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Impact of industry-education collaborative cooperation on the social reintegration ability of cancer survivors: a structural path analysis based on psychosocial adaptation

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Abstract: Resuming employment, rebuilding social relationships, and reengaging in community life continue to be among the most persistent challenges for cancer survivors. While coordination between different sectors (i.e., hospitals, vocational training institutions, employers) may support this process, the specific mechanisms through which such coordination operates remain unclear. To bridge this gap, the current study introduces the concept of Industry-Education Collaborative Cooperation (IECC), measured as survivors' perceived experience of cross-institutional coordination, and develops a serial mediation model linking IECC exposure to social reintegration ability, with psychosocial adaptation as the proximal mediator and self-efficacy, perceived social support, and coping strategies as antecedent mediators. A cross-sectional survey collected data from 383 cancer survivors recruited across three tiers of service coordination (tertiary hospitals, community rehabilitation centers, and general outpatient clinics) in Jilin Province, China. Structural equation modeling indicated that IECC did not retain a significant direct effect on reintegration; rather, its influence operated indirectly through the hypothesized psychosocial pathways, with indirect effects accounting for approximately 51.5% of the total effect. Self-efficacy and perceived social support emerged as parallel distal mediators of comparable magnitude, while coping strategies did not serve as a significant transmission channel. Psychosocial adaptation functioned as the key proximal mechanism, and multi-group analysis supported the structural stability of the model across gender groups. These findings suggest that rehabilitation programs should establish formal cross-sector coordination mechanisms and attend to the activation of survivors' psychological resources to facilitate social reintegration.

Keywords: cancer survivors; social reintegration; industry-education collaborative cooperation; psychosocial adaptation; structural equation modeling

1. Introduction

There have been tremendous advancements in cancer diagnosis and treatments during the last twenty years, which led to increased cancer survivor rates [1]. On the one hand, this achievement deserves celebration; yet, on the other hand, the growing number of survivors is accompanied by numerous difficulties associated with the struggle for resumption of everyday activities, interpersonal relations, and normal functioning. Indeed, there are many reports about the challenges connected with going back to work, building new relations, and becoming engaged in social activity after a diagnosis [2]. Quantitative evidence suggests that although a majority of

cancer survivors eventually return to employment, a substantial proportion experience prolonged absence, involuntary job changes, or reduced working capacity. A meta-review of return-to-work studies reported that return rates varied considerably across cancer types and healthcare systems, with many survivors facing persistent occupational difficulties even years after treatment completion. The consequences of reintegration difficulties for the psychological state and long-term prognosis in terms of the quality of health were revealed earlier [3]. Moreover, since the world population of cancer survivors is continuously growing [1], finding efficient ways of helping them reintegrate into everyday life appears to be crucial for health practitioners.

As was already mentioned above, psychosocial adaptation was found to play a key role in successful functional restoration in people suffering from various forms of cancer [4]. Several recent works using structural equation modeling found out that self-efficacy, social support perception, and coping strategy were interconnected psychological factors which affected adaptation process in the population [5]. It means that successful adaptation is a process associated with multiple variables which interact with each other [6]. However, the problem is that most of the previous studies concentrated on the role of psychological resources, while paying little attention to the role of environment in making these resources operational.

In rehabilitation sciences, there is another stream of research which pays special attention to cross-institutional cooperation as the key element of reintegration in the labor market. As was found by several studies, vocational rehabilitation programs combining medical care with vocational counseling showed better outcomes for patients' productivity [7]. Stakeholder analysis demonstrated that communication and cooperation of the involved parties appeared to be necessary conditions for effective rehabilitation [8]. Emerging practical initiatives have begun to operationalize such coordination: for example, the Beyond Cancer program in Australia integrated oncology rehabilitation with vocational support to facilitate survivors' return to health and work [9], while the UNAMANO project in Italy (named after the Italian phrase "una mano," meaning "a helping hand") established a social-healthcare pathway linking clinical teams with employment services [10]. These pioneering efforts suggest that cross-sector collaboration can be feasible and beneficial, yet they have typically been implemented as standalone programs without a unifying theoretical framework or a validated measure of institutional coordination. Thus, it appears that we can talk about the kind of support which exists beyond the borders of a particular institution. Namely, the concept of Industry-Education Collaborative Cooperation (IECC) can be introduced here, defined as an interaction of medical, educational, and employment agencies aimed at the delivery of joint services for cancer survivors. The notion of IECC comprises such concepts as referral linkages, information exchange, and collaborative planning concerning rehabilitation/re-employment issues.

Despite the obvious theoretical attractiveness of the proposed multi-sector perspective, the empirical research in this area seems to be extremely rare. To the best of my knowledge, there is no research which explored the connection between institutional collaboration and social reintegration outcomes for patients in question. Besides, the mechanisms which make the former factor conducive to the latter one still require elaboration and verification. Thus, there is a need for the development of the appropriate empirical basis.

Therefore, the main objective of the proposed study will be to construct and

verify a structural path model which links exposure to the IECC practice with the ability of reintegration into society among patients who suffer from cancer. Psychosocial adaptation will be considered a mediator in this model; self-efficacy, social support perception, and coping strategy will serve as antecedents linking exposure to IECC to adaptation.

2. Literature review and hypotheses

2.1. Social reintegration of cancer survivors

First and foremost, the development of the concept of social reintegration in relation to cancer survivors has undergone many significant shifts over the last ten years. In previous literature, reintegration was largely considered from a very narrow perspective, namely, the return of a cancer survivor to work after the completion of the therapeutic process. However, more recent research has expanded the definition of reintegration to include the re-integration across various aspects of survivors' lives. Ore and Foli define reintegration as a complex process during which cancer survivors have to adjust to new forms of social identification, roles, daily routines, and responsibilities as the result of experiencing long-term consequences of the disease [11]. This conceptualization has been validated by qualitative studies with cancer survivors who have found at least four different patterns of reintegration experiences, ranging from active pursuit of recovery to social confusion influenced by social stigma [12]. Overall, it can be argued that the concept of social reintegration includes various forms of integration into work and social life.

In terms of empirical knowledge of the subject, several personal and environmental factors that influence reintegration processes have been identified. Personal factors include the presence of cancer-related symptoms and psychological distress, which are linked to delayed or failed social reintegration [13]. Additionally, a set of environmental factors has been recognized to affect the success rate of this process. Specifically, employment-related difficulties may include difficulties in negotiations regarding workplace adjustments and concerns related to discussing the condition with the employer [2]. Moreover, a content analysis of data produced by survivors, health care providers, and employers suggests that sustained reintegration requires coordination between all three groups of stakeholders [14]. Indeed, coordination-based vocational rehabilitation has shown promise across various clinical populations. Early integrated rehabilitation programs combining medical follow-up with vocational counseling have demonstrated improvements in work ability and reductions in sick leave duration among breast cancer patients [7]. In broader rehabilitation contexts, tailored return-to-work interventions involving healthcare professionals, employers, and patients as co-designers of the support process have been advocated to improve occupational outcomes [8]. However, these efforts have largely remained fragmented, with coordination treated as a programmatic feature rather than a measurable construct in its own right. However, this aspect of the issue seems to remain underrepresented in the current literature compared to individual predictors of success.

It appears that rehabilitation programs focusing mainly on either psychological or physical intervention may fail to consider the environmental factors influencing the survivor's ability to integrate into society. The need for research on the importance of interorganizational coordination as one of the key determinants of reintegration success represents a significant gap addressed in this study.

2.2. Conceptual framework and theoretical foundation of IECC

Survivorship care for cancer patients currently hinges on multidisciplinary teams in a single health care institution, in which rehabilitation services are coordinated across diverse disciplines within a single organization [15]. Although successful in tackling both medical and psychological aspects of recovery, this model does not venture out into the external world to involve stakeholders such as employers and vocational trainers. In addition, another strand of research on vocational rehabilitation has analyzed the role of workplace-related variables and coordination among stakeholders in facilitating the process of returning to work, but it does not incorporate the role of education and health care institutions to tackle the issue holistically [8]. At this moment, there is no existing construct that integrates the collaboration of these three sectors in delivering supportive services for cancer survivors.

The current research proposes the concept of IECC, which refers to the extent to which medical institutions, vocational and educational training institutes (i.e., organizations providing job-related skills training and competency development, rather than psychoeducation about illness management), and employers coordinate their actions and deliver services together toward the goal of functional recovery and social reintegration of cancer survivors. Although IECC is measured through survivor self-report, it captures perceived cross-institutional coordination activities, including referrals, joint consultations, and collaborative planning, rather than the emotional and instrumental support assessed by social support scales. The construct thus differs from perceived social support in content domain: the former reflects the survivor's experience of organizational coordination across sectors, while the latter reflects subjective appraisals of interpersonal supportiveness. Unlike the concept of multidisciplinary teamwork, IECC entails perceived collaboration across organizations in different sectors rather than coordination among medical professionals within a single hospital. It should be acknowledged that, as a self-report measure, the Industry-Education Collaborative Cooperation Reintegration Perception Questionnaire (IECC-RPQ) captures the survivor's perception of institutional engagement rather than objective institutional behavior; triangulation with institutional-level indicators is discussed in the Limitations. Two theories have been used as the theoretical background to justify the predictive power of IECC on the outcomes of reintegration after cancer.

First, ecological systems theory postulated by Bronfenbrenner stresses the importance of connections between different settings where the subject spends time [16]. When applied to cancer survivors, IECC reflects the mesosystem, that is, the pattern of interconnections among the microsystems of hospitals, workplaces, and training institutes in which the survivor participates; stronger mesosystem linkages enable the survivor to gain additional benefits from the interaction of settings in his/her environment [16,17]. Second, the International Classification of Functioning (ICF), Disability and Health underscores the importance of environmental factors such as services, systems, and policies along with body functions and activities in determining participation outcomes [18]. Thus, IECC reflects the environmental factor domain, and the mechanism of its effect on reintegration will include both facilitation of the process itself and augmentation of personal resources. For instance, the adapted ICF Core Set for vocational rehabilitation has shown the importance of inter-institutional cooperation and attitudes of organizations to work rehabilitation of cancer patients [19]. Based on the above discussion, the following hypothesis can be formulated:

H1 (competing hypothesis): After accounting for indirect pathways through psychosocial processes, IECC exposure retains a significant direct effect on social

reintegration ability among cancer survivors. A significant direct effect would indicate partial mediation, whereas a non-significant direct effect would support full mediation.

2.3. Mediating role of psychosocial adaptation

By definition, psychosocial adaptation in the context of cancer refers to the mechanism of handling and responding to various disruptions introduced to an individual's physical, psychological, social, and vocational functioning as a result of the illness [4]. This is not viewed as an outcome, but rather as a dynamic process of appraisal and accommodation, driven both by the characteristics of the illness itself and the individual's resources. Measurement tools commonly employed to assess psychosocial adaptation are validated scales, capturing the extent of adaptation in various aspects of an individual's life, such as vocational, familial, social, and interpersonal spheres. Meta-analysis of studies on the topic, conducted over a period of almost three decades, has found that among the most stable determinants of adaptation are self-efficacy, social support, coping mechanisms, and uncertainty about the illness, although communal and structural variables have not been studied extensively enough [4].

The logic behind the proposed role of psychosocial adaptation in mediating the impact of IECC on social reintegration is drawn from resource-based models of coping. In this context, when faced with a situation requiring greater collaboration and support across institutions, the person acquires additional informational, instrumental, and psychological resources. The evaluation of an individual's vocational skills, for example, performed collaboratively between medical personnel and relevant specialists in vocational training programs, enables him or her to better understand and adjust to his or her abilities. Similarly, cooperation between medical teams and potential employers concerning the employee's health and needs could mitigate stress associated with navigating the process of disclosing personal information and adapting to work demands [13]. It should be noted that these inputs are not assumed to circumvent psychological processes, but rather to facilitate reintegration through improved adaptive opportunities.

In line with this reasoning, structural models in a related area of research lend indirect support to the proposed approach. Several existing studies, looking at the relationship between institutional support and functional outcomes among cancer populations, revealed that the effect takes place through the medium of psychological variables, such as adjustment, coping mechanisms, and self-appraisal, rather than directly influencing functional well-being [20]. Building on these findings, the present study proposes a serial mediation model in which IECC first activates psychological antecedents (self-efficacy, perceived social support, and coping strategies), which in turn shape psychosocial adaptation, and adaptation subsequently determines social reintegration outcomes. In this sequential chain, psychosocial adaptation functions as the proximal mediator linking distal antecedent resources to reintegration. Therefore, the following hypothesis is proposed:

H2: Psychosocial adaptation serves as the proximal mediator in a serial pathway from IECC exposure to social reintegration ability, transmitting the effects of psychological antecedents (SE, PSS, CS) activated by IECC into reintegration outcomes.

2.4. Antecedent pathways

Given that psychosocial adaptation acts as the mediator between IECC and

social reintegration, one additional research question can be raised regarding the exact psychological mechanisms by which exposure to IECC is linked to improved adaptation. To begin with, considering the existing body of literature on cancer rehabilitation, three constructs may be viewed as the potential antecedents: self-efficacy, perceived social support, and coping strategies. Within the serial mediation framework, these three constructs serve as distal mediators: IECC is hypothesized to activate each antecedent, which then influences psychosocial adaptation, and adaptation in turn affects social reintegration (i.e., $IECC \rightarrow \text{antecedent} \rightarrow PSA \rightarrow SRA$).

First, self-efficacy is described as an individual's belief that he or she can effectively perform certain actions necessary to obtain a desirable result. In numerous studies on cancer survivorship, self-efficacy has been considered a construct central to the discussion. From the perspective of Bandura's social cognitive theory, mastery experiences and social persuasion have been identified as the main sources of self-efficacy beliefs. Both mechanisms can be easily triggered through IECC. On the one hand, the mastery experience will take place in the process of organizing vocational training programs in cooperation with medical and educational institutions, thus giving the survivor chances to practice new skills. On the other hand, employer-physician communication within IECC can serve as a social persuasive source, providing clear performance expectations and encouragement. It has been shown that, in the case of lung cancer patients, self-efficacy mediates the relationship between social support and resilience, with positive coping strategies strengthening the effect of social support [5].

H3a: Self-efficacy mediates the relationship between IECC exposure level and psychosocial adaptation among cancer survivors.

Next, perceived social support may be considered an important antecedent. As discussed in Section 2.2, IECC involves assessing cross-institutional collaboration behavior, whereas perceived social support describes an individual's subjective estimate of the availability and adequacy of support from others. Although related to each other, these constructs should not be treated as redundant, and there exists a directional link between them. Whenever survivors engage in cross-institutional communication involving physicians and employers or medical specialists and vocational training centers, their network of potential supporters will expand to include representatives from outside the immediate circles of friends and relatives. A study using structural equation modeling in which lung cancer patients participated showed that perceived social support had a direct and indirect effect on the severity of depressive symptoms through self-efficacy and learned helplessness [6]. In the present conceptual model, IECC will play the role of the institutional antecedent, increasing the survivors' perception of social support and facilitating their psychosocial adaptation.

H3b: Perceived social support mediates the relationship between IECC exposure level and psychosocial adaptation among cancer survivors.

Finally, coping strategies represent another potentially important antecedent. Cancer patients use both cognitive and behavioral approaches to cope with stressful events and illness; in particular, the use of avoidant and problem-focused strategies has been widely discussed in literature. Active coping has been proven more efficient than avoidance and, therefore, should positively influence survivors' psychosocial adaptation. Since IECC has the educational component associated with increasing survivors' knowledge about their physical abilities and workplace rights as well as

opportunities for rehabilitation, the chances for active coping can be significantly increased. For example, a structural equation modeling study involving hematological cancer patients showed that social support could be linked with posttraumatic growth through mediation by positive coping and could be associated with avoidant coping and anxiety/depression [21].

H3c: Positive coping strategies mediate the relationship between IECC exposure level and psychosocial adaptation among cancer survivors.

2.5. Hypothesized model

Theoretical and empirical arguments discussed in the preceding sections have been used to construct a structural model that assesses the links between the levels of exposure to IECC, self-efficacy, perceived social support, coping skills, psychosocial adaptation, and social reintegration capacity. **Figure 1** illustrates the proposed serial mediation model. The model specifies three distal mediators (SE, PSS, and CS) that are hypothesized to be activated by IECC, one proximal mediator (PSA) through which their effects are transmitted to SRA, and a competing direct path from IECC to SRA (H1) to test whether full or partial mediation holds.

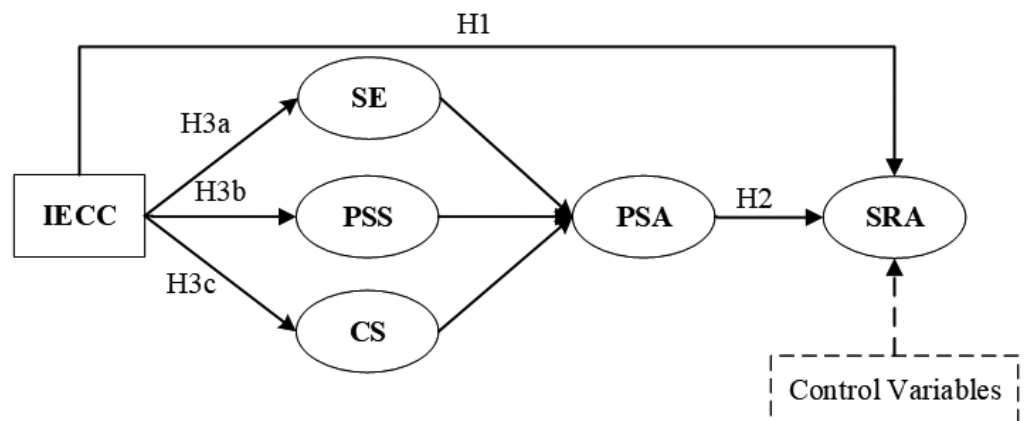


Figure 1. Hypothesized structural path model.

Note. IECC = Industry-Education Collaborative Cooperation; SE = Self-Efficacy; PSS = Perceived Social Support; CS = Coping Strategies; PSA = Psychosocial Adaptation; SRA = Social Reintegration Ability. H1 tests the direct path IECC → SRA (competing hypothesis for partial mediation). H2 tests the proximal mediation path PSA → SRA. H3a, H3b, and H3c refer to the serial chain paths IECC → SE → PSA, IECC → PSS → PSA, and IECC → CS → PSA, respectively; their full indirect effects on SRA operate through the complete chain (e.g., IECC → SE → PSA → SRA). Control variables include age, gender, cancer type, time since diagnosis, treatment modality, education level, marital status, and household income. Solid arrows represent hypothesized paths; the dashed arrow represents control paths.

3. Methods

3.1. Study design

A cross-sectional survey design was adopted in this study. Data were collected between March 2024 and November 2024 from cancer survivors recruited across six clinical and community settings in Jilin Province, China. The study protocol was approved by the Medical Ethics Committee of the Affiliated Hospital of Changchun University of Chinese Medicine (approval number: CCUCM-2024-037), and all participants provided written informed consent prior to data collection.

3.2. Participants and recruitment

The inclusion criteria for participants were: (a) having a confirmed diagnosis of cancer, regardless of its type; (b) being at least three months post-primary treatment (surgery, chemotherapy, or radiotherapy); (c) being within the age range of 18–65 years; and (d) being literate enough to complete a self-administered questionnaire. In order to increase the generalizability of findings, all types of cancer were considered, while cancer type was introduced as a control variable into further analysis. Those who were currently receiving palliative treatment; had known cognitive impairment; or had coexisting diagnoses of a severe psychiatric disorder were not eligible to participate.

In order to create adequate variability in the level of IECC exposure, a stratified convenience sampling strategy was adopted. The recruitment sites were selected in terms of cross-institutional service coordination at three tiers, which was established by means of preliminary site visitation and interviews with the heads of departments regarding the frequency of referral, communication, and coordination between organizations. At the first tier, there were two tertiary hospitals having a well-established oncology rehabilitation service providing referral to vocational training agencies or employment services. At the second tier, there were two cancer recovery centers within the community that had peer support programs and some kind of sporadic contacts with local employers or educational organizations. At the third tier, there were two general hospital oncology outpatient clinics providing mostly medical follow-up services with no systematic cross-institutional coordination among participating organizations. The number of recruited patients was approximately the same (about one-third of all subjects) in each group.

Based on the structural equation modeling principles, the necessary sample size was calculated. The proposed model had six latent constructs with around 25–30 manifest variables, resulting in the estimated number of about 50–60 estimated parameters. According to the commonly used rule of 7 to 10 respondents per parameter estimate [22], at least 350 valid responses were needed, while it was also a number higher than the minimum number (200) recommended for moderate SEM studies [23]. Taking into account that only 80% of questionnaires would be considered as valid, the total number of questionnaires to be distributed was 440 in six sites.

3.3. Instruments

Six constructs were measured using validated self-report instruments, summarized in **Table 1**.

Table 1. Study variables and measurement instruments.

Variable	Instrument	Items	Dimensions	Response format
IECC exposure level	IECC-RPQ	15	3 (MEL, EEL, MEmL)	5-point Likert (1–5)
Self-efficacy	GSES	10	1	4-point Likert (1–4)
Perceived social support	MSPSS	12	3	7-point Likert (1–7)
Coping strategies	Brief COPE (active subscales)	14	7	4-point Likert (1–4)
Psychosocial adaptation	PAIS-SR	46	7	4-point Likert (0–3)
Social reintegration ability	RNLI	11	2	Visual analogue (1–10)

Self-efficacy was measured using the Chinese version of the General Self-Efficacy Scale [24]. Perceived social support was measured by the Multidimensional Scale of Perceived Social Support, which is valid with measurement invariance among multicenter cancer patients [25]. Coping strategies were measured using a subset of the Brief COPE [26]. Based on theoretical considerations and prior research suggesting that active coping strategies are more strongly associated with positive psychosocial outcomes in cancer populations than avoidant strategies, seven approach-oriented subscales were selected: active coping, planning, positive reframing, acceptance, emotional support, instrumental support, and humor. For each subscale, there are two items rated on a 4-point Likert scale, making up 14 items in total. It should be noted that avoidant coping subscales (e.g., denial, behavioral disengagement, substance use) were not included in this study; this decision may limit variability in coping scores and is addressed in the Discussion. The Psychosocial Adjustment to Illness Scale-Self Report (PAIS-SR), a 46-item self-report measure assessing psychosocial adaptation across seven dimensions of life, was applied to capture psychosocial adaptation [27]. Each item is rated on a 4-point scale (0–3), with higher total scores indicating poorer adjustment. The Chinese version of the PAIS-SR, translated and validated by Yao (2013) in a sample of Chinese cancer patients, was adopted in this study [28]. Social reintegration ability was measured by the Reintegration to Normal Living Index [29]. Each of the 11 items is rated on a visual analogue scale anchored at 1 (“does not describe my situation”) to 10 (“fully describes my situation”). Item scores were averaged to produce a composite score, with higher values indicating better reintegration. All scales were used in Chinese versions, which have been verified previously.

For this study, we constructed the IECC-RPQ for measuring the level of cancer survivors’ exposure to inter-institutional collaborative service practices during the process of rehabilitation. There are three dimensions included in this scale: Medical-Educational Linkage (e.g., “My medical team recommended/indicated me to a vocational skills training program”), Educational-Employer Linkage (e.g., “A rehabilitation professional discussed my work capacity and job accommodation requirement with my employer”) and Medical-Employer Linkage (e.g., “My medical team and my employer discussed my health conditions and returned-to-work issues”). Each dimension includes five questions answered by participants based on a 5-point Likert scale ranging from “Never happened” to “Continuously happened”. To construct the instrument, we first conducted a literature review, followed by semi-structured expert interviews, two rounds of Delphi consultation and content validity indexing (with I-CVI ≥ 0.80 and S-CVI/Ave ≥ 0.90). Afterward, a pretest of the instrument was conducted among 124 cancer survivors, and the exploratory factor analysis (KMO = 0.87, cumulative variance explained = 67.3%) revealed the three-dimensional structure, with satisfactory internal consistency (α of total scale = 0.91, and α of subscales ranged from 0.79 to 0.85).

3.4. Data collection

The data collection process used both online and offline methods. Online questionnaires were collected using Wenjuanxing, and the subjects would access the survey by clicking the QR code provided during the recruitment process. Paper questionnaires were given out to subjects who opted for offline data entry or those with little access to technology and would be collected personally by research assistants. Two attention checks were included in the questionnaire to ensure data quality. The questionnaire was marked for further checking in cases where the time

taken to answer was below 480 seconds, where answers to more than 15 questions were consistent, and if any of the two attention checks were wrongly answered.

3.5. Statistical analysis

Descriptive statistics were performed for demographic, clinical, and scale variables. The distributions of IECC-RPQ scores were checked for the presence of skewness and kurtosis, where values that were more than 2 and 7 in absolute terms indicated non-normality. Cronbach's alpha and composite reliability were calculated for each scale while average variance extracted (AVE) was utilized to check convergent validity. Finally, confirmatory factor analysis was employed to check the validity of the measurement model for all latent variables, with particular emphasis on IECC-RPQ's three-factor model for the formal sample. Common method bias was controlled through a Harman's single factor test and a confirmatory factor analysis adding the common method factor in the measurement model. This was done in conjunction with procedural controls such as anonymity assurance, reverse item scoring, and temporal separation between predictor and outcome scales in the questionnaires.

Structural equation modeling was done following a two-step process where the measurement model was first validated before running the structural model. In cases where there was substantial non-normality, the Bollen-Stine bootstrap correction was utilized alongside maximum likelihood estimation. The goodness-of-fit of models was based on chi-square to degrees of freedom ratio (< 3), comparative fit index (> 0.90), Tucker-Lewis index (> 0.90), root mean square error of approximation (< 0.08), and standardized root mean square residual (< 0.08). Mediation effects were checked using bootstrapping procedure with bias-corrected confidence interval with 5,000 bootstrap samples, where significance was indicated when 95% confidence interval did not have zero value in it. Multi-group analysis was conducted by gender to establish the stability of paths. This was done by conducting multi-group analysis on the structural model, but with cancer type as a covariate.

4. Results

4.1. Sample characteristics

Among the 440 distributed questionnaires, 406 were retrieved. Among the 406 retrieved, those who did not pass the attention check ($n = 11$), whose response duration was lower than the minimum value ($n = 7$), or whose questionnaire included more than 10% missing data ($n = 5$) were excluded, yielding 383 valid questionnaires (valid rate: 94.3%). Three levels of services coordinators were invited to take part in the research; 131 (34.2%) of them were at tertiary hospitals, 128 (33.4%) at community rehabilitation centers, and 124 (32.4%) at outpatient clinics.

Table 2. Demographic and clinical characteristics of participants ($N = 383$).

Characteristic	Category	n	%
Gender	Male	164	42.8
	Female	219	57.2
Age (years)	18–35	58	15.1
	36–50	174	45.4
	51–65	151	39.4

Continuation Table:

Characteristic	Category	n	%
	Mean $\pm$ SD	46.7 $\pm$ 10.3	
Education level	Junior high school or below	87	22.7
	Senior high school/vocational	138	36.0
	College degree or above	158	41.3
Marital status	Married	298	77.8
	Unmarried/divorced/widowed	85	22.2
Household annual income (CNY)	< 50,000	104	27.2
	50,000–100,000	163	42.6
	> 100,000	116	30.3
Cancer type	Breast	97	25.3
	Lung	72	18.8
	Colorectal	64	16.7
	Gastric	53	13.8
	Thyroid	46	12.0
	Other	51	13.3
Treatment modality	Surgery only	74	19.3
	Surgery + chemotherapy	147	38.4
	Surgery + radiotherapy	63	16.4
	Combined (surgery + chemo + radio)	81	21.1
	Chemotherapy/radiotherapy only	18	4.7
Time since treatment completion	3–12 months	119	31.1
	13–36 months	168	43.9
	> 36 months	96	25.1
Recruitment tier	Tier 1 (tertiary hospitals)	131	34.2
	Tier 2 (community rehab centers)	128	33.4
	Tier 3 (general outpatient clinics)	124	32.4

4.2. Reliability and validity

All measurement scales demonstrated acceptable psychometric properties in the study sample. Cronbach's alpha coefficients, composite reliability values, and AVE for each construct are presented in **Table 3**.

Table 3. Reliability and validity of measurement scales (N = 383).

Construct	Items	Cronbach's α	CR	AVE
IECC (total)	15	0.92	0.93	0.52

Continuation Table:

Construct	Items	Cronbach's α	CR	AVE
MEL	5	0.84	0.85	0.54
EEL	5	0.81	0.82	0.51
MEML	5	0.83	0.84	0.53
SE	10	0.89	0.90	0.50
PSS	12	0.93	0.93	0.58
CS	14	0.85	0.86	0.51
PSA	46	0.94	0.95	0.55
SRA	11	0.90	0.91	0.54

Note. CR = composite reliability; AVE = average variance extracted.

When analyzing models with many items, subscale scores of these scales were taken as observed indicators of their latent constructs in further CFA and SEM. In particular, seven subscale scores of the PAIS-SR were used as indicators of the latent construct of PSA, three dimensions of the IECC-RPQ were used as indicators of IECC, and item parcels were created based on subscales of the active coping strategies from the Brief COPE scale. Other scales included GSES, MSPSS, and RNLI; individual items were used as indicators of their latent constructs.

The confirmatory factor analysis of the six-factor measurement model revealed good fit indices ($\chi^2/\text{df} = 1.86$, CFI = 0.92, TLI = 0.91, RMSEA = 0.047, SRMR = 0.049). It was noted that the three-factor structure of the IECC-RPQ was replicated by EFA in an independent sample ($n = 124$). The factor loading for all observed variables was above 0.50 and statistically significant ($p < 0.001$). The discriminant validity of the proposed model was confirmed using the Fornell-Larcker criterion: the square root of the AVE for each construct was greater than its correlation with all other constructs. The correlation between IECC and PSS ($r = 0.39$) was significantly lower than the square root of AVE for both constructs (0.72 and 0.76, respectively), which proves their discriminant validity. The heterotrait-monotrait ratio (HeteroMT) between IECC and PSS was estimated to be 0.41, lower than 0.85.

Common method bias was examined using both statistical and procedural controls. Harman's single-factor test showed that the first unrotated factor explained 23.6% of total variance, below the 40% threshold. Additionally, a CFA model including an unmeasured latent method factor (ULMC) did not improve model fit ($\Delta\text{CFI} = 0.005$). While these results provide some evidence that common method bias did not substantially distort the findings, it should be noted that Harman's test is generally regarded as a conservative diagnostic, and the ULMC approach has limited power when all constructs are collected from a single respondent at a single time point. Procedural controls — including anonymity assurance, reverse-scored items, and temporal separation between predictor and outcome scales in the questionnaire — were implemented to further mitigate this risk (see Section 3.5). The possibility that common method variance may have influenced the results cannot be fully excluded and is acknowledged as a limitation.

4.3. Descriptives and correlations

Means, standard deviations, and bivariate correlations among all study variables

are presented in **Table 4**. IECC scores ranged from 1.07 to 4.53, with a mean of 2.61 (SD = 0.78), indicating a wide spread of exposure levels across the sample. The skewness (0.34) and kurtosis (−0.41) of IECC scores fell within acceptable limits, supporting the use of maximum likelihood estimation without correction.

Table 4. Descriptive statistics and Pearson correlations among study variables (N = 383).

Variable	M	SD	1	2	3	4	5	6
1. IECC	2.61	0.78	—					
2. SE	2.58	0.54	0.33**	—				
3. PSS	4.72	1.13	0.39**	0.48**	—			
4. CS	2.63	0.47	0.17**	0.35**	0.42**	—		
5. PSA	1.42	0.49	−0.12*	−0.51**	−0.46**	−0.40**	—	
6. SRA	6.83	1.62	0.30**	0.38**	0.41**	0.14*	−0.53**	—

Note. * $p < 0.05$, ** $p < 0.01$. IECC scores on a 1–5 scale; SE scores on a 1–4 scale; PSS scores on a 1–7 scale; CS scores on a 1–4 scale; PSA scores on a 0–3 scale (higher scores indicate poorer adaptation); SRA scores on a 1–10 scale.

All correlations were in the anticipated direction and significant, but the degree of their magnitude differed. The strongest correlation between any two variables was the one between PSA and SRA ($r = -0.53$), reflecting the hypothesis regarding the mediating influence of psychosocial adaptation on the social reintegration process. IECC correlated moderately with self-efficacy ($r = 0.33$) and social support perception ($r = 0.39$); however, its correlation with coping strategies was relatively weak ($r = 0.17$). It should be noted that the bivariate correlation between IECC and PSA was notably low ($r = -0.12$), despite the significant indirect pathways through SE and PSS reported in the structural model (see Section 4.5). This pattern is consistent with a suppression-like configuration: IECC correlated moderately with SE ($r = 0.33$) and PSS ($r = 0.39$), both of which in turn correlated substantially with PSA ($r = -0.51$ and -0.46 , respectively). When the indirect effects through these mediators are aggregated, they yield a meaningful total indirect effect, but the direct IECC-PSA link remains weak. In other words, the low zero-order correlation does not imply the absence of an effect; rather, the influence of IECC on psychosocial adaptation is largely channeled through the antecedent variables, which compress the apparent bivariate association.

4.4. Structural model results

The fit indices for the structural model met satisfactory criteria ($\chi^2/df = 2.03$, CFI = 0.91, TLI = 0.90, RMSEA = 0.052, SRMR = 0.058). The standardized estimates of the path coefficients are shown in **Table 5** and **Figure 2**. The structural model explained 35.2% of the variance in psychosocial adaptation ($R^2 = 0.352$) and 41.7% of the variance in social reintegration ability ($R^2 = 0.417$), indicating that the hypothesized predictors accounted for a substantial proportion of variation in both endogenous constructs.

Table 5. Standardized path coefficients and hypothesis testing results.

Path	β	SE	p	Result
Direct path				

Continuation Table:				
Path	β	SE	p	Result
IECC $\rightarrow$ SRA (H1)	0.08	0.05	0.072	Not supported
Antecedent paths				
IECC $\rightarrow$ SE (H3a)	0.30	0.07	< 0.001	Supported
IECC $\rightarrow$ PSS (H3b)	0.36	0.06	< 0.001	Supported
IECC $\rightarrow$ CS (H3c)	0.09	0.08	0.136	Not supported
Mediating paths				
SE $\rightarrow$ PSA	-0.31	0.05	< 0.001	—
PSS $\rightarrow$ PSA	-0.24	0.06	< 0.001	—
CS $\rightarrow$ PSA	-0.21	0.09	0.008	—
PSA $\rightarrow$ SRA (H2)	-0.43	0.03	< 0.001	Supported

Note. PSA was measured by the PAIS-SR, in which higher scores indicate poorer psychosocial adjustment (i.e., greater maladjustment). Consequently, negative path coefficients involving PSA reflect a beneficial direction. Control variable coefficients are reported in **Table 6**.

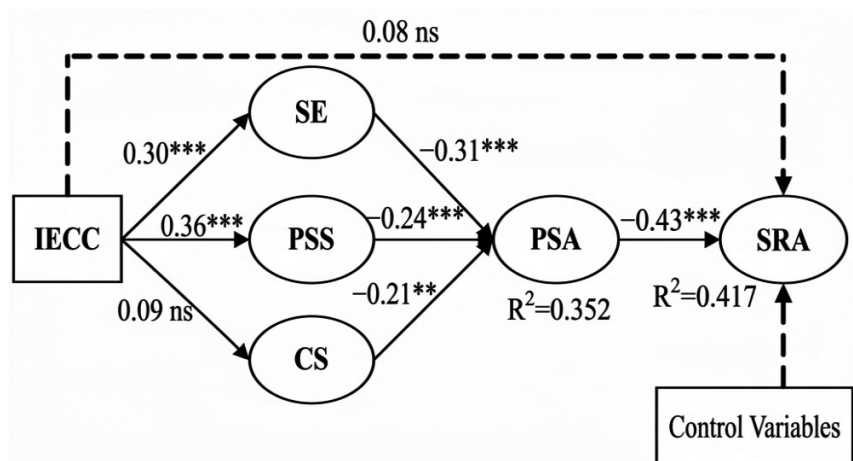


Figure 2. Structural model with standardized path coefficients.

The competing hypothesis 1 (H1), that IECC would retain a significant direct effect on SRA after accounting for indirect pathways, was not supported ($\beta = 0.08$, $p = 0.072$). This result favors a full mediation interpretation, suggesting that the influence of IECC on social reintegration operated entirely through the hypothesized psychosocial pathways. In addition to the hypothesized paths, the effects of eight control variables on PSA and SRA were estimated and are reported in **Table 6**. Most control variables did not reach statistical significance. Two notable exceptions were education level, which was negatively associated with psychosocial maladjustment ($\beta = -0.10$, $p = 0.027$), suggesting that higher education may facilitate better adaptation, and household income, which was positively associated with social reintegration ability ($\beta = 0.09$, $p = 0.041$), indicating that greater financial resources may support the reintegration process. Out of the three paths between the antecedent constructs, only perceived social support and self-efficacy were found to have been positively predicted by IECC (H3a and H3b supported, H3c not supported), implying that collaboration at the organizational level might be more easily transformed into

social support and self-efficacy than into changes in coping strategies. The three psychological variables were positively associated with psychosocial adaptation. The path between PSA and SRA was the most powerful in the structural model, thereby validating the central mediation hypothesis (H2).

Table 6. Effects of control variables on psychosocial adaptation and social reintegration ability.

Control variable	PSA β	SE	p	SRA β	SE	p
Age	0.07	0.04	0.086	-0.05	0.04	0.214
Gender	0.03	0.04	0.438	-0.02	0.04	0.617
Cancer type	0.05	0.05	0.281	-0.04	0.05	0.392
Time since diagnosis	-0.08	0.04	0.058	0.07	0.04	0.091
Treatment modality	0.06	0.05	0.205	-0.07	0.05	0.138
Education level	-0.10	0.04	0.027	0.08	0.04	0.064
Marital status	-0.04	0.04	0.327	0.05	0.04	0.244
Household income	-0.07	0.04	0.096	0.09	0.04	0.041

4.5. Mediation analysis

The significance of indirect effects was examined using bias-corrected bootstrap confidence intervals with 5,000 resamples. Results are presented in **Table 7**.

Table 7. Decomposition of direct, indirect, and total effects (Bootstrap, 95% CI).

Path	Effect	β	95% CI	Significant
Direct effect				
IECC $\rightarrow$ SRA	Direct	0.08	[-0.007, 0.163]	No
Indirect effect				
IECC $\rightarrow$ SE $\rightarrow$ PSA $\rightarrow$ SRA	Chain	0.040	[0.019, 0.074]	Yes
IECC $\rightarrow$ PSS $\rightarrow$ PSA $\rightarrow$ SRA	Chain	0.037	[0.016, 0.068]	Yes
IECC $\rightarrow$ CS $\rightarrow$ PSA $\rightarrow$ SRA	Chain	0.008	[-0.004, 0.031]	No
IECC $\rightarrow$ PSA $\rightarrow$ SRA (total indirect)	Sum	0.085	[0.048, 0.139]	Yes
Total effect				
IECC $\rightarrow$ SRA	Total	0.165	[0.094, 0.247]	Yes

Note. Confidence intervals that do not contain zero indicate significant mediation.

The overall indirect effect of IECC on SRA was significant ($\beta = 0.085$; 95% CI = [0.048, 0.139]) but the direct effect was not significant, thereby implying that IECC had an effect on social reintegration indirectly via the hypothesized psychological mechanisms. This means that around 51.5% of the overall effect is due to the indirect effect which involves psychosocial adaptation and the antecedents thereof.

Two of the three serial indirect paths were significant. The IECC $\rightarrow$ SE $\rightarrow$ PSA $\rightarrow$ SRA chain ($\beta = 0.040$, 95% CI [0.019, 0.074]) and the IECC $\rightarrow$ PSS $\rightarrow$ PSA

→ SRA chain ($\beta = 0.037$, 95% CI [0.016, 0.068]) were of comparable magnitude, suggesting that self-efficacy and perceived social support operated as parallel distal mediators within the serial mediation framework. However, the coping strategies chain was not significant ($\beta = 0.008$) which is in agreement with the non-significant IECC → CS path in **Table 5**.

The results suggest that cross-institutional collaborative cooperation is associated with social reintegration via two parallel serial mediation channels, namely self-efficacy and perceived social support, both of which influence psychosocial adaptation as the proximal mediator, which in turn is linked to reintegration outcomes.

4.6. Measurement invariance and multi-group analysis by gender

Gender-based measurement invariance was verified using a series of nested models; fit measures are provided in Panel A of **Table 8**. All three stages — configural, metric, and scalar — proved to be acceptable according to the standards set by Chen (2007), though scalar invariance was achieved with a slight reduction in CFI ($\Delta\text{CFI} = 0.007$). This permitted comparison of paths between groups.

Table 8. Measurement invariance and multi-group path comparison by gender (male $n = 164$, female $n = 219$).

Model	χ^2/df	CFI	RMSEA	SRMR	ΔCFI	ΔRMSEA	Decision
M1. Configural	1.89	0.916	0.048	0.054	—	—	Baseline
M2. Metric	1.93	0.913	0.049	0.056	0.003	0.001	Supported
M3. Scalar	2.04	0.906	0.053	0.061	0.007	0.004	Supported

Panel B presents four critical paths calculated for male and female victims separately. Equality constraints were met by three paths, while the other one (PSA → SRA) was significant only in females, demonstrating a significant but close-to-insignificant change in χ^2 ($\Delta\chi^2 = 3.21$, $p = 0.073$). Using $p = 0.05$ as the strict test standard, the path was declared equivalent; nonetheless, there is a suggestion that psychosocial adaptation might have an even stronger impact on social reintegration among females, which should be studied in further research with relatively equal gender representation.

Panel B. Multi-group comparison of core structural paths.

Path	β (Male)	β (Female)	$\Delta\beta$	$\Delta\chi^2$ ($\Delta\text{df} = 1$)	p	Invariant
IECC → SRA (H1)	0.11	0.06	0.05	1.78	0.182	Yes
IECC → SE (H3a)	0.27	0.32	0.05	0.94	0.332	Yes
IECC → PSS (H3b)	0.41	0.33	0.08	2.43	0.119	Yes
PSA → SRA (H2)	−0.38	−0.47	0.09	3.21	0.073	Marginal

In conclusion, multi-group analysis confirms the validity of the structural paths postulated in the hypothesized model, apart from a marginally insignificant one. Additionally, multi-group analysis across the three recruitment tiers (which served as the basis for IECC exposure stratification) would provide a more direct test of the model's substantive assumptions. However, with approximately 124–131 participants per tier, the subgroup sample sizes fall below the recommended minimum for stable multi-group SEM estimation given the number of parameters in the current model.

This analysis is therefore deferred to future research with larger tier-specific samples and is acknowledged as a limitation in Section 5.

5. Discussion

In the current study, an indirect effect of IECC on the reintegration of cancer survivors was investigated using the structural path model framework. IECC exposure did not have a statistically significant direct effect on social reintegration outcomes. The association between the variables occurred via psychosocial pathways. Two parallel channels of self-efficacy and perceived social support acted as precursors of comparable magnitude to psychosocial adaptation, which in turn was associated with reintegration. The indirect effects through these two channels were numerically similar ($\beta = 0.040$ vs. 0.037); however, a formal contrast test was not conducted, and the near equivalence should therefore be interpreted as a descriptive observation rather than a statistically confirmed finding. In turn, coping strategies did not mediate the association. The proportion mediated stood at 51.5% of the total effect, and multi-group analysis revealed the structural stability of the model among gender groups.

The lack of a direct effect on social reintegration suggests that collaboration alone does not guarantee functional recovery. Services need to pass psychological processing for them to bear behavioral consequences. This mechanism resembles findings from a previous study on the Beyond Cancer rehabilitation program in Australia, where the effectiveness of the program depended on participant involvement rather than mere participation in it [9]. A similar dynamic was demonstrated by UNAMANO, the social-healthcare coordination program in Italy [10]. Thus, the current study complements existing literature with specification of psychological factors through which coordinated service delivery is associated with reintegration of cancer survivors.

Psychosocial adaptation played the crucial mediating role by accounting for 35.2% of its variance and carrying the strongest standardized path effect on reintegration. Adaptation, thus, serves as the intermediary channel through which external service delivery translates into functional recovery. According to recent meta-analysis on the impact of cancer treatments on breast cancer survivorships, adaptation-related mechanisms have been recognized as a key element in shaping psychological recovery after treatment [30]. Moreover, intervention programs aimed at reducing illness-related distress showed their influence on survivor functioning [31]. Hence, monitoring survivors' adaptation status in rehabilitation programs seems to be warranted.

The near-perfect equivalence of the two antecedent channels highlights the dual role played by IECC in activating multiple psychosocial factors. Vocational coordination creates learning opportunities aligned with the self-efficacy development model described by Bandura [32]. Additionally, coordination expands survivors' perceived social support network outside the family realm [33]. Empirical evidence shows that self-efficacy plays an essential role in maintaining return-to-work behavior in colorectal cancer survivors among the working population [34]. The non-significant IECC $\rightarrow$ CS path warrants careful interpretation. Several factors may account for this null finding. First, only the approach-oriented subscales of the Brief COPE were included in this study (see Section 3.3), which may have constrained the variability in coping scores. Indeed, the descriptive statistics ($M = 2.63$, $SD = 0.47$, on a 1–4 scale) suggest relatively limited dispersion, raising the possibility of a ceiling effect in which most survivors already reported moderately active coping. Second, the zero-

order correlation between IECC and CS was notably low ($r = 0.17$), suggesting that institutional coordination may not readily translate into changes in coping behavior, which is typically conceptualized as a more internally regulated psychological process shaped by personality and prior experience rather than by environmental input. Third, the exclusion of avoidant coping subscales means that a potentially important dimension of coping variability was not captured; it is plausible that IECC could reduce avoidant coping even if it does not increase active coping. Future research should incorporate both approach and avoidant coping as separate constructs to disentangle these possibilities. Designing targeted coping-skills intervention programs alongside coordination services may therefore be necessary if institutional collaboration is to influence the full range of coping responses.

These results provide implications for the design of cancer rehabilitation programs. Coordination between hospitals and vocational training institutions and employers needs to involve formal referral mechanisms rather than informal communication, considering the magnitude of the effect dependent on such coordinated efforts. The curriculum developed by the vocational centers should correspond to survivor capability levels, as their work ability perception is weak even during the second year post-treatment [35]. Employers are more effective when participating in the structured return-to-work process rather than passively accepting the employee's return, which is in line with stakeholder-based rehabilitation [15].

Several caveats should be considered. The cross-sectional design precludes causal or temporal inferences; mediation estimates derived from cross-sectional data may be biased [36,37], reverse causation cannot be ruled out, and longitudinal replication is strongly recommended. The IECC-RPQ captures survivors' perceived experience of cross-institutional coordination rather than objective institutional behavior, and future studies should triangulate self-report data with institutional-level indicators such as referral records or formal collaboration agreements. Although Harman's test and the ULMC approach did not indicate severe common method bias, these diagnostics have limited power when all constructs come from a single respondent at one time point, and a marker-variable approach or multi-source design would provide stronger safeguards. Multi-group analysis across the three recruitment tiers could not be conducted due to insufficient subgroup sample sizes and should be pursued in future research. Occupation type (e.g., manual labor vs. office work) was not collected, yet the physical demands of employment may moderate reintegration outcomes and should be incorporated in subsequent studies. Finally, the IECC construct was assessed within the Chinese healthcare system and may not generalize to other institutional contexts; further validation of the IECC-RPQ in diverse settings and triangulation with behavioral indicators such as return-to-work records would strengthen the evidence base.

6. Conclusion

A structural path model was developed to examine the associative relationship between IECC and social reintegration capability of cancer survivors, with psychosocial adaptation serving as the proximal mediator and self-efficacy, perceived social support, and coping strategy operating as antecedent mediators within a serial mediation framework. The empirical analysis of 383 valid responses revealed that IECC did not retain a significant direct effect on reintegration; rather, its influence operated entirely through the hypothesized psychosocial pathways, with indirect effects accounting for 51.5% of the total effect. Self-efficacy and perceived social

support showed indirect effects of comparable magnitude, while coping strategy did not function as a significant transmission channel.

These findings provide initial evidence that perceived cross-institutional collaboration is associated with functional recovery through psychosocial processes. The study identified two parallel serial mediation channels linking IECC to reintegration and offers mechanism-level evidence for a form of cross-sector collaboration that has seldom been studied in the cancer survivorship context. Furthermore, the study empirically distinguished IECC from perceived social support, both conceptually and statistically, supporting their treatment as separate constructs in future survivorship research.

In terms of practical value, medical institutions, vocational training organizations, and employers should establish sustained coordination mechanisms and ensure that service delivery processes support the development of survivors' self-efficacy and perceived social support. Future research is encouraged to extend these findings through mixed-methods or longitudinal designs combined with behavioral indicators of reintegration.

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Informed consent statement: Written informed consent was obtained from all participants prior to their participation in the study.

Data availability statement: The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request. The data are not publicly available because they contain information that could compromise the privacy of research participants.

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