

Latent Transition Analysis of Depressive Symptoms and Associated Factors Among Middle-aged and Older Adults with Cancer

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Abstract

Background

Psychological health among middle-aged and older adults with cancer is an increasing concern. Depressive symptoms are common in this population, yet their manifestations and longitudinal changes may vary substantially across individuals. Evidence regarding distinct depressive symptom profiles and their transitions over time remains limited. This study aimed to identify latent profiles of depressive symptoms, characterize transitions between them, and examine associated factors.

Methods

Data were obtained from the 2018 and 2020 waves of the China Health and Retirement Longitudinal Study (CHARLS). A total of 285 middle-aged and older adults with physician-diagnosed cancer were included. Depressive symptoms were assessed using the 10-item Center for Epidemiologic Studies Depression Scale (CES-D-10). Latent profile analysis (LPA) and latent transition analysis (LTA) based on item-level scores were used to identify latent depressive symptom profiles and estimate transition probabilities over time. Multivariable multinomial logistic regression was subsequently performed to examine the associations of sleep duration, pain severity, social participation, and life satisfaction with latent state transitions.

Results

Three latent profiles were identified and labelled as the low depressive symptoms class, high depressive symptoms class, and transitional class at both time points. Participants in the low depressive symptoms class showed the greatest stability, with 78.5% remaining in the same category after two years. In contrast, those in the transitional class showed the lowest stability, with 26.8% transitioning to the low depressive symptoms class and 30.8% transitioning to the high depressive symptoms class. Pain severity was significantly associated with depressive symptom transitions, with greater pain burden associated with unfavorable transitions and a lower likelihood of recovery.

Conclusions

Depressive symptoms among middle-aged and older adults with cancer exhibited substantial heterogeneity and dynamic changes over time, with different latent states showing distinct patterns of stability and transition. Pain severity was significantly associated with transitions between latent depressive symptom profiles. Dynamic monitoring of depressive symptom states should therefore be strengthened and integrated with pain assessment and management to facilitate the early identification of patients at risk of symptom deterioration or impaired recovery and to provide targeted psychological support.

1 Introduction

The global population is undergoing a rapid aging process, with the number and proportion of older adults increasing substantially worldwide¹. As one of the countries with the largest aging populations worldwide, China is facing a growing burden of age-related diseases². Cancer is one of the most important age-associated diseases, and its incidence increases markedly with advancing age³. With the accelerating aging of the population, the cancer burden is increasingly concentrated among middle-aged and older adults, making this population a key target for cancer

prevention, treatment, and long-term health management⁴. According to the National Cancer Center of China, an estimated 4.8247 million new cancer cases occurred in China in 2022, with a crude incidence rate of 341.75 per 100,000 population⁵. The cancer burden in China remains considerable, and population aging has been identified as an important driver of the increasing cancer burden. Furthermore, epidemiological studies among older inpatients in China have indicated that cancer has become one of the major causes of hospitalization among older adults⁶.

Cancer is not only a serious physical disease that threatens patients' health and survival but also a significant psychological stressor⁷. During cancer diagnosis, treatment, and long-term management, patients may encounter multiple stressors, including uncertainty regarding prognosis, physical symptoms, treatment-related adverse effects, functional decline, and changes in social roles. These challenges may increase psychological vulnerability and contribute to the onset or persistence of depressive symptoms^{7,8}. Depressive symptoms not only compromise patients' psychological well-being but are also associated with reduced quality of life, poorer treatment adherence, impaired functional status, and unfavorable clinical outcomes^{8,9}. Previous studies have demonstrated that depressive symptoms are prevalent among older adults in China, with an estimated prevalence of approximately 20%¹⁰, and cancer has been identified as an important contributor to psychological distress among middle-aged and older adults¹¹.

Previous studies investigating depressive symptoms among middle-aged and older adults with cancer have primarily focused on assessing the prevalence, severity, and associated factors of depressive symptoms using total scores from depression scales or predefined cut-off values^{12,13}. Although these approaches can reflect the overall severity or prevalence of depressive symptoms, they mainly represent variable-centered approaches that focus on population-average effects and assume that individuals with similar depressive symptom scores exhibit comparable symptom patterns. However, depressive symptoms are multidimensional and heterogeneous; even individuals with similar overall symptom scores may differ substantially in their emotional, cognitive, and somatic symptom presentations¹⁴. Therefore, assessments based solely on overall scores or average trajectories may fail to identify clinically meaningful subgroups with distinct characteristics and psychological risks, and may not adequately capture the dynamic transitions of depressive symptoms over time.

Latent profile analysis (LPA) is a person-centered statistical approach that identifies latent subgroups based on patterns of continuous observed indicators, thereby characterizing heterogeneity in symptom profiles and identifying individuals with similar symptom patterns¹⁵. However, depressive symptoms are not static and may change over time in response to changes in health conditions and psychosocial factors. Latent transition analysis (LTA) is a longitudinal extension of latent class/profile analysis that can be used to examine the stability and changes of latent states over time and to estimate the probabilities of individuals transitioning from one latent state to another or remaining in the same state¹⁶.

Previous studies have demonstrated that pain, sleep characteristics, life satisfaction, and social participation are closely associated with depressive symptoms among middle-aged and older adults with cancer. Pain, as a common symptom burden among patients with cancer, may not only directly exacerbate psychological distress but may also increase the risk of depressive symptoms by impairing daily functioning and reducing quality of life¹⁷. Sleep disturbances are bidirectionally associated with depressive symptoms; insufficient sleep duration or poor sleep quality may compromise psychological adjustment and contribute to the onset and persistence of depressive symptoms¹⁸. Life satisfaction reflects individuals' overall evaluation of their living conditions, and higher life satisfaction is generally associated with better psychological adaptation and lower levels of depressive symptoms¹⁹. Social participation may reduce psychological distress and depressive symptoms among patients with cancer by promoting social connectedness, providing emotional support, and facilitating the maintenance of social roles²⁰. However, existing

studies have predominantly focused on cross-sectional associations, and limited evidence is available regarding the associations of these factors with longitudinal transitions between depressive symptom states among middle-aged and older adults with cancer. Therefore, this study used data from the China Health and Retirement Longitudinal Study (CHARLS) and adopted a person-centered approach to identify latent depressive symptom profiles among middle-aged and older adults with cancer. Furthermore, we examined longitudinal transitions between depressive symptom states and explored factors associated with these transitions, aiming to provide evidence for early identification of psychological risks and the development of tailored psychological management strategies for this population.

2 Methods

2.1 Data source and study population

The data for this study were obtained from the China Health and Retirement Longitudinal Study (CHARLS), a nationally representative longitudinal survey of middle-aged and older adults in China. CHARLS was designed to collect multidimensional information on socioeconomic status, health conditions, and psychological well-being through standardized face-to-face interviews. The survey adopts a multistage probability sampling design and conducts follow-up surveys approximately every two years, providing high-quality longitudinal data for research on aging and health.

This study used data from Wave 4 (2018) and Wave 5 (2020) of CHARLS. The selection criteria for participants were as follows. First, participants were required to be aged 45 years or older at baseline, to have participated in both the 2018 and 2020 surveys, and to have successfully matched individual identification numbers across waves. Second, participants were required to report physician-diagnosed cancer in the 2018 survey. Third, participants were required to have valid CES-D-10 data at both waves, with at least 9 of the 10 items completed at each assessment. Participants with missing data on the covariates required for the regression analyses were excluded. Finally, 285 participants were included in the primary analysis. The CHARLS project was approved by the Biomedical Ethics Review Committee of Peking University (approval number: IRB00001052-11015).

2.2 Assessment of depressive symptoms

Depressive symptoms were assessed using the 10-item Center for Epidemiologic Studies Depression Scale (CES-D-10), which has been widely used in previous studies and has demonstrated satisfactory reliability and validity. The CES-D-10 consists of 10 items assessing depressive symptoms experienced during the previous week. Each item is rated on a 4-point Likert scale ranging from 0 to 3, yielding a total score ranging from 0 to 30, with higher scores indicating more severe depressive symptoms. A total score of ≥ 10 is commonly considered indicative of significant depressive symptoms. Among them, the 5th item “I felt hopeful about the future” and the 8th item “I was happy” were positively worded and were reverse-scored before analysis.

2.3 Covariates

Based on previous evidence and the availability of variables in the CHARLS database, relevant covariates were selected from the Health Status and Functioning module of the fourth wave of CHARLS (2018) to examine their associations with transitions in depressive symptom profiles. The covariates included sleep duration, pain severity, social participation, and life satisfaction. Sleep duration, pain severity, and life satisfaction were included as continuous variables, whereas social participation was included as a categorical variable. Sleep duration was assessed based on participants’ self-reported average number of hours of actual sleep per night during the previous month. Pain severity was measured using the pain assessment item in CHARLS and was rated on a five-point scale, with higher scores

indicating more severe pain. Social participation was assessed according to participation in social activities during the previous month and was recoded as a binary variable (no participation in social activities vs. participation in at least one social activity). Life satisfaction was assessed using a single-item five-point scale and reverse-coded, with higher scores indicating greater life satisfaction.

2.4 Statistical analysis

All statistical analyses were performed using Mplus 7 and R version 4.4.1. Latent profile analyses (LPA) were conducted separately at baseline (2018, T1) and follow-up (2020, T2), with individual CES-D-10 item scores used as continuous observed indicators. The optimal number of latent profiles was determined based on model fit indices, including the Akaike information criterion (AIC), Bayesian information criterion (BIC), adjusted Bayesian information criterion (aBIC), entropy, and the clinical interpretability of the identified profiles. After determining the optimal latent profiles at both time points, unconditional latent transition analysis (LTA) without covariates was performed. Longitudinal measurement invariance was examined to determine the final LTA model, which was subsequently used to estimate transition patterns and probabilities between depressive symptom profiles from 2018 to 2020. Missing CES-D-10 item-level data were handled using full information maximum likelihood (FIML) estimation within the latent variable models. Subsequently, multivariable multinomial logistic regression analyses were conducted to examine the associations of sleep duration, pain severity, social participation, and life satisfaction with latent transitions in depressive symptom profiles. Sensitivity analyses of LTA and factors associated with transitions were conducted among participants with complete CES-D-10 responses at both waves (n = 248) to assess the robustness of the findings. All statistical tests were two-sided, and P < 0.05 was considered statistically significant.

3 Results

3.1 Participant characteristics

A total of 285 patients with cancer were included in the study. The mean age of participants was 61.79 ± 9.05 years. Of these, 103 (36.1%) participants were male and 182 (63.9%) were female. Regarding residential location, 100 (35.1%) participants lived in urban areas, while 185 (64.9%) lived in rural areas. In terms of educational attainment, 50 (17.5%) participants were illiterate, 133 (46.7%) had primary school education, 64 (22.5%) had middle school education, 32 (11.2%) had high school education, and 6 (2.1%) had college education or above.

3.2 Number of latent profiles

Latent profile analyses were conducted separately at T1 and T2. At both time points, the three-profile solution showed good classification quality, with entropy values of 0.958 at T1 and 0.932 at T2. Although models with additional profiles showed further reductions in some fit indices, the newly identified classes were relatively small and had limited clinical interpretability. Considering model fit, classification quality, parsimony, and clinical interpretability, the three-profile solution was selected at both time points (Table 1).

Table 1. Fit indices for latent profile models at T1 and T2

Time	Class	LL	AIC	BIC	aBIC	Entropy	LMR (P)	BLRT (P)	Estimated class proportions
T1	Classes-1	-4451.352	8942.703	9015.753	8952.332	—	—	—	1.000
	Classes-2	-3985.497	8032.994	8146.221	8047.919	0.939	<0.001	<0.001	0.685 / 0.315
	Classes-3	-3851.721	7787.442	7940.847	7807.662	0.958	0.0006	<0.001	0.589 / 0.205 / 0.206
	Classes-4	-3756.504	7619.008	7812.590	7644.523	0.979	0.3134	<0.001	0.116 / 0.163 / 0.602 / 0.119
	Classes-5	-3683.314	7494.628	7728.387	7525.439	0.966	0.0777	<0.001	0.564 / 0.171 / 0.122 / 0.053 / 0.091
T2	Classes-1	-4408.538	8857.075	8930.125	8866.704	—	—	—	1.000
	Classes-2	-4021.009	8104.019	8217.246	8118.943	0.988	<0.001	<0.001	0.767 / 0.233
	Classes-3	-3870.155	7824.310	7977.715	7844.530	0.932	<0.001	<0.001	0.572 / 0.219 / 0.209
	Classes-4	-3788.137	7682.273	7875.855	7707.789	0.953	0.1418	<0.001	0.548 / 0.175 / 0.175 / 0.103
	Classes-5	-3700.657	7529.313	7763.072	7560.125	0.963	0.0384	<0.001	0.146 / 0.543 / 0.092 / 0.102 / 0.117

LL, log-likelihood; AIC, Akaike information criterion; BIC, Bayesian information criterion; aBIC, adjusted Bayesian information criterion; LMR, Lo-Mendell-Rubin test; BLRT, bootstrap likelihood ratio test.

3.3 Characteristics of the latent profiles

Based on the response patterns across the CES-D-10 items, the three latent profiles were labelled as the low depressive symptoms class, high depressive symptoms class, and transitional class. Class 1 represented the low depressive symptoms class, characterized by generally lower item scores, with estimated class proportions of 58.9% at T1 and 57.2% at T2. Class 2 represented the high depressive symptoms class, showing relatively higher scores across most items, with estimated proportions of 20.5% and 21.9%, respectively; notably, this class had substantially higher scores on item 10 (“could not get going”) than the other two classes. Class 3 represented the transitional class, which generally showed symptom levels between the low and high depressive symptoms classes, with elevated scores on

most negative affect items but a relatively low score on item 10. The estimated proportions were 20.6% at T1 and 20.9% at T2. The profile patterns at T1 and T2 are shown in Figures 1 and 2.

3.4 Latent transition analysis

Before estimating the latent transition probabilities, longitudinal measurement invariance was tested to ensure that the latent depressive symptom profiles had comparable meanings across the two time points. Compared with the unconstrained model, the measurement-invariant model showed lower AIC, BIC, and aBIC values, with no significant deterioration in model fit [$\Delta\chi^2(40) = 54.613$, $P = 0.062$] and satisfactory classification quality (entropy = 0.937). Therefore, the measurement-invariant model was retained as the final LTA model (Supplementary Table S1).

The estimated transition probabilities revealed substantial differences in the stability of depressive symptom classes over time (Table 2). Participants in the low depressive symptoms class showed the greatest stability, with 78.5% remaining in the same class at T2; 8.2% transitioned to the high depressive symptoms class and 13.3% to the transitional class. Among participants in the high depressive symptoms class at T1, 50.2% remained in the same class, whereas 23.4% transitioned to the low depressive symptoms class and 26.3% to the transitional class. The transitional class showed the lowest within-class stability, with 42.4% remaining in the same class at T2. Of those initially classified into the transitional class, 26.8% transitioned to the low depressive symptoms class and 30.8% transitioned to the high depressive symptoms class. Sensitivity analyses restricted to participants with complete CES-D-10 data at both waves ($n = 248$) yielded transition probabilities broadly consistent with the primary analysis (Supplementary Table S2).

Table 2. Latent transition probabilities of depressive symptom profiles from T1 to T2

T1 (2018)	T2 (2020)		
	Low depressive symptoms class	High depressive symptoms class	Transitional class
Low depressive symptoms class	0.785	0.082	0.133
High depressive symptoms class	0.234	0.502	0.263
Transitional class	0.268	0.308	0.424

Values are model-estimated latent transition probabilities. Bold values indicate stability within the same latent profile across the two waves.

3.5 Factors associated with latent transitions

Multinomial logistic regression analyses were performed to examine factors associated with transitions between depressive symptom profiles among middle-aged and older adults with cancer. Sleep duration, pain severity, social participation, and life satisfaction were included as covariates. Separate models were constructed according to baseline latent profiles, with remaining in the same latent profile over time (low depressive symptoms class→low depressive symptoms class, transitional class→transitional class, and high depressive symptoms class→high depressive symptoms class) used as the reference categories. The results are presented in Table 3.

Using the low depressive symptoms class→low depressive symptoms class trajectory as the reference category, factors associated with subsequent transitions among participants in the low depressive symptoms class at baseline

were examined. Higher pain severity was significantly associated with increased odds of transitioning to the transitional class (OR = 1.481, $P = 0.040$) and the high depressive symptoms class (OR = 1.591, $P = 0.048$). These findings indicated that greater pain burden was associated with an increased likelihood of depressive symptom deterioration among participants initially classified in the low depressive symptoms class. Sleep duration, social participation, and life satisfaction were not significantly associated with subsequent transitions.

Using the transitional class→transitional class trajectory as the reference category, factors associated with transitions among participants in the transitional class were evaluated. None of the examined covariates showed statistically significant associations with subsequent latent transitions.

Using the high depressive symptoms class→high depressive symptoms class trajectory as the reference category, factors associated with subsequent transitions among participants in the high depressive symptoms class were examined. Higher pain severity was significantly associated with lower odds of transitioning to the low depressive symptoms class (OR = 0.431, $P = 0.004$). No significant associations were observed for sleep duration, social participation, or life satisfaction. In sensitivity analyses including 248 participants with complete CES-D-10 data, the results were generally consistent with the primary analyses (Supplementary Table S3).

Table 3. Factors associated with transitions between latent depressive symptom profiles

Covariates	Latent profile (T1)	Low depressive symptoms class (T2)	Transitional class (T2)	High depressive symptoms class (T2)
Sleep duration	Low depressive symptoms class (T1)	1.000	0.800	0.777
	Transitional class (T1)	0.809	1.000	0.870
	High depressive symptoms class (T1)	1.171	0.928	1.000
Pain severity	Low depressive symptoms class (T1)	1.000	1.481*	1.591*
	Transitional class (T1)	0.965	1.000	0.762
	High depressive symptoms class (T1)	0.431*	0.785	1.000
Social participation	Low depressive symptoms class (T1)	1.000	0.455	1.436
	Transitional class (T1)	0.548	1.000	0.908
	High depressive symptoms class (T1)	0.452	0.944	1.000
Life satisfaction	Low depressive symptoms class (T1)	1.000	0.837	0.722
	Transitional class (T1)	1.106	1.000	0.470
	High depressive symptoms class (T1)	1.377	1.193	1.000

Values on the diagonal (1.000) indicate the reference category (Ref). Values presented in the table are odds ratios (ORs). * $P < 0.05$.

4 Discussion

In the present study, CES-D-10 item-level scores were analyzed using a person-centered longitudinal approach, and three distinct depressive symptom profiles were identified among middle-aged and older adults with cancer at both assessment points: low depressive symptoms class, high depressive symptoms class, and transitional class. These findings indicate substantial heterogeneity in depressive symptom presentations among middle-aged and older adults with cancer. This finding is consistent with previous studies. Gouraud et al. conducted a latent class analysis among 847 older patients with cancer and identified five distinct depressive symptom subgroups, including no depression/somatic only, no depression/pauci-symptomatic, mild depression, severe depression, and demoralization profiles¹⁴. Similarly, Saracino et al. applied latent profile analysis to examine depressive symptom patterns among younger and older adults with cancer and identified multiple profiles with different levels of depressive symptom severity²¹. Although patients with cancer commonly experience shared stressors, including uncertainty regarding prognosis, treatment burden, physical symptoms, and functional decline, individual differences in disease adaptation and psychological resources may contribute to distinct psychological response patterns. Therefore, depressive symptoms among middle-aged and older adults with cancer should not be viewed solely in terms of overall symptom severity; attention should also be given to distinct underlying symptom patterns.

The longitudinal analysis further revealed distinct transition patterns across the three depressive symptom profiles. Participants in the low depressive symptoms class showed relatively high stability, with most remaining in the same class after two years. Those in the high depressive symptoms class also demonstrated a certain degree of stability, although some transitioned to the low depressive symptoms class, suggesting the possibility of psychological improvement even among individuals with a relatively high symptom burden. In contrast, the transitional class showed greater instability. During follow-up, 26.8% of participants in the transitional class moved to the low depressive symptoms class, whereas 30.8% transitioned to the high depressive symptoms class, indicating the potential for both improvement and deterioration. Previous longitudinal studies in patients with cancer have similarly suggested that depressive symptom patterns may change over time²². These findings highlight the importance of monitoring not only patients with high depressive symptoms but also those with transitional symptoms, who may be particularly vulnerable to changes in psychological status. Regular psychological assessment may facilitate early identification of individuals at risk of progressing to high depressive symptoms and support timely intervention^{23,24}.

According to the analysis of associated factors, pain severity emerged as an important correlate of transitions between latent depressive symptom states among middle-aged and older adults with cancer. Among participants classified in the low depressive symptoms class at baseline, greater pain severity was associated with a higher likelihood of subsequently transitioning to either the transitional class or the high depressive symptoms class. In contrast, among those initially classified in the high depressive symptoms class, greater pain severity was associated with a lower likelihood of transitioning to the low depressive symptoms class. These findings suggest that pain may be relevant to the maintenance, deterioration, and recovery of depressive symptom states over time. Cancer-related pain is often persistent and recurrent and may not only cause direct physical discomfort but also impose a sustained physical and psychological burden by restricting daily activities, disrupting sleep, impairing functional status, and reducing quality of life^{25,26}. The cumulative stress and depletion of psychological coping resources associated with persistent pain may compromise patients' ability to maintain a stable psychological state or recover from a more severe depressive symptom state, thereby increasing the likelihood of transition toward an unfavorable state or persistence of a high-symptom state²⁷.

Previous longitudinal studies have similarly reported that the burden of the fatigue–pain–insomnia symptom cluster was significantly associated with membership in different depressive symptom trajectories²⁸. Other research has

further shown that improvement in pain was associated with subsequent improvement in depressive symptoms, with a 1–2-point reduction in pain associated with approximately 12%–24% greater odds of achieving clinically meaningful improvement in depressive symptoms²⁹. Among middle-aged and older adults with cancer, the psychological impact of cancer-related pain may be further compounded by age-related functional decline and multimorbidity, potentially increasing difficulties in long-term psychological adaptation³⁰. These findings underscore the importance of incorporating systematic pain assessment and management into psychological care for this population and of considering pain status within the dynamic monitoring of depressive symptoms. Patients in the low depressive symptoms class with a high pain burden may warrant closer psychological surveillance because of their potential risk of transitioning to transitional or high depressive symptom states. Likewise, patients in the high depressive symptoms class with substantial pain may require particular attention because persistent pain may impede psychological recovery. In clinical practice, standardized pain assessment could be integrated with psychological evaluation, together with multimodal approaches such as pharmacological analgesia, non-pharmacological pain management, functional support, and psychological interventions when appropriate²⁴. Compared with risk identification based solely on a single depression scale assessment, dynamic risk stratification incorporating pain status may facilitate earlier identification of patients at risk of depressive symptom deterioration or delayed recovery.

In contrast, sleep duration, social participation, and life satisfaction were not independently associated with transitions between latent depressive symptom states in the present study. These findings should not be interpreted as evidence that these factors are unrelated to psychological health in middle-aged and older adults with cancer. Rather, after accounting for pain and the other included covariates, no independent associations with latent state transitions were detected in this sample. This may partly reflect the measurement approaches used and the characteristics of the study population. Sleep was assessed solely on the basis of average nighttime sleep duration, without further assessment of sleep quality or specific sleep disturbances. Social participation was dichotomized according to whether participants had engaged in at least one type of social activity, while life satisfaction was assessed using a single-item measure. These relatively simplified indicators may not have fully captured the complexity of the corresponding constructs. Previous longitudinal research in older adults has reported associations of sleep, social participation, and life satisfaction with transitions in depressive symptoms³¹, suggesting that differences across studies may also reflect population-specific characteristics.

This study used data from a nationally representative longitudinal survey and adopted a person-centered approach to identify latent profiles of depressive symptoms and their transition patterns among middle-aged and older adults with cancer, while further examining factors associated with these transitions. Compared with conventional approaches based solely on total depression scores or predefined cut-off values, our study characterized the heterogeneity and dynamic transitions of depressive symptoms, providing longitudinal evidence for identifying patients at increased risk of psychological deterioration or impaired recovery. Several limitations should be acknowledged. First, the number of participants in some latent transition categories was relatively small, which may have limited the detection of weaker associations and reduced the precision of effect estimates. Second, only two assessment waves were included, limiting our ability to capture longer-term fluctuations and more complex transition patterns in depressive symptoms. Third, some variables were assessed using relatively simplified measures, which may not have fully captured the multidimensional nature of the corresponding constructs. Finally, owing to limitations of the CHARLS database, detailed cancer-related clinical characteristics, such as cancer type, disease stage, and treatment modality, were not included. Future studies with larger samples, multiple follow-up assessments, and more comprehensive clinical and psychosocial measures are needed to further validate the present findings and clarify the factors associated with transitions between depressive symptom states among middle-aged and older adults with cancer.

5 Conclusion

In conclusion, this study used a person-centered approach to identify three latent profiles of depressive symptoms among middle-aged and older adults with cancer: low depressive symptoms class, high depressive symptoms class, and transitional class, and further characterized their transitions over time. The findings demonstrated differences in the stability of these depressive symptom states, with the low depressive symptoms class showing relatively high stability and the transitional class exhibiting greater bidirectional movement. Pain severity was an important factor associated with latent depressive symptom transitions, with greater pain associated with both transitions toward more severe symptom states and a reduced likelihood of recovery from the high depressive symptoms class. These findings highlight the need to consider the heterogeneity and dynamic changes of depressive symptoms in middle-aged and older adults with cancer and support integrating pain assessment and management with ongoing psychological monitoring and targeted interventions according to patients' latent symptom states and transition risks.

Declarations

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Author contributions

XL: Conceptualization, Methodology, Formal analysis, Writing– original draft, Writing– review & editing. HL: Methodology, Validation, Funding acquisition. HY: Supervision, conceptualization, Writing – review & editing. All authors contributed to the article and approved the submitted version.

Competing interests

The authors declare no competing interests.

Ethics statement

The studies involving humans were approved by the Biomedical Ethics Review Committee of Peking University (IRB00001052-11015). The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Data availability

The datasets analyzed in this study are publicly available from the China Health and Retirement Longitudinal Study (CHARLS). The data can be accessed through the official CHARLS website at <https://charls.pku.edu.cn/> following registration and approval. No new datasets were generated in this study.

References

1. Vollset, S. E. et al. Fertility, mortality, migration, and population scenarios for 195 countries and territories from 2017 to 2100: a forecasting analysis for the Global Burden of Disease Study. *Lancet* 396, 1285-1306, doi:10.1016/s0140-6736(20)30677-2 (2020).
2. Ju, W. et al. Cancer statistics in Chinese older people, 2022: current burden, time trends, and comparisons with the US, Japan, and the Republic of Korea. *Sci China Life Sci* 66, 1079-1091, doi:10.1007/s11427-022-2218-x (2023).
3. Guerville, F. et al. Does Inflammation Contribute to Cancer Incidence and Mortality during Aging? A Conceptual Review. *Cancers (Basel)* 14, doi:10.3390/cancers14071622 (2022).
4. Ju, W. et al. The occurrence of cancer in ageing populations at global and regional levels, 1990 to 2019. *Age Ageing* 52, doi:10.1093/ageing/afad043 (2023).
5. Han, B. et al. Cancer incidence and mortality in China, 2022. *J Natl Cancer Cent* 4, 47-53, doi:10.1016/j.jncc.2024.01.006 (2024).
6. Gao, S. et al. Chronic diseases spectrum and multimorbidity in elderly inpatients based on a 12-year epidemiological survey in China. *BMC Public Health* 24, 509, doi:10.1186/s12889-024-18006-x (2024).
7. Van Beek, F. E. et al. Psychological problems among cancer patients in relation to healthcare and societal costs: A systematic review. *Psychooncology* 30, 1801-1835, doi:10.1002/pon.5753 (2021).
8. Riedl, D. & Schüßler, G. Factors associated with and risk factors for depression in cancer patients - A systematic literature review. *Transl Oncol* 16, 101328, doi:10.1016/j.tranon.2021.101328 (2022).
9. McFarland, D. C. et al. Cancer-related inflammation and depressive symptoms: Systematic review and meta-analysis. *Cancer* 128, 2504-2519, doi:10.1002/cncr.34193 (2022).
10. Tang, T., Jiang, J. & Tang, X. Prevalence of depressive symptoms among older adults in mainland China: A systematic review and meta-analysis. *J Affect Disord* 293, 379-390, doi:10.1016/j.jad.2021.06.050 (2021).
11. Park, G. R. & Kim, J. Depressive symptoms among cancer patients: Variation by gender, cancer type, and social engagement. *Res Nurs Health* 44, 811-821, doi:10.1002/nur.22168 (2021).
12. Parajuli, J., Berish, D., Valenti, K. G. & Jao, Y. L. Prevalence and predictors of depressive symptoms in older adults with cancer. *J Geriatr Oncol* 12, 618-622, doi:10.1016/j.jgo.2020.12.009 (2021).
13. Bird, M. J. et al. Pandemic-Induced Depression Among Older Adults with a History of Cancer During the COVID-19 Pandemic: Findings from the Canadian Longitudinal Study on Aging. *Cancer Manag Res* 15, 937-955, doi:10.2147/cmar.S421675 (2023).
14. Gouraud, C. et al. Depressive Symptom Profiles and Survival in Older Patients with Cancer: Latent Class Analysis of the ELCAPA Cohort Study. *Oncologist* 24, e458-e466, doi:10.1634/theoncologist.2018-0322 (2019).
15. Hu, H. et al. Symptom profiles and related factors among patients with advanced cancer: A latent profile analysis. *Asia Pac J Oncol Nurs* 10, 100296, doi:10.1016/j.apjon.2023.100296 (2023).
16. Moore, E. W. G., Quartiroli, A. & Little, T. D. Introduction to the Best Practice Recommendations for Longitudinal Latent Transition Analysis. *Int J Psychol* 60, e70021, doi:10.1002/ijop.70021 (2025).
17. Al-Obaidi, M. et al. Pain among older adults with gastrointestinal malignancies- results from the cancer and aging resilience evaluation (CARE) Registry. *Support Care Cancer* 30, 9793-9801, doi:10.1007/s00520-022-07398-4 (2022).

18. Loh, K. P. et al. Elucidating the associations between sleep disturbance and depression, fatigue, and pain in older adults with cancer. *J Geriatr Oncol* 9, 464-468, doi:10.1016/j.jgo.2018.02.006 (2018).
19. Zhou, Y. & Bian, Y. Analysis of the Status and Influencing Factors of Depression in Chinese Middle-Aged and Older Cancer Patients-Based on Empirical Evidence from the 2020 CHARLS Database. *Healthcare (Basel)* 13, doi:10.3390/healthcare13091036 (2025).
20. Kim, K. & Yoon, H. Types of Social Engagement Among Older Cancer Survivors and the Effect on Depressive Symptoms and Life Satisfaction: A Latent Class Analysis. *Oncol Nurs Forum* 51, 25-37, doi:10.1188/24.Onf.25-37 (2023).
21. Saracino, R. M., Cham, H., Rosenfeld, B. & C, J. N. Latent Profile Analyses of Depressive Symptoms in Younger and Older Oncology Patients. *Assessment* 27, 1383-1398, doi:10.1177/1073191118784653 (2020).
22. Sanghvi, D. E., Chen, M. S. & Bonanno, G. A. Prospective trajectories of depression predict mortality in cancer patients. *J Behav Med* 47, 682-691, doi:10.1007/s10865-024-00485-3 (2024).
23. Grassi, L. et al. Anxiety and depression in adult cancer patients: ESMO Clinical Practice Guideline. *ESMO Open* 8, 101155, doi:10.1016/j.esmoop.2023.101155 (2023).
24. Andersen, B. L. et al. Management of Anxiety and Depression in Adult Survivors of Cancer: ASCO Guideline Update. *J Clin Oncol* 41, 3426-3453, doi:10.1200/jco.23.00293 (2023).
25. Snijders, R. A. H., Brom, L., Theunissen, M. & van den Beuken-van Everdingen, M. H. J. Update on Prevalence of Pain in Patients with Cancer 2022: A Systematic Literature Review and Meta-Analysis. *Cancers (Basel)* 15, doi:10.3390/cancers15030591 (2023).
26. Bouvron, B. et al. Impact of worst pain severity and morning fatigue profiles on oncology outpatients' symptom burden and quality of life. *Support Care Cancer* 30, 9929-9944, doi:10.1007/s00520-022-07431-6 (2022).
27. Chen, J. et al. Increased Stress Is Associated With Severe Pain and Decrements in Cognitive Function in Patients Receiving Chemotherapy. *Semin Oncol Nurs* 40, 151577, doi:10.1016/j.soncn.2023.151577 (2024).
28. Luo, Y. et al. Trajectories of depression and predictors in lung cancer patients undergoing chemotherapy: growth mixture model. *BMC Psychiatry* 24, 578, doi:10.1186/s12888-024-06029-y (2024).
29. Cohee, A. A. et al. Predictors of depression outcomes in adults with cancer: A 12 month longitudinal study. *J Psychosom Res* 136, 110169, doi:10.1016/j.jpsychores.2020.110169 (2020).
30. Gaudernack, H. E. et al. Symptom experience of older oncology patients with low versus high levels of multimorbidity prior to chemotherapy. *Eur J Oncol Nurs* 54, 102029, doi:10.1016/j.ejon.2021.102029 (2021).
31. Zhu, J. et al. Bidirectional transitions of depressive symptoms among middle-aged and older Chinese adults: A multi-state Markov model analysis. *Maturitas* 205, 108822, doi:10.1016/j.maturitas.2025.108822 (2026).

Figures

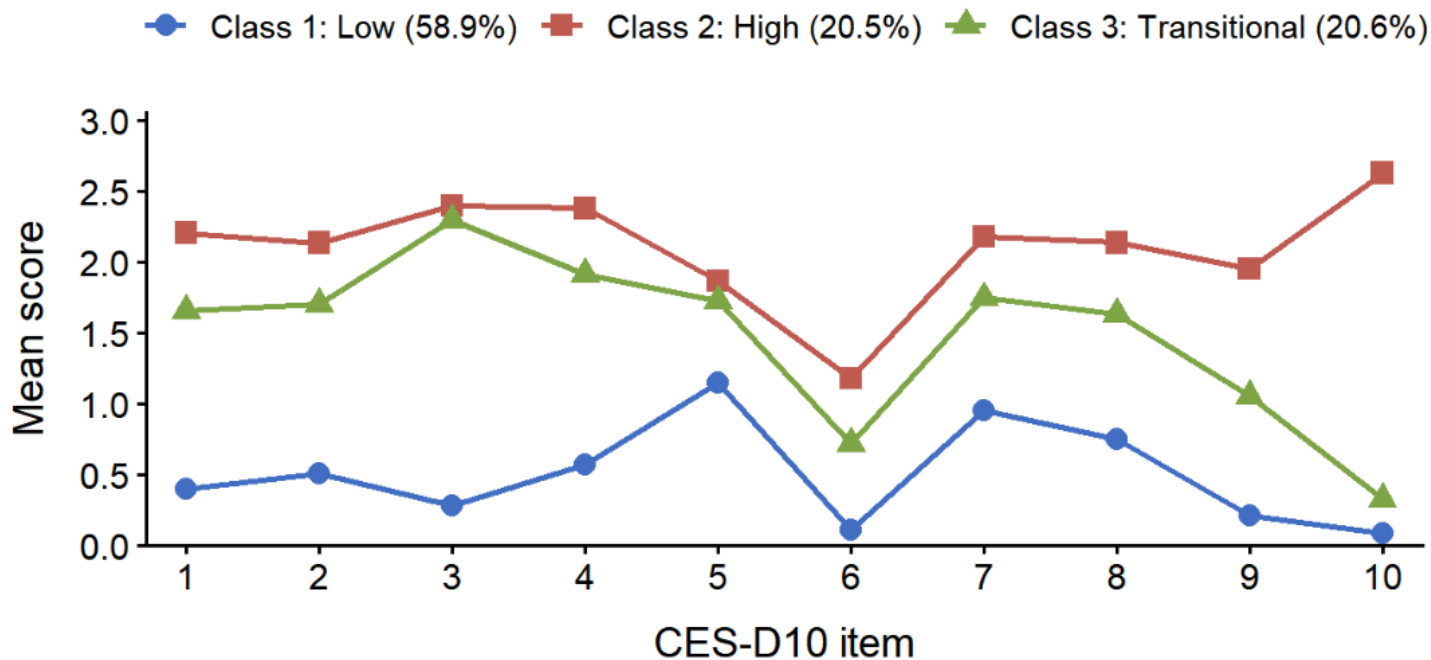


Figure 1

Latent profiles of depressive symptoms at T1 (2018). Items 1–10 represent the 10 items of the CES-D-10. Higher scores indicate greater depressive symptom severity.

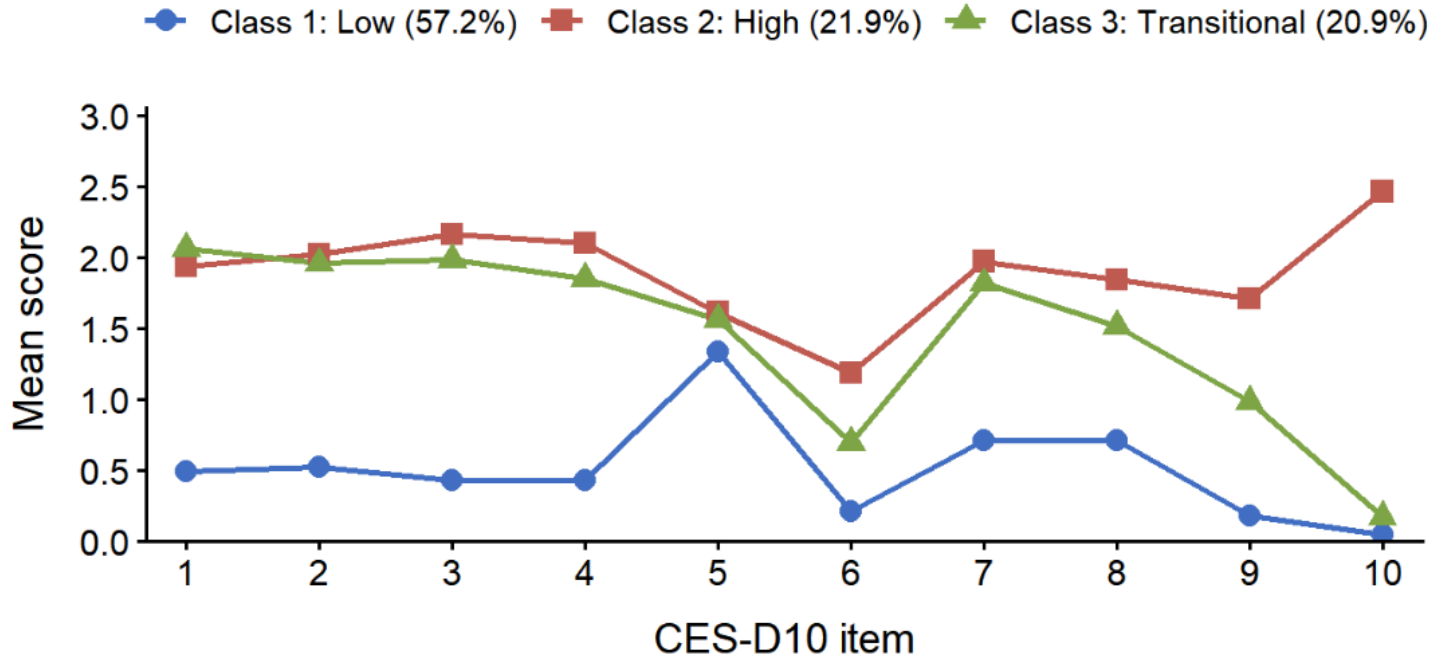


Figure 2

Latent profiles of depressive symptoms at T2 (2020). Items 1–10 represent the 10 items of the CES-D-10. Higher scores indicate greater depressive symptom severity.

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