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RESEARCH

The relationship between returning to work self-efficacy, anxiety, and depression in renal cancer patients: a cross-lagged analysis

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Abstract

Objectives This longitudinal study aimed to examine the relationship between return-to-work self-efficacy (RTW-SE), anxiety, and depression in patients with renal cancer.

Methods A total of 282 patients with renal cancer from Sun Yat-sen University Cancer Center were recruited between April and December 2022. Patients were assessed at one month (T1), three months (T2), and six months (T3) after surgery using a general information questionnaire, Return-to-Work Self-Efficacy Scale, Generalized Anxiety Disorder Scale (GAD- 7), and Patient Health Questionnaire (PHQ- 9).

Results RTW-SE progressively increased over time, while anxiety and depression scores showed a decreasing trend. Pearson's correlation analysis revealed a significant negative association between RTW-SE and both anxiety and depression at all three-time points. Cross-lagged analysis demonstrated that RTW-SE at T1 significantly predicted depression at T2 ($\beta = -0.066$, $P < 0.001$), whereas RTW-SE at T2 significantly predicted both anxiety ($\beta = -0.177$, $P < 0.001$) and depression ($\beta = -0.077$, $P < 0.001$) at T3.

Conclusion Higher RTW-SE scores were associated with lower levels of post-surgery anxiety and depression. These findings highlight the importance of systematic RTW-SE assessments and early interventions to enhance work reintegration and psychological well-being. Incorporating RTW-SE monitoring into postoperative care plans may help to identify high-risk patients and facilitate timely psychological and vocational support.

Keywords Renal cancer · Anxiety · Depression · Returning to work self-efficacy · Cross-lagged analysis

Introduction

Renal cancer (RC) is one of the most common urological malignancies worldwide [14]. Advances in medical technology, including early detection and improved treatment, have significantly enhanced the survival rates of RC patients,

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with the 5-year survival rate for early-stage cases exceeding 90% [23, 27]. Despite these advancements, patients with RC continue to face significant psychological distress, with high rates of anxiety, depression, and stress. Studies have shown that 91.2% of RC patients experience anxiety, 87.2% report symptoms of depression, and 93.6% experience perceived stress during their cancer journey [7]. These psychological conditions not only reduce quality of life but are also associated with poorer physical recovery, increased postoperative complications, and lower survival rates [8, 25].

Return-to-work self-efficacy (RTW-SE), a construct describing an individual's belief in their ability to resume work after illness, is an essential predictor of psychological and functional recovery in cancer survivors [19]. Higher RTW-SE has been shown to facilitate earlier return to work, sustain employment, and improve mental health outcomes by reducing anxiety and depression [18, 28]. Employment itself is closely linked to quality of life, with those who return to work reporting lower levels of depression, anxiety, and stress than those who remain unemployed [18]. Despite its importance, significant heterogeneity exists in RTW-SE trajectories, particularly among individuals with mental health challenges, where personal resilience, workplace support, and disease severity influence outcomes [14, 24]. Depressive symptoms are often found to improve in parallel with RTW-SE over time, suggesting that self-efficacy may play a crucial role in mitigating psychological distress [24].

While existing tools, such as the Generalized Anxiety Disorder Scale (GAD- 7) and the Patient Health Questionnaire (PHQ- 9), are effective in identifying psychological distress [17], they primarily focus on symptom severity and do not capture the broader psychosocial dimensions of recovery, such as patients' readiness to return to work. By contrast, RTW-SE offers a unique perspective by assessing patients' confidence in overcoming work-related and psychological barriers, thus bridging a critical gap in understanding the recovery process [23]. RTW-SE reflects not only the psychological state of the individual but also their perceived capacity to navigate workplace challenges and social reintegration, making it a valuable tool for designing interventions tailored to cancer survivors [19].

This study aimed to explore the relationship between RTW-SE and psychological health outcomes, specifically anxiety and depression, in patients with postoperative RC patients. By employing cross-lagged regression modeling, which accounts for the temporal relationships and bidirectional associations between RTW-SE and psychological distress, we aimed to provide new insights into how early RTW-SE influences mental health outcomes over time. The findings from this study could inform targeted interventions designed to enhance RTW-SE, ultimately improving psychological well-being and facilitating work reintegration among RC survivors. This research contributes to promoting mental health, enhancing quality of life, and supporting the recovery and return to work process in this patient population.

Methods

Study design and setting

This longitudinal, prospective research was approved by the Ethics Committee of Sun Yat-sen University Cancer Center (SL-B2022 - 176–02). Between April and December 2022, we recruited patients diagnosed with renal cancer and undergoing surgery at Sun Yat-sen University Cancer Center. The researcher screened patients who met the inclusion–exclusion criteria and invited them to participate. After receiving a comprehensive explanation of the study objectives, patients provided informed consent. Baseline data, including sociodemographic factors, medical history, and employment status, were collected before discharge. Follow-up data were gathered at 1 month (T1), 3 months (T2), and 6 months (T3) post-surgery through telephone interviews and self-administered questionnaires, conducted by trained research nurses.

Sample size estimation

Given the longitudinal design, we estimated the required sample size using G Power 3.1 software for repeated measures ANOVA. Assuming a medium effect size ($f = 0.25$), $\alpha = 0.05$, power = 0.80, and a correlation of 0.5 among repeated measures, the minimum required sample size was 150 participants. Additionally, our study employs a cross-lagged panel model (CLPM) to examine longitudinal relationships. Previous research [9] suggests that a sample size of at least 150 participants is sufficient to detect a moderate effect size ($\beta \approx 0.26$) with $\geq 87\%$ power. Our sample of 282 participants exceeds this recommendation, ensuring adequate power for our statistical analyses. The final study sample consisted of 282 participants, all of whom provided informed consent and voluntarily participated in this study.

Participants

Participants were eligible based on the following inclusion criteria: (1) renal cancer diagnosed clinically, radiologically, or pathologically and treated with surgery; (2) aged 18–60 years; (3) were able to understand and independently complete the questionnaire without external assistance; (4) were employed at the time of surgery and intended to return to work postoperatively; (5) an ECOG performance status of 0–1 before discharge after surgical treatment; and (6) meeting the criteria for medical discharge, defined as the ability to consume a semi-liquid diet or oral nutritional supplements, no need for intravenous infusion therapy, effective

pain control with oral analgesics, well-healed surgical wounds without signs of infection, good organ function, and sufficient mobility.

The exclusion criteria were as follows: (1) the presence of other primary tumors at the time of surgery and (2) preoperative severe comorbidities, such as uncontrolled cardiovascular or pulmonary disease, diabetes, or any condition judged by the physician to significantly impair postoperative recovery.

Patients were screened preoperatively, and only those who completed follow-up questionnaires at 1, 3, and 6 months postoperatively were included in the analysis. Participants were excluded from the study if they experienced (1) significant changes in condition during follow-up, such as severe complications, deterioration in health, or death, which were deemed by the treating physician to affect their ability to complete the study assessments; or (2) were lost to follow-up, defined as being unreachable by phone after three attempts at one follow-up point, and after making three additional attempts within two weeks. Participants who voluntarily withdrew from the study were also excluded.

Variables and measurement

Generalized Anxiety Disorder Scale (GAD- 7)

The GAD- 7, developed by Spitzer et al. (2006) [28], is a one-dimensional, self-administered scale designed to assess symptoms of Generalized Anxiety Disorder (GAD) as outlined in the Diagnostic and Statistical Manual of Mental Disorders (DSM)IV. The scale consists of seven items, each rated on a 4-point Likert scale ranging from 0 to 3, resulting in a total score between 0 and 21. A score of 10 or greater indicates a diagnosis of GAD, which has been validated in Chinese populations [17]. In this study, the internal consistency of the Chinese version of the GAD- 7 was 0.859, which was consistent with previous validation studies in the Chinese population [3].

Patient Health Questionnaire (PHQ- 9)

The PHQ- 9, created by Kroenke et al. (2001) [15], is a widely used tool for assessing depressive symptoms. The Chinese version of the PHQ- 9 has been validated for use in Chinese populations, with a cut-off score of ≥ 10, providing the best diagnostic performance for screening depression [20]. This threshold has been shown to maintain high diagnostic accuracy in Chinese clinical settings, as confirmed by previous studies[17]. In this study, the internal consistency of the Chinese version of the PHQ- 9 was 0.852, which is consistent with previous validation studies in the Chinese population [3].

Return-to-work self-efficacy questionnaire

The Return-to-Work Self-Efficacy Questionnaire developed by Lagerveld (2010) [16] has been validated in Chinese cancer survivors, demonstrating good reliability with a Cronbach's alpha of 0.93 [30]. A score above 45 indicated higher self-efficacy in returning to work. In this study, the Chinese version was used to assess return-to-work self-efficacy among renal cancer survivors [29].

General information questionnaire

Data on demographic characteristics (e.g., age, sex, BMI, marital status, education level, occupation type, nature of work, employment status before surgery, and family income) and disease-related information (e.g., type of surgery, surgical method, length of hospital stay, family history of cancer, comorbidities, and follow-up treatment) were collected using two methods.

The participants self-administered a General Information Questionnaire to provide demographic and work-related data. Occupational type was classified according to the Chinese National Standard "Classification of Physical Labor Intensity" (GB 3869–1997). This standard categorizes labor into four levels based on physical intensity. In this study, Level 1 (light labor) was defined as intellectual labor, Level 2 (moderate labor) as mixed labor, and Levels 2–4 were grouped as physical labor.

Medical information, including the type of surgery, surgical method, length of hospital stay, and follow-up treatment, was extracted from electronic health records to ensure accuracy and reliability. Preoperative clinical staging (Stages I-IV) was recorded from diagnostic evaluations based on clinical assessments, while metastasis status was determined through postoperative pathological examination and follow-up imaging.

Data analysis

Descriptive and inferential statistics were used to analyze the data. Demographic variables and questionnaire scores are presented as frequencies, percentages, means, and standard deviations. Differences in the same variable across different time points were analyzed using repeated-measures ANOVA. Pearson's correlation analysis was conducted to examine associations between RTW-SE, anxiety, and depression over time.

To investigate the temporal relationship between RTW-SE and psychological symptoms, a cross-lagged panel model was constructed using Mplus (version 7.11). This approach allows for the assessment of bidirectional and time-dependent associations between variables across multiple time points while accounting for the directionality of

effects. Given that CLPM is designed to examine reciprocal influences among key psychological variables rather than adjusting for external covariates, no covariates were included in the final model. Model fit was evaluated using multiple fit indices, including chi-square divided by degrees of freedom (χ^2/df <3 for acceptable fit), Comparative Fit Index (CFI ≥ 0.90 for good fit), Tucker-Lewis Index (TLI ≥ 0.90 for acceptable fit), and Root Mean Square Error of Approximation (RMSEA ≤ 0.08 for acceptable fit, <0.05 for excellent fit).

Statistical significance was set at $P < 0.05$, and p-values were based on two-tailed probability tests. All statistical analyses, except for the cross-lagged model, were performed using SPSS (version 26.0), whereas structural equation modeling, including latent variables, was conducted in Mplus (version 7.11). Although the majority of participants completed all assessments, some data were missing due to loss of follow-up. To assess the missing data mechanism, we performed Little's MCAR test, which was non-significant ($p > 0.05$), indicating that missing data were likely missing completely at random (MCAR). Accordingly, full information maximum likelihood (FIML) was applied to handle missing data in the structural equation modeling analysis, as it is a widely recommended approach for longitudinal data.

Results

Participant characteristics

A total of 304 eligible patients were approached for participation, and all consented to enroll in the study, yielding a response rate of 100%. These 304 patients were enrolled during the inclusion period from April to December 2022. Among them, 282 completed all three surveys, with a study completion rate of 92.76%. The specific reasons for loss to follow-up were as follows: (1) 15 patients refused follow-up or were unreachable, (2) one patient died from COVID-19 and another experienced disease progression, (3) three patients withdrew, stating that they found the study unhelpful, and (4) two patients were excluded due to severe illness.

A total of 282 patients with RC were included in the study (ages 18–60 years). Among them, 129 (45.7%) were younger than 45 years, and 153 (54.3%) were aged 45 years or older. A total of 197 (69.9%) patients were male, and 85 (30.1%) were female. Regarding education, 120 (42.6%) had a college degree or higher, while 32 (11.3%) had a primary education or lower. Based on the occupational classification criteria used in this study, 97 participants (34.4%) were classified as engaging in intellectual labor, 90 (31.9%) in physical labor, and 95 (33.7%) in mixed labor.

In terms of tumor staging, 233 (82.6%) patients were classified as Stage I, 10 (3.5%) as Stage II, 23 (8.2%) as Stage III, and 16 (5.7%) as Stage IV based on preoperative clinical staging. Postoperative pathological examination and follow-up imaging identified metastases in 33 (11.7%) patients, and 52 (18.4%) received subsequent tumor treatment. Regarding surgical treatment, 235 (83.3%) patients underwent partial nephrectomy and 47 (16.7%) underwent radical nephrectomy. The primary surgical approaches included robot-assisted surgery in 201 patients (71.3%), laparoscopic surgery in 50 patients (17.7%), and open surgery in 31 patients (11.0%).

Comparison of RTW-SE, anxiety, and depression scores at T1 to T3 in RC patients

The results of the repeated measures ANOVA indicated statistically significant differences in RTW-SE, GAD- 7, and PHQ- 9 scores among patients with RC from T1 to T3 ($P < 0.001$) (Table 1). The proportions of patients with moderate-to-severe anxiety symptoms (GAD- 7 $\geq$ 10) at 1, 3, and 6 months postoperatively were 135 (47.87%), 131 (46.45%), and 107 (37.94%), respectively. Similarly, the proportion of patients with moderate-to-severe depressive symptoms (PHQ- 9 $\geq$ 10) at the same time points was 144 (51.06%), 140 (49.65%), and 131 (46.45%), respectively. Additionally, the proportions of patients experiencing moderate-to-severe anxiety and depressive symptoms were 97 (34.4%), 103 (36.5%), and 94 (33.3%) at T1, T2, and T3, respectively.

Pearson correlation matrix of RTW-SE, anxiety, and depression in RC patients

Pearson correlation analysis revealed a significant negative correlation between RTW-SE and both anxiety (GAD- 7) and depression (PHQ- 9) from T1 to T3 ($P < 0.01$). For anxiety, RTW-SE at T1 showed correlations with GAD-7 of $r = -0.175$ (T1, weak), $r = -0.204$ (T2, weak), and $r = -0.244$ (T3, weak). RTW-SE at T2 exhibited moderate to strong correlations ($r = -0.577$ to -0.632), with RTW-SE at T3 showing the strongest correlation ($r = -0.635$, strong). For depression, RTW-SE at T1 showed correlations with PHQ- 9 of $r = -0.279$ (T1, weak), $r = -0.315$

Table 1 Scores of RTW-SE, Anxiety, and Depression from T1 to T3 (n = 282)

Variable	T_1	T_2	T_3	F	P
PHQ- 9	10.48 ± 4.96	10.16 ± 4.55	9.41 ± 4.73	35.58	< 0.001
GAD- 7	9.66 ± 4.22	9.61 ± 4.19	8.6 ± 4.30	38.18	< 0.001
RTW-SE	39.09 ± 10.71	42.26 ± 9.76	45.61 ± 10.62	78.14	< 0.001

PHQ- 9: depression; GAD- 7:anxiety; RTW-SE: return-to-work self-efficacy;

T1: 1 month post-surgery; T2: 3 month post-surgery, T3: 6 month post-surgery

(T2, weak to moderate), and $r = -0.299$ (T3, weak). RTW-SE at T2 demonstrated moderate to strong correlations ($r = -0.615$ to -0.629), with RTW-SE at T3 showing a strong correlation ($r = -0.616$, strong). These findings indicate that while a higher RTW-SE is consistently associated with lower levels of anxiety and depressive symptoms in patients with RC over time, the effect sizes were relatively weak in the early recovery phase (T1) but became stronger in later stages (T2 and T3), suggesting an increasing role of RTW-SE in psychological adaptation over time (Tables 2 and 3).

Cross-lagged model between RTW-SE, anxiety, and depression in RC patients

The cross-lagged model results showed that the model fit indices for the RTW-SE and GAD- 7 models were $\chi^2/df = 1.249$, CFI = 0.950, TLI = 0.827, and RMSEA = 0.230 (95% CI: 0.183–0.282), whereas those for the RTW-SE and PHQ- 9 models were $\chi^2/df = 1.511$, CFI = 0.970, TLI = 0.894, and RMSEA = 0.179 (95% CI: 0.131–0.231). The cross-lagged coefficient from RTW-SE to GAD- 7 from T1 to T2 ($\beta = -0.058$, $P > 0.05$) was not statistically significant, whereas the coefficient from T2 to T3 ($\beta = -0.177$, $P < 0.001$) was statistically significant (Fig. 1). For the RTW-SE to PHQ- 9 pathway, the cross-lagged coefficients were statistically significant from T1 to T2 ($\beta = -0.066$, $P < 0.001$) and from T2 to T3 ($\beta = -0.077$, $P < 0.001$) (Fig. 2).

Discussion

This study achieved a 100% initial recruitment rate, as all eligible patients approached during hospitalization consented to participate. This unusually high rate may be attributed to the inpatient timing of recruitment, strong rapport between patients and clinical nursing staff, and minimal study burden. Patients were invited to join the study during a critical period when they were engaged in care planning and more receptive to follow-up support. Nevertheless, some attrition occurred during the follow-up period, with a final completion rate of 92.76%.

Postoperative anxiety and depression persist in a substantial proportion of RC patients

Anxiety and depression are prevalent psychological responses among cancer survivors, often co-occurring, and contributing to significant distress. The incidence rates of moderate-to-severe anxiety and depression in our

Table 2 Correlation Matrix between Anxiety and RTE-SE in RC Patients (n = 282, *r*)

Variable	GAD- 7 (T1)	GAD- 7 (T2)	GAD- 7 (T3)	RTW-SE (T1)	RTW-SE (T2)	RTW-SE (T3)
GAD- 7(T1)	1					
GAD- 7(T2)	0.845**	1				
GAD- 7(T3)	0.793**	0.891**	1			
RTW-SE(T1)	− 0.175**	− 0.204**	− 0.244**	1		
RTW-SE(T2)	− 0.372**	− 0.577**	− 0.632**	0.617**	1	
RTW-SE(T3)	− 0.296**	− 0.545**	− 0.635**	0.446**	0.892**	1

** indicates $P < 0.01$

PHQ- 9: depression; GAD- 7:anxiety; RTW-SE: return-to-work self-efficacy;

T1: 1 month post-surgery; T2: 3 month post-surgery, T3: 6 month post-surgery

Table 3 Correlation matrix between depression and RTW-SE in RC Patients (n = 282, *r*)

Variable	PHQ- 9 (T1)	PHQ- 9 (T2)	PHQ- 9 (T3)	RTW-SE (T_1)	RTW-SE (T2)	RTW-SE (T3)
PHQ- 9(T1)	1					
PHQ- 9(T2)	0.912**	1				
PHQ- 9(T3)	0.863**	0.945**	1			
RTW-SE(T1)	− 0.279**	− 0.315**	− 0.299**	1		
RTW-SE(T2)	− 0.423**	− 0.615**	− 0.629**	0.617**	1	
RTW-SE(T3)	− 0.329**	− 0.552**	− 0.616**	0.446**	0.892**	1

** indicates $P < 0.01$

PHQ- 9: depression; GAD- 7:anxiety; RTW-SE: return-to-work self-efficacy

T1: 1 month post-surgery; T2: 3 month post-surgery, T3: 6 month post-surgery

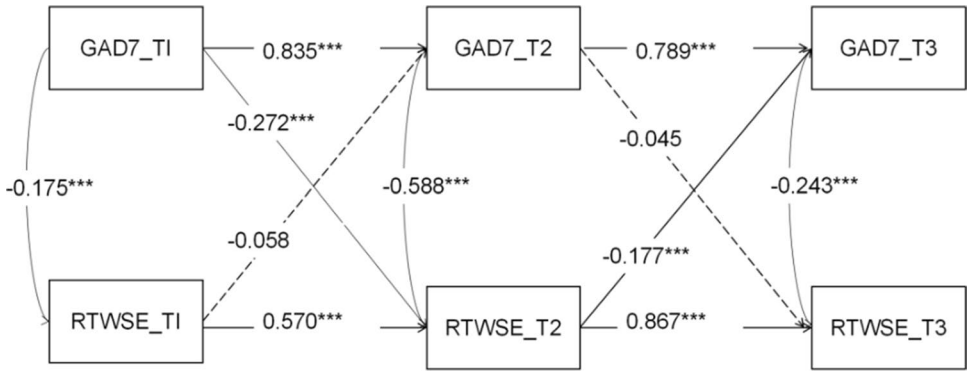

Fig. 1 Cross-lagged relationship between anxiety and RTW-SE. *Note*: Data in the figure represent standardized β values; *** indicates $P < 0.001$. GAD-7:anxiety; RTW-SE: return-to-work self-efficacy; T1: 1 month post-surgery; T2: 3 month post-surgery, T3: 6 month post-surgery

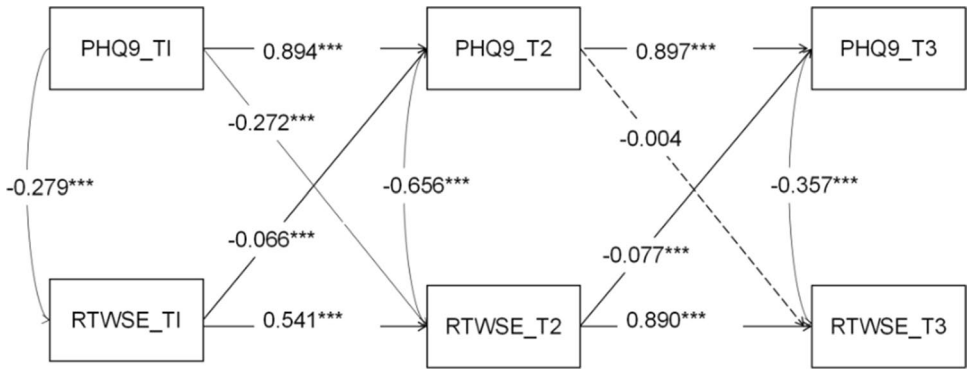

Fig. 2 Cross-lagged relationship between depression and self-Efficacy. *Note*: Data in the figure represent standardized β values; *** indicates $P < 0.001$. PHQ- 9: depression;RTW-SE: return-to-work self-efficacy; T1: 1 month post-surgery; T2: 3 month post-surgery, T3: 6 month post-surgery

study were slightly lower than those reported in previous research [7], possibly because of the inclusion of a higher proportion of early stage RC cases, where the disease burden is generally lower. Consistent with previous findings, psychological distress exhibited a gradual decline over time, likely due to postoperative physical recovery, reduced surgical trauma, and improved psychological adaptation [5, 8]. However, despite this overall improvement, a notable proportion of patients (94, 33.3%) continued to experience both anxiety and depressive symptoms six months postoperatively, highlighting that time alone may be insufficient for full psychological recovery. This finding underscores the necessity of targeted psychological interventions to address persistent distress, particularly in patients with ongoing concerns about disease prognosis and work reintegration challenges [6].

Furthermore, our results suggest a close relationship between psychological distress and work-related confidence. Patients with lower RTW-SE are more likely to experience sustained anxiety and depression, as concerns about work reintegration, financial stability, and role adaptation become more prominent in later recovery stages [4]. These findings highlight the need to integrate psychological support with vocational rehabilitation to promote holistic recovery in RC patients.

RTW-SE improves over time, but recovery remains incomplete

This study demonstrated that RTW-SE increased progressively from one to six months postoperatively, which is consistent with prior longitudinal studies on cancer survivors [26]. However, the mean RTW-SE score at six months (45.61 ± 10.62) remained below the optimal level, indicating that while improvements were observed, many patients still lacked full confidence in their ability to return to work successfully. There are several possible explanations for this incomplete recovery in RTW-SE. While physical health typically stabilizes within the first few months post-surgery, psychological readiness for work reintegration is a more complex process shaped by both personal factors (e.g., perceived work ability, role identity) and external influences (e.g., workplace support and job demands) [10]. Concerns about job performance, workplace stigma, and the ability to manage work-related stress may contribute to continued uncertainty in returning to work [1]. Given the observed stagnation in RTW-SE at later time points, clinicians should proactively identify individuals at risk and implement structured interventions such as work-focused cognitive-behavioral therapy, vocational counseling, and gradual return-to-work programs to support work reintegration [12]. These

targeted approaches may help to enhance self-efficacy and prevent prolonged psychological distress.

Longitudinal associations between RTW-SE and psychological health

This study found that RTW-SE at one month postoperatively negatively predicted depressive symptoms at three months, whereas RTW-SE at three months negatively predicted both anxiety and depression at six months. These findings provide further evidence that RTW-SE serves not only as a concurrent psychological marker but also as a predictor of future mental health outcomes [11]. Moreover, the association between RTW-SE and psychological symptoms strengthened over time, with relatively weaker correlations at one month but progressively stronger correlations at three and six months. This pattern suggests that psychological adaptation to work reintegration becomes increasingly relevant in later recovery stages, as patients transition from immediate physical recovery to long-term functional and social reintegration [21]. Although these associations were statistically significant, the correlation coefficients were in the weak to moderate range, particularly at T1. This may indicate that, in the early postoperative phase, factors beyond RTW-SE (such as pain and physical discomfort, sleep disturbances, complications, and perceived health status[22]) play a more dominant role in psychological distress. As recovery progresses, RTW-SE may become a more central determinant of psychological outcomes, leading to stronger associations at T2 and T3. Future research should further explore these mediating factors to clarify the underlying mechanisms driving this temporal shift.

A potential explanation for this trend is that patients with persistently low RTW-SE may enter a negative feedback loop, in which doubts about workability lead to greater psychological distress [26], which further weakens self-efficacy. This bidirectional influence suggests that early interventions targeting RTW-SE may help prevent long-term emotional distress in RC patients. Given these findings, RTW-SE could serve as an early indicator for identifying patients at risk for prolonged anxiety and depression. Routine RTW-SE assessments during postoperative follow-ups could enable timely psychological support and work-related counseling, potentially mitigating long-term mental health complications.

Clinical implications of RTW-SE in psychological health

The findings of this study underscore the critical role of RTW-SE in the postoperative psychological recovery of RC patients. The bidirectional associations observed between RTW-SE and anxiety/depression suggest that monitoring RTW-SE over time could serve as a valuable indicator of mental health trajectory during recovery. Given that RTW-SE at earlier time points predicts future anxiety and depression, routine assessment in clinical practice may help identify patients at risk of prolonged psychological distress and guide personalized interventions [13]. Integrating RTW-SE assessments into survivorship care plans may allow healthcare providers to better tailor psychological support and vocational rehabilitation based on individual work-related self-efficacy levels [11].

Additionally, the RTW-SE could complement standard mental health assessments (e.g., GAD- 7 and PHQ- 9) by capturing a work-specific dimension of psychological adaptation. Prior studies have demonstrated that successful work reintegration is associated with lower psychosocial distress and better quality of life among cancer survivors [2, 19]. These findings emphasize the need for clinicians to monitor RTW-SE and implement timely interventions for patients with persistently low scores [18].

Patients with low RTW-SE may benefit from structured cognitive-behavioral interventions, targeted vocational counseling, or phased return-to-work programs aimed at enhancing self-efficacy [26]. While this study primarily focused on the psychological aspects of RTW-SE, future research should explore how multidisciplinary interventions interact with RTW-SE to optimize both psychological well-being and work reintegration.

Conclusion

This longitudinal study explored the dynamic relationship between RTW-SE and psychological distress (anxiety and depression) in patients with RC by employing a cross-lagged analysis to assess the predictive role of early RTW-SE in subsequent mental health outcomes. The findings demonstrated a progressive increase in RTW-SE along with a reduction in anxiety and depression symptoms within six months postoperatively, suggesting a reciprocal relationship between work-related self-efficacy and psychological adaptation. Moreover, RTW-SE has emerged as a significant predictor of future psychological distress, reinforcing its potential role as an early indicator of long-term mental health trajectories in postoperative patients. These results emphasize the importance of integrating RTW-SE assessments into routine post-discharge evaluations to identify individuals at risk for prolonged psychological distress.

To enhance work reintegration confidence and mitigate psychological distress, clinicians should implement structured interventions, such as empowerment education, vocational counseling, and cognitive-behavioral strategies tailored to patients with low RTW-SE. These vocational rehabilitation efforts may serve as key facilitators supporting long-term psychological well-being and work reintegration in renal cancer survivors.

Strengths and limitations

A major strength of this study is its prospective longitudinal design, which allowed for a more precise evaluation of the temporal relationship between RTW-SE and psychological distress in patients with renal cancer. The application of cross-lagged analysis provides a novel perspective on the bidirectional associations between RTW-SE, anxiety, and depression, highlighting their evolving interplay over time.

However, the single-center design and six-month follow-up period may limit the generalizability and long-term applicability of the findings. In addition, factors such as social support, workplace accommodation, and economic constraints were not considered. Furthermore, the occupational classification used in this study was based on the Chinese National Standard GB 3869–1997, which, although still widely used, may not fully reflect the complexity of modern work environments and evolving labor roles. Future studies should consider updated occupational classification frameworks and incorporate broader psychosocial variables across diverse clinical settings to validate and extend the current findings.

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Data availability The data are available upon request. Please contact the corresponding author for further information.

Declarations

Ethics This study strictly adhered to the principles and standards of the Declaration of Helsinki. The study was approved by the Ethics Committee of *Sun Yat-sen University Cancer Center* (SL-B2022 - 176–02). All patients provided informed consent and voluntarily participated in this study.

Competing interest The authors declare no competing interests.

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