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Original Article

Dyadic effects of perceived stress, relationship satisfaction and distress disclosure on emotional distress in colorectal cancer patients and their family caregivers: An actor-partner interdependence mediation model

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ABSTRACT

Objective: This study adopted a dyadic analysis method to examine the effect of perceived stress on emotional distress and determine whether relationship satisfaction and distress disclosure act as mediators in colorectal cancer (CRC) enterostomy patient-caregiver dyads.
Methods: A total of 312 patient-caregiver dyads completed measures assessing perceived stress, relationship satisfaction, distress disclosure, and emotional distress. The data were analyzed using the actor-partner interdependence mediation model.
Results: This study found that the perceived stress of patients and caregivers both had direct and indirect actor effects on emotional distress (through relationship satisfaction). Another important finding is that perceived stress had indirect actor-partner effects (through distress disclosure) on emotional distress.
Conclusions: This study highlights that perceived stress, relationship satisfaction, and distress disclosure of patients and their caregivers are key factors that can be considered for improving emotional distress. It also partially confirmed the interdependence of patients with CRC and their caregivers.

Introduction

Globally, colorectal cancer (CRC) is a frequently occurring cancer and a major cause of mortality.[1] Enterostomy is a surgical operation that removes the tumor and creates a stoma on the abdominal wall, providing a new artificial pathway for waste elimination.[2] A considerable proportion of survivors diagnosed with CRC require enterostomy and must live with a stoma. Although enterostomy alleviates symptoms and prolongs survival, it changes the patient's body image, the physiological functions of the intestines and anus, and the position for defecation.[3] A considerable amount of evidence shows that enterostomy patients experience severe psychological and emotional distress, including anxiety, depression, distress, stigma, and disgust.[4–6] Given the limited professional support provided by the health care system, family caregivers are the most important source of care for patients; they provide emotional, physical, and financial support, monitor symptoms,

and make care decisions.[7–9] Regrettably, because of their engagement in long-term care activities, family caregivers also report high rates of emotional distress.[10–12]

Several studies have concluded that the response of patients and their family caregivers to cancer is an emotional system, and there is a reciprocal correlation between each person's emotional reaction to the disease.[13–15] Interdependence theory explains how the interpersonal interaction between two closely related individuals (e.g., patients and their family caregivers) affects one another's health outcomes.[16,17] The patients' disease affects their family caregivers, and in turn, the emotional response and behavior of the family caregiver can affect the patient's health status due to the close relationship. In recent years, emphasis has been placed on the cooperative relationship between the patient and their family caregivers, and the patient-caregiver dyad has been proposed. Generally, the concept of the patient-caregiver dyad is defined as a collaborative relationship between a patient who needs physical,

emotional, psychological, and financial assistance and a self-selected individual who can be biologically, legally related, or unrelated, but is willing to assume the role of caregiver in the healthy disease state, with the common goal of providing help in the disease state.[18] The creation of a "patient-caregiver dyad" indicates a synergistic relationship that is dynamic and mutually beneficial. Obviously, focusing on the patient-caregiver dyads and the possible interrelationships between the sequelae of individuals in dyads enables researchers to examine the impact of each person's health outcome on their companion to identify the factors affecting health.

Generally, cancer and enterostomy, as stressful life events, have severe negative psychological outcomes for patients and their family caregivers.[19,20] The stress and coping model provides valuable insights for understanding how individuals respond to their stressors (e.g., CRC and enterostomy).[21] In this theoretical framework, stressors successively trigger cognitive appraisals and coping processes, and individuals assess the degree of threats related to the stressors and their coping resources. Cognitive appraisal is the evaluation of the perceived severity of the cancer and enterostomy.[22,23] For example, individuals are likely to perceive stress and feel overloaded when they consider how the diagnosis of cancer and the provision of care threaten their lives and livelihoods. The coping process is the individual's use of coping resources (e.g., interpersonal and emotional support) and coping strategies (e.g., communication and disclosure). Finally, the results of the stress process model are indicators of physical and mental health, which are most proximally predicted by coping resources and strategies in the secondary appraisal.[24] According to the model of stress and coping, an individual's cognitive appraisal, coping resources, and strategies for stressful events influence health outcomes. In this study, we focus on emotional distress as the primary observational outcome because it has been shown to play a significant role in determining the trajectory of health or deterioration of patients with cancer, as well as their family caregivers. Interdependence theory extends the stress and coping model of the individual to the context of interpersonal relationships and considers cognitive appraisals and coping processes of dyadic members in the face of a common stressor at a dyadic level (e.g., examining how each member of a patient-caregiver dyad perceives and responds to a stressful event, how their perceptions and responses interact with one another, which cognitive appraisals and coping strategies they adopt and how their interactions affect each other's outcomes).[25,26]

While coexisting with the disease, patients and family caregivers must jointly cope with the complexity of a dramatically changed life and life-threatening events. In studies of couples coping with cancer and other chronic diseases, relationship satisfaction involving trust, open communication, and reciprocal support endowed psychosocial benefits.[27,28] Similarly, among cancer patients and family caregivers, better relationship satisfaction has been associated with better health outcomes, such as more disclosures and better emotional responses to stressful events.[29,30] Relationship satisfaction is defined as a subjective sense of relationship quality, derived from the evaluation of feelings, thoughts, and behaviors associated with a romantic relationship.[31] As research deepens, relationship satisfaction has been expanded to the individual's subjective experience and perception of the relationship between patients and their family caregivers (including conjugal relationships between couples and family relationships with other family members) in the context of physical, emotional, and psychological mutual assistance during the process of fighting the disease together.[32,33] Good relationships closely link the patient and family caregiver together and influence the dyad's joint coping with, emotional response to, and even mental health outcomes of cancer events.[16] One factor that relationship satisfaction has a positive impact on the patient-caregiver dyad is that a good relationship can provide support and comfort, and this interpersonal emotional support encourages family members to talk frankly and openly about their experience with disease and care, especially when they experience distress and difficulty.[34,35] Obviously, such disclosures of cancer-related thoughts and feelings to one partner in a relationship can allow people to make sense of their experiences and achieve reciprocal support and can also facilitate the realignment of their perceptions, thereby alleviating emotional distress.[36]

Based on the above stress and coping model and interdependence theory, we believe that in the specific stressful context of cancer and enterostomy, relationship satisfaction could promote individuals' distress disclosure; simultaneously, relationship satisfaction (as a coping resource) and distress disclosure (as a coping strategy) have mediating effects on the stress and coping process and directly or indirectly affect emotional responses. However, to our knowledge, the potential mechanisms underlying these relationships have rarely been explored in the cancer patient-caregiver dyadic, and research on the interaction of such dyadic pairs has long been inadequate due to methodological limitations. Specifically, previous studies of dyadic relationships have typically attempted to analyze the individual responses of each member, treating them as independent observations (e.g., analyzing 50 dyadic relationships as 100 individual cases) and predicting each individual outcome variable by their own predictor variable. This method ignored the non-independence of dyadic data, thus jeopardizing the accuracy of the analysis. To address this problem, Kenny et al.[37] proposed the Actor-Partner Interdependence Model (APIM). This model is an innovative approach to addressing interdependence issues in dyadic research that distinguishes between actor effects (the influence of one's own characteristics on their attributes) and partner effects (the influence of a partner's characteristics on another's attributes). By adopting this approach, numerous studies have begun to focus on the interactions between dyads. Extending this standard APIM by a third variable pair we get the Actor-Partner Interdependence Mediation Model (APIMeM).[38] The APIMeM has three pairs of variables, X, Y, and M for two members, and it can also contain chain mediation of multiple pairs of variables.

Therefore, to better understand the mechanism of the effects of dyadic stress perception and coping on emotional distress, this study used the APIMeM to explore actor effects (how a person's perceived stress influences their own emotional distress) and partner effects (how a person's perceived stress influences the other person's emotional distress), as well as whether Based on the above stress and coping model and interdependence theory, we believe that in the specific stressful context of cancer and enterostomy, relationship satisfaction (including conjugal relationships between couples and family relationships with other family members) could promote individuals' distress disclosure; simultaneously, relationship satisfaction (as a coping resource) and distress disclosure (as a coping strategy) have mediating effects on the stress and coping process and directly or indirectly affect emotional responses. We investigated these processes separately in patients and their family caregivers and captured the potential interdependence of these associations from a dyad perspective. In this study, family caregivers are defined as relatives, possibly spouses, parents, children, and siblings, who support the broad range of needs of the patient without pay.

Methods

Aims

The study aims included (i) examining associations between perceived stress and emotional distress; (ii) exploring the mediating effects based on the above stress and coping model and interdependence theory, we believe that in the specific stressful context of cancer and enterostomy, relationship satisfaction (including conjugal relationships between couples and family relationships with other family members) could promote individuals' distress disclosure; simultaneously, relationship satisfaction (as a coping resource) and distress disclosure (as a coping strategy) have mediating effects on the stress and coping process and directly or indirectly affect emotional distress; and (iii) exploring the differences between the couple and non-couple dyadic relationships in the model, as dyads include multiple family relationships.

Design

Our study was designed as a cross-sectional survey and was reported according to the STROBE guidelines.

Setting and participants

This study used convenience sampling in multiple centers. Patients and their family caregivers were recruited from the stoma clinics and anorectal in-hospital departments of three tertiary hospitals in Hunan, Tianjin, and Jiangxi, China, between June 2021 and September 2021. The stoma clinic is managed by enterostomal therapists with specialist nursing qualifications and is committed to providing comprehensive services for in-hospital and out-of-hospital enterostomy patients. The services of the stoma clinic include: determining the location of the stoma, introducing postoperative care, providing technical support and counseling for patients and their family caregivers, and dealing with stoma complications. The anorectal in-hospital department mainly provides routine treatment and care for in-hospital patients with enterostomy who are about to undergo or have undergone a stoma operation (including radiotherapy and chemotherapy) by anorectal surgeons and nurses. The inclusion criteria for patients were as follows: 1) had a confirmed diagnosis of CRC and underwent an enterostomy, 2) were at least 18 years old, 3) were able to complete the questionnaire independently, and 4) were willing to participate. The inclusion criteria for family caregivers were as follows: 1) were the primary family caregivers designated by the patients, 2) were able to complete the questionnaire independently, 3) were at least 18 years old, and 4) were willing to participate. The exclusion criteria for dyadic members were cognitive or psychiatric impairments and suffering from severe heart, liver, kidney, and other serious complications. The sample size was estimated for an effect size of 0.2, a significance level of 0.05, and a power of 0.8, which is regarded as appropriate to detect actor and partner effects in dyadic data.[37] We expected a dropout rate so recruited 350 participants.

Data collection

We set up a research team, which was composed of a postdoctoral researcher and five master's students, all from the nursing field. Every member of the research team underwent systematic training to ensure that they were familiar with the research content and the necessary precautions to take during the questionnaire survey (e.g., the uniform use of verbal guidance; checking the missing values). When potential patients visited the stoma clinic and anorectal in-hospital department for treatment (due to the special nature of the stoma and the cultural background of China, the primary family caregiver usually accompanied patients), the persons in charge of recruitment received notification from the designated staff and went to the corresponding location to recruit the dyads. In both locations, research members presented the content and purpose of the research to potential dyadic participants, assessed them to determine whether they met the inclusion and exclusion criteria, and assured that participation was voluntary. After obtaining written consent, the researcher distributed the questionnaire to the patients and their family caregivers in quiet and independent treatment rooms. According to our pilot experiment, to prevent patients or family caregivers from worrying that the other party would see the questionnaire results and not answer truthfully, patients and family caregivers filled in the questionnaires in different rooms. Once they completed the questionnaire, the researcher immediately checked their questionnaire to ensure the integrity of the data. If there were missing values, the questionnaires were returned to the patients or family caregivers so that they could fill in the missing items. Generally, the questionnaires were completed within 20–30 minutes, and we provided a thank-you letter and an ostomy bag as gifts for the contribution of patients and family caregivers.

Variables and measures

Perceived stress

The Chinese version of the Perceived Stress Scale (PSS) was used to measure an individual's perceived stress in the past month.[39,40] The PSS consists of 14 items and responses are given using a five-point scale (0 = "not at all" to 4 = "very much"). Total scores range from 0 to 56, and higher scores denote more perceived stress. Previous studies have shown that the PSS has good validity and reliability.[41,42] In the reliability test conducted for our study, the PSS obtained a Cronbach's α of 0.779 for the patients and 0.810 for the family caregivers, which means this scale can measure perceived stress consistently.

Relationship satisfaction

The Chinese version of the Relationship Assessment Scale (RAS) was used to measure relationship satisfaction.[43] The scale consists of 7 items that the respondent rates on a five-point scale ranging from 1 ("not well") to 5 ("very well"). The total scores range from 7 to 35, and higher scores denote greater relationship satisfaction. Previous research has indicated that the Cronbach's alphas of the 7 test items ranged from 0.784 to 0.834.[44] Since there was currently no tool specifically for measuring non-couple relationship satisfaction in a family setting, we changed the word "partner" in the RAS to "family caregiver" and "patient" to measure relationship satisfaction in the dyads. To ensure the reliability of the modified RAS, we conducted an internal consistency test. In this study, Cronbach's α was 0.684 among the patients and 0.687 among the family caregivers. Considering the small number of items in RAS, the value of Cronbach's α greater than 0.65 is minimally acceptable.

Distress disclosure

The Chinese version of the Distress Disclosure Index Scale (DDI) was used to assess the extent to which individuals tell others about their distress and troubles.[45] The DDI consists of 12 items rated on a five-point scale (1 = "strongly disagree" to 5 = "strongly agree"). The scale has a total score of 12–60, and higher scores denote a greater tendency to disclose distress. Previous research has indicated that the Cronbach's α of the 12 items ranged from 0.89 to 0.95[46] The internal consistency reliability of the DDI obtained a Cronbach's α of 0.782 for the patients and 0.834 for the family caregivers in our study.

Emotional distress

Emotional distress was measured by the Chinese version of the Profile of Mood States-Short Form (POMS-SF).[47,48] The scale consists of 30 items distributed across six factors. The POMS-SF items are rated on a five-point scale ranging from 0 ("not at all") to 4 ("extremely"). Total scores range from 0 to 120, and high scores indicate high emotional distress levels. Previous research has indicated that the POMS-SF has good internal consistency reliability (Cronbach's alpha = 0.95).[49] In the present study, the POMS-SF had good reliability, with Cronbach's α exceeding 0.80 in both the patients and the family caregivers (0.843; 0.832).

Ethical considerations

This study complied with the Declaration of Helsinki and has obtained the approval of the Ethics Committees of Nanjing Medical University (IRB No. 2018–21). Both verbal and written information about this research, such as the voluntary nature of participation, the degree of involvement needed, and the freedom to withdraw from participation at any time, were given to each participant. Written informed consent was obtained from all participants, and assurances of confidentiality were provided.

Data analysis

The data analysis was performed using IBM SPSS Statistics Version 22.0 and MPLUS Version 8.3. Descriptive statistics (frequency,

percentages, means, and standard deviations) were used to characterize demographic and disease-related characteristics, perceived stress, relationship satisfaction, distress disclosure, and emotional distress. Pearson's correlation analyses of the study variables were conducted in patient-caregiver dyads. Paired-sample t-tests were used to compare the differences in the research variables between patients and family caregivers. Independent samples t-tests and one-way ANOVA were performed to test the differences in emotional distress according to demographic and clinical characteristics.

Next, we applied structural equation modeling (SEM) to test the hypothesis model and estimate the model parameters. The APIM was used to examine interdependence.[38] The APIM could model the responses of dyad members simultaneously, allow variable interactions between them, and specify the correlations of all pairs of variables in the dyad. In this model, we can estimate not only the conventional actor effects for patients and family caregivers (the influence of individual predictors on their own outcomes) but also the patient-partner effects and caregiver-partner effects (the influence of individual predictors on their partner's outcomes). APIMeM extends the standard APIM by adding one or more mediation variables, which can result in several mediation effects, leading to possible paths of mediation. The models were fitted using maximum likelihood estimation. We used bias-corrected bootstrapping procedures to test the indirect effects using 5000 bootstrap samples. Four fit indices were employed to examine the adequacy of model fit: a chi-square to degrees of freedom ratio ($\chi^2/\text{df} < 3$), the comparative fit index (CFI $\geq$ 0.90), the Tucker–Lewis index (TLI $\geq$ 0.90), and the root mean square error of approximation (RMSEA $\leq$ 0.05).[50] The β coefficient is the estimate of actor and partner effects, and a statistically significant coefficient represents a significant actor or partner effect.

Furthermore, to explore the differences between the couple and non-couple dyadic relationships in the model, we regarded the dyad relationship as a moderating variable and conducted a multiple-group analysis to compare model 1 (with all paths constrained to be equal) with model 2 (with all paths allowed to vary). The significance of the change in chi-square between the two models was used as the criterion for comparison. If the change in chi-square is not significant, it indicates that there is no difference between the two models.

Validity and reliability/rigour

This study minimizes the threats of Common Method Bias (CMB) by using anonymous measurement and some item reversals.[51] After data collection, we examined missing data, outliers, and Harman's single factor test.[52] There were no missing data and outliers, the data distribution of all variables had a normal distribution. Unrotated exploratory factor analysis extracted a total of 43 factors with eigenvalues greater than 1, the maximum factor variance explanation rate was 7.929% (lower than 40%), indicating that there was no CBM. Besides, the main variables in this study were assessed with previously validated scales and each scale had a Chinese version and showed an acceptable internal consistency.

Results

Sample characteristics

Of the 362 CRC enterostomy patient-caregiver dyads that were approached, 25 dyads did not meet the inclusion criteria, and 16 dyads declined to participate for various reasons (e.g., lack of time, lack of interest, and concern about sensitive information). Finally, 312 patient-caregiver dyads were eligible for the study and consented to participate. The mean ages of the patients and family caregivers were 58.55 (SD = 8.23) and 52.79 (SD = 7.88) years, respectively. The majority of patients were male ($n = 204$, 65.39%), while the majority of the family caregivers were female ($n = 187$, 59.94%). The relationships between the patients and family caregivers included spouses ($n = 256$, 82.05%),

children ($n = 32$, 10.26%), parents ($n = 11$, 3.53%), siblings ($n = 8$, 2.56%), and other family members (e.g., daughter-in-law, cousin, niece, aunt) ($n = 5$, 1.60%). The demographic and clinical characteristics of the patient-caregiver dyads are shown in Table 1.

Correlations

The means, standard deviations, and correlations between the study variables are presented in Table 2. Paired-sample t-tests indicated significant differences in perceived stress, relationship satisfaction, distress disclosure, and emotional distress within patient-caregiver dyads. Patients [37.301 (11.963)] had a higher rate of emotional distress than their family caregivers [33.740 (11.515)]. Concerning demographic and clinical characteristics, independent t-tests and one-way ANOVA revealed that there was no difference in emotional distress according to

Table 1

Demographic and clinical characteristics of the patient-caregiver dyads ($N = 312$ dyads).

Variable	n	%
Patients ($N = 312$)		
Age (years, mean $\pm$ SD)	58.55 $\pm$ 8.23	
Sex		
Male	204	65.38
Female	108	34.62
Occupational level		
Employed	255	81.73
Retired	39	12.50
Others	18	5.77
Monthly income (yuan)		
< 1000	30	9.62
1001 ~ 3000	88	28.21
3001 ~ 5000	150	48.08
> 5000	44	14.10
Complications of stoma		
Yes	148	47.44
No	164	52.56
Comorbidity		
Yes	211	67.63
No	101	32.37
Duration of stoma implantation		
< 3 months	70	22.44
3 months to one year	168	53.85
> one year	74	23.72
CRC type		
Rectal cancer	210	67.31
Colon cancer	102	32.69
Stoma state		
Permanent	109	34.94
Temporary	203	65.06
Chemotherapy or/and radiation		
Chemotherapy	71	22.76
Radiation	25	8.01
Chemotherapy and radiation	38	12.18
None	178	57.05
Caregivers ($N = 312$)		
Age (years, mean $\pm$ SD)	52.79 $\pm$ 7.88	
Sex		
Male	125	40.06
Female	187	59.94
Occupational level		
Employed	231	74.04
Retired	24	7.69
Others	57	18.27
Caregiver relationship to the patient		
Spouse	256	82.05
Child	32	10.26
Parent	11	3.53
Slibling	8	2.56
Other family member	5	1.60
Chronic disease in caregiver		
Yes	140	44.87
No	172	55.13
Caregiving hours per day (mean $\pm$ SD)	5.93 $\pm$ 1.36	

Table 2

Correlations, means and standard deviations of the variable for the patient-caregiver dyads ($N = 312$ dyads).

Variable	Perceived stress		Distress-disclosure		Relationship satisfaction		Emotional distress	
	PT	CG	PT	CG	PT	CG	PT	CG
Perceived stress (PT)	1							
Perceived stress (CG)	0.394**	1						
Distress-disclosure (PT)	0.197**	0.204**	1					
Distress-disclosure (CG)	0.460**	0.313**	0.229**	1				
Relationship satisfaction (PT)	−0.336**	−0.140**	0.116*	−0.139**	1			
Relationship satisfaction (CG)	−0.202**	−0.254**	−0.004	0.019	0.018	1		
Emotional distress (PT)	0.128**	−0.098	−0.290**	−0.210**	−0.237**	0.033	1	
Emotional distress (CG)	−0.156**	0.162**	−0.256**	−0.331**	0.013	−0.293**	0.383**	1
Mean	42.061	38.619	42.026	38.619	28.420	27.128	37.301	33.740
SD	6.434	7.111	6.384	7.160	3.554	3.808	11.953	11.515
t	8.132		7.137		4.419		4.822	
Different test[a]	$P < 0.001$		$P < 0.001$		$P < 0.001$		$P < 0.001$	

PT, patient; CG, caregiver; SD, standard deviation; [a] paired-sample t test; *** $P < 0.001$, ** $P < 0.01$, * $P < 0.05$.

demographic (e.g., age, gender) or clinical factors (e.g., stoma type, stoma complications) (Supplementary Table).

Correlation analyses found that for patients, their emotional distress was negatively correlated with their relationship satisfaction ($r = -0.237$, $P < 0.01$) and distress disclosure ($r = -0.290$, $P < 0.01$) and positively correlated with their own perceived stress ($r = 0.128$, $P < 0.01$). For family caregivers, emotional distress was also negatively related to their own relationship satisfaction ($r = -0.293$, $P < 0.01$) and distress disclosure ($r = -0.331$, $P < 0.01$) and positively correlated with their own perceived stress ($r = 0.162$, $P < 0.01$). Furthermore, perceived stress ($r = 0.394$, $P < 0.01$), distress disclosure ($r = 0.229$, $P < 0.01$) and emotional distress ($r = 0.383$, $P < 0.01$) between patients and family caregivers were significantly related, but the correlation between their relationship satisfaction was small and nonsignificant ($r = 0.018$, $P = 0.753$).

Actor-partner interdependence mediation model

Using the APIMeM, we tested whether the patients' and family caregivers' perceived stress was associated with their own and/or their partner's emotional distress via each person's relationship satisfaction and distress disclosure. In general, the model fitting indices of the model can be calculated, which have been fully determined in APIM.[38] In this way, if a path is not significant for an outcome variable, the path could be deleted from the model. The initial APIMeM analysis showed an adequate fit ($\chi^2/df = 1.117$, $P = 0.327$; CFI = 0.999; TLI = 0.991; RMSEA = 0.019, 95% CI = 0.000–0.116). However, the path of relationship satisfaction was significant only for individuals and not for patient-caregiver dyads. Additionally, due to the nonsignificant bivariate correlation between patients' and family caregivers' relationship satisfaction, we removed the path of relationship satisfaction within dyads and retained it only for individuals. Subsequently, the APIMeM analysis still had an excellent fit (Fig. 1), with $\chi^2/df = 1.219$, $P = 0.288$; CFI = 0.996; TLI = 0.985; RMSEA = 0.027, 95% CI = 0.000–0.023.

Direct effect analysis

Fig. 1 and Table 3 show the direct effect of the APIMeM. The perceived stress of patients and family caregivers had a significant positive actor effect on their own emotional distress ($\beta = 0.13$, $P = 0.027$; $\beta = 0.16$, $P = 0.005$), while their own perceived stress had no significant partner effect on their partner's emotional distress ($P > 0.05$). Patients' and family caregivers' perceived stress had a significant positive actor effect on their own distress disclosure ($\beta = 0.21$, $P < 0.001$; $\beta = 0.19$, $P < 0.001$), and their own perceived stress also had a significant positive partner effect on their partner's distress disclosure ($\beta = 0.41$, $P < 0.001$; $\beta = 0.15$, $P < 0.001$). Similarly, the patients' and family caregivers' distress disclosure showed a significant negative actor effect on their own emotional distress ($\beta = -0.23$, $P < 0.001$; $\beta = -0.28$, $P < 0.001$), and their own distress disclosure also showed a significant negative partner

effect on their partner's emotional distress ($\beta = -0.20$, $P < 0.001$; $\beta = -0.23$, $P < 0.001$). Additionally, patients' and family caregivers' perceived stress showed a significant negative effect on their own relationship satisfaction ($\beta = -0.34$, $P < 0.001$; $\beta = -0.25$, $P < 0.001$); in turn, their relationship satisfaction had a significant positive effect on their own distress disclosure ($\beta = 0.20$, $P < 0.001$; $\beta = 0.141$, $P < 0.001$) and a negative effect on their own emotional distress ($\beta = -0.20$, $P < 0.001$; $\beta = -0.29$, $P < 0.001$).

Indirect effect analysis

Fig. 1 and Table 4 show the indirect effects of the APIMeM. Regarding the indirect effects, the patients' and family caregivers' perceived stress was associated with their own and their partners' emotional distress not only through the mediating effect of their own distress disclosure but also through their partners' distress disclosure; that is, distress disclosure mediated the relationship between perceived stress and emotional distress for each dyad member. At the actor level, relationship satisfaction had a separate mediating effect on perceived stress and emotional distress ($\beta = 0.07$, 95% CI = 0.06, 0.22; $\beta = 0.07$, 95% CI = 0.06, 0.20); moreover, relationship satisfaction and distress disclosure together mediated the actor's own perceived stress and emotional distress ($\beta = 0.02$, 95% CI = 0.01, 0.06; $\beta = 0.01$, 95% CI = 0.01, 0.04) as well as his or her partners' emotional distress ($\beta = 0.01$, 95% CI = 0.01, 0.03; $\beta = 0.01$, 95% CI = 0.01, 0.05).

Comparison of models of dyadic relationships between couples and non-couples

We conducted a multi-group analysis to explore the differences between the couple and non-couple dyadic relationships in the model. As shown in Table 5, two models exhibited a good fit to the data, and the chi-square difference was not significant. Therefore, we selected the model with large degrees of freedom, that is, the paths in the two models of couples and non-couples were equal, indicating that the dyadic relationship was not a moderator and there was no difference between the two models.

Discussion

Based on the APIMeM, we explored the relationship between perceived stress and emotional distress, as well as the mechanism by which relationship satisfaction and distress disclosure might protect cancer patient-caregiver dyads from the adverse effects of cancer stress through a dyadic perspective.

First, both patients and family caregivers in our study had high levels of perceived stress and emotional distress. These findings were in line with previous studies involving cancer patients and family caregivers,[53,54] suggesting that both patients and family caregivers were affected by cancer and enterostomy. In addition, we found that the
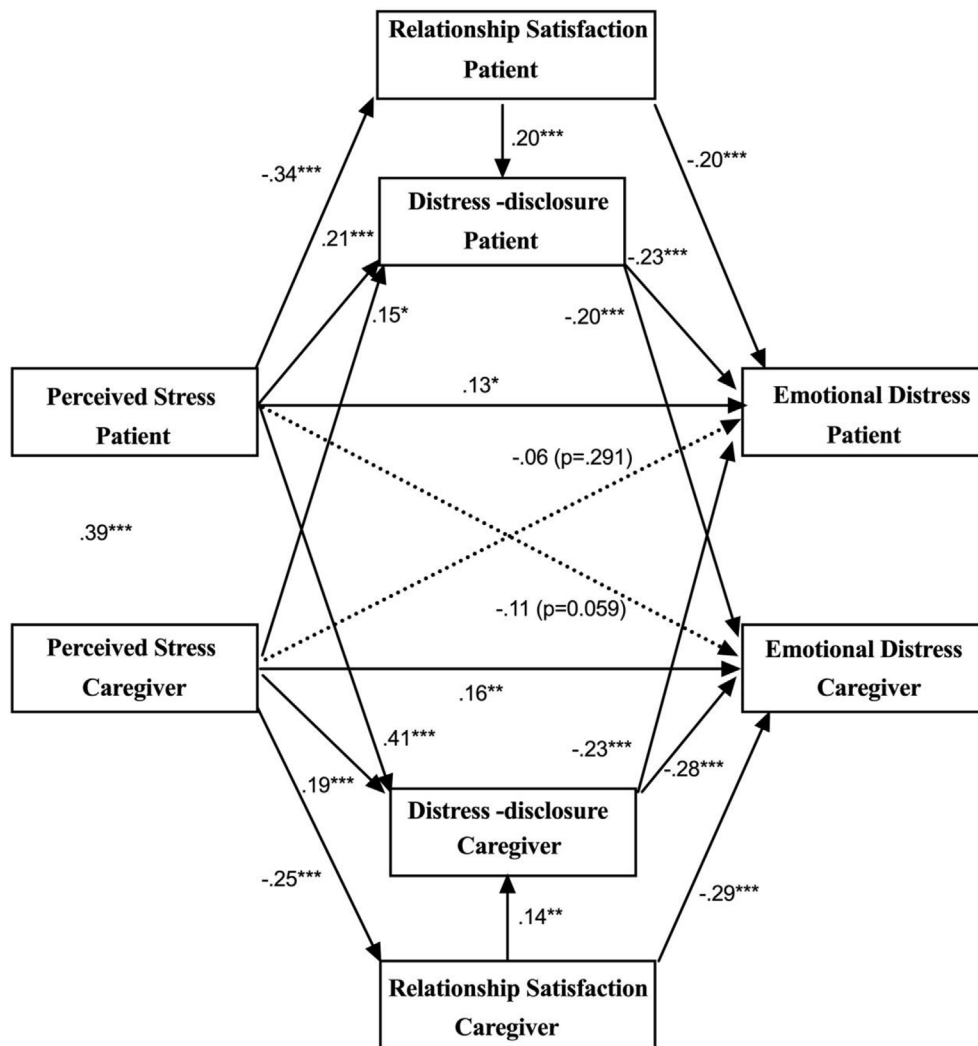
Note. APIMeM: Actor Partner Interdependence Mediation model; Figure values are standardized regression coefficients. ***=$P < 0.001$, **=$P < 0.01$, *=$P < 0.05$.

Fig. 1. APIMeM results for the effects of perceived stress, relationship satisfaction, and distress disclosure on emotional distress. APIMeM, actor partner interdependence mediation model.

patients' scores for perceived stress, relationship satisfaction, distress disclosure, and emotional distress were significantly higher than those of their family caregivers, indicating that patients, as direct survivors of cancer and enterostomy events, experience significantly more stress and emotional problems than family caregivers and, correspondingly, have greater support and disclosure needs.

Our research indicated that perceived stress is a nonnegligible threat to the health of cancer patient-caregiver dyads, which directly affects the emotional level. Previous studies have indicated that cancer-related stress affects psychological distress and the emotional state of patients and family caregivers.[55–57] According to family stress theory, the occurrence of stressful events affects not only one person but also the whole family. Both CRC enterostomy patients and family caregivers experienced distress and emotional distress caused by cancer-related stress. As previous studies have shown that cancer patients and family caregivers experience comparable levels of distress, these findings suggest that this stress may predict similar psychosocial outcome variables.[58,59] However, the APIM showed that perceived stress had a significant actor effect on emotional distress, while the partner effect was not statistically significant. The dearth of partner effect of perceived stress on emotional distress indicated that each person's perceived stress

only had an effect on their own subsequent emotional distress and had little effect on his or her partner, which is inconsistent with the interdependence theory. A potential explanation for the discrepancy between this research finding and previous theory is that patients and family caregivers were most aware of (and therefore most influenced by) their own experiences and stressful feelings about CRC and enterostomy, the effects of its negative symptoms (e.g., the exposure of the intestinal mucosa, involuntary bowel movements, fecal leakage, and unpleasant odors) and the related distressful experiences. Depending on the extent of their own distress, they may have been relatively unaffected by how their partners responded to CRC and enterostomy. Additionally, given that the majority of our participants were couples and that the patients were primarily male, the family caregivers were predominantly female. According to Fischer et al.[60] females tend to be more aware of negative influences and sensitive to emotional cues, which may hinder the efficacy and manifestation of the partner effects in this study. This suggests that future studies may need to examine whether and how sex-induced differences in perceived stress are related to emotional responses in dyads.

Our findings showed that the relationship between perceived stress and emotional distress was also mediated by relationship satisfaction and distress disclosure. Previous studies have shown that in the context of

Table 3

Direct effects of patients' and caregivers' perceived stress on emotional distress via relationship satisfaction and distress disclosure in the APIMeM (*N* = 312 dyads).

Dependent variable	Independent variable	*β*	SE	*P*
Distress-disclosure (PT)	Perceived stress (PT)	0.21	0.06	0.000
Distress-disclosure (PT)	Perceived stress (CG)	0.15	0.06	0.013
Distress-disclosure (PT)	Relationship satisfaction (PT)	0.20	0.06	0.000
Distress-disclosure (CG)	Perceived stress (PT)	0.41	0.05	0.000
Distress-disclosure (CG)	Perceived stress (CG)	0.19	0.05	0.000
Distress-disclosure (CG)	Relationship satisfaction (CG)	0.14	0.05	0.004
Relationship satisfaction (PT)	Perceived stress (PT)	−0.34	0.05	0.000
Relationship satisfaction (CG)	Perceived stress (CG)	−0.25	0.06	0.000
Emotional distress (PT)	Perceived stress (PT)	0.13	0.06	0.027
Emotional distress (PT)	Perceived stress (CG)	−0.06	0.06	0.291
Emotional distress (PT)	Distress-disclosure (PT)	−0.23	0.05	0.000
Emotional distress (PT)	Distress-disclosure (CG)	−0.23	0.06	0.000
Emotional distress (PT)	Relationship satisfaction (PT)	−0.20	0.05	0.000
Emotional distress (CG)	Perceived stress (CG)	0.16	0.06	0.005
Emotional distress (CG)	Perceived stress (PT)	−0.11	0.06	0.059
Emotional distress (CG)	Distress-disclosure (PT)	−0.20	0.05	0.000
Emotional distress (CG)	Distress-disclosure (CG)	−0.28	0.05	0.000
Emotional distress (CG)	Relationship satisfaction (CG)	−0.29	0.05	0.000

APIMeM, actor partner interdependence mediation model; PT, patient, CG, caregiver; *β*, standardized estimate; SE, standard error.

cancer stress, relationship satisfaction, and distress disclosure are closely related to an individual's health outcomes.[61–63] It is widely believed that sharing thoughts and feelings with others during times of stress is beneficial to emotional health.[64] Additionally, open communication and disclosure about cancer-related experiences within dyads are considered to be important for patients' and family caregivers' emotional health when dealing with cancer.[35] The general idea is that disclosure to family members could provide opportunities for verification and reappraisal of the situation, and even for finding positive meaning in the cancer experience. This process can promote the cognitive processing of positive cancer-related feelings and thoughts, allowing the individual to interpret them meaningfully and achieve a state of emotional acceptance.[35] Since the reaction of patients and family members to cancer is one emotional system and there is a reciprocal relationship between each person's emotional response to disease, it may be beneficial to both sides when patients or family caregivers disclose cancer-related distress and concerns. The APIM showed that the relationship satisfaction of patients and family caregivers mediated the impact of perceived stress on their own emotional distress (actor effect) and those of their partners (partner effect), which is consistent with interdependence theory and confirms the interdependence effect of cancer patients and family caregivers. Moreover, this finding validated the dyadic illness management proposed by Lyons and Lee;[65] that is, positive dyadic coping behaviors, such as disclosure and communication within dyads, will promote healthy outcomes.

Relationship satisfaction is another mediating factor that helps to explain the indirect relationship between perceived stress and emotional distress. First, relationship satisfaction as emotional support can facilitate truthful expression and disclosure of an individual's illness or care experience. For example, when an individual feels a good relationship, understanding, and concern from family members, he or she is more willing to engage in disclosure. In addition, relationship satisfaction as a coping resource can directly affect emotional distress, which is consistent with the result of the study on dyads coping with cancer and other chronic diseases: reciprocal and supportive relationships can confer psychosocial benefits.[62,66] While perceived stress had an indirect effect on emotional distress through relationship satisfaction, this indirect effect operated only through patients' and family caregivers' own relationship satisfaction (actor effect). There are several potential explanations for the apparent actor effect. First, the items that assessed relationship satisfaction were essentially the individual's perception and evaluation of the specific relationship. Female family caregivers tend to position themselves as full-time caregivers, which leads them to take on excessive responsibility and experience high degrees of self-sacrifice and distress. However, depending on obligations, moral

Table 4

Indirect effects of patients' and caregivers' perceived stress on emotional distress via relationship satisfaction and distress disclosure in the APIMeM (*N* = 312 dyads).

Path	*β*	95% CI	*P*
Patient actor effect			
Perceived stress (PT)→Relationship satisfaction (PT)→Emotional distress (PT)	0.07	(0.06, 0.22)	0.001
Perceived stress (PT)→Distress-disclosure (PT)→Emotional distress (PT)	−0.05	(−0.16, −0.04)	0.005
Perceived stress (PT)→Relationship satisfaction (PT)→Distress-disclosure (PT)→Emotional distress (PT)	0.02	(0.01, 0.06)	0.013
Perceived stress (PT)→Distress-disclosure (CG)→Emotional distress (PT)	−0.10	(−0.14, −0.03)	0.001
Patient partner effect			
Perceived stress (CG)→Distress-disclosure (PT)→Emotional distress (PT)	−0.04	(−0.13, −0.01)	0.038
Perceived stress (CG)→Distress-disclosure (CG)→Emotional distress (PT)	−0.04	(−0.30, −0.08)	0.014
Perceived stress (CG)→Relationship satisfaction (CG)→Distress-disclosure (CG)→Emotional distress (PT)	0.01	(0.01, 0.03)	0.038
Caregiver actor effect			
Perceived stress (CG)→Relationship satisfaction (CG)→Emotional distress (CG)	0.07	(0.06, 0.20)	0.001
Perceived stress (CG)→Distress-disclosure (CG)→Emotional distress (CG)	−0.05	(−0.13, −0.03)	0.004
Perceived stress (CG)→Relationship satisfaction (CG)→Distress-disclosure (CG)→Emotional distress (CG)	0.01	(0.01, 0.04)	0.032
Perceived stress (CG)→Distress-disclosure (PT)→Emotional distress (CG)	−0.03	(−0.11, −0.01)	0.044
Caregiver partner effect			
Perceived stress (PT)→Distress-disclosure (CG)→Emotional distress (CG)	−0.12	(−0.15, −0.04)	0.000
Perceived stress (PT)→Distress-disclosure (PT)→Emotional distress (CG)	−0.04	(−0.15, −0.03)	0.011
Perceived stress (PT)→Relationship satisfaction (PT)→Distress-disclosure (PT)→Emotional distress (CG)	0.01	(0.01, 0.05)	0.018

APIMeM, actor partner interdependence mediation model; PT, patient, CG, caregiver; *β*, standardized estimate; CI, confidence interval.

Table 5

Comparison of models of dyadic relationships between couples (*N* = 256) and non-couples (*N* = 56).

Model	*χ²*	df	CFI	TLI	RMSEA	Δ*χ²*	Δ*df*	*P*
Model 1	36.689	37	0.992	0.991	0.067			
Model 2	26.884	18	0.975	0.926	0.056	9.805	19	0.957

Model 1: with all paths constrained to be equal; Model 2: with all paths allowed to vary.
CFI, comparative fit index; TLI, Tucker–Lewis index; RMSEA, root mean square error of approximation.

constraints, and the patient's health, the care and concern that the family caregivers showed to patients (that is, the patient's perceptions of the relationship) were inconsistent with the family caregiver's actual relationship satisfaction rating. This view confirms the relationship cost and return proposed in interdependence theory;[67] that is, the return on the relationship was positively correlated with relationship satisfaction, and the cost of the relationship was negatively correlated with relationship satisfaction. In addition, the fact that CRC is a disease experienced primarily by middle-aged and elderly people is potentially relevant (the mean age of the patients in this study was 58.551). Middle-aged and elderly people frequently interact with other family members and friends, and their emotions may be closely related to the company, assistance, and support they obtain from these relationships.

Finally, we explored whether the hypothesized model differed between couples and non-couples dyadic relationships. The results showed no significant differences in the model paths between couples and non-couples, which seemed inconsistent with our assumptions. We speculated that this might be due to the small sample size of non-couples ($N = 56$), which may not be sufficient to accurately reflect the true model paths for this type of dyadic relationship.

Implications for nursing practice and research

The present study has some theoretical and practical implications. First of all, the results of this study expand the application of the interdependence theory and stress and coping theory. The findings help researchers better understand the dyadic interaction between CRC patients and their family caregivers. Cancer coping is a dyadic process involving both the patient and the caregiver. Emotional distress in CRC patients and their family caregivers requires regular screening for early intervention. What's more, the findings contribute to a better understanding of the dyadic issues in the response to CRC and enterostomy, promote a broader improvement in the quality of cancer care, and refine individual and dyadic interventions. Medical staff can help CRC patients and their family caregivers reduce their perceived stress levels through meditation, relaxation training, or other methods. Both close family relationships and disclosure are important ways to relieve the emotional distress of the dyad. It's worth noting that a distinctive feature of the dyadic approach to patient care is the focus on dyadic health, rather than the individual patient or family caregiver. Specifically, it is necessary for clinicians and stoma nurses to evaluate patient-caregiver dyads experiencing a high level of perceived stress after diagnosis and surgery. Moreover, individual and dyadic interventions that target relationship satisfaction and disclosure may be useful for decreasing emotional distress and thus improving the health outcomes of patients and their family caregivers.

Limitations

There are several study limitations and future research directions that should be considered. First, this cross-sectional study design did not examine the changes over time in CRC enterostomy patients' and their family caregivers' perceived stress, relationship satisfaction, distress disclosure and emotional distress; thus, the directionality of relationships cannot be inferred. A longitudinal study design is necessary to confirm these findings in future research. Second, patients with different cancer trajectories had different receptions and emotional responses to enterostomy, which also accordingly affected their family caregivers. However, we did not collect data on patients' cancer stage and severity, so our results are not powerful enough to explain emotional distress in patients with different cancer trajectories. Additionally, another limitation is whether the RAS can accurately capture the satisfaction of non-couple dyadic relationships. Due to the lack of tools for non-couple relationship satisfaction, we changed the word "partner" in the RAS to "family caregiver" and "patient" to measure the relationship satisfaction between patients and family caregivers. Although we tested the internal consistency of the

modified RAS and the Cronbach α of the RAS reached an acceptable critical level,[68] this still raised concerns about whether the RAS can accurately measure non-couple relationship satisfaction, the selection of tools for this variable should be cautious in the future. Moreover, the result that the hypothesized model in our study does not differ between couples and non-couple dyadic relationships may be due to the small sample size of our non-couple dyadic relationships, which may limit the generalization of this conclusion. In the future, we should further compare the differences between couples and non-couples in the dyadic relationships in the model when the sample size is sufficient. Last, the model tested in this study was limited because other factors (e.g., family structure, social support, personal resilience) may affect relationships between the study variables. Due to collaboration issues and time constraints, we cannot exhaust all potential confounders in this study; thus, a more rigorous study design including randomization, restriction, and matching should be adopted to actively control or exclude confounding variables.

Study strength

This is the first known study to explore the relationship between perceived stress, relationship satisfaction, distress disclosure, and emotional distress in CRC enterostomy patients and their family caregivers in China. In addition, this study adopted the APIMeM design to explore the mediating role of relationship satisfaction and distress disclosure. To our knowledge, this is also the first study to show that relationship satisfaction and distress disclosure might be a protective factor associated with reduced emotional distress in CRC enterostomy patients and their family caregivers at a dyadic level. The present study adds to the growing body of literature that examines the dyadic impact of patients and their family caregivers' responses to cancer events and reinforces the importance of conceptualizing cancer events as a common stressor in clinical settings.

Conclusions

This study highlighted that the perceived stress, relationship satisfaction, and distress disclosure of patients and their family caregivers are key factors that can be considered for improving emotional distress; furthermore, it partially confirms the interdependence of patients with CRC enterostomy and their family caregivers. The interdependence (actor-partner) effect of distress disclosure was significant, and the actor effects of perceived stress and relationship satisfaction were more powerful than the partner effects, which indicated that the intervention focusing on reducing each person's perceived stress and enhancing dyadically relationship satisfaction and distress disclosure may be the most effective way to decrease emotional distress. Our findings also provide empirical evidence for dyadic-based cognitive behavioral interventions that can focus on positive cognitive reappraisal and interpersonal efficacy (relationship and disclosure) therapies to improve emotional distress in patients and their family caregivers.

Ethics statement

The study was approved by the Ethics Committees of Nanjing Medical University (IRB No. 2018–21). All participants provided written informed consent.

Data availability statement

The data that support the findings of this study are available from the corresponding author, Y Jin, upon reasonable request.

CRediT authorship contribution statement

Yanfei Jin: Conceptualization, Methodology, Data curation, Formal analysis, Writing. **Xuying Li and Hongmei Ma**: Conceptualization, Methodology, Data collection, Writing – Original and Revised draft preparation. **Lina Xiong, Mengshu Zhao and Honghong Wang**: Formal analysis, Writing – Revised draft preparation, Data curation. All authors had full access to all the data in the study, and the corresponding author had final responsibility for the decision to submit for publication. The corresponding author attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted.

Declaration of generative AI and AI-assisted technologies in the writing process

No AI tools/services were used during the preparation of this work.

Declaration of competing interest

The authors declare no conflict of interest.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.apjon.2024.100580.

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