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Promoting Post-Traumatic Growth in Colorectal Cancer Patients: Exploring the Role of Social Support through a Chain Mediation Model

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ABSTRACT

Colorectal cancer (CRC) poses significant physical and psychological challenges that necessitate an exploration of factors influencing post-traumatic growth (PTG) for patient well-being. This study aims to investigate the effects of positive psychological capital (PsyCap) and perceived stress on mediating the social support-PTG relation among 673 CRC patients. Social support, positive PsyCap, perceived stress, and PTG were assessed through questionnaires. The results indicated a direct prediction effect of social support on PTG (LICI = 0.481, ULCI = 0.644), with the direct effect being 59.5%. Both positive PsyCap and perceived stress exerted a mediating role in the correlation between social support and PTG, with the mediating effects occupying 29.4% (LICI = 0.217, ULCI = 0.343) and 5.7% (LICI = 0.030, ULCI = 0.082), respectively. Positive PsyCap further had a chain mediating effect on perceived stress (LICI = 0.031, ULCI = 0.074)), with the chain effect accounting for 5.4%. The total impact of social support on PTG was 100% (LICI = 0.882, ULCI = 1.008). This model underscores the pivotal role of social support in promoting PTG in CRC patients. Positive PsyCap serves as a crucial mediator in the social support-PTG link, with perceived stress playing a sequential mediating role. These findings suggest that strengthening social support networks and cultivating positive PsyCap may reduce perceived stress and promote the development of PTG in CRC patients. Consequently, intervention programs are recommended to improve the psychosocial well-being of CRC patients.

KEYWORDS

Social support; positive psychological capital; perceived stress; mediating effect; post-traumatic growth

Introduction

Colorectal cancer (CRC) ranks the 3rd place among cancers globally with regard to its morbidity and takes the 2nd place among factors inducing cancer-associated mortality. In 2018, over 1.8 million newly diagnosed cases together with 881,000 CRC-associated death cases were reported [1]. Surgery is an efficient therapeutic strategy. Patients encounter different challenges induced by surgery, diagnosis and imaging disease resulting from the stoma, including emotional stress, invasive medical treatment, and disturbed life trajectory or sense of identity [2]. Regardless of the above difficulties, many CRC patients show personal growth and resilience after treatment. Such a phenomenon is called post-traumatic growth (PTG), indicating positive psychological alterations taking place among people with traumatic disease or injury [3,4].

PTG can take five forms, namely, new possibilities, close relations, personal strength, spiritual development, and great life appreciation [5]. Various articles examined factors

related to PTG, particularly in cancer patients. One factor worth noting is social support, that is, the material and psychological resources of the social network that contribute to the stress-coping capability of one person [6]. Social support is regarded as an important resource that helps individuals cope with the challenges posed by cancer and thus buffers against psychological distress and facilitates positive psychological outcomes [7]. In addition, a study of 217 female victims of intimate partner violence indicated that social support played a vital role in actively seeking personal solutions after experiencing a traumatic incident of intimate partner violence, and the research showed that having higher levels of social support was linked to higher levels of PTG [8]. Also, as revealed by a study of 1236 Chinese cancer survivors, social support was a critical predictor of PTG such that survivors having further social support might develop increased levels of PTG [9]. PTG among male rectal cancer patients is related to their perceived social support, while interventions targeting social support for single or non-religious men may promote their PTG [10]. In addition, receiving social support from family and friends was strongly related to PTG among arthritis patients [11]. Based on the literature reviewed, we propose that social support would positively predict levels of PTG among CRC patients in the current study.

Positive psychological capital (PsyCap) is one of the mediators investigated in this work. According to positive psychology, positive PsyCap indicates the positive psychological state of development with the features of optimism, self-efficacy, resilience and hope [12]. Social support directly and positively affects the level of positive PsyCap in cancer patients [13,14], and focusing on patients' social support is an effective method to enhance colorectal patients' psychological resilience [15]. Also, as discovered by Yang et al., resilience regulated the relation of perceived social support with post-traumatic stress disorder (PTSD) from one study involving 489 early kidney cancer and bladder cancer cases. Among them, Resilience and hope show partial mediating effects between social support and PTSD [16]. Furthermore, positive PsyCap had a role in mediating the relationship between family-work conflict and PTG among medical staff, according to a study conducted during the COVID-19 pandemic, in which family-work conflict reduced perceived social support and PsyCap, which further decreased both levels of PTG [17]. PTG occurred among oral cavity cancer patients, besides, hope and optimism showed a positive relation with PTG [18]. Consequently, the hypothesis is proposed: positive PsyCap would mediate the relation of social support with PTG among CRC cases.

Another focus of this work is the effect of perceived stress on mediation. Perceived stress is the degree of situations in a person's life rated as overwhelming, uncontrollable or unpredictable [19]. CRC patients often have increased stress because of the demands of treatment, uncertainty about the future, and lifestyle changes. Studies have shown that increased perceptions of family dimension in participants significantly reduce the perceived stress levels and that multidimensional social support interprets 11% of the overall variance of perceived stress [20]. In a study of 402

health workers conducted during the COVID-19 pandemic, resilience can regulate the relation of perceived social support with work stress. Through promoting resilience and social support, the negative mental health risks among healthy workers were reduced [21]. Staff members involved in preventing and controlling epidemics within a community often experience high levels of perceived stress. The implementation of a robust social support system is expected to positively reduce their stress levels, with sleep quality and psychological resilience serving as mediators in this association [22]. Among breast cancer patients, global stress is negatively correlated with PTG, whereas positive growth during the 6-month follow-up assessment is related to reduced stress subsequently [23]. Refugees with a history of multiple traumas seeking care at outpatient clinics reported PTG, and PTG was negatively correlated with post-migration stressors, including unemployment, low social integration and weak social networks [24]. Therefore, social support may positively influence positive PsyCap, which may in turn negatively affect perceived stress, which ultimately leads to PTG. Social support may function as a catalyst by enhancing individuals' psychological resources, which in turn influence their perceived pressure and facilitate their ability to grow and thrive after a traumatic experience. Therefore, we propose that perceived stress mediates the relationship between social support and PTG, and positive PsyCap and perceived stress together have a chain effect on social support and PTG.

To recap, for investigating the mechanism underlying social support and PTG, the current work focuses on the chain mediating model, and tests the hypotheses below: (1) social support would significantly positively predict PTG in CRC patients; (2) positive PsyCap independently mediated association of social support with PTG; (3) perceived stress plays an independent mediating role in social support with PTG; and (4) positive PsyCap and perceived stress play chain mediating roles in social support with PTG.

Methods

Participants

In this study, we used convenience sampling. Following the approval from the Ethics Committee of Xuzhou Medical University and the acquisition of informed consent from CRC patients, questionnaires were collected through three approaches: gathering data from (1) the ostomy clinics of Affiliated Hospital of Xuzhou Medical University, (2) telephone and home follow-up interviews with discharged patients, and (3) colorectal patients' WeChat groups from hospitals in Xuzhou. Individuals whose durations of illness were fewer than 6 months and those who were taking antidepressants or anxiety medication at the time of the investigation were not involved. In addition, participants who were unable to take care of themselves or had a history of mental illness or intellectual disability were also excluded from this study. There were a total of 725 subjects completing questionnaires. After those giving fixed answers and missing data were eliminated, a total of 673 valid questionnaires were valid, which was equivalent to an

effective rate of 92.8%. Participants were 348 females and 325 males; 26 aged 18–30, 48 aged 31–40, 144 aged 41–50, 257 aged 51–60, and 198 aged 61 or over; 383 lived in urban areas, 78 lived in urban-rural fringe, and 212 lived in rural area; 402 were with no stoma, 221 were with temporary stoma, and 50 were with permanent stoma.

Research Tools

Perceived social support scale (PSSS)
PSSS was used to investigate the social support of CRC patients. This scale was developed by Zimet et al. and translated into the Chinese version in 1996 [25]. The PSSS consists of 3 domains: support from friends, family, and significant others, with 4 items in each domain. Scores range from 1 (strongly disagree) to 7 (strongly agree). Higher scores indicate that patients feel more social support.

Positive PsyCap questionnaire (PPQ)
Participants' positive psychological resources or strengths were measured by the PPQ. The PPQ was formulated by Luthans et al. and was adapted to a Chinese version by Zhang in 2010 [26]. PPQ includes a total of 26 questions and seven points. The questionnaire includes four factors self-efficacy, optimism, hope, and resilience. The PPQ shows adequate internal consistency reliabilities (αs range from 0.76 to 0.86) and the overall positive PsyCap is with an α of 0.90. In addition, the questionnaire also has good construct validity. The factor loadings of all items are above 0.50 (the average is 0.64) and the item discrimination is above 0.60 (the average is 0.71). Moreover, the discriminant validity of each sub-questionnaire is good.

Perceived stress scale (PSS)
The PSS accounts for the psychological measure for assessing the level of individual perceived stress. It was developed by Sheldon Cohen in 1994 and has become an extensively applied instrument to measure subjective perceived stress [27]. The PSS was compiled into a Chinese version in 2003. The PSS consists of 14 items. Participants are needed to rate all items with a 5-point Likert-type scale ranging from 1 to 5, which indicates how frequently they have experienced certain thoughts and feelings in the given timeframe. The scale covers positive together with negative aspects of stress, which address feelings of being overwhelmed, the ability to cope, and the perception of control over life events.

PTG inventory (PTGI-C)
The PTGI-C of the Chinese version is primarily adopted for assessing positive results reported by people experiencing traumatic events. It was originally compiled by Tedeschi et al. [28], and Wang translated it into Chinese and adjusted the content in 2011 as well as validated it with patients with bone tumors. In terms of the total scale, its Cronbach's alpha is 0.91. Meanwhile, it has five dimensions (n = 21 items): interpersonal relationship (n = 7), new possibilities (n = 5), life appreciation (n = 3), personal strength (n = 4), and spiritual change (n = 2). A 6-point scale is used. Each item is rated between 0 ("not at all") and 5 ("very much"),

and the total scores are 0–105, with greater scores representing higher PTG levels of patients.

Statistical Analysis
SPSS 25.0 was employed for statistical analyses. Descriptive statistics were employed to present variable characteristics. Internal consistency reliabilities were assessed using Cronbach's alpha, where 0.70 was identified as acceptable, 0.80 as good, and 0.90 as excellent. We also applied the Harman single-factor test for assessing common method bias, and less than 40% of the standard threshold value was used as the cutoff in the current study. We used Pearson correlation analysis for calculating zero-order correlations between social support, positive PsyCap, perceived stress, and PTG. Influence degree or regression coefficients among the variables was examined with multiple regression analysis. PROCESS macro (Model 4, 6) in SPSS 25.0 was used to measure mediating effects.

Results

Internal consistency and common method bias
Cronbach's alpha was used for assessing the inner consistencies of questionnaires, with the greater coefficient indicating stronger internal consistency. Cronbach's alpha values of PSSS, PPQ, PSS and PTGI-C were 0.90, 0.95, 0.89 and 0.93 separately. With alpha values above 0.80 being preferred, these results indicated adequate internal consistency reliabilities in our data. According to the Harman single-factor test, the characteristic roots of the 16 factors were >1, besides, the principle factor interpreted 31.1% of overall variance, <50% of the threshold, showing the absence of severe common method bias.

Statistical description and correlation analysis
From Table 1, the scores of social support, positive PsyCap, perceived stress, and PTG were 54.755 ± 15.074, 123.143 ± 29.747, 38.658 ± 10.298, 58.172 ± 18.945, respectively. Based on Pearson bivariate correlation results, (1) social support showed significant positive relation to positive PsyCap, perceived stress, and PTG, respectively; (2) positive PsyCap exhibited significant positive relation to perceived stress and PTG; and (3) perceived stress exhibited positive relation to PTG. The corresponding significant *p*-values between the four variables were all less than 0.05, which indicates that there were significant correlations between the four variables investigated.

Linear regression among variables
We used linear regression for examining predictive associations between variables through regression equations, which enabled us to estimate the relations between the variables under study. Table 2 displays the analysis results. Effect of social support on positive PsyCap was 1.391 (LICI = 1.285, ULCI = 1.497), that of positive PsyCap on PTG was 0.200 (LICI = 0.157, ULCI = 0.242), and that of social support on PTG was 0.563 (LICI = 0.481, ULCI = 0.644). These results show positive associations between each pair of the examined variables. Moreover, the effect of social

TABLE 1

Average, standard deviation, and correlation coefficient of each variable

	Mean	SD	1	2	3	4
1. Social support	54.755	15.074	–			
2. Positive PsyCap	123.143	29.747	0.705**	–		
3. Perceived stress	38.658	10.298	−0.522**	−0.548**	–	
4. PTG	78.187	18.954	0.752**	0.717**	−0.565**	–

Note: **At the level of 0.01, the correlation is significant.

TABLE 2

Analysis of regression relation of variables

		B	SE	t	LICI	ULCI
Indirect effect	social support → positive PsyCap	1.391	0.054	25.753	1.285	1.497
	social support → perceived stress	−0.183	0.03	−6.045	−0.243	−0.124
	positive PsyCap → perceived stress	−0.124	0.015	−8.101	−0.155	−0.094
	perceived stress → PTG	−0.294	0.052	−5.704	−0.395	−0.193
	positive PsyCap → PTG	0.200	0.021	9.297	0.157	0.242
Direct effect	social support → PTG	0.563	0.042	13.544	0.481	0.644
Total effect	social support → PTG	0.945	0.032	29.551	0.882	1.008

Note: *B*: unstandardized coefficients; SE: standard error; LICI: lower bounds of the 95% confidence interval; ULCI: upper bounds of the 95% confidence interval.

TABLE 3

Analysis results of the mediating effect of positive PsyCap

	PTG			Positive PsyCap			PTG		
	B	SE	t	B	SE	t	B	SE	t
Constant	6.422	1.816	3.536**	46.959	3.068	15.305**	−4.671	1.936	-2.413*
Social support	0.945	0.032	29.551**	1.391	0.054	25.753**	0.616	0.041	14.896**
Positive PsyCap							0.236	0.021	11.265**
R^2	0.566			0.497			0.635		
F	873.250			663.204			582.000		

Note: *$p < 0.05$, **$p < 0.01$. B: unstandardized coefficients; SE: standard error.

support on perceived stress was −0.356 (LICI = −0.400, ULCI = −0.312), that of positive PsyCap on perceived stress was −0.190 (LICI = −0.212, ULCI = −0.168), while that of perceived stress on PTG was −0.294 (LICI = −0.395, ULCI = −0.193). These results indicate the negative associations between each pair of the examined variables. Therefore, Hypothesis 1 was supported.

Mediating effect of positive PsyCap
The mediating effect of positive PsyCap between social support and PTG was analyzed. As displayed in Table 3, social support significantly and directly affected PTG (t = 29.551, $p < 0.01$), and social support significantly and directly affected positive PsyCap (t = 25.753, $p < 0.01$). After addition of both social support and positive PsyCap in

regression equation, social support still significantly affected PTG (t = 14.860, $p < 0.01$), while positive PsyCap remained to statistically positively affected PTG (t = 11.265, $p < 0.01$). In line with the formula (a×b/c) used for calculating effect proportion, positive PsyCap partially mediated the relation of social support with PTG, which explained 34.8% of total effect. Therefore, Hypothesis 2 was supported.

Mediating effect of perceived stress
As seen from Table 4, social support significantly and directly affected PTG (t = 29.551, $p < 0.01$) and perceived stress (t = −15.833, $p < 0.01$). After adding the above two variables into this regression equation, social support still significantly affected PTG (t = 22.115, $p < 0.01$), while perceived stress statistically and negatively predicted PTG (t = −8.369,

TABLE 4

Analysis results of the mediating effect of perceived stress

	PTG			Perceived stress			PTG		
	B	SE	t	B	SE	t	B	SE	t
Constant	6.422	1.816	3.536**	58.166	1.278	45.517**	31.856	3.497	9.110**
Social support	0.945	0.032	29.551**	−0.356	0.023	−15.833**	0.789	0.036	22.115**
Perceived stress							−0.437	0.052	−8.369**
R^2	0.566			0.272			0.607		
F	873.250			250.672			516.572		

Note: *$p < 0.05$, **$p < 0.01$. B: unstandardized coefficients; SE: standard error.

TABLE 5

Bootstrap analysis of mediation effect significance test

Affect the path	Effect	Boot SE	Boot LLCI	Boot ULCI	Effect (%)
Total effect	0.945	0.032	0.882	1.008	100%
Direct effect	0.563	0.042	0.481	0.644	59.5%
Social support → positive PsyCap → PTG	0.278	0.031	0.217	0.343	29.4%
Social support → perceived stress→ PTG	0.054	0.013	0.030	0.082	5.7%
Social support → positive PsyCap → perceived stress→ PTG	0.051	0.011	0.031	0.074	5.4%

Note: Effect: effect size of mediation model; Boot SE: bootstrap standard error; Boot LLCI: lower bounds of the 95% bootstrap Interval; Boot ULCI: upper bounds of the 95% bootstrap Interval.
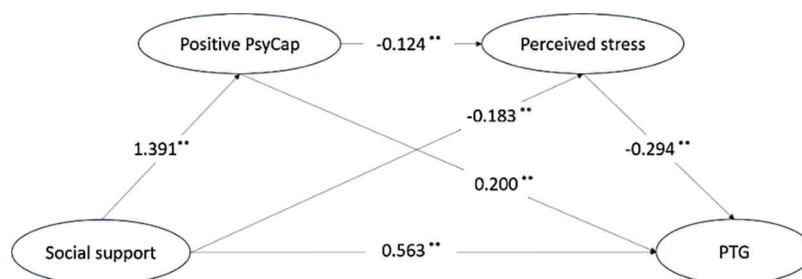

FIGURE 1. Chain mediation model of social support and PTG. Note: **$p < 0.01$.

$p < 0.01$). Perceived stress could partially mediate the relation of social support with PTG, which interpreted 16.5% of total effect. Therefore, Hypothesis 3 was supported.

Chain mediating effect of positive PsyCap and perceived stress We utilized Bootstrap approach of deviation correction for testing chain mediating effects of positive PsyCap and perceived stress on social support and PTG. To be specific, we randomized 5000 Bootstrap samples for estimating indirect effect. Table 5 displays 95% confidence intervals of every path in Bootstrap sampling test. When 0 was not incorporated, statistical significance was observed in mediating effect. Besides, 0 was not included in 95% confidence intervals for 3 influence paths, suggesting that positive PsyCap exerted the statistical mediating effect (B = 0.278 (LICI = 0.217, ULCI = 0.343)), and the intermediary effect accounts for 29.4%. Perceived stress had obvious mediating effect (B = 0.054 (LICI = 0.030, ULCI = 0.082)), and the intermediary effect accounts for 5.7%. Positive

PsyCap exerted the obvious chain mediating effect on perceived stress (B = 0.051 (LICI = 0.031, ULCI = 0.074)), and the intermediary effect accounts for 5.4%. Fig. 1 displays the model diagram. Therefore, Hypothesis 4 was supported.

Discussion

Our results highlight the positive correlation of social support with PTG among individuals dealing with CRC, underscoring that social support is important as a precious resource for navigating challenges posed by this condition. Such findings conform to a body of existing studies involving cancer patients [29], hospitalized patients [30], and Syrian refugee women [31]. Importantly, the study shows that perceived social support significantly contributes to PTG, providing valuable insights that can inform the development of improvement plans and the provision of mental health and PTG services for trauma survivors. The potential of social

support to elevate levels of PTG is underpinned by its multifaceted contributions. Social support functions as a wellspring of both material and emotional assistance and fosters a nurturing environment that instills a profound sense of security [32]. In the supportive backdrop, social support mediates the adverse impacts of exposure to traumatic events as well as the corresponding negative consequences. Such improvements help people redirect the focus out of negative events, and positively reassess the possibility emerging from the traumatic events. Therefore, it helps people start the transformative journey and probe into the deep significance of the adverse situation, finally realizing PTG [33]. The above results provide more insights into the correlation of social support with PTG in CRC and highlight the deeper significance of such association, illustrating a way for growth and resilience in people experiencing great challenges.

The direct relationship of social support with PTG is extensively recognized. Nonetheless, the chain mediating effects of positive PsyCap and perceived stress were detected in our enrolled CRC cases. The original relation in the complicated chain mediating effect focuses on positive PsyCap, comprising 4 pivotal components: self-efficacy, hope, optimism and resilience [26]. In the context of the challenges of a complicated disease like CRC, PsyCap is critical for connecting social support with PTG. Previous studies have indicated that strong social support leads to positive PsyCap among people, like refugees [34] and job seekers [35]. Patients with strong social support networks also tend to develop and maintain hope [36], providing them with a sense of purpose and a belief in the possibility of recovery. A study among patients with type 2 diabetes discovered that social support showed a positive relationship to self-efficacy, and self-efficacy exerted a significant mediating role between social support and psychological outcomes [37]. Optimism, as a mediator, played a regulating role in the relationship between social support and peripartum depression [38]. This intricate interplay underscores the significance of not only the presence of social support but also the quality and nurturing nature of this support. Such factors directly influence the development of PsyCap in CRC patients. In this study, there exists a significant positive association between positive PsyCap and PTG, conforming to the research among medical workers [39] and patients with mechanical valve replacement [40], further confirming the mediating role of positive PsyCap between social support and PTG of CRC patients. Based on these results, it is important for social support to affect PTG by enhancing positive PsyCap in CRC cases.

According to our results, it is important to enhance positive PsyCap in CRC cases so that social support has a positive effect on their PTG, moreover, it has become complicated if perceived stress is incorporated in step two during the process. CRC cases usually manage increased stress levels because of the complicated and demanding disease as well as its management [41,42]. Based on our results, social support has a direct effect on positive PsyCap and an indirect effect on mediating perceived stress, finally positively affecting PTG. The pattern can be detected in breast cancer patients [43,44]. Moreover, the lower stress level is tightly related to improvements in psychological outcomes and a higher probability of undergoing PTG [45]. The important effect of social support itself on decreasing stress should not be overstated, because social support includes emotional support, a profound security sense, and practical assistance, which are important for people who navigate the emotional rollercoaster in whom a cancer is diagnosed and treated. Through the active alleviation of perceived stress, support networks are crucial for strengthening PTG in CRC cases [46]. Further, in this work, it is feasible to establish a relation of positive PsyCap with perceived stress in chain mediating effect. Consequently, if the support offered to CRC cases and its relation with PTG are considered, the functions of positive PsyCap and perceived stress deserve more attention as the obvious "bridges" in the complicated mechanism.

The complicated chain mediating effect is of great practical significance, in particular in CRC treatment. It emphasizes that healthcare professionals and support networks are important for providing help and culturing psychological resources and mitigating stress, finally improving the post-trauma outcomes of patients. Consequently, our results are of great significance for practitioners in psychosocial interventions and clinical practice. Healthcare providers and support networks should prioritize the provision of social support to CRC patients and recognize its positive influence on PTG. Encouraging patients to build and maintain strong support systems can enhance their ability to address cancer-related challenges and foster their growth. Besides, interventions must pay more attention to the development and enhancement of positive psychological resources through psychoeducation and targeted interventions. Through enhancing positive PsyCap, healthcare professionals ensure that patients can efficiently use social support, mediate their stress, and direct their cancer journey with a higher sense of well-being and growth.

Nevertheless, it is crucial to recognize certain limitations inherent in the current study. The principal constraint is related to the dependence on the solitary-center questionnaire survey. To bolster our result generalizability, more samples are needed to replicate our results. As this work only enrolls CRC patients, our results should be interpreted with caution in other populations. For expediting the application of the model clinically, more studies emphasizing the development of practical implementation strategies are warranted. Through solving this problem, the applicability and practicality of our results are enhanced, thus ensuring the efficient use by healthcare professionals for improving patient outcomes.

Conclusion

To conclude, this study analyzed the correlation of social support with PTG in CRC cases and examined the mediating roles of positive PsyCap and perceived stress. Our findings demonstrate the significant effect of social support on enhancing PTG among these patients and highlight the importance of considering both internal psychological resources and external support systems in facilitating PTG

among CRC patients. Healthcare providers and support networks should concentrate on promoting positive PsyCap and reducing perceived stress levels through the provision of social support. Through enhancing social support networks and bolstering positive PsyCap, interventions and support programs can effectively reduce stress and facilitate the growth and well-being of individuals facing CRC.

Author Contributions: The authors confirm contribution to the paper as follows: study conception and design: Wenjing Yan; data collection: Xia Sun, Yang Li; analysis and interpretation of results: Wenjun Yan; draft manuscript preparation: Shuai Gong, Qin Li. All authors have viewed and approved the final version of the manuscript and approved its submission for publication.

Availability of Data and Materials: Dataset of this research can be accessed from the corresponding author upon reasonable request (Email: ywj1561@xzhmu.edu.cn).

Ethics Approval: The present study exclusively included human subjects and was approved by Ethics Committee of Xuzhou Medical University. Adhering to principles outlined in the Declaration of Helsinki, as well as national and institutional guidelines, the research rigorously ensured the informed consent of participants. The unique reference number for the granted ethics approval is XZHMU-2023081. All participants signed the informed consent in this study.

Conflicts of Interest: The authors declare that there are no conflicts of interest to report in this study.

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