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RESEARCH

The association between physical activity levels and quality of life in elderly lung cancer patients undergoing chemotherapy in China: a cross-sectional study

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Abstract

Objective This study aimed to investigate the association between physical activity (PA) levels and quality of life (QOL) in elderly lung cancer patients undergoing chemotherapy in China.

Methods Two hundred eight elderly lung cancer patients undergoing chemotherapy were recruited by convenient sampling at two tertiary A hospitals in Guangxi from October 2023 to March 2024. The evaluation of PA Levels by the International Physical Activity Questionnaire Short Form (IPAQ-SF) was conducted, and the Functional Assessment of Cancer Therapy-Lung (FACT-L) was utilized to measure the QOL. Multiple linear regression was used to identify factors correlated with QOL.

Results Out of 208 elderly patients with lung cancer who were undergoing chemotherapy, 119 (57.20%) had low-level PA, 79 (38.00%) had moderate-level PA, and 10 (4.80%) had high-level PA. The mean score of FACT-L was 95.41 ± 15.01, and FACT-L was correlated with age, residency, education level, and per capita monthly household income ($P < 0.05$). Moderate to high PA levels explained 19.4% of the variation in QOL among elderly patients undergoing chemotherapy for lung cancer.

Conclusion Elderly lung cancer patients undergoing chemotherapy exhibited lower levels of PA. The increase in PA levels was associated with better QOL. Treatment options for elderly lung cancer patients undergoing chemotherapy may involve PA plans to boost their QOL. It is vital to evaluate the patient's physical condition and functional level when creating these plans to ensure safety and effectiveness, thereby increasing patient engagement and maximizing enhancements in their QOL.

Keywords Elderly lung cancer · Chemotherapy · Physical activity · Quality of life · Cross-sectional study

Introduction

As outlined in the 2023 National Cancer Report [1], approximately 412,000 new instances of lung cancer are diagnosed in males and 200,000 cases in females aged 60 and above in China. Lung cancer was responsible for around 361,000 deaths in men and 162,000 deaths in women, holding the top position among all malignant tumors in terms of mortality. At present, lung cancer has emerged as a leading cause of cancer deaths in both China and around the world [2]. Chemotherapy plays a vital role in the therapy of middle-aged and elderly patients with advanced lung cancer [3]. It is effective in suppressing the proliferation of cancer cells, eliminating residual cancer cells within the body, and ultimately prolonging the survival of patients. However, elderly patients may experience challenges related to drug absorption, distribution, metabolism, and clearance due to age-related reductions in body function, increased prevalence of underlying diseases, reduced organ reserve capacity, and alterations in physiological functions [4, 5]. Furthermore, tiredness, nausea, and anxiety are more prevalent in older cancer patients, and, when combined with other symptoms and comorbidities, they lower the QOL that these patients feel [6].

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Physical activity (PA), as a non-pharmacological intervention, has been demonstrated to enhance fatigue management and cardiorespiratory fitness in lung cancer patients [7]. Additionally, PA levels are closely linked to therapy outcomes and QOL in elderly lung cancer patients [8]. Safely increasing patients' PA levels holds the potential for clinical benefits, alleviating symptoms and elevating QOL [9]. However, lung cancer patients frequently demonstrate decreased levels of PA and diminished exercise tolerance [10]. While existing studies have explored PA in lung cancer patients, there remains a significant deficient in research specifically addressing PA among elderly lung cancer patients undergoing chemotherapy in China [11–13]. While elderly lung cancer patients may achieve comparable treatment outcomes from chemotherapy as younger patients, the QOL of elderly cancer patients has been significantly affected by several age-related problems, including functional limitations, emotional distress, cognitive changes, and socioeconomic factors [6]. In the context of aging, more emphasis should be placed on improving the QOL of elderly cancer patients.

Currently, there is a growing burden of elderly lung cancer patients undergoing chemotherapy. Despite the many salutary effects of PA in the prevention and management of cancer [14], there has been insufficient research on the relationship between PA levels and QOL in the Chinese population. Comprehending this correlation can help refine the management of elderly lung cancer patients undergoing chemotherapy and encourage active lifestyles, ultimately reducing their disease burden and enhancing their QOL. Therefore, the objective of this study was to investigate the correlation between PA levels and QOL in elderly lung cancer patients undergoing chemotherapy, and to establish a theoretical foundation for designing an effective exercise regimen to enhance patients' QOL.

Methods

Participants and setting

The research was intended to be cross-sectional and conducted from October 2023 to March 2024. Elderly lung cancer patients undergoing chemotherapy were recruited from three departments of two tertiary A hospitals in Guangxi. The criteria for inclusion were as follows: (1) age ≥ 60 years old; (2) patients diagnosed with lung cancer through pathological examination and currently undergoing chemotherapy; (3) clear consciousness, able to communicate normally, and self-care; (4) voluntary participation in the study and the able to independently complete the questionnaire or do so under the guidance of the researcher. The criteria for exclusion were as follows: (1) patients had a serious mental or psychological illness; (2)combined with severe organic diseases that limit exercise. The answers to the questionnaire were obtained through face-to-face collection or by literate participants filling them out themselves. To minimize the creation of invalid questionnaires, the researchers checked and verified incorrect or incomplete responses in real-time. Consequently, this study exhibited no instances of missing data. A total of 208 elderly patients undergoing chemotherapy for lung cancer were eventually surveyed. The First Affiliated Hospital of Guangxi Medical University's Research Ethics Committee approved the project. (2024-K035-01).

Outcome measurements

The social-demographic information survey

This survey included patients' age, sex, residency, education level, per capita monthly household income, duration of disease, tumor types, stage of disease, metastasis, chemotherapy cycle, and comorbidities (select the common chronic diseases in the patterns of coexistence of multiple chronic conditions among Chinese elderly [15], including hypertension, diabetes, and chronic respiratory diseases).

PA

The International Physical Activity Questionnaire (IPAQ) [16], created by the International Physical Activity Measurement Working Group in 2001, was used to evaluate PA. The IPAQ proved to be valid and reliable in measuring the general PA levels among Chinese adults [17, 18]. Comprising seven questions, it inquires about the frequency and cumulative duration of various intensity activities over the past week. PA is quantified in metabolic equivalents (METs) per minute per week, with MET representing the physiological measure of PA energy expenditure, equivalent to the energy consumed by a person while sitting (1 kcal/kg/hour). Walking, for instance, has a MET value of 3.3, moderate-intensity exercise is worth 4.0, and strenuous exercise is worth 8.0 [16]. The amount of PA is calculated as METs multiplied by the number of days of weekly activity (d) and the duration of daily activity (min). Participants were categorized into high, moderate, or low PA levels based on their MET values [19]:

High: Individuals engaging in at least 3 days of strenuous exercise, achieving a metabolic equivalent of no less than 1500 MET-minutes/week, or accumulating a total metabolic equivalent of at least 3000 MET-minutes/week from activities of varying intensities.
Moderate: Individuals participating in a minimum of 3 days of strenuous exercise for at least 20 min each session, or those involved in moderate-intensity exercise/walking for at least 30 min on 5 separate days, or attain-

ing a cumulative metabolic equivalent of no less than 600 MET-minutes/week across diverse intensity levels.
Low: Individuals who do not fulfill the criteria established for either moderate or strenuous exercise are categorized within this group.

QOL

QOL was assessed using the Functional Assessment of Cancer Therapy-Lung (FACT-L) scale developed by Cella et al. [20] in 1993. The FACT-L questionnaire, consisting of 36 self-reported items, encompasses five dimensions: 7 items focusing on Physiological health, 7 items addressing familial well-being, 6 items related to emotional wellness, 7 items about functional health, and another 9 items specifically targeting aspects related to lung cancer. Each item was rated on a scale of 0 to 4, yielding a total score ranging from 0 to 144. Higher scores corresponded to an improved QOL. The Chinese iteration of the FACT-L demonstrates strong reliability and validity [21].

Statistical analysis

SPSS 26.0 software was used for statistical analysis. Measurement data corresponding to a normal distribution was expressed as mean ± standard deviation. An independent sample *t*-test was used to compare two groups, and an ANOVA was used for multiple comparisons. Multiple linear stratified regression analyses were performed to assess factors related to QOL. Test level $\alpha = 0.05$.

Results

FACT-L comparison of patients with different demographic characteristics and PA levels

The QOL of elderly lung cancer patients showed statistically significant differences based on age, residency, education level, per capita monthly household income, and PA levels ($P < 0.05$) (Table 1).

An analysis of QOL using multivariate linear stratified regression in elderly lung cancer patients receiving chemotherapy

In the hierarchical regression analysis, QOL was designated as the dependent variable, while PA level served as the independent variable. Acknowledging that demographic variables could potentially confound the model, these were incorporated as control variables in Model 1 to assess their influence on QOL. The findings indicated that control variables accounted for 12.8% of the variance in QOL in Model 1 ($R^2 = 0.128$, $F = 4.179$). Building upon this foundation, Model 2 introduced PA level as an independent variable to further investigate its effect on QOL. The results revealed that PA level explained 19.4% of the variance in QOL ($R^2 = 0.194$, $F = 5.290$), with a change in R^2 (ΔR^2) of 0.066, indicating a significant enhancement in explanatory power for the model. After controlling for age, residency, education level, and per capita monthly household income, it was determined that moderate to high levels of PA positively influenced QOL ($\beta = 6.169$, $P < 0.05$; $\beta = 15.82$, $P < 0.05$). For moderate PA, the average enhancement in QOL per unit increase is 6.169 points, whereas for high PA, the average enhancement in QOL per unit increase is 15.82 points (Table 2).

Discussion

In this study, we examined the association between PA levels and QOL in 208 elderly lung cancer patients undergoing chemotherapy in China. This study found statistically significant disparities in the QOL among elderly lung cancer patients undergoing chemotherapy based on age, residency, educational level, per capita monthly household income, and level of PA ($P < 0.05$); similar to the findings of Wen et al. [22], the distinction is that our study did not reveal any influence of tumor type on QOL. Furthermore, a separate investigation into the determinants of health-related quality of life (HR-QoL) in newly diagnosed lung cancer patients in Taiwan also established a correlation between stage of disease and HR-QoL [23]. One potential explanation is that the participants were patients undergoing chemotherapy, and the influence of chemotherapy on the QOL among lung cancer patients with varying tumor types and stages may be comparable, particularly in older adults. The common side effects of chemotherapy, such as fatigue, appetite loss, and nausea—tend to universally impact QOL [6], potentially obscuring any differences attributable to variations in tumor type and stage. The research conducted by Daroszewski et al. [24] on the QOL among patients with advanced non-small cell lung cancer undergoing palliative chemotherapy indicates that individuals with stage III and IV non-small cell lung cancer generally maintain a stable QOL. In the present study, a predominant proportion of participants were patients in stages III and IV, which suggests that the uneven sample distribution and limited sample size may hinder our ability to detect differences in QOL across tumor stages. However, they did not observe a relationship between PA and QOL scores. Another study revealed [25] that, at the time of NSCLC diagnosis, higher health-related QOL was associated with older age, better performance status, participation in PA, and adenocarcinoma histology. PA has emerged as a crucial factor in enhancing the QOL for individuals with lung cancer.

Table 1 FACT-L comparison of patients with different demographic characteristics and PA levels ($N=208$)

Items	N (%)	FACT-L score ($\bar{x}\pm s$)	t/F	P
Age				
60 ~ 70	159 (76.4)	96.69 ± 14.80	2.232	0.027
> 70	49 (23.6)	91.27 ± 15.09		
Sex				
Male	156 (75.0)	94.81 ± 14.74	− 1.000	0.318
Female	52 (25.0)	97.21 ± 15.78		
Residency				
City	75 (36.1)	99.77 ± 14.19	5.906	0.003
County or township	50 (24.0)	94.90 ± 16.25		
Rural areas	83 (39.9)	91.77 ± 14.08		
Education level				
Primary school	66 (31.7)	91.53 ± 15.10	4.880	0.003
Secondary school	73 (35.1)	94.08 ± 15.16		
High school/technical secondary school	45 (21.7)	99.29 ± 12.47		
College or above	24 (11.5)	102.83 ± 15.18		
Per capita monthly household income (yuan)				
< 3000	124 (59.6)	92.10 ± 14.53	− 3.995	< 0.001
≥ 3000	84 (40.4)	100.29 ± 14.44		
Duration of disease (year)				
< 1	123 (59.1)	95.63 ± 14.69	0.550	0.578
1 ~ 3	57 (27.4)	93.93 ± 15.55		
> 3	28 (13.5)	97.46 ± 15.50		
Tumor types				
Non-small cell lung cancer	175 (84.1)	95.51 ± 14.97	0.221	0.826
Small cell lung cancer	33 (15.9)	94.88 ± 15.45		
Stage of disease				
II	15 (7.2)	95.40 ± 19.20	0.624	0.537
III	51 (24.5)	93.39 ± 15.05		
IV	142 (68.3)	96.13 ± 14.55		
Metastasis				
Yes	178 (85.6)	95.38 ± 14.93	− 0.075	0.940
No	30 (14.4)	95.60 ± 15.72		
Chemotherapy cycle				
1 ~ 3	87 (41.8)	96.40 ± 14.49	0.874	0.419
4 ~ 8	81 (39.0)	93.69 ± 15.69		
> 8	40 (19.2)	96.73 ± 14.75		
Comorbidities				
Hypertension	57 (27.4)	95.93 ± 13.71	1.502	0.215
Diabetes	28 (13.5)	90.46 ± 15.78		
Chronic respiratory diseases	6 (2.8)	90.50 ± 16.74		
No	117 (56.3)	96.59 ± 15.25		
PA levels				
Low	119 (57.2)	91.15 ± 14.22	14.947	< 0.001
Moderate	79 (38.0)	99.97 ± 14.15		
High	10 (4.8)	110.00 ± 11.55		

PA, physical activity; metastasis, including local and distant metastasis

In the elderly population, the adoption of a healthy lifestyle that includes PA has gained considerable attention due to its potential for cancer prevention as well as improving survival rates and boosting the QOL of cancer survivors [26]. Extensive research has consistently demonstrated [27–29] that escalating PA levels can significantly reduce

Table 2 Stratified regression analysis of QOL in elderly lung cancer patients undergoing chemotherapy

Constant		Model 1	Model 2
Age	60 ~ 70	ref	ref
	> 70	− 4.634	− 3.272
Residency	City	ref	ref
	County or township	− 1.502	− 1.002
	Rural areas	− 2.529	− 0.811
Education level	Primary school	ref	ref
	Secondary school	1.592	1.984
	High school/technical secondary school	4.738	3.743
	College or above	6.941	6.105
Per capita monthly household income (yuan)	< 3000	ref	ref
	≥ 3000	5.605*	4.932*
PA levels	Low	/	ref
	Moderate	/	6.169*
	High	/	15.82*
R^2		0.128	0.194
ΔR^2		0.128	0.066
F		4.179	5.290

*$P < 0.05$

cancer recurrence and mortality rates. Furthermore, both low- and high-intensity PA have been found to substantially enhance muscle strength in middle-aged and elderly cancer patients, alleviate cancer-related fatigue, and elevate overall QOL [30]. Notably, elderly cancer patients who participated in regular walking activities demonstrated a lower likelihood of disability, experienced shorter hospital stays, and incurred reduced hospitalization costs compared to those who were physically inactive patients [31]. In a prospective cohort study, Fassier et al. [32] conducted research on PA levels in 942 adults before and after cancer diagnosis and discovered a decline in PA levels after diagnosis, especially in older subjects (≥ 60 years), despite a decline in PA levels during anti-cancer treatment, most cancer patients still had a positive outlook on exercise and desired to increase their PA levels. Mikkelsen et al. [33] conducted a qualitative interview of 23 elderly patients with advanced tumors on their attitudes toward PA and exercise and found that patients held a positive view of exercise, but most had difficulty maintaining PA during tumor treatment. In this study, we considered the health obstacles potentially encountered by elderly lung cancer patients undergoing chemotherapy. Most patients were observed to lack PA, and their involvement in activities was limited; walking was identified as their primary form of PA. The inclination could result from physical discomfort induced by illness and treatment, alongside constraints on the variety and intensity of PA.

The exercise guidelines for cancer survivors recommended by the American College of Sports Medicine (ACSM) advise that cancer patients should complete 150 min per week of moderate-intensity aerobic exercise or 75 min per week of vigorous-intensity aerobic exercise [14]. A recent study showed [34] that only 39.1% of 92 lung cancer survivors met the recommendations of PA guidelines. Although the guidelines made recommendations for PA in cancer patients, many elderly cancer patients do not meet the recommended levels of PA. In this study, we found that 57.2% of elderly lung cancer patients undergoing chemotherapy had low levels of PA and only 4.8% of patients with high levels of PA. The reason may be the adverse effects caused by chemotherapy, such as nausea, vomiting, loss of appetite, and general malaise, which make patients experience weakness and fatigue, thus reducing their overall activity level. In addition, elderly patients often encounter other health problems that limit their mobility.

In terms of QOL, PA levels are significantly related to treatment outcomes and QOL in elderly lung cancer patients. Interventions that promote leisure-time PA and/or exercise-based rehabilitation could enhance the QOL for lung cancer survivors [35]. In addition, PA levels were moderate correlated with aspects of HRQoL, including dyspnoea, pain, and depression [36]. The advantages of PA for cancer patients encompass a wide range of dimensions. Peddle's [37] review indicates that, in comparison to the control group that did not participate in exercise, the intervention group undergoing exercise training demonstrated a significant enhancement in the distance covered during the 6-min walk test following the completion of the intervention. Furthermore, the disease-specific overall HRQoL for the intervention group was markedly superior to that of the control group post-intervention. This implies that exercise training not only augments physical capabilities among patients with advanced lung cancer and improves their QOL but also enhances their physical fitness and cardiopulmonary function, thereby alleviating discomfort associated with their condition. The research indicates [38] that the numerous advantages of PA encompass the inhibition of tumor growth and metastasis, amelioration of cancer treatment side effects, enhancement of patients' treatment tolerance, and improvement in their overall functional status. Consequently, exercise training is integral to clinical nursing interventions. Nevertheless, despite the preliminary evidence from prior studies indicating the potential advantages of exercise training, the certainty regarding the efficacy of exercise interventions for patients with advanced lung cancer remains limited, this is primarily due to inherent limitations in most existing literature, particularly the absence of high-quality, large-sample randomized controlled trials [39]. Consequently, future research should aim to further elucidate the long-term benefits of exercise training for this patient population, encompassing its effects on survival

rates, immune function, and mental health by implementing more rigorous and comprehensive clinical trial designs. In this context, it is essential to formulate personalized PA plans for patients with advanced lung cancer. When designing an exercise intervention strategy, it is imperative to thoroughly assess the patient's physical condition and level of functioning in order to create an activity regimen that aligns with their physical capabilities. For elderly lung cancer patients undergoing chemotherapy, light to moderate aerobic exercises should be prioritized. Additionally, the plan must be dynamically adjusted based on the patient's actual circumstances to ensure both safety and efficacy of the exercise program. For instance, in cases where patients exhibit significant physical weakness, low-intensity exercises can be implemented gradually to enhance endurance; conversely, for those with relatively better physical strength, efforts should focus on progressively increasing exercise intensity to optimize their functional ability and overall QOL. In conclusion, incorporating exercise training into the supportive care regimen for patients with advanced lung cancer holds considerable promise; however, further high-quality research is essential to substantiate its long-term effects and safety profile. Consequently, healthcare professionals should formulate scientifically grounded and individualized exercise intervention strategies tailored to each patient, thereby facilitating the maintenance of optimal physical function and QOL throughout their treatment journey.

Limitations

This study was also subject to limitations. Firstly, our subjects were recruited from specific departments, potentially leading to a sample that did not fully represent the overall PA levels and QOL of elderly lung cancer patients undergoing chemotherapy. To gain a more complete understanding of the relationship between QOL and PA in this population, further research is necessary. Secondly, the The IPAQ scale evaluated PA over the previous 7 days, and illness could have an impact on activity levels during this period. Utilizing questionnaires to gather PA information could introduce recall bias, resulting in a potential disparity between reported and actual PA levels among the elderly. Hence, future studies may consider employing objective measurement tools such as accelerometers to more accurately assess patients' PA levels, thereby providing a more robust foundation for targeted intervention strategies. Finally, the definition of elderly age across countries and may be shaped by cultural, historical, socioeconomic factors, as well as welfare systems. Consequently, when undertaking cross-cultural comparisons directly, it is crucial to consider the contextual differences underlying these definitions in order to prevent misunderstandings. Furthermore, it employed a cross-sectional design, which inhibits causal inferences among the study variables. Consequently, future research should consider adopting a longitudinal approach to thoroughly investigate the genuine causal relationships between these variables.

Conclusions

Elderly lung cancer patients undergoing chemotherapy exhibited lower levels of PA. Improved levels of PA were linked to a higher QOL. Incorporating PA plans to enhance their QOL may be part of the treatment options for elderly lung cancer patients undergoing chemotherapy. However, when formulating these plans, it is essential to assess the patient's physical condition and level of functioning to assure safety and efficacy in order to increase patient engagement and maximize their QOL.

Author contribution Xijie Hou, Siqin Lian, Weichen Liu, and Ming Li were responsible for the preparation of the material, data collection, and distribution. Xijie Hou handwrote the first draft of the manuscript. Ying Ling provided thesis guidance and funding acquisition. All authors provided comments on previous versions of the manuscript. All authors have read and approved the final manuscript.

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Data availability No datasets were generated or analysed during the current study.

Declarations

Ethics approval The First Affiliated Hospital of Guangxi Medical University's Research Ethics Committee approved the study (2024-K035-01). The study followed the Declaration of Helsinki and related guidelines and protocols. After being informed of the risks and benefits of the study, each participant provided written consent.

Competing interests The authors declare no competing interests.

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