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Analysis of Biological Stress Indices in Patients with Gastrointestinal Cancer Based on Perceived Stress Mediated by Rumination using Structural Equation Modeling

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Abstract

Background: Considering the prevalence of gastrointestinal cancer and its high mortality in Iran, it is necessary to investigate the causes and factors affecting the incidence of this disease.

Objective: This study aimed to analyze biological stress indices in patients with gastrointestinal cancer based on perceived stress mediated by rumination using structural equation modeling.

Materials and Methods: This study was conducted in the form of a descriptive correlational design based on structural equation modeling. The statistical population of this study (n=250) included all patients with gastrointestinal cancer referred to Reza-Mashhad hospital and Avicenna Hospital, Tehran, in 2020, and selected by convenience sampling method. The instruments used to collect the necessary data were the Perceived Stress Scale, Ruminative Responses Scale, and biological stress indices. The gathered data were analyzed in SPSS software (version 22) and AMOS software (version 22) using structural equation modeling and Pearson correlation statistical methods.

Results: The results showed that perceived stress directly affected rumination (β=0.45, P-value>0.001). Moreover, rumination had a direct effect on biological stress indices (β=0.30, P-value=0.001). Rumination played a mediating role in the relationship between perceived stress and biological stress indices (RMSEA=0.001; AGFI=0.93).

Conclusion: Considering that perceived stress and rumination were effective on biological stress of gastrointestinal patients, therapists must pay attention to modifying beliefs related to stress and rumination in the psychological health of gastrointestinal patients to improve the quality of life of such patients.

Keywords: Gastrointestinal neoplasms, Stress, Psychological

1. Introduction

Cancer is considered one of the leading global causes of mortality. After cardiovascular disease, cancer is the second leading cause of death in most countries. Among different cancers, gastrointestinal cancer is one of the leading causes of cancer death (1). In terms of incidence, gastric cancer is the fourth most common cancer and the second leading death cancer globally. The occurrence of this cancer in the world (especially in developed countries) is decreasing. In the United States, the incidence rate of this cancer has declined in recent decades (2). This trend has also been observed in Canada, decreasing from 18.4 to 9.5 per 100,000 people within 1984-2013. Although this cancer is not common in European countries, it is experiencing an increasing trend in Asian and developing countries (3).

In Iran, contrary to developed countries, the incidence of gastric cancer is increasing. This growing trend is particularly significant in the western part of Iran and is recognized as a problem. This increase has also been observed in other parts of the country (4). This cancer is of great importance in Iran and is one of the major health problems. According to the results of the latest research in Iran, gastric cancer with an incidence rate of 9.3% is the third most common cancer in the country in general among men and women. Considering the prevalence of this disease and the high mortality rate of gastric cancer in the country, it is necessary to investigate the causes and factors affecting this disease incidence (5).

Perceived stress is a psychological variable that can affect the biological index of stress. For a person who is under stressful conditions, it is important to assess stress levels and coping strategies. High, persistent, and prolonged stress can lead to inconsistencies in the

individual and cause physical and emotional problems, such as dissatisfaction, feeling of failure, anxiety, severe stress, frustration, defensive behaviors, depression, and poor life quality (6). There is strong evidence that stress can lead to different negative outcomes, such as physical illnesses, mental disorders, or burnout feelings (7). The development of the Perceived Stress Scale is based on the Lazarus evaluation concept. Psychological stress emphasizes the study and evaluation of possible damage caused by a confrontation with exciting environmental experiences. When the surrounding environment demands exceed individuals' set of coping resources, they are exposed to stress. In the psychological model of stress, it is emphasized that events only affect individuals who assess them as stressful (8).

The selected models of stress assessment are not only the product of environmental conditions or response variables but also the product of individuals' interpretations of their relationships with their surroundings. Different people react differently to chronic diseases, such as cancer (9). These reactions affect many factors, such as personality, adaptation skills, social support, nature of the disease, and the consequences of the disease on the quality of life and performance of the individual and depend on the amount of stress perceived by the patient. One of the issues that cancer patients are involved with is the stress and anxiety caused by exposure to and dealing with the disease (10). Stress originates from the relationship of a person and the environment that they perceive it threatening to their health. Therefore, stress is known as one of the causes of cancer, and one of the effects of this disease, which can lead to its exacerbation (11).

The results of a meta-analysis study conducted by Aldao et al. (12) showed that avoidance, rumination, and resentment (as a sideway) are associated with anxiety, depression, and eating disorders. Problem-solving has also a negative relationship with anxiety, depression, and an eating disorder. Lack of emotion regulation is considered a psychopathological factor in many other mental illnesses, such as borderline personality disorder, emotional trauma, hyperactivity disorder, anorexia, and bulimia (13). Rumination is a process of constant thinking about one's feelings and problems in the sense of certain content of thoughts. It is one of the important cognitive components in people with depression (14). One of the possible pathways through which rumination can cause depression in nonclinical populations is increasing negative problem orientation and avoidance problem-solving style. The findings of a study showed that each of the predictive variables of depression, rumination, and negative problem-solving orientation had an inverse relationship (15). Rumination response style is a kind of distress response through which a depressed or anxious person repeatedly and passively focuses on the symptoms of distress and its causes and consequences. These thoughts enter awareness non-administratively and divert the individual's attention from the current issues and objectives to the feelings of anxiety and its causes and consequences (16). Accordingly, this study aimed to analyze the structural equations of biological stress indices in patients with gastrointestinal cancer based on perceived stress mediated by rumination.

Objectives

This study aimed to analyze the structural equations of biological stress indices in patients with gastrointestinal cancer based on perceived stress mediated by rumination.

Materials and Methods

This study was conducted in the form of a descriptive correlational design based on structural equation modeling. The statistical population of this study consisted of all patients with gastrointestinal cancer referred to Imam Reza Hospital, Mashhad, Iran, and Avicenna Hospital, Tehran, Iran, in 2019. The subjects (n=250) were diagnosed with gastrointestinal cancer according to their medical record and selected using the convenience sampling method. According to Klein, if structural equation modeling is used, about 20 samples are required for each factor (latent variable). Regarding this, the minimum sample size of 200 is defensible (17). In this study, five main variables, including five independent variables and one dependent variable with the average of two components for each variable were investigated. According to Klein's theoretical foundations for sample selection, 20 samples for each component are needed. However, to control the probability of subject loss and achieve more validity, the sample size was increased to 250 cases.

In the present study, initially, the researchers negotiated with educational and therapeutic centers affiliated to Tehran University of Medical Sciences. After they obtained the approval of center authorities and the permission to conduct the research, they signed the ethical contract and collected the members of the sample group. Subsequently, the participants were explained briefly about the research process and the research plan questionnaires were distributed among them after obtaining their consent to participate in the study.

The subjects who had gastrointestinal cancer, were content to participate in the study, and lacked serious medical disease other than cancer, major psychiatric disorder, and substance dependency were entered into the study. The exclusion criteria were having psychiatric disorders, abusing drugs, and failing to answer all questions of questionnaires. In order to observe ethical consideration, all subjects were first explained about the purpose of the study. Afterward, they were assured about the confidentiality of their information. In this way, the confidentiality, preservation, and collective analysis of information were discussed. Finally, the contact number of the participant willing to be informed of the results of

the questionnaire were collected.

Perceived Stress Scale: This 14-item scale was developed by Cohen et al. (2004) and is scored on a 5-point Likert scale (none=0, low=1, medium=2, high=3, and very high=4). This instrument measures two subscales as well. The internal consistency coefficients of this scale were obtained using Cronbach's alpha coefficient in a range of 0.84 to 0.86 in two groups of students and a group of smokers in the Leave program. In a study on Japanese students, Mymura estimated the Cronbach's alpha coefficient of the original revised Japanese scale at 0.88 and 0.81, respectively (18). In the current study, Cronbach's alpha coefficients for positive and negative perceived stress were respectively calculated at 0.78 and 0.72.

Ruminative Responses Scale: Nolen et al. (1989) developed a self-assessment questionnaire that evaluated four different types of negative mood reactions. Response styles questionnaire is composed of two scales of rumination responses and distraction responses scale. The Rumination Responses Scale consists of 22 items scored on a 4-point Likert scale ranging from 1 (never) to 4 (most of the time) (19). Based on empirical evidence, the internal reliability of this tool was confirmed using Cronbach's alpha coefficient rendering the range of 0.88-0.99. Various researches showed that the test-retest correlation for this instrument was 67% (19). In this study, the reliability of these scales was appropriate, and their Cronbach's alpha was reported between 0.89 and 0.93.

Biological stress indices: Glucocorticoids play a complex role in response to stress, including mediation in response to current stress, inhibition of response to present stress, and body preparation for later stress. Glucocorticoid receptors are present in all tissues of the body and play a role in the volume of body fluids, cardiovascular system, inflammation and immune system, metabolism, sugar displacement, appetite, cognition, and fertility. Glucocorticoids can be measured in serum, urine, nails, and hair. Biological stress indicators include catecholamines, epinephrine and norepinephrine, dopamine, and inflammatory cytokines.

In this study, descriptive statistics, such as mean and standard deviation, were used to organize, summarize, and describe variables and patients' demographic information. Inferential statistics, structural equation modeling, and Pearson correlation statistical methods were applied to analyze the data in SPSS software (version 22) and AMOS software (version 22).

Results

The mean age of the participants was obtained as 57.17±13.39 years. The minimum and maximum ages were estimated at 32 and 83 years, respectively.

In this section, the correlation matrix is first reported since path analysis was the correlation matrix between variables. The obtained correlation coefficients among perceived stress, resilience and hardness scales, emotional regulation, and rumination were significant (P<0.05). The coefficients of skewness and kurtosis related to the distribution of the scores of research variables showed that due to normality, the research all variables had the absolute magnitude of the crooked coefficient less than

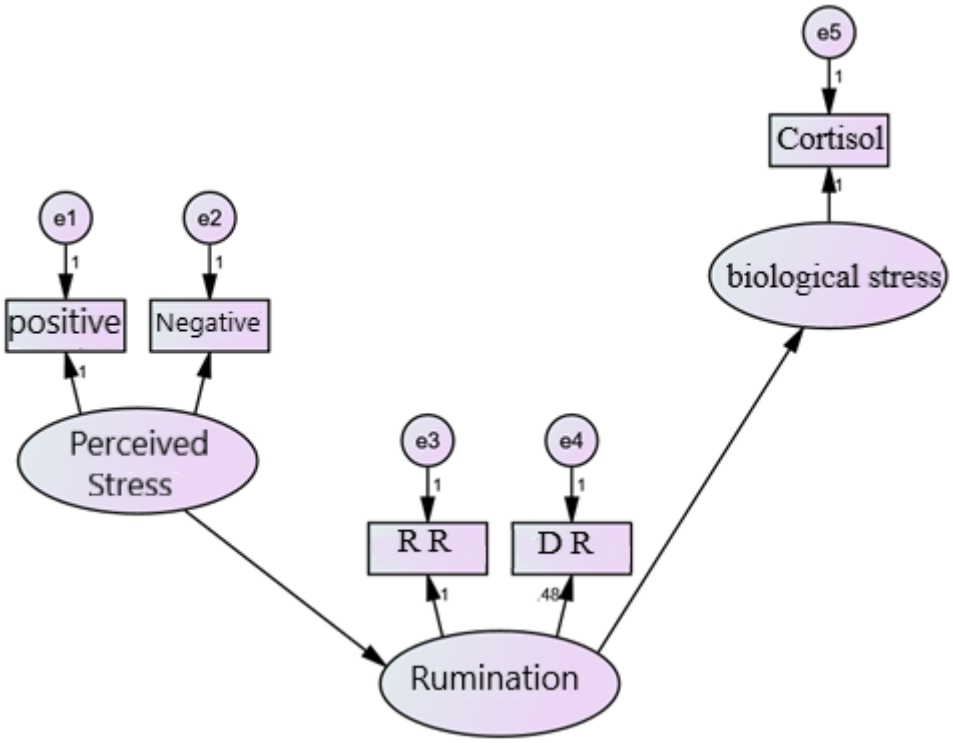

Figure 1. Conceptual model of research

three and the absolute value of the elongation coefficient was less than one.

Therefore, the violation of the normality of the data was not visible. In this respect, the distribution of research variables was normal. The obtained tolerance values for variables were above 0.10, indicating the absence of multiple linearities between variables. Furthermore, the amount of variance inflation factor obtained for variables was smaller than ten, showing that there were no multiple linearities between the variables. Figure 1 and Table 2 present the results of implementing the initial model in standard mode, along with some of the most important indicators of model grace. Table 2 shows their structural patterns, pathways, and standard coefficients in the final model of the present study.

The results of Table 2 showed that perceived stress had a direct effect on rumination and biological stress indicators, confirming the hypothesis about the relationship among perceived stress and rumination and biological stress indices with the confidence of >95%. To investigate the mediating contribution of rumination in the relationship between perceived stress and biological stress indices, bootstrap instructions were used, and the results were listed in Table 4.

As Table 3 shows, the indirect effect of perceived stress on biological stress indices was obtained as 0.11 (P-value=0.012).

The obtained results for these indicators showed that, in general, the model had a good status to explain and grace (Table 4).

Discussion

Based on the results, perceived stress directly affects rumination and biological stress indicators, confirming

Table 1. Descriptive statistics of research variables

Variables		M	SD	Min.	Max.
Perceived stress	Positive perception	15.51	2.84	5	23
	Negative perception	17.22	5.53	8	25
Rumination	Rumination responses	21.14	8.81	15	33
	Distracting responses	29.56	10.10	17	39
Biological stress indicators (cortisol)		26.81	32.94	1.80	149

Table 2. Coefficients and significant direct effect of exogenous variables, perceived stress on rumination (middle dependent), and biological stress indicators variable (main dependent)

Predicting variable	Criterion variable	B	β	t	P
Perceived stress	Rumination	0.65	0.45	10.26	0.001
Rumination	Biological stress indicators	0.23	0.30	4.20	0.001

Table 3. Estimation of indirect paths in the model using bootstrap

		Variables	B	β	Upper limit	Low limit	P
Predicting variable	Mediating variable	Criterion variable					
Perceived stress	Rumination	Biological stress indicators	0.149	0.117	0.239	0.002	0.012

Table 4. Model fit index

Index	Fit Indices	
	Value	Limit
$\frac{\chi 2}{df}$	0.60	Less than 3
RMSEA	0.001	Less than 0.1
CFI	0.95	More than 0.9
NFI	0.94	More than 0.9
GFI	0.92	More than 0.9
AGFI	0.93	More than 0.9

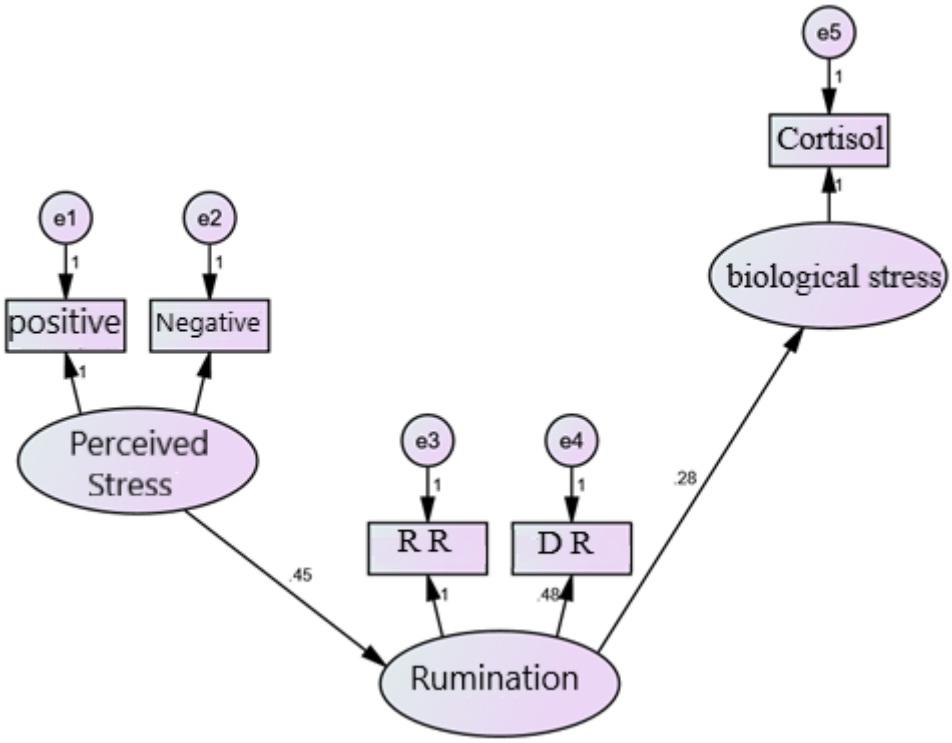

Figure 2. Perceived stress model and biological stress indicators with the mediating role of rumination (in standard mode)

the hypothesis on the relationship among perceived stress and rumination and biological stress indices with 95% confidence.

These results were in line with those of the researches performed by Li et al. (7). Accordingly, perceived stress was reported as the most important psychological disorder in patients with gastrointestinal cancer. The most important predictors of biological indices in these patients were determined as high anxiety sensitivity and perceived stress (13). Cancer is considered a fatal traumatic disease that its diagnosis can cause perceived stress in patients since such patients, experiencing one of the symptoms of stress, such as the sudden body temperature decrease, start concerning about the symptoms of the body. They also consider such symptoms the signs of disease aggravation, which eventually causes more perceived stress in them and increases biological states and stress perception. It becomes more than the states.

Cancer patients experience more worry and rumination since they suppress emotions that are stressed; however, emotion regulation strategies are used at the response level (emotional suppression) and do not allow emotions to be experienced. As a result, they experience more worry and rumination, which can result in the formation and deterioration of the disease. Rumination is defined as a subjective representation of stress without the presence of stressors. Researches indicate that rumination experience over time has many negative psychological and physical consequences, including physiological effects and psychological experience of stress without the presence of stressors (11). The results of the current study indicated that in case that emotions associated with perceived stress were not fully experienced and repressed, mental processes of rumination about stress and perceived stress would launch. These processes exacerbate stress symptoms in the person, resulting in physical illnesses; however, conscious people feel stressed completely at the psychological and physical level. They experience, do not deal with their feelings, are in contact with them, and accept them. Such people have higher levels of physical and psychological health, preventing them people from developing different diseases.

Since cancer patients consider upcoming situations more stressful and threatening than others, it is more likely that they are at risk of cancer. In other words, people with cancer assess situations and events more threateningly (5). Considering that cancer causes perceived stress in patients, it seems that perceived stress is associated with a disease, the way to deal with emotions evoked by perceived stress is perceived, perceived stress is destructive if it mentally lasts with the launch of rumination, and therefore, with chronic physiological arousal, causes a devastating impact on health. In conclusion, perceived stress directly affects rumination and biological stress indicators.

One of the limitations of this research was the use of self-report tools. The subjects' feedback or opinions and self-report reported in these tests might be different from what can be seen in one's real action and behavior. Environmental and familial factors, such as family circumstances and economic and social conditions, were not controlled in this study. Another limitation of this study was related to the use of the correlation

method, which limits causal inference about the resulting relationships. Moreover, this study was conducted only on the population of patients with gastrointestinal cancer in Tehran; therefore, caution should be taken in generalizing the results to other regions and cities. It is suggested that this study be conducted in another sample group, and the results be evaluated and compared with the results of this study. It is also recommended that further studies be performed in the form of experimental research to investigate the effect of teaching different methods on biological indicators of stress, perceived stress, resilience, hardiness, emotional regulation, and rumination of patients with gastrointestinal cancer.

It is suggested that similar studies be conducted in other cities, and their results be evaluated. The examination of a larger population facilitates generalization to improve biological indicators of stress, perceived stress, resilience, hardiness, emotional regulation, and rumination of patients with gastrointestinal cancer. Conducting several types of research in different centers, a suitable platform for comparing the results and better application of these researches. Considering the relationship of resilience, hardiness, and emotional regulation with perceived stress and rumination in patients with gastrointestinal cancer, it is proposed that educational plans and courses be held to promote such skills among these patients. The other measure that can be adopted is specialist training by relevant organizations in improving biological indicators of stress perceived stress, resilience, hardiness, emotional regulation, and rumination in patients with gastrointestinal cancer.

Conclusion

Considering that perceived stress and rumination are effective on biological stress of gastrointestinal patients, therapists must pay attention to modifying beliefs related to stress and rumination in the psychological health of gastrointestinal patients to improve the quality of life of such patients.

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