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The impact of digital tourism marketing on psychological recovery of cancer survivors: An empirical study from the perspective of sports tourism

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Abstract: Background: Cancer survivors' psychological recovery requires not only medical treatment but also psychological support and lifestyle interventions. Wellness tourism, particularly sports tourism, can improve psychological states while promoting physical health. However, mechanisms through which digital tourism marketing influences psychological recovery remain inadequately studied. **Objective:** To explore how digital tourism marketing affects cancer survivors' wellness tourism motivation and analyze the mediating role of sports tourism participation in psychological recovery (psychological well-being and resilience). **Methods:** Questionnaire data were collected from 386 cancer patients in recovery at a tertiary hospital. Structural Equation Modeling tested direct effects of digital tourism marketing on wellness tourism motivation and mediating effects of sports tourism participation. Bootstrap method was used for mediation testing, and multi-group analysis compared differences across recovery stages. **Results:** Digital tourism marketing significantly enhanced wellness tourism motivation ($\beta = 0.52, p < 0.001$). Sports tourism participation positively affected psychological well-being ($\beta = 0.42, p < 0.001$) and psychological resilience ($\beta = 0.38, p < 0.001$), partially mediating the relationship between wellness tourism motivation and psychological recovery. Multi-group analysis revealed stronger path coefficients for early-stage survivors (<6 months) compared to late-stage survivors (>12 months). **Conclusion:** Digital tourism marketing improves cancer survivors' psychological well-being and resilience by stimulating wellness tourism motivation and promoting sports tourism participation. This study provides theoretical foundations and practical guidance for wellness tourism product design, psychological interventions, and digital marketing strategy development for cancer survivors.

Keywords: digital tourism marketing; cancer survivors; wellness tourism motivation; sports tourism participation; psychological well-being; psychological resilience

1. Introduction

The global population of cancer survivors is experiencing unprecedented growth, with numbers in the United States projected to exceed 22 million by 2035 [1]. However, approximately 38.9% of cancer patients face significant psychological health challenges during recovery [2]. Tourism experiences possess unique therapeutic value for cancer survivors, providing improved psychological states, enhanced social connections, and elevated quality of life [3,4]. For patients facing terminal diagnoses, tourism becomes an important means to redefine life's meaning and fulfill unfinished wishes [5]. Natural environments play a crucial role in cancer survivors' psychological recovery through outdoor activities and wilderness experiences [6]. However, systematically integrating these experiences into tourism products through modern digital marketing remains an urgent issue.

Digital transformation has created new possibilities for cancer survivors'

tourism participation through artificial intelligence and personalized recommendation technologies. However, research on promoting cancer survivors' wellness tourism participation through digital marketing remains scarce. Sports tourism demonstrates unique value in promoting psychological health by providing participants with achievement experiences, control, and social support. For cancer survivors, it represents an opportunity to reconnect with their bodies and prove their survival value. Existing research lacks integrative frameworks explaining the connections between digital marketing, wellness tourism motivation, and psychological recovery, while failing to examine complex mediating mechanisms or provide practical guidance for cancer survivor groups.

This study addresses these gaps by constructing and testing a theoretical model of how digital tourism marketing influences cancer survivors' psychological recovery through sports tourism participation. The research innovations include integrating digital marketing with cancer survivors' special needs and providing empirical evidence for targeted tourism strategies. This study provides theoretical contributions to understanding technology-tourism-health relationships while offering practical guidance for wellness tourism industry development and cancer survivor care.

2. Literature review and hypotheses

2.1. Theoretical foundation

2.1.1. Psychological recovery needs of cancer survivors

Self-determination theory provides an important framework for understanding the psychological recovery needs of cancer survivors. This theory posits that individuals' psychological health and well-being depend on the satisfaction of three basic psychological needs: autonomy, competence, and relatedness [7]. For cancer survivors, the disease experience often leads to deficiencies in these basic needs, making it particularly important to seek activities that can restore a sense of autonomous control, rebuild competence beliefs, and strengthen social connections.

Tourism, as a comprehensive health promotion method, demonstrates unique advantages in meeting cancer survivors' psychological needs. Research indicates a close relationship between tourism and psychological health, as tourism can effectively promote psychological recovery by providing opportunities to escape daily environments, experience novelty, and establish social connections [8]. Tourists' psychological health status not only influences their destination choices and tourism decisions but also determines the quality and effectiveness of their tourism experiences [9].

Cancer survivors seek life meaning reconstruction through tourism. Research has found that cancer patients assign special symbolic meanings to landscapes during tourism, constructing new senses of life meaning through these symbols [10]. This meaning construction process plays an important role in coping with existential anxiety, rebuilding self-identity, and achieving post-traumatic growth. Tourism is not merely a leisure activity but an important pathway for cancer survivors to achieve psychological transformation and spiritual elevation.

2.1.2. Digital tourism marketing and wellness tourism motivation

Personalized recommendation technology is revolutionizing the methods and effects of tourism marketing. Recommendation systems based on user behavior data and preference analysis can significantly enhance users' trust and willingness to use [11]. This personalized information push not only reduces information search costs but, more importantly, enhances users' perceived value and participation motivation. In the e-tourism environment, personalized recommendations, visual presentation, and information quality have become key factors influencing user experience.

The health benefits of wellness tourism have been widely recognized. Systematic literature reviews show that wellness tourism produces positive effects across multiple dimensions including physical health, psychological well-being, social connections, and spiritual growth [12]. These multidimensional health benefits provide comprehensive recovery support for cancer survivors, meeting their complex health needs. Digital marketing can effectively stimulate survivors' wellness tourism motivation by precisely conveying these health value messages.

The application of artificial intelligence technology further enhances tourism marketing effectiveness. Through affective computing, natural language processing, and intelligent interaction, AI systems can understand users' emotional needs and provide emotionalized service experiences [13]. This transition from satisfied tourists to sustained service use reflects the value of technological innovation in enhancing user loyalty. For the special group of cancer survivors, emotionalized digital marketing can establish deeper emotional connections.

Consumer experiences with smart technologies are reshaping the tourism industry. Developed measurement tools show that technology experiences include multiple dimensions such as sensory, cognitive, practical, emotional, and relational [14]. These dimensions collectively constitute users' overall perception of technology services, influencing their subsequent usage behavior. In research on customer experience with AI-enabled products, data capture, classification, delegation, social, and interaction experiences have been identified as key elements [15].

2.1.3. Sports tourism and psychological health

Sports tourism experience scenarios have significant impacts on tourists' psychological recovery. Research shows that positive sports tourism experience perception promotes tourists' psychological recovery by inducing flow experiences [16]. This mechanism involves multiple aspects including stress reduction, fatigue relief, attention restoration, and mood improvement. The challenging activities and achievement experiences provided by sports tourism play important roles in rebuilding confidence and enhancing psychological resilience. These findings provide important directions for future development of tourism and psychological health research [17].

Complex interactions exist between wellness tourism motivation, participation, satisfaction, and destination loyalty [18]. Deep understanding of the relationships between these elements helps design more effective wellness tourism products and marketing strategies. For cancer survivors, strong wellness motivation is an important prerequisite for driving actual sports tourism participation, while positive

participation experiences strengthen their willingness for continued participation.

Artificial intelligence is becoming a catalyst for driving sustainable tourism growth [19]. By optimizing resource allocation, improving service efficiency, and enhancing user experience, AI technology not only promotes the economic benefits of the tourism industry but also enhances its social and environmental sustainability. This sustainable development concept highly aligns with the health promotion goals of wellness tourism, providing cancer survivors with more responsible and meaningful tourism choices.

The relationship between leisure activities and psychological health is moderated by psychological resilience. Research has found that participation in diverse leisure activities can enhance individuals' psychological resilience, thereby improving their psychological health status [20]. This relationship was particularly evident during the COVID-19 pandemic, when sports and outdoor activities became important means of maintaining psychological health. For cancer survivors, sports tourism provides opportunities to gradually restore physical function and psychological state in safe environments.

Digital technology's impact on tourism marketing is multilevel. Research has identified ten key trends, including data and content as competitiveness catalysts, augmented workers, and massive personalization and customization [21]. These trends not only change marketing methods but also reshape organizational capabilities and business models. The application of generative AI has brought revolutionary changes, significantly improving tourism industry operational efficiency by providing hyper-personalized recommendations and efficient services [22].

The future agenda of smart tourism destinations emphasizes AI's core role in new tourism marketing [23]. By integrating technologies such as IoT, big data, and cloud computing, smart destinations can provide seamless tourist experiences and precise marketing services. This technology-driven transformation provides more inclusive and personalized tourism services for special groups such as cancer survivors.

2.2. Research hypotheses

A meta-analysis of health interventions based on self-determination theory shows that interventions supporting basic psychological needs can significantly enhance motivation levels, promote health behaviors, and improve physical and mental health status [24]. Digital tourism marketing effectively satisfies survivors' basic psychological needs by providing personalized information, enhancing decision-making autonomy, and establishing community connections, thereby stimulating their wellness tourism motivation. Therefore, we propose:

H1: Digital tourism marketing positively influences cancer survivors' wellness tourism motivation.

Tourism activity characteristics influence tourists' experience-sharing behavior, with tourists' well-being and social context playing important roles [25]. When survivors develop strong wellness tourism motivation, they are more inclined to choose sports tourism activities that bring positive experiences and social support.

High motivation levels help overcome participation barriers and promote actual sports tourism participation behavior. Therefore, we propose:

H2: Wellness tourism motivation positively influences sports tourism participation.

Research on the psychological health rescue effect of women's outdoor tourism shows that outdoor activities can produce unique effects such as psychological rescue, recognizing missing parts of life, and influencing family members [26]. Sports tourism can significantly enhance participants' psychological well-being by providing challenging experiences and a sense of achievement. The development and application research of the Connor-Davidson Resilience Scale confirms that individuals' psychological resilience is enhanced through the process of facing challenges and overcoming difficulties [27]. Therefore, we propose:

H3a: Sports tourism participation positively influences psychological well-being. H3b: Sports tourism participation positively influences psychological resilience.

Research shows that multiple facilitators, barriers, and strategies exist in the process of building cancer survivors' psychological resilience [28]. Sports tourism participation, as a comprehensive strategy, can simultaneously provide physical challenges, emotional support, and social connections, thereby playing a mediating role between wellness tourism motivation and psychological recovery. Research on the healing effects of tourism on breast cancer patients' psychological health found that tourism experiences play key roles in alleviating death anxiety, reducing psychological stress, and promoting systematic recovery [29]. Cancer survivors' positive psychological health involves overlapping constructs including psychological well-being, personal meaning, and post-traumatic growth [30]. Therefore, we propose:

H4a: Sports tourism participation mediates the relationship between wellness tourism motivation and psychological well-being. H4b: Sports tourism participation mediates the relationship between wellness tourism motivation and psychological resilience.

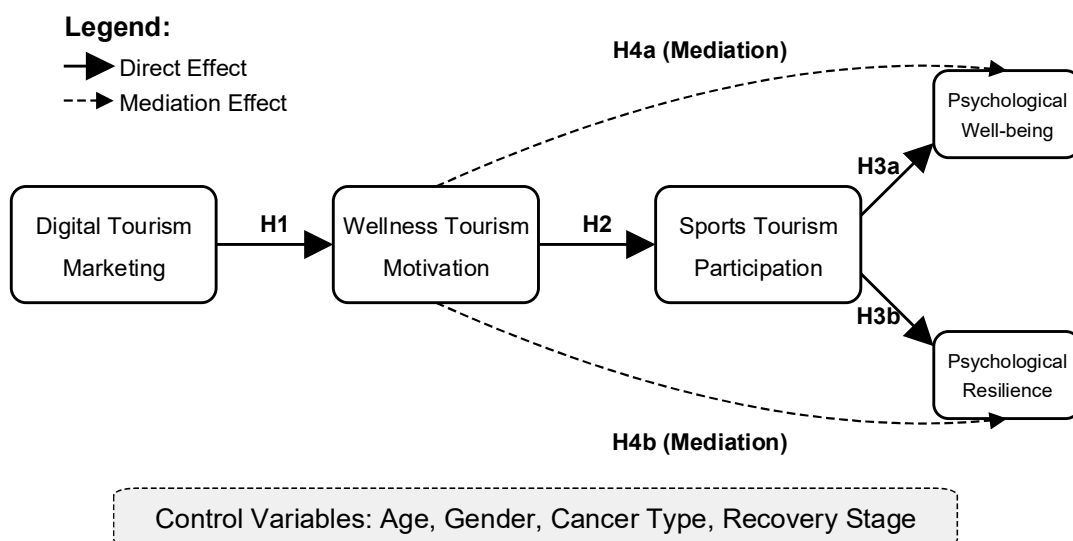


Figure 1. Conceptual framework and research hypotheses.

3. Research methods

3.1. Data collection and sample

This study employed a cross-sectional survey design with data collected through questionnaire surveys. The research strictly adhered to ethical standards and obtained approval from the hospital ethics committee. All participants signed informed consent forms, ensuring their understanding of the research purpose, procedures, and rights protection measures. Data were coded to ensure participant privacy and data security.

The study subjects were cancer patients in the recovery phase from the oncology department of a tertiary hospital in eastern China. Sample inclusion criteria included: (1) age 18 years and above; (2) pathologically diagnosed with malignant tumor and completed primary treatment (surgery, chemotherapy, or radiotherapy); (3) in recovery phase (within 6 months after treatment completion as early recovery, 6-12 months as mid-recovery, over 12 months as late recovery); (4) possessing basic cognitive and communication abilities; (5) voluntary participation in the study. Exclusion criteria included: (1) history of severe mental illness; (2) severe cognitive impairment; (3) disease progression or terminal stage.

Data collection was conducted from March to August 2024. The research team first established a collaborative relationship with the hospital oncology department and used convenience sampling to invite eligible survivors to participate during their follow-up visits. The questionnaire survey was conducted in quiet consultation rooms, with trained research assistants helping patients complete the questionnaires. For patients who had difficulty filling out the questionnaires independently due to physical reasons, research assistants read each question aloud and recorded their responses.

Based on sample size calculation principles for structural equation modeling, considering model complexity and statistical power requirements, the target sample size was set at 400 [31]. Ultimately, 420 questionnaires were distributed, with 386 valid questionnaires collected, yielding an effective response rate of 91.9%. Sample characteristics showed: females accounted for 58.3%, average age was 52.4 years ($SD = 11.2$); breast cancer patients comprised 31.6%, lung cancer 24.4%, digestive system tumors 28.0%, and other types 16.0%; early recovery patients accounted for 35.8%, mid-recovery 32.9%, and late recovery 31.3%. This sample distribution was basically consistent with domestic cancer epidemiological characteristics [32], demonstrating good representativeness. The single tertiary hospital recruitment may limit geographical generalizability, though the hospital serves patients across multiple eastern provinces. The intentionally balanced recovery stage distribution enables meaningful multi-group comparisons, while findings are most applicable to urban populations with established follow-up care access.

3.2. Variable measurement

This study adopted established scales to measure each major variable, with appropriate adjustments made according to the research context. All scales employed a 7-point Likert scale (1 = strongly disagree, 7 = strongly agree). The selection of

measurement instruments was based on their applicability in cancer patient populations and psychometric properties [33]. The Digital Tourism Marketing scale was adapted by integrating theoretically relevant dimensions from established instruments measuring personalized recommendation systems [11], AI-enabled services [13], and smart technology experiences [14]. The three dimensions (personalization, information quality, interactivity) were selected based on Self-Determination Theory principles, as they address cancer survivors' needs for autonomy (personalized control), competence (quality information for decision-making), and relatedness (interactive communication). Items were adapted to reflect health tourism contexts and cancer survivor perspectives, with language modifications to ensure appropriateness for this population. Specific measurement instruments are shown in **Table 1**.

Table 1. Measurement instruments and psychometric properties.

Variable	Measurement Tool	Dimensions	Items	Source	Cronbach's α
Digital Tourism Marketing	Adapted Scale	Personalization (3), Information Quality (3), Interactivity (3)	9	Adapted from [11,13,14]	0.892
Wellness Tourism Motivation	Tourism Motivation Scale	Health Recovery (4), Relaxation (3), Social Connection (3)	10	Adapted from [12,18]	0.876
Sports Tourism Participation	Participation Scale	Frequency (2), Intensity (2), Duration (2)	6	Adapted from [16,20]	0.834
Psychological Well-being	PWB-18	Autonomy (3), Environmental Mastery (3), Personal Growth (3), Positive Relations (3), Purpose in Life (3), Self-acceptance (3)	18	[34]	0.913
Psychological Resilience	CD-RISC-10	Single Factor	10	[35]	0.887
Control Variables	Demographic Items	Age, Gender, Cancer Type, Recovery Stage	4	-	-

Digital tourism marketing was developed based on existing literature, encompassing three dimensions: personalization level, information quality, and interactivity. Personalization level measures the customized recommendations and personalized service levels provided by digital platforms; information quality assesses the accuracy, relevance, and timeliness of health tourism information; interactivity reflects the two-way communication and feedback mechanisms between users and digital platforms.

Wellness tourism motivation adopted an adapted scale covering three aspects: health recovery, relaxation and leisure, and social connections. This scale fully considers the special needs of cancer survivors, including motivational elements such as physical recovery, psychological adjustment, and social support.

Sports tourism participation was measured through three indicators: frequency, intensity, and duration. To ensure consistent understanding, participants were informed that "sports tourism" included any physical activities during travel experiences adapted to individual capabilities, ranging from low-impact activities (walking, swimming) to moderate activities (cycling, recreational sports), without requiring professional skills or high-intensity exercise. This multi-dimensional approach comprehensively reflects survivors' voluntary physical engagement during

tourism experiences. Frequency refers to the number of participations per month, intensity refers to the degree of physical exertion in activities, and duration refers to the length of each activity session.

Psychological well-being adopted the 18-item brief version of Ryff's Psychological Well-being Scale [34]. This scale comprehensively evaluates individuals' psychological well-being from six dimensions, including autonomy, environmental mastery, personal growth, positive relations, life purpose, and self-acceptance. This multidimensional measurement method transcends traditional hedonistic views of well-being and is more suitable for evaluating cancer survivors' overall psychological state [36].

Psychological resilience used the 10-item version of the Connor-Davidson Resilience Scale (CD-RISC-10) [35]. This brief version retains the core content of the original scale, possesses good psychometric properties, and has been widely applied in cancer patient populations [37]. The scale measures individuals' adaptive capacity and recovery ability when facing adversity.

Control variables included age, gender, cancer type, and recovery stage. These variables were determined based on cancer epidemiology research [38] and previous literature, as they may influence survivors' tourism participation and psychological recovery processes.

While established scales were adapted for this study's cancer survivor context, formal re-validation procedures such as expert panels or extensive pilot testing were not conducted due to resource constraints. The adapted scales demonstrated good reliability in this sample (Cronbach's α ranging from 0.834 to 0.913), but future research would benefit from more comprehensive validation procedures specifically designed for cancer survivor populations. The self-report nature of all measures may be subject to social desirability bias or recall limitations, particularly for tourism participation behaviors. Additionally, the cross-sectional design limits causal inference capabilities, as discussed further in the limitations section.

3.3. Analysis methods

Data analysis was conducted using SPSS 26.0 and AMOS 24.0 software, following systematic statistical analysis procedures. The analysis process included six main stages: data preparation, descriptive analysis, reliability and validity testing, structural equation model analysis, mediation effect testing, and robustness testing.

The data preparation stage involved data cleaning and preprocessing. Missing values were handled using the Expectation-Maximization (EM) algorithm, with variables having less than 5% missing data retained. Multivariate outliers were identified and removed using Mahalanobis distance. Descriptive statistical analysis calculated means, standard deviations, skewness, and kurtosis for each variable, assessing data normality distribution characteristics. Demographic characteristic analysis employed frequency analysis and chi-square tests to ensure sample representativeness.

Reliability analysis was evaluated using Cronbach's α coefficient and Composite Reliability (CR), with α and CR values greater than 0.7 indicating good reliability [39]. Validity testing included content validity, convergent validity, and

discriminant validity. Content validity was ensured through expert review and pilot testing; convergent validity was assessed through Average Variance Extracted (AVE), with AVE greater than 0.5 indicating good convergent validity; discriminant validity was determined by comparing the square root of AVE with inter-variable correlation coefficients. Confirmatory Factor Analysis (CFA) tested measurement model fit, with evaluation indicators including chi-square to degrees of freedom ratio ($\chi^2/\text{df} < 3$), Comparative Fit Index (CFI > 0.90), Tucker-Lewis Index (TLI > 0.90), Root Mean Square Error of Approximation (RMSEA < 0.08), and Standardized Root Mean Square Residual (SRMR < 0.08) [31]. The measurement model demonstrated satisfactory psychometric properties in this cancer survivor population. As reported in the Results section, all scales achieved adequate reliability (Cronbach's α ranging from 0.834 to 0.913), and the confirmatory factor analysis supported the hypothesized factor structures with good model fit indices ($\chi^2/\text{df} = 2.28$, CFI = 0.943, TLI = 0.931, RMSEA = 0.058).

Correlation analysis employed Pearson correlation coefficients to test the degree of association between variables, with multicollinearity checked through Variance Inflation Factors (VIF). VIF values less than 3 indicated no serious multicollinearity.

Structural equation modeling was used to test research hypotheses. Maximum likelihood estimation was employed to estimate model parameters, with standardized path coefficients and significance levels evaluating hypothesized relationships. Model construction followed theory-driven principles, ensuring theoretical significance and practical value [39]. Path analysis examined not only direct effects but also calculated total effects, comprehensively evaluating relationships between variables. Model modifications were based on modification indices and theoretical reasonableness, avoiding overfitting.

Mediation effect testing constituted the core analytical content of this study. The Bootstrap method was employed for mediation analysis, with 5,000 resampling iterations and 95% confidence intervals calculated [40]. If confidence intervals excluded zero, mediation effects were significant. This method does not rely on normal distribution assumptions of mediation effects, possessing higher statistical power. Total effects were decomposed into direct and indirect effects, with mediation type determined by comparing their relative magnitudes. Complete mediation occurred when indirect effects were significant but direct effects were not; partial mediation occurred when both were significant.

Robustness testing employed multiple methods to ensure research conclusion reliability. Multi-group analysis divided groups by recovery stage (early vs. late), testing model path stability across different groups [41]. By constraining path coefficients to be equal and comparing model fit changes, between-group differences were identified. Significant chi-square difference tests indicated moderation effects. Alternative model comparisons constructed competing models, including changing mediation paths, adding direct paths, or adjusting variable relationships, with optimal models selected based on AIC and BIC information criteria [42]. Model comparisons followed nested model comparison principles, ensuring comparison validity.

Common method bias control employed combined procedural and statistical control strategies. Procedural controls included anonymous responses, reverse-

scored items, randomized questionnaire item order, and data collection from different sources; statistical control employed Harman's single-factor test, incorporating all measurement items into exploratory factor analysis. Results showed the first factor explained 31.2% of variance, below the 40% critical value, indicating common method bias was not serious. Additionally, the control for unmeasured marker variable method was used for further validation, with results supporting measurement validity.

The multi-group analysis findings warrant cautious interpretation. While the observed patterns are theoretically consistent, the mixed statistical significance levels suggest that recovery stage effects may be more pronounced for motivational and behavioral pathways than for final psychological outcomes. The marginally significant results indicate meaningful trends but require replication with larger sample sizes to establish robust statistical support.

The data analysis process strictly adhered to academic standards, with all statistical tests using two-tailed tests and significance levels set at 0.05. Marginally significant results ($0.05 < p < 0.10$) were interpreted cautiously. Effect sizes were reported using standardized coefficients for cross-study comparability. All analytical results retained three decimal places, ensuring precision and reproducibility.

4. Results

4.1. Descriptive statistics and reliability & validity

Demographic characteristics of the research sample and descriptive statistics of main variables are shown in **Table 2**. Among the 386 cancer survivors, females accounted for 58.3%, slightly higher than males. Age distribution was relatively uniform, primarily in the 45–54 years (31.3%) and 55–64 years (28.5%) age groups, with an average age of 52.4 years. Regarding cancer types, breast cancer (31.6%), digestive system tumors (28.0%), and lung cancer (24.4%) comprised the main proportions. Recovery stage distribution was relatively balanced, with early recovery patients accounting for 35.8%, mid-recovery 32.9%, and late recovery 31.3%.

Table 2. Demographic characteristics and descriptive statistics ($N = 386$).

Variables	Categories	<i>n</i> (%)	Mean	SD	Skewness	Kurtosis
Demographics						
Gender	Male	161 (41.7%)	-	-	-	-
	Female	225 (58.3%)	-	-	-	-
Age	18–34	43 (11.1%)	52.4	11.2	0.23	−0.41
	35–44	67 (17.4%)	-	-	-	-
	45–54	121 (31.3%)	-	-	-	-
	55–64	110 (28.5%)	-	-	-	-
	≥65	45 (11.7%)	-	-	-	-
Cancer Type	Breast	122 (31.6%)	-	-	-	-
	Lung	94 (24.4%)	-	-	-	-
	Digestive	108 (28.0%)	-	-	-	-

Table 2. (Continued).

Variables	Categories	n (%)	Mean	SD	Skewness	Kurtosis
Recovery Stage	Others	62 (16.0%)	-	-	-	-
	Early (<6m)	138 (35.8%)	-	-	-	-
	Middle (6–12m)	127 (32.9%)	-	-	-	-
	Late (>12m)	121 (31.3%)	-	-	-	-
Main Variables						
Digital Tourism Marketing	-	-	4.83	1.12	−0.32	0.18
Wellness Tourism Motivation	-	-	5.21	0.98	−0.45	0.27
Sports Tourism Participation	-	-	4.56	1.23	−0.21	−0.15
Psychological Well-being	-	-	4.92	1.05	−0.38	0.22
Psychological Resilience	-	-	4.78	1.18	−0.29	0.09

The means of main variables ranged from 4.56 to 5.21, indicating that survivors had relatively high perceptions of digital tourism marketing, strong wellness tourism motivation, moderately high sports tourism participation, and moderately high levels of psychological well-being and psychological resilience. Skewness values ranged from −0.45 to −0.21, and kurtosis values ranged from −0.15 to 0.27, all within the ± 1 range, indicating that the data basically met normal distribution assumptions and were suitable for subsequent structural equation model analysis.

The reliability and validity test results of the measurement model are shown in **Table 3**. Cronbach's α coefficients for all variables ranged from 0.834 to 0.913, and Composite Reliability (CR) values ranged from 0.842 to 0.919, all exceeding the recommended standard of 0.7, indicating that the scales possessed good internal consistency reliability. Average Variance Extracted (AVE) values ranged from 0.518 to 0.628, all exceeding the critical value of 0.5, indicating that the measurements possessed good convergent validity.

Table 3. Reliability, validity, and correlation matrix.

Variables	CR	AVE	α	1	2	3	4	5
1. Digital Tourism Marketing	0.895	0.549	0.892	0.741				
2. Wellness Tourism Motivation	0.881	0.518	0.876	0.523***	0.720			
3. Sports Tourism Participation	0.842	0.521	0.834	0.418***	0.486***	0.722		
4. Psychological Well-being	0.919	0.628	0.913	0.387***	0.462***	0.512***	0.792	
5. Psychological Resilience	0.891	0.539	0.887	0.402***	0.443***	0.497***	0.581***	0.734

Note: *** $p < 0.001$; Bold diagonal values are square roots of AVE for discriminant validity assessment; values below diagonal are correlation coefficients between constructs. Discriminant validity is supported when square roots of AVE values exceed inter-construct correlations.

Discriminant validity was assessed by comparing the square root of AVE with inter-variable correlation coefficients. The bold values on the diagonal represent the square root of AVE for each variable (0.720–0.792), all of which were greater than the correlation coefficients between that variable and other variables (0.387–0.581), indicating good discriminant validity of the measurements. All inter-variable correlation coefficients were positively significant ($p < 0.001$), providing preliminary

support for the research hypotheses.

4.2. Hypothesis testing

Structural equation model analysis results showed good model fit: $\chi^2/df = 2.28$, CFI = 0.943, TLI = 0.931, RMSEA = 0.058 (90% CI: 0.051-0.065), SRMR = 0.052. These indicators all met recommended standards, indicating good fit between the theoretical model and actual data.

As shown in **Figure 2**, all hypothesized paths were supported. Digital tourism marketing had a significant positive effect on wellness tourism motivation ($\beta = 0.52$, $p < 0.001$), supporting H1. Wellness tourism motivation significantly positively influenced sports tourism participation ($\beta = 0.49$, $p < 0.001$), supporting H2. Sports tourism participation had significant positive effects on both psychological well-being ($\beta = 0.42$, $p < 0.001$) and psychological resilience ($\beta = 0.38$, $p < 0.001$), supporting H3a and H3b. The R^2 values of endogenous variables showed that the model explained 27% of the variance in wellness tourism motivation, 24% of the variance in sports tourism participation, 31% of the variance in psychological well-being, and 28% of the variance in psychological resilience.

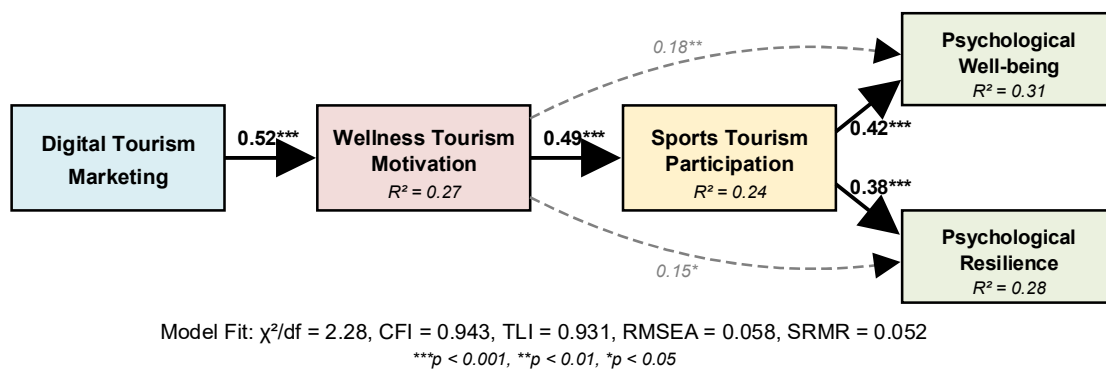


Figure 2. Structural equation model results with standardized path coefficients.

Mediation effect analysis was conducted using the Bootstrap method (5,000 resampling iterations), with results shown in **Table 4**. The indirect effect of sports tourism participation between wellness tourism motivation and psychological well-being was 0.206 (95% CI: 0.142–0.279), and the indirect effect between wellness tourism motivation and psychological resilience was 0.186 (95% CI: 0.125–0.261). Neither confidence interval contained zero, indicating significant mediation effects.

Table 4. Direct, indirect, and total effects analysis.

Path	Direct effect	Indirect effect	Total effect	95% CI	p-value
DTM → WTM	0.520***	-	0.520	[0.432, 0.598]	<0.001
WTM → STP	0.490***	-	0.490	[0.396, 0.571]	<0.001
STP → PWB	0.420***	-	0.420	[0.325, 0.503]	<0.001
STP → PR	0.380***	-	0.380	[0.284, 0.468]	<0.001
WTM → PWB	0.180**	0.206***	0.386	[0.291, 0.474]	0.003
WTM → PR	0.150*	0.186***	0.336	[0.241, 0.428]	0.012
DTM → STP	-	0.255***	0.255	[0.187, 0.329]	<0.001

Table 4. (Continued).

Path	Direct effect	Indirect effect	Total effect	95% CI	p-value
DTM → PWB	-	0.294***	0.294	[0.218, 0.376]	<0.001
DTM → PR	-	0.271***	0.271	[0.198, 0.352]	<0.001

Note: DTM = Digital Tourism Marketing; WTM = Wellness Tourism Motivation; STP = Sports Tourism Participation; PWB = Psychological Well-being; PR = Psychological Resilience *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$; CI = Confidence Interval.

Wellness tourism motivation had significant direct effects on both psychological well-being and psychological resilience (0.180 and 0.150, respectively), while also producing significant indirect effects through sports tourism participation. The indirect effects accounted for 53.4% (0.206/0.386) and 55.4% (0.186/0.336) of the total effects, respectively, indicating that sports tourism participation played a partial mediating role, supporting H4a and H4b.

4.3. Robustness testing

To test the robustness of the research conclusions, multi-group analysis was conducted. The sample was divided into early recovery group ($n = 138$) and late recovery group ($n = 121$) based on recovery stage. To enhance the contrast between groups, the multi-group analysis selected two extreme groups for comparison: early recovery (<6 months) and late recovery (>12 months), comparing the differences in model paths between the two groups.

As shown in **Figure 3**, multi-group analysis results revealed that recovery stage moderated certain paths. In the early recovery group, the effect of digital tourism marketing on wellness tourism motivation ($\beta = 0.58$) was significantly stronger than in the late recovery group ($\beta = 0.45$), with a significant chi-square difference test ($\Delta\chi^2 = 4.82$, $p = 0.028$). Similarly, the effect of wellness tourism motivation on sports tourism participation was stronger in the early group ($\beta = 0.54$) than in the late group ($\beta = 0.42$), with marginally significant difference ($\Delta\chi^2 = 3.91$, $p = 0.048$).

The effects of sports tourism participation on psychological outcomes also showed differential trends between groups. In the early recovery group, the effects of sports tourism participation on psychological well-being ($\beta = 0.47$) and psychological resilience ($\beta = 0.43$) were both stronger than in the late recovery group ($\beta = 0.36$ and $\beta = 0.32$, respectively). Although between-group differences did not reach statistical significance ($p > 0.05$), they showed marginally significant trends.

The stronger responsiveness of early-stage survivors can be understood through Self-Determination Theory frameworks. During early recovery (<6 months), survivors experience acute psychological adjustment challenges as they transition from patient to survivor roles, characterized by heightened information-seeking behavior and greater openness to external support. Digital marketing interventions may be particularly effective during this window because survivors are actively reconstructing their post-treatment identities and exploring new possibilities for health management. In contrast, late-stage survivors (>12 months) have typically developed more stable coping patterns and may be less receptive to new intervention approaches.

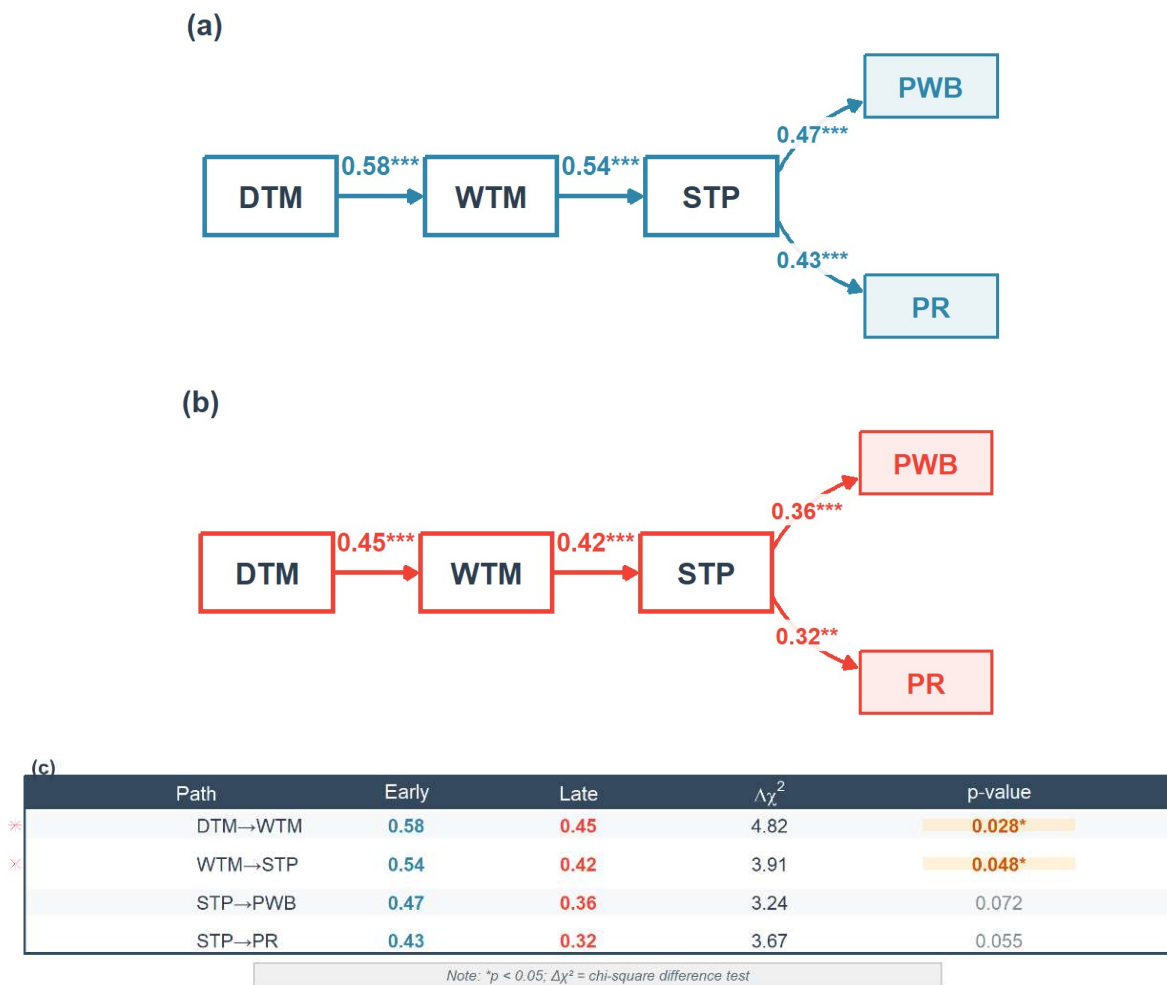


Figure 3. Multi-group Analysis of Structural Model Paths Across Recovery Stages. **(a)** Early Recovery Group (<6 months): Standardized path coefficients for cancer survivors in early recovery stage. **(b)** Late Recovery Group (>12 months): Standardized path coefficients for cancer survivors in late recovery stage. **(c)** Group Difference Test Results: Chi-square difference tests comparing path coefficients between early and late recovery groups.

Alternative model comparisons further validated the reasonableness of the research model. Three competing models were constructed: Model A (mediation paths removed), Model B (direct paths added from digital marketing to psychological outcomes), and Model C (mediation order changed). Comparisons based on AIC and BIC information criteria showed that the original model had the lowest AIC (8462.3) and BIC (8593.7) values, indicating that the research model was superior to alternative models.

Common method bias test results showed that in Harman's single-factor test, the first factor explained 31.2% of total variance, below the 40% critical value. After adding a common method factor, model fit improvement was not significant ($\Delta CFI = 0.008$, $\Delta RMSEA = 0.003$), further confirming that common method bias did not constitute a serious threat.

5. Discussion

This study, by constructing and testing a theoretical model of how digital

tourism marketing influences cancer survivors' psychological recovery, revealed the mediating mechanisms of sports tourism participation, providing new theoretical perspectives and empirical evidence for understanding how technology-enabled wellness tourism promotes psychological health in special populations. The study found that digital tourism marketing can effectively stimulate cancer survivors' wellness tourism motivation, which in turn promotes improvements in their psychological well-being and psychological resilience through sports tourism participation. This finding has important implications for psychological health management of cancer survivors.

The results supported all research hypotheses, confirming the significant positive effect of digital tourism marketing on wellness tourism motivation ($\beta = 0.52$). This finding is consistent with research on the role of artificial intelligence in tourism marketing transformation [43]. Digital technology effectively meets the special needs of cancer survivors through personalized recommendations, intelligent interaction, and precise information push, enhancing their willingness to participate in tourism. The digital transformation of the tourism industry has not only changed marketing methods but, more importantly, created new value creation opportunities [44]. For the special group of cancer survivors, the value of digital marketing lies in reducing information search costs, providing customized service options, and reducing decision uncertainty through virtual experience previews.

The positive effect of wellness tourism motivation on sports tourism participation ($\beta = 0.49$) reflects the process of motivation transforming into behavior. Research on the psychological health benefits of outdoor adventure activities shows that sports activities in natural environments can produce significant psychological recovery effects [45]. Through participating in sports tourism, cancer survivors not only achieve physical function recovery training but, more importantly, rebuild connections with nature and society. This participation process itself is a positive coping strategy that helps survivors transition from passive patient roles to active health managers.

The significant positive effects of sports tourism participation on psychological well-being and psychological resilience ($\beta = 0.42$ and $\beta = 0.38$, respectively) constitute the core findings of this study. These results echo clinical guidelines for anxiety and depression management in adult cancer survivors [46]. Sports tourism creates favorable conditions for survivors' psychological recovery by providing multi-sensory stimulation, creating achievement experiences, and promoting social interaction. Psychometric research on the Connor-Davidson Resilience Scale confirms that individuals' psychological resilience is systematically enhanced through processes of facing challenges and overcoming difficulties [47]. Sports tourism precisely provides such opportunities, allowing survivors to gradually challenge themselves and rebuild confidence in safe, controlled environments.

Mediation effect analysis revealed the bridging role of sports tourism participation between wellness tourism motivation and psychological recovery. Indirect effects accounting for over 50% of total effects indicate that sports tourism participation is a key pathway for achieving psychological health improvement. This finding is consistent with the application of structural equation modeling in tourism research, confirming the mediating role of behavioral participation in motivation-

outcome relationships [42]. The mediating role of sports tourism participation operates through multiple psychological recovery mechanisms. Cancer treatment often disrupts survivors' relationship with their physical bodies, while sports tourism provides opportunities to re-establish positive bodily experiences and reclaim physical agency, supporting the competence component of psychological well-being. Unlike medical contexts where survivors are passive recipients, sports tourism enables active engagement and skill development, fostering sense of control and self-efficacy. Additionally, tourism activities create natural contexts for peer interaction and community building, addressing social connection needs that are often compromised during illness and treatment. These mechanisms work synergistically to transform wellness tourism motivation into tangible psychological benefits, explaining why sports tourism participation accounts for over 50% of the total effects in our mediation analysis. Notably, wellness tourism motivation retains significant direct effects on psychological outcomes, suggesting that motivation itself also has psychological value, possibly operating through mechanisms such as expectancy effects and cognitive restructuring.

Multi-group analysis showed that recovery stage moderated model paths, with early-stage survivors demonstrating stronger path relationships. Beyond recovery stage, several other factors may moderate the relationships observed in this study. Age differences could influence both digital technology adoption and physical activity capacity, with younger survivors potentially showing greater responsiveness to digital marketing while older survivors may prefer traditional information sources. Cancer type variations may also matter, as survivors of different cancers face distinct physical limitations and treatment sequelae that affect tourism participation capability. Socioeconomic status represents another important moderator, as higher-income survivors may have greater access to tourism resources and technology, while those with limited resources face participation barriers regardless of motivation levels. Additionally, functional status and comorbidity burden could significantly influence survivors' ability to engage in sports tourism activities, suggesting that interventions may need careful tailoring to individual capability levels. This finding has important practical implications, suggesting that digital marketing and sports tourism interventions may produce more significant effects in early recovery stages. The early recovery stage is a critical period for psychological reconstruction, when survivors have more urgent needs for external support and positive experiences, making them more sensitive to digital marketing information and more likely to convert motivation into actual action.

The research findings have implications for the development of telemedicine and digital health services. Application of Self-Determination Theory in telemedicine implementation challenge research indicates that technology acceptance depends on the satisfaction of basic psychological needs [48]. This study found that digital tourism marketing effectively promoted survivors' tourism participation by satisfying needs for autonomy, competence, and relatedness—a mechanism that can be extended to broader digital health intervention domains.

The application of artificial intelligence in the tourism industry is rapidly developing, with systematic literature reviews showing AI technology's enormous potential in personalized services, emotion recognition, and predictive analysis [49].

This study provides empirical support for AI technology application in tourism services for special populations. By integrating health data, behavioral preferences, and contextual information, AI systems can provide cancer survivors with more precise tourism recommendations and health management advice.

Understanding these psychological pathways suggests specific intervention strategies for practitioners. Digital platforms should emphasize autonomy-supporting features such as personalized activity recommendations and self-paced program design, particularly for early-stage survivors who show greater responsiveness. Sports tourism programs should integrate graduated challenge levels that provide achievable mastery experiences while building social connections through group activities. The strong mediation effects indicate that simply motivating survivors toward wellness tourism is insufficient; actual participation in meaningful physical activities is essential for psychological benefits to emerge.

Systematic review research on survivor psychological resilience scales emphasizes applicability issues of measurement tools across different cultures and populations [41]. The CD-RISC-10 used in this study demonstrated good reliability and validity in Chinese cancer survivor populations, but future research still needs to develop more localized and disease-specific measurement tools. The multidimensional characteristics and dynamic change processes of psychological resilience require more refined assessment methods.

The research also has certain limitations. The cross-sectional design limits the strength of causal inference. Although structural equation modeling can test theoretical hypothetical path relationships, it cannot fully determine causal directions between variables. The cross-sectional design presents several specific limitations that warrant emphasis. First, recall bias may affect participants' self-reports of tourism participation and psychological states, particularly for those in later recovery stages who may have difficulty accurately recalling early post-treatment experiences. Second, common method variance poses concerns when all variables are measured through self-report questionnaires administered at a single time point, potentially inflating correlations between constructs. Third, the inability to establish temporal precedence means that alternative causal models cannot be definitively ruled out—for example, individuals with better baseline psychological health may be more likely to engage in digital tourism marketing and sports activities. These methodological constraints limit confidence in the directional relationships proposed in our theoretical model. Future research should adopt longitudinal designs or experimental studies to track survivors' complete process from digital marketing exposure to psychological recovery achievement. Specifically, randomized controlled trials could test the effectiveness of digital tourism marketing interventions compared to standard survivorship care, with psychological outcomes measured at multiple time points over 12–24 months. Mixed-methods studies could provide deeper understanding of survivors' subjective experiences with digital tourism platforms and the mechanisms through which sports tourism activities contribute to psychological recovery. Cost-effectiveness analyses would inform healthcare policy decisions about digital wellness tourism integration. Additionally, studies examining dose-response relationships between sports tourism participation frequency and psychological outcomes could guide optimal intervention design. Cross-cultural validation of these

findings in different healthcare systems and cultural contexts would strengthen generalizability. The sample sourced from a single regional hospital may affect the external validity of research results. Different regions' medical resources, tourism resources, and cultural backgrounds may influence digital marketing effectiveness and sports tourism accessibility.

The research primarily focused on sports tourism as a specific form, while wellness tourism encompasses richer content such as hot spring therapy, forest wellness, and traditional Chinese medicine health preservation. Future research could explore the psychological health effects of different types of wellness tourism activities, identifying tourism forms most suitable for patients at different recovery stages and with different cancer types. The measurement of digital marketing was relatively simple, failing to fully capture the complexity of technological characteristics. With the development of virtual reality, augmented reality, and other technologies, future research needs to develop more comprehensive digital marketing measurement tools.

This study provides new insights for promoting cancer survivors' psychological health. For clinical practitioners, these findings suggest several actionable strategies for integrating digital tourism approaches into survivorship care. Oncology teams could incorporate digital tourism platforms into survivorship care plans, particularly during the early recovery phase when survivors show greatest responsiveness to digital interventions. Clinical social workers or patient navigators could provide guidance on appropriate sports tourism activities matched to individual functional status and treatment history. Healthcare systems might consider partnerships with local tourism organizations to develop survivor-specific programs that combine health monitoring with recreational travel. Additionally, digital health platforms could be enhanced to include tourism-based wellness modules that provide graduated physical activity recommendations within travel contexts. The timing of such interventions appears crucial, with our findings suggesting that digital tourism counseling may be most effective when introduced within six months post-treatment completion. In the context of digital transformation and the Healthy China strategy, integrating digital technology, tourism resources, and health services to construct smart wellness tourism systems oriented toward special populations can not only improve patients' quality of life but also drive innovative development of the wellness tourism industry. The research findings have important reference value for policy-making, industry practice, and academic research.

At the policy level, these results support the development of cross-sector collaboration frameworks between healthcare systems, tourism industries, and technology providers. Health insurance systems could consider coverage for digital wellness tourism programs as part of survivorship care benefits, particularly given the demonstrated psychological health outcomes. Tourism industry regulations might incorporate specific standards for cancer survivor accessibility and safety in sports tourism offerings. Healthcare quality metrics could include measures of digital health resource utilization and survivorship care integration. Furthermore, professional education curricula for healthcare providers should include training on digital health literacy and wellness tourism referral processes to ensure effective implementation of these evidence-based approaches in clinical practice.

6. Conclusion

This study constructed and validated a theoretical model of how digital tourism marketing influences cancer survivors' psychological recovery, empirically testing the mediating mechanisms of sports tourism participation, providing a new theoretical framework for understanding how technology-enabled wellness tourism promotes psychological health in special populations. The study found that digital tourism marketing stimulates wellness tourism motivation, promotes sports tourism participation, and ultimately improves cancer survivors' psychological well-being and psychological resilience. This mechanism differs across recovery stages, with early-stage survivors showing stronger responsiveness. The theoretical contribution lies in integrating Self-Determination Theory and positive psychology perspectives, revealing the complete pathway from technology exposure to psychological recovery, and expanding the theoretical boundaries of digital marketing and health tourism research. At the practical level, the research provides scientific evidence for tourism enterprises to develop digital marketing strategies and sports tourism products targeting cancer survivors, recommending strengthened digital health tourism information push in early recovery stages, designing progressive sports tourism programs, and constructing integrated online-offline wellness tourism service systems. Policymakers should emphasize the application of digital technology in special population health management, promote cross-sector collaboration among medical, tourism, and technology departments, and establish supportive policy environments for cancer survivors' wellness tourism. Future research could adopt longitudinal designs to deeply explore dynamic processes of psychological recovery, extend to other chronic disease groups to verify model universality, and explore innovative applications of emerging technologies such as virtual reality and artificial intelligence in wellness tourism. This study not only provides new intervention pathways for improving cancer survivors' quality of life but also provides theoretical support and practical guidance for high-quality development and digital transformation of the wellness tourism industry.

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Ethical approval: This study was conducted in accordance with the ethical principles of the Declaration of Helsinki. As the Chengdu Gulian Tianchen Geriatric Hospital does not have an independent institutional review board, ethical approval was obtained from the Scientific Research and Ethics Committee of Chengdu Gulian Tianchen Geriatric Hospital. The research protocol, including recruitment procedures, intervention content, and data confidentiality, was reviewed and approved by the institutional academic committee (Approval No.: CGTGH-SREC-2024-015).

Informed consent statement: Informed consent was obtained from all subjects involved in the study.

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