	0.084
Yes	38	12	26			13	54		
No	251	107	144			54	197		
Monthly income, n				24.238	0.000			11.917	0.018
< 3,000	64	17	47			15	49		
3,000–	100	37	63			33	67		
6,000–	43	20	23			9	34		
10,000–	64	29	35			7	57		
≥ 20,000	18	16	2			3	15		
Monthly cost, n				7.221	0.125			2.066	0.724
< 3,000	62	25	37			15	47		
3,000–	101	43	58			25	76		
6,000–	65	19	46			13	52		
10,000–	39	21	18			7	32		
≥ 20,000	22	11	11			7	15		

Note. $\bar{x} \pm s$, mean ± standard error; M (P_{25}, P_{75}), Median (interquartile range); ADLS, Activities of Daily Living Scale; BADLS, Basic Activities of Daily Living Scale; IADLS, Instrumental Activities of Daily Living Scale.

IC Burden

Most IC households (29.8%) spent > RMB 100,000 on medical expenses over the past year. This group was followed by the RMB 10,000–RMB 50,000 group (59, 20.4%) and the RMB 50,000–RMB 100,000 group (58, 20.1%). Regarding the duration of caregiving, the majority of ICs spent < 6 months on caregiving (176, 60.9%), while 197 (68.2%) spent six months to one year caregiving. A total of 133 (46.0%) ICs spent more than eight hours per day caring for patients. Additionally, 100 ICs (34.6%) had at least one underlying medical condition, 38 (13.1%) experienced acute events during caregiving, 64 (22.1%) had a monthly income of < RMB 3,000, and the monthly expenses of 22 (7.6%) exceeded RMB 20,000.

In the Caregiver Reaction Assessment (CRA) scale for lung cancer, the scores for the subscales self-esteem (SE), lack of family support (FS), financial problems (FP), disturbed schedule (DS), and health problems (HP) were 30.21 ± 3.70, 11.20 ± 3.93, 8.51 ± 3.41, 18.15 ± 3.85, and 9.75 ± 3.80, respectively. The subscales of the Hospital Anxiety and Depression Scale (HADS) scores were 7.26 ± 4.69 and 6.84 ± 4.88, respectively. Among the 289 ICs of patients with lung cancer, 159 had no symptoms of anxiety, 69 had suspected symptoms, and 61 had definite symptoms, 163 had no symptoms of depression, 59 had suspected symptoms, and 67 had definite symptoms. Based on the overall HADS score, 53 (18.34%) ICs had suspected symptoms of depression and anxiety, and 32 (11.07%) had definite symptoms of depression and anxiety. The ISI score was 8.96 ± 6.71; according to the score classification, 139 ICs had no insomnia, 83 had mild insomnia, 53 had moderate insomnia, and 14 had severe insomnia (Table 2).

Table 2. Burden of lung cancer patients' ICs

Basic characteristics	Both (n = 289)	Male (n = 119)	Female (n = 170)	T/χ^2	P value	Insomnia (n = 150)	Non-insomnia (n = 139)	T/χ^2	P value
CRA, $\bar{x} \pm s$									
SE	30.21 ± 3.70	30.36 ± 3.65	30.11 ± 3.75	−0.563	0.574	30.09 ± 3.34	30.35 ± 4.07	0.573	0.567
FS	11.20 ± 3.93	10.77 ± 3.75	11.51 ± 4.04	1.581	0.115	11.51 ± 3.91	10.87 ± 3.94	−1.376	0.170
FP	8.51 ± 3.41	8.27 ± 3.54	8.68 ± 3.31	1.001	0.318	9.45 ± 3.33	7.50 ± 3.20	−5.068	< 0.001
DS	18.15 ± 3.85	17.90 ± 3.76	18.32 ± 3.91	0.922	0.357	19.41 ± 3.28	16.79 ± 3.96	−6.083	< 0.001
HP	9.75 ± 3.80	9.02 ± 3.65	10.27 ± 3.82	2.796	0.006	11.36 ± 3.62	8.02 ± 3.17	−8.305	< 0.001
HADS									
HAS	7.26 ± 4.69	6.58 ± 4.50	7.74 ± 4.77	2.074	0.039	9.31 ± 4.67	5.04 ± 3.58	−8.766	< 0.001
HDS	6.84 ± 4.88	6.04 ± 4.56	7.40 ± 5.04	2.344	0.020	9.25 ± 4.45	4.24 ± 3.90	−10.151	< 0.001
HAS Group, n				6.576	0.037			39.522	< 0.001
No symptoms	159	76	83			59	100		
Suspected symptoms	69	24	45			40	29		
Positive symptoms	61	19	42			51	10		
HDS Group, n				6.390	0.041			50.182	< 0.001
No symptoms	163	77	86			55	108		
Suspected symptoms	59	22	37			42	17		
Positive symptoms	67	20	47			53	14		
ISI, $\bar{x} \pm s$	8.96 ± 6.71	7.73 ± 6.00	9.81 ± 7.06	2.620	0.009	14.05 ± 5.19	3.45 ± 2.49	−22.861	< 0.001
ISI Group, n				8.664	0.034			289.00	< 0.001
No insomnia	139	64	75			139	0		
Mild insomnia	83	31	52			0	83		
Moderate insomnia	53	23	30			0	53		
Sever insomnia	14	1	13			0	14		

Note. $\bar{x} \pm s$, mean ± standard error; CRA, Caregiver Reaction Assessment; SE, Self-esteem; FS, Family Support; FP, Financial Problems; DS, Disturbed Schedule; HP, Health Problems; HADS, Hospital Anxiety and Depression Scale; HAS, Hospital Anxiety Scale; HDS, Hospital Depression Scale; ISI, Insomnia Severity Index.

Factors Influencing the ISI Burden of ICs of Patients with Lung Cancer

The ISI risk factors for ICs of patients with lung cancer were female gender, alcohol consumption, underlying medical conditions, years of caregiving, and monthly expenses. The ISI score of female ICs was 2.597 times higher than that of male ICs (95% confidence interval [*CI*]: −4.711 to 0.483, *P* = 0.016). The ISI score of ICs who consumed alcohol was 2.247 times higher than that of ICs who did not consume alcohol (95% *CI*: 0.170–4.325, *P* = 0.034). The ISI score of ICs with underlying medical conditions was 3.579 times higher than that of ICs without such conditions (95% *CI*: 1.677–5.480, *P* < 0.001). The ISI score of ICs increased 1.236 times (95% *CI*: 0.361–2.112, *P* = 0.006) for each increase in the number of years of caregiving. The ISI score for ICs decreased 0.975 times (95% *CI*: 0.263–1.687, *P* = 0.007) for each increase in monthly expenses. The ISI protective factors were the number of years since cancer diagnosis and the ICs' monthly income. The ISI score of ICs decreased by 0.838 times (95% *CI*: −1.489 to 0.188, *P* = 0.012) for each additional year in which the patient had cancer, and decreased by 0.990 times (95% *CI*: −1.748 to 0.233, *P* = 0.011) for

each increase in their monthly income. Alcohol consumption, underlying medical conditions, and monthly expenses were risk factors for insomnia in the ICs of patients with lung cancer, whereas monthly income was a protective factor (Table 3).

The ICs of patients with lung cancer were classified into four categories according to their ISI scores: no insomnia, mild insomnia, moderate insomnia, and severe insomnia. Ordinal logistic regression was performed; however, because it did not satisfy the test of parallel lines (*P* < 0.001), nominal logistic regression was used instead. Given the small sample size of the severe insomnia group, it was combined with the moderate insomnia group to form a moderate-to-severe insomnia group. Using the no-insomnia group as the reference, the ISI score of ICs was set as the dependent variable, while the ICs' marital status, education level, gender, smoking status, alcohol consumption, underlying medical conditions, experience of acute events, years of caregiving, income, and expenses, as well as the patients' number of years with cancer, gender, age, and ADL score were set as independent variables for analysis. The results of the model likelihood ratio test were χ^2 = 152.995, *P* < 0.001.

Multinomial logistic regression analysis showed

Table 3. Risk factors of insomnia among lung cancer patients' ICs

Variables	*OR*	LL	UL	*P* value
Years diagnosed with cancers	1.312	1.004	1.715	0.047
Marriage	4.548	1.490	13.881	0.008
Education	0.651	0.318	1.329	0.008
Patients' sex	1.048	0.494	2.223	0.903
Sex	2.071	0.908	4.719	0.083
Smoking	0.509	0.211	1.232	0.134
Alcohol consumption	0.513	0.221	1.190	0.120
Underlying condition	0.688	0.323	1.466	0.333
Acute events	1.757	0.712	4.333	0.211
Years of caregiving	0.668	0.460	0.970	0.034
Monthly income	0.862	0.625	1.189	0.366
Monthly cost	0.936	0.702	1.249	0.653
Age	0.988	0.957	1.020	0.452
Patients Age	0.979	0.949	1.020	0.183
Patients ADL score	0.985	0.947	1.020	0.444
Anxiety & depression	0.517	0.216	1.234	0.137
Anxiety or depression	0.136	0.607	0.303	< 0.001

Note. ICs, Informal Caregivers; ADLS, Activities of Daily Living Scale; *OR*, Odds Ratio; LL, Lower limits, UL, Upper Limits.

that for lung cancer patients with higher ADL scores, the likelihood of ICs' ISI scores indicating definite symptoms was *OR* = 0.940 (95% *CI*: 0.898–0.983, *P* = 0.007). Compared to female ICs, the likelihood of a male IC's ISI score indicating mild insomnia was *OR* = 0.263 (95% *CI*: 0.095–0.729, *P* = 0.010), and moderate to severe insomnia was *OR* = 0.171 (95% *CI*: 0.046–0.635, *P* = 0.008). Compared to ICs who did not consume alcohol, the likelihood of the ISI scores of ICs who consumed alcohol indicating moderate-to-severe insomnia was *OR* = 3.745 (95% *CI*: 1.086–12.821, *P* = 0.037). Compared to ICs without underlying medical conditions, the likelihood of ICs with underlying medical conditions showing ISI scores indicating mild insomnia was *OR* = 11.765 (95% *CI*: 4.065–34.483, *P* < 0.001). Compared to ICs with < 6 months of caregiving experience, ICs with 5–10 years of caregiving experience showed a higher risk of moderate-to-severe insomnia based on their ISI scores (*OR* = 37.037, 95% *CI*: 2.141–500.000, *P* = 0.013). Compared to ICs with monthly expenses of < RMB 3,000, ICs with monthly expenses of RMB 6,000–RMB 10,000 were 5.714 times more likely to have moderate-to-severe insomnia, as shown by their ISI scores (95% *CI*: 1.074–30.303, *P* = 0.041). Compared to ICs with monthly expenses of < RMB 3,000, ICs with monthly expenses of RMB 10,000–RMB 20,000 were 11.236 times more likely to have moderate-to-severe insomnia, as shown by their ISI scores (95% *CI*: 1.883–66.667, *P* = 0.008). Finally, compared to ICs with monthly expenses of < RMB 3000, ICs with monthly expenses of > RMB 20,000 were 0.183 more likely to suffer from mild insomnia, as shown by their ISI scores (95% *CI*: 0.034–0.989, *P* = 0.049; Table 4).

DISCUSSION

ICs are increasingly becoming the primary providers for patients with cancer in both European countries and the United States, and most ICs are adults[14]. Dementia, stroke, and cancer require substantial effort and commitment from ICs. A study estimating the time spent on caregiving revealed that ICs provided an average of 20.5 hours of care per week and 20% of ICs provided care for more than 40 hours per week[15]. ICs play an indispensable role in supporting patients during their treatment course, particularly in the progressive stage. Previous studies have shown that ICs report lower perceived burdens and better clinical interaction skills in a more open and honest family communication environment[16]. However, most ICs

lack professional skills and have limited clinical knowledge regarding caregiving. Moreover, chronic overwork and stress may lead to anxiety, depression, sleep problems, mental health issues, and post-traumatic stress disorder[17-20], it can even affect an individual's immune function and hormone release[21,22]. Additionally, ICs for terminally ill patients may be concerned about the patient's death. It is widely accepted that caring for patients with cancer involves a greater burden of care than caring for older adults or patients with other chronic diseases such as diabetes[23,24].

Overall, lung cancer is a major cause of death in the general population[25]. Therefore, ICs of patients with lung cancer have considerable responsibilities and duties. Early targeted interventions, such as psychoeducation and other interventions that have proven to be effective, should be provided to ICs of lung and colorectal cancer patients promptly according to the severity of the patient's disease[26]. A long-term sustainable approach to intervention and counseling can be adopted for ICs of patients with breast cancer.

ICs are characterized by an emotionally charged caregiving process that provides concrete and helpful support[27]. ICs are not only responsible for caregiving but also for daily activities, such as sourcing social and financial support for patients, making hospital appointments, and coordinating their own work lives. Simultaneously, they are required to provide physical and psychological support and guidance to patients with cancer. The proportion of severe insomnia among ICs with lung cancer in this study was 22.8%, which was slightly higher than that previously reported. However, despite using a different sleep assessment tool, a similar prevalence of insomnia (16.3%) was observed in this study[28].

Globally, the burden of cancer is expected to increase by 50% by 2040 owing to an increase in the aging population, at which point the number of new cancer cases worldwide will reach nearly 30 million[29]. This impact is most pronounced in countries undergoing social and economic transition. The GLOBOCAN 2020 database revealed[30] that providing cancer prevention and care in transitioning countries is critical for global cancer control. As a transitioning country, China has a substantial cancer incidence and mortality burden. Therefore, ICs require urgent attention and support as a powerful complement to professional care. While cancer and non-cancer caregivers have several similarities, the informal cancer caregiving experience has several

unique characteristics[31]. Social support from other families with caregiving experience and professional institutions will empower ICs to cope with stress and ease their caregiving experiences, thereby reducing caregiver stress.

Implications for cancer patients and ICs: cancer patients and ICs should be made aware that cancer affects not only patients but also their ICs. These two factors are mutually influential and form an inseparable entity. Cancer patients, with their ICs, can control relevant factors and correct modifiable factors. The mental health of patients with cancer is

Table 4. Multinomial logistic regression of insomnia among ICs of lung cancer patients

Variables	Mild insomnia				Moderate and severe insomnia			
	OR	95% CI		P value	OR	95% CI		P value
		LL	UL			LL	UL	
Patients' age	0.973	0.940	1.006	0.105	1.014	0.969	1.060	0.549
ICs' age	1.021	0.982	1.062	0.287	0.987	0.948	1.029	0.549
ADL	0.989	0.943	1.037	0.646	0.940	0.898	0.983	0.007
Years with cancers	1.359	0.890	2.075	0.155	1.131	0.801	1.597	0.484
Marriage	0.523	0.166	1.645	0.267	0.649	0.120	3.521	0.617
Education	0.898	0.382	2.110	0.805	2.857	0.985	8.333	0.053
Patients' sex	0.648	0.280	1.499	0.311	1.464	0.513	4.167	0.476
ICs sex	0.263	0.095	0.729	0.010	0.171	0.046	0.635	0.008
Smoking	1.757	0.662	4.651	0.258	1.656	0.489	5.587	0.418
Drinking	2.451	0.973	6.173	0.057	3.745	1.086	12.821	0.037
Underlying diseases	0.908	0.374	2.203	0.831	11.765	4.065	34.483	< 0.001
Acute events	1.855	0.622	5.525	0.268	1.055	0.352	3.155	0.924
Years of caregiving, y								
< 0.5	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
0.5–	–	–	–	0.998	22.727	0.920	500.000	0.056
1–	–	–	–	0.998	7.463	0.308	166.667	0.217
3–	–	–	–	0.998	4.405	0.185	100.000	0.359
5–	–	–	–	0.998	37.037	2.141	500.000	0.013
≥ 10	–	–	–	0.997	0.912	0.912	0.912	–
Monthly income								
< 3,000	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
3,000–	0.469	0.079	2.801	0.407	0.242	0.023	2.532	0.237
6,000–	0.948	0.181	4.975	0.950	0.108	0.012	1.007	0.051
10,000–	0.310	0.058	1.650	0.170	0.187	0.020	1.773	0.144
≥ 20,000	0.797	0.171	3.704	0.772	2.242	0.269	18.868	0.455
Monthly expenses								
< 3,000	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
3,000–	2.066	0.448	9.524	0.352	4.630	0.903	23.810	0.066
6,000–	0.670	0.160	2.801	0.583	5.714	1.074	30.303	0.041
10,000–	1.205	0.274	5.291	0.805	11.236	1.883	66.667	0.008
≥ 20,000	0.183	0.034	0.989	0.049	0.853	0.123	5.917	0.872

Note. ICs, Informal Caregivers; ADLS, Activities of Daily Living Scale. Ref, Reference group; –: means sample size in the group was too small to estimate; *OR*, Odds Ratio; LL, Lower Limits, UL, Upper Limits.

closely related to their ICs, and changes in patients with cancer can affect the psychological state of the ICs. Similarly, changes in the ICs can affect patients with cancer. ICs can evaluate their modifiable factors through nomograms and related factors to help them face cancer positively together with patients. They can proactively seek social support, appropriate training for caregiving skills, and pathways for intervention and counseling. Additionally, ICs can seek respite and rotate their duties by adjusting care hours, finding help, etc. Cancer patients and ICs should be aware that it is necessary to actively seek help and support, which will benefit both patients and their ICs.

Implications for medical care: Oncology clinicians should assess the abilities and stress levels of ICs and provide them with additional care support services. In the community, primary healthcare workers should screen ICs promptly and provide counseling and interventions to ensure that ICs remain in good physical and mental health. Referral pathways should be established for ICs who are unable to receive interventions and counseling at the primary care level to determine feasible and effective interventions and counseling. This study recommends that future clinical practice in the diagnosis and care of patients with cancer should focus not only on patients but also on their ICs. In particular, ICs with long-term caregiving responsibilities should receive timely counseling and attention to relieve psychological stress. During the clinical treatment process, emphasis should be placed on ICs and professional help should be provided based on the skills and resources available. For example, ICs can be provided with professional care knowledge and skills training. Other methods such as reminding ICs to obtain adequate rest and respite can also have positive effects on ICs.

Social implications: attention should be paid to ICs and corresponding policies and measures should be formulated to safeguard them. This includes but is not limited to, financial support, social resource support, and support for care information technology. Currently, ICs are responsible for the vast majority of in-home cancer care, and social support plays an integral role in their physical and mental health. Therefore, a robust social support system can effectively assist ICs of cancer patients in providing high-quality and effective care, thereby reducing the pressure of caregiving at the societal level. The construction of respite and rotation platforms for ICs should be actively explored to supplement and rotate their duties with professional

caregiving institutions. Novel technologies, such as smart robots and telemedicine, which can share the ICs' burdens, are also worth extending to the ICs of patients with cancer.

This study included 447 ICs of patients with different types of cancer, and the burden of ICs for patients with cancer was assessed using standardized scales. This assessment involved the evaluation of caregiver burden, anxiety, depression, and sleep. This study's focus on the ICs of cancer patients was not limited to the state of the ICs but also extended to improving the emotional and physical states of cancer patients through the close connection of these patients with their ICs.

This study had several limitations. First, only the ICs of hospitalized patients with cancer were investigated. Therefore, future studies should examine the ICs' burden in the community and other contexts of long-term in-home care. Second, the patients' cancer stages and severity were not analyzed, which may have introduced some bias. Third, ICs with organic diseases were not excluded from this study, which may have introduced some bias. Fourth, the potential association between mental status and insomnia was not analyzed due to a lack of relevant data. In the future, our research group will further examine the ICs of cancer patients in the community and add necessary procedures to our study to obtain more useful evidence for lung cancer ICs interventions and healthcare.

CONCLUSION

This study revealed that 51.9% of ICs of patients with lung cancer experienced insomnia. Patients' ADL, ICs gender, alcohol consumption, underlying medical conditions, caregiving duration, and monthly expenses were influencing factors. Prompt screening and early intervention, such as scale evaluation and psychological support offered by hospitals or communities, should be provided to improve ICs' health. Future studies should include larger sample sizes and multiple centers to promote the generalization of this study's findings.

AUTHOR CONTRIBUTIONS

SAI Xiao Yong and HU Yi designed the study; SONG Yu Jian analyzed the data; LI Chun Yan and SONG Yu Jian wrote and revised the manuscript; ZHAO Lan, DENG Mu Hong, LI Rui Xin, ZHANG Xiao Ling, SHI Ying, LUAN Heng Yu, LI Qiong Xuan, and SUN Yuan Yuan collected the data; SAI Xiao Yong

provided funding support. All authors reviewed and approved the final manuscript.

AVAILABILITY OF DATA AND MATERIALS

The dataset used in this study can be obtained from the corresponding author upon reasonable request.

ETHICAL APPROVAL AND INFORMED CONSENT

All participants provided informed consent (Clinical research registration no. ChiCTR20000 41546; hospital ethics no. S2020-445-02).

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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