



## Research Article

## Mediation Effect of Adaptation on the Quality of Life in Patients with Gastric Cancer Undergoing Gastrectomy: A Structure Equation Model

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## ARTICLE INFO

## Article history:

Received 26 June 2018

Received in revised form

27 December 2018

Accepted 2 January 2019

## Keywords:

models, structural  
quality of life  
stomach neoplasms

## SUMMARY

**Purpose:** This study aimed to develop a model for estimating the quality of life mediated by adaptation to changes experienced after stomach cancer diagnosis and surgery in patients with gastrectomy and to verify the model based on the Cancer Survivor Adaptation Model by Naus et al. (2009) and literature reviews.

**Methods:** Data was collected from 297 gastric cancer patients who underwent a gastrectomy at an outpatient clinic of two university hospitals in Daegu city from May to August, 2016. The exogenous variables were perceived gastrointestinal symptoms, self-efficacy, anxiety, social support, and spiritual well-being. The endogenous variables were adaptation and quality of life, and adaptation was the mediating variable. For data analysis, structural equation modeling was performed using IBM SPSS 21.0 and AMOS 18.0.

**Results:** The fitness parameters of the final model showed a reasonable fit to the data. Based on  $R^2$ , the exogenous variables explained 73.9% of the quality of life of stomach cancer patients who underwent surgery, through the mediation of adaptation; adaptation alone explained 73.5% of quality of life. Adaptation of stomach cancer patients with gastrectomy was a factor that strongly influenced their quality of life.

**Conclusion:** It is important for gastric cancer patients with gastrectomy to adapt well to changes after surgery in order to improve the quality of life. Nursing interventions to aid successful adaptation would ultimately exert positive influences and improve the patients' quality of life.

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## Introduction

Stomach cancer is the second most common cancer in Korea after thyroid cancer [1]. However, despite its high incidence rate, outcomes have greatly improved owing to increased early discoveries and the developments of various treatment methods, such as endoscopic mucosal resection, surgery, and chemotherapy; this has led to more than 30% increase in the 5-year survival rate of patients with stomach cancer in Korea in the past 20 years [1,2].

Among the various treatment methods for stomach cancer, gastrectomy with lymph node resection is a typical method that enables a radical resection of the cancer [2,3]. However, because of the resection of the stomach, patients must adhere to dietary restrictions, and they may experience various physical symptoms, such as loss of stomach storage capacity and pyloric sphincter

functions, early satiety after meals, reflux, vitamin B12 deficiency, dumping syndrome, and weight loss [2,3]. Because such symptoms are caused by permanent changes to one's physical structure and physiology, patients who have undergone gastrectomy continue to experience various symptoms caused by gastrectomy even after the successful completion of treatment for stomach cancer.

In addition, patients who have undergone surgery for stomach cancer feel anxious regarding its recurrence [4,5] and may experience difficulties in performing household chores and work-related activities and engaging in hobbies once they return to their homes and workplaces after treatment [6]. Moreover, they also experience stress owing to the stigma attached to cancer patients, with their family members or colleagues considering them weak and unable to function well [7]. It is also not uncommon for patients to experience spiritual hardships as they go through cycles of hope and despair due to the pain and discouragement arising from cancer as well as fear of death [8]. As such, patients undergoing surgery for stomach cancer experience various physical, psychological, social, and spiritual changes because of their diagnosis and surgery, and it is very important for them to adapt to these changes.

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Adaptation is a dynamic process in which humans interact with the environment. For patients with cancer, adaptation involves continued, dynamic cognitive evaluation of various changes that appear after they survive cancer and is a course in life during which they handle stress caused by cancer [9]. According to the cancer survivor adaptation (CSA) model [9], cancer patients adapt to changes they experience during cancer diagnosis and treatment. Individual cancer patients' physical, psychological, social, and spiritual characteristics influence the adaptation process in a continuous, integrative manner, and positive or negative outcomes of adaptation are reflected in their quality of life. In other words, even among cancer patients experiencing similar physical symptoms, those who have adapted well to physical changes can perform appropriate self-management of health, actively participate in daily lives by controlling their roles at home and in society, and manage their emotions about cancer; in turn, this can positively influence their quality of life [10–13].

Therefore, adaptation is expected to mediate the relationship between changes experienced after surgery and quality of life of patients with stomach cancer undergoing surgery, and it will be necessary to investigate how adaptation influences the quality of life of patients with stomach cancer undergoing gastrectomy. Although two Korean studies [12,13] that predicted the quality of life of patients with stomach cancer undergoing surgery have been reported, globally, studies that have predicted the same with adaptation as a mediating variable have been extremely limited.

The two previous studies predicted the quality of life of patients with stomach cancer undergoing surgery to be high at 70.2% [12] and 67.9% [13]. However, although health-promoting and self-care behaviors, which were used as mediating variables in these studies, influence physical and psychological adaptation [12,13], they cannot reflect adaptation from various other perspectives, including social and spiritual adaptation. Moreover, neither of the previous studies [12,13] investigated spiritual characteristics, although they defined the quality of life as an integrative concept combining physical, psychological, social, and spiritual factors. In addition, patients with stomach cancer who have undergone surgery experience many physical symptoms within a year, which may negatively influence their quality of life [2,14]. The fear of recurrence and sequelae of treatment are also known to negatively influence the patients' quality of life for up to 5 years after diagnosis [15]. However, the previous studies failed to include patients who underwent surgery within 1–5 years after gastrectomy.

Therefore, to gain a more comprehensive understanding of the quality of life of patients with stomach cancer undergoing surgery, it is necessary to analyze the mediating effects of adaptation on the quality of life from various perspectives, including physical, psychological, social, and spiritual characteristics. It is also necessary to expand the scope of analysis to patients who just underwent surgery and to those who underwent surgery within 5 years after gastrectomy because the quality of life is influenced by many aspects during this period.

Accordingly, this study aims to establish a model to investigate how physical, psychological, social, and spiritual characteristics of patients with stomach cancer undergoing surgery influence their quality of life through the mediation of adaptation, based on previous findings and the CSA model. Essentially, this study seeks to comprehensively understand the quality of life of patients with stomach cancer undergoing surgery from multiple perspectives.

#### *Theoretical foundation and hypothetical model*

We developed a theoretical foundation based on the CSA model of Naus et al [9] and conducted a literature review to establish a

model to predict the quality of life of patients with stomach cancer undergoing surgery with adaptation as a mediating variable.

According to the CSA model [9], patients with cancer have internal and external characteristics composed of physical, psychological, social, and spiritual factors, with the experience of cancer diagnosis and treatment serving as the background; these characteristics influence adaptation in a continuous and integrative manner. Adaptation of patients with cancer involves the interaction of individual memories of experiences and current goals. Positive adaptation in patients with cancer leads to improved coping mechanisms and altruism, as well as the ability to sympathize, perceive their own health status, understand the meaning of cancer, and conduct positive self-evaluation, all of which ultimately positively influence their quality of life. In contrast, negative adaptation causes patients with cancer to focus on appearance and become anxious regarding physical changes, which in turn causes reduced functioning in daily life and gives rise to other anxieties, all of which negatively influence their quality of life [9].

Based on a literature review, the following individual characteristics were found to influence the quality of life of patients with stomach cancer undergoing surgery: perceived gastrointestinal symptoms, which are considered a physical characteristic [2,14]; self-efficacy [12,14,16] and anxiety [17,18], which are psychological characteristics; social support from family and medical staff [13,17], which are social characteristics; and spiritual well-being [18], which is a spiritual characteristic. Although adaptation involves cognitive evaluation, there exist few tools to measure the process of cognitive evaluation. Therefore, we set the result of adaptation, which is an outcome of cognitive evaluation, as the mediating variable and assumed that it manifests as the quality of life.

Finally, we set the hypothetical model with the assumption that perceived gastrointestinal symptoms, self-efficacy, anxiety, social support, and spiritual well-being are exogenous variables that can directly influence not only adaptation but also the quality of life, which is the final variable, of patients with stomach cancer undergoing surgery through the mediation of adaptation.

## **Methods**

### *Study design*

This study seeks to establish a structural equation model of the quality of life of patients with stomach cancer undergoing surgery with adaptation as a mediating variable and to test the goodness of fit of the model and hypothesis.

### *Setting and sample*

The participants were patients who underwent surgery for stomach cancer at A and B university hospitals located in Daegu Metropolitan City and were followed up as outpatients. Among patients who underwent surgery for stomach cancer within five years of the initial treatment, the participants who were recruited were those who (1) had no recurrence or metastasis; (2) did not have cancer in any other organ; (3) did not have any history of psychiatric diseases or cognitive disorders; and (4) were older than 18 years, understood the purpose of the study, and voluntarily consented to participate. Participants who underwent gastrectomy for other diseases in the past were excluded.

In structural equation modeling, sample sizes of 200–400 are usually recommended to test the model. Based on the recommendation that the ratio between sample size and free parameters should be 20:1 [19], the present study recruited 320 participants to account for dropouts due to outlier variables and omissions of answers on questionnaires. All questionnaires were returned, and

23 participants were eliminated to exclude outliers; in total, 297 participants' data were analyzed.

### Measurements

#### Perceived gastrointestinal symptoms

To measure perceived gastrointestinal symptoms, we used the tool modified and supplemented by Jeon [6] by adding questions of Nakamura et al on insufficiency experienced after surgery to the Gastrointestinal Symptom Rating Scale developed by Svedlund et al. The tool consists of 17 questions: 15 on the subdomains of abdominal pain, reflux symptoms, dyspepsia, diarrheal symptoms, and constipation-related symptoms and 2 questions not belonging to any subdomain. The questions are scored on a 7-point Likert scale from no discomfort (1) to very serious discomfort (7), and higher scores indicate that the respondent has experienced many symptoms.

Cronbach's  $\alpha$  was .80 at the time of development, .87 in Jeon's study [6], and .88 in the present study.

#### Self-efficacy

Self-efficacy was measured using the self-efficacy tool developed by Oh and modified and supplemented by Kim and Tae [13]. The tool consists of eight questions scored on a 5-point Likert scale, from strongly disagree (1) to strongly agree (5). Higher scores indicate higher self-efficacy.

Cronbach's  $\alpha$  was .86 at the time of development, .86 in the study by Kim and Tae [13], and .76 in the present study.

#### Anxiety

Anxiety was measured using the anxiety subscale from the Hospital Anxiety and Depression Scale initially developed by Zigmond and Snaith, which was translated into Korean and standardized by Oh et al [20]. The tool consists of seven questions scored on a 4-point Likert scale, from none (0) to serious (3), with higher scores indicating higher levels of anxiety. The scores for negatively worded questions were calculated in reverse.

Cronbach's  $\alpha$  of the anxiety subscale was .80 at the time of development, .89 in the study by Oh et al [20], and .89 in this study.

#### Social support

Social support was measured using Kang's social support tool modified and supplemented by Han et al [21]. The tool consists of six questions under two domains of support from family and medical staff. The questions are scored on a 5-point Likert scale from very dissatisfied (1) to very satisfied (5), and higher scores indicate higher levels of social support.

Cronbach's  $\alpha$  was .82 at the time of development [21] and .88 in this study. In this study, Cronbach's  $\alpha$  of support from the family domain was .90 and .91 from the medical staff domain.

#### Spiritual well-being

Spiritual well-being was measured using the spiritual well-being tool developed by Paloutzian and Ellison and translated into Korean by Choi [22]. The tool consists of 20 questions under the categories of existential and religious spiritual well-being. The questions are scored on a 4-point Likert scale from strongly disagree (1) to strongly agree (4), and the scores for negatively worded questions were calculated in reverse. Higher scores indicate higher levels of spiritual well-being.

Cronbach's  $\alpha$  was .93 at the time of development, .91 in Choi's study [22], and .90 in this study. At the time of tool

development, Cronbach's  $\alpha$  of each domain was .78–.87. In this study, Cronbach's  $\alpha$  of the existential spiritual well-being domain was .89 and that of the religious spiritual well-being domain was .84.

#### Adaptation

Adaptation was measured using the self-report psychosocial adaptation tool developed initially by Derogatis and Lopez for patients with cancer, summarized by Van Wert, and modified and supplemented by Kim [23]. The tool consists of 46 questions belonging to the following 7 domains: overall health management, occupational environment, family environment, extended family relationship, leisure environment, psychological pain, and sexual life. The questions are scored on a 5-point Likert scale from strongly disagree (1) to strongly agree (5). Higher scores indicate higher levels of psychosocial adaptation.

Cronbach's  $\alpha$  was .56–.86 at the time of development, .87 in Kim's study [23], and .94 in the present study. In this study, Cronbach's  $\alpha$ 's of the overall health management, occupational environment, family environment, extended family relationship, leisure environment, psychological pain, and sexual life domains were .87, .78, .81, .73, .88, .90, and .97, respectively.

#### Quality of life

We obtained the Korean version of the European Organization for Research and Treatment of Cancer Quality of Life Questionnaire-C30, version 3.0 developed to measure the quality of life of patients'. The tool consists of 28 questions belonging to the functional domain comprising overall health and physical, role-related, cognitive, emotional, and social functions and the symptomatic domain comprising fatigue, pain, and changes in appetite. As it also includes two questions assessing the overall health and quality of life, the tool consists of a total of 30 questions measured on Likert scales [24]. The functional and symptomatic domains are scored from strongly disagree (1) to strongly agree (4). Questions assessing overall health and quality of life are scored from strongly disagree (1) to strongly agree (7), and higher scores indicate higher responses. Therefore, the functional domain and quality of life questions indicate better function and quality of life with higher scores. In contrast, higher scores in the symptomatic domain indicate more symptoms, and lower scores indicate better quality of life [24]. In the present study, the scores for questions in the symptomatic domain were calculated in reverse.

Cronbach's  $\alpha$  of the Korean version of the European Organization for Research and Treatment of Cancer Quality of Life Questionnaire-C30, version 3.0 was .60–.87 at the time of development [24]. In this study, Cronbach's  $\alpha$ 's of the functional, symptomatic, and overall health and quality of life domains were .88, .87, and .81, respectively.

#### Ethical considerations

This study was conducted in accordance with the approval obtained from Keimyung University's institutional review board (Approval no. 40525-2016-01-HR-111-02). The potential participants received an explanation about all aspects of the study. Participation was completely voluntary, and there was no disadvantage with refusing to participate. Those who agreed to voluntarily participate signed written consent forms before data collection.

## Data collection

Data were collected between May and August, 2016. Patients who met the inclusion criteria were informed of the study purpose and methods. Those who voluntarily consented to participate were asked to complete structured questionnaires, which were collected in person. The participants' disease-related characteristics were collected through electronic medical records after obtaining approval from the IRBs at each university hospital. To evaluate weight loss after surgery, the participants' weight was measured in outpatient clinics on the day the questionnaires were completed. This weight was then compared with the weight measured when the patients were hospitalized for surgery.

## Data analysis

The collected data were analyzed using IBM SPSS, version 21.0, and AMOS, version 18.0 (IBM Corp., Armonk, NY, USA). Variables related to the participants' general and disease-related characteristics were analyzed in terms of descriptive statistics. The reliability of each tool was tested using Cronbach's  $\alpha$ , and construct validity was analyzed through confirmatory factor analysis. The correlation between measurement variables was assessed with Pearson's correlation coefficient, and multicollinearity was analyzed using tolerance and variation inflation factor (VIF).

The normality of the sample was analyzed in terms of mean, standard deviation, skewness, and kurtosis using the maximum likelihood method to assume multivariate normality. To evaluate the model's goodness of fit,  $\chi^2$ ,  $Q(\chi^2/df)$ , root mean square residual (RMR), root mean square error of approximation (RMSEA), comparative fit index (CFI), goodness of fit index (GFI), incremental fit index, and Tucker–Lewis index (TLI) were used.

Regression coefficient, standard error, standardized coefficient, critical ratio, and  $p$  values were used to test the significance of paths in the structural equation model. Bootstrapping was used to test the statistical significance of the direct, indirect, and total effects of the model.

## Results

### Demographic characteristics

The mean age of the 297 participants was 63.18 years. Among them, 64.3% were male, 33.0% had graduated from high school, 62.0% followed religions, 59.3% were unemployed, and 76.1% were married. The participants lived with an average of two other family

members. Regarding monthly family income, 39.0% of the participants reported less than 1,000,000 KRW. Among the participants, 65.7% did not have support from private insurance for their cancer treatment and 57.9% did not have any other accompanying disease.

The participants were surveyed 2.67 years after surgery. On average, 74.1% had stage 1 stomach cancer, 76.8% underwent subtotal gastrectomy for gastric reconstruction, and 70.0% were being followed up as outpatients without any adjuvant therapy. Open abdominal surgery was performed in 50.8% of the participants, whereas laparoscopic or robotic surgery was performed in 49.2% of participants. On average, the participants lost 5.84 kg of body weight after surgery; however, 37.4% lost less than 5 kg.

### Descriptive statistics and confirmatory factor analysis of measurement variables

Table 1 shows the descriptive statistics and normality test results of the measurement variables used in this study. According to the univariate normality test, skewness ranged between  $-1.22$  and  $1.54$ , whereas kurtosis ranged between  $-1.15$  and  $2.70$ ; as the absolute values did not exceed 3 for skewness and 10 for kurtosis, the conditions for univariate normal distribution were satisfied [19]. As the samples size and univariate normality test results satisfied the requirements for univariate normality, parameters were estimated through the maximum likelihood method [19].

### Analysis of correlation and review of multicollinearity between major variables

Table 2 demonstrates correlation and multicollinearity between measurement variables. When the average variance was extracted and the multiple correlation coefficient of the major variables was compared, the correlation coefficients between latent variables of the measurement model ranged between  $-.68$  and  $.78$ ; as the absolute values of the correlation coefficients were all below  $.85$ , the multiple correlation coefficient was found to be small, thus indicating that the model can reliably distinguish between factors [19].

In the present study, tolerance ranged between  $.39$  and  $.80$ , with VIF ranging between  $1.25$  and  $2.59$ ; therefore, there was no issue with multicollinearity [19].

### Test of the hypothetical model

Before testing the hypothetical model, a confirmatory factor analysis model was established to evaluate the validity of the components; the coefficient of goodness of fit was within the

**Table 1** Descriptive Statistics and Normality Test of Measured Variables ( $N = 297$ ).

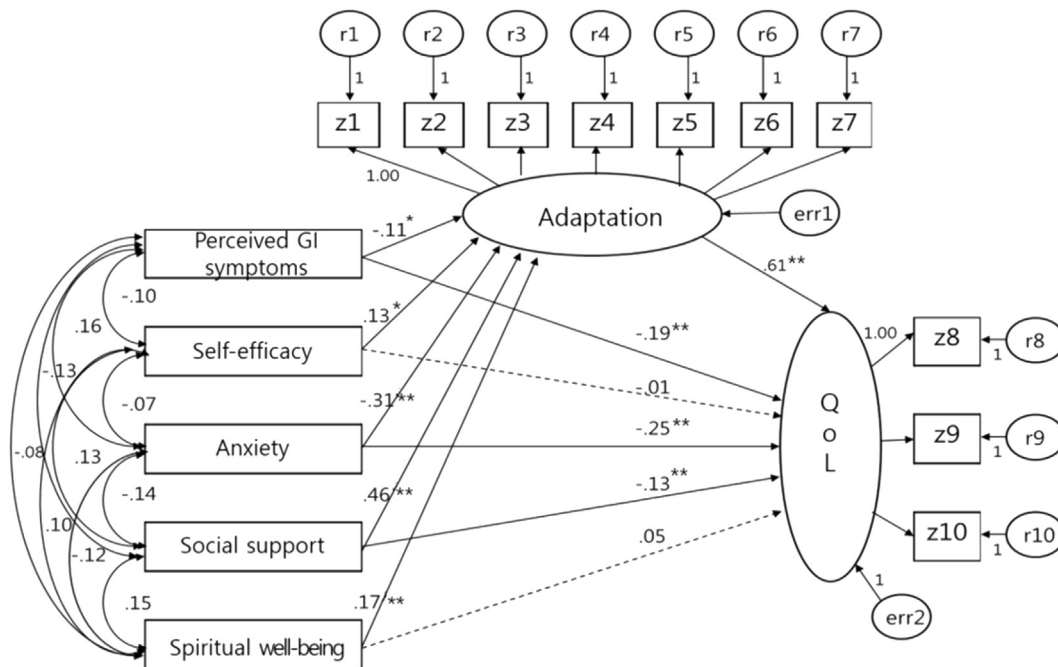
| Variables                           | Measurement                    | Range | M $\pm$ SD      | Skewness | Kurtosis | AVE |
|-------------------------------------|--------------------------------|-------|-----------------|----------|----------|-----|
| Perceived gastrointestinal symptoms |                                | 1–7   | 1.71 $\pm$ 0.72 | 1.54     | 2.58     | —   |
| Self-efficacy                       |                                | 1–5   | 4.19 $\pm$ 0.58 | –1.22    | 2.70     | —   |
| Anxiety                             |                                | 0–3   | 0.53 $\pm$ 0.54 | 1.19     | 1.14     | —   |
| Social support                      |                                | 1–5   | 4.15 $\pm$ 0.71 | –0.53    | –0.30    | —   |
| Spiritual well-being                |                                | 1–4   | 2.76 $\pm$ 0.53 | 0.32     | 0.18     | —   |
| Adaptation                          | Overall health management      | 1–5   | 4.12 $\pm$ 0.62 | –0.62    | 0.61     | .65 |
|                                     | Occupational environment       | 1–5   | 3.57 $\pm$ 0.63 | 0.40     | –0.26    |     |
|                                     | Family environment             | 1–5   | 3.92 $\pm$ 0.65 | –0.18    | –0.43    |     |
|                                     | Extended family relationship   | 1–5   | 3.89 $\pm$ 0.79 | –0.30    | –0.52    |     |
|                                     | Leisure environment            | 1–5   | 3.36 $\pm$ 0.82 | –0.15    | 0.08     |     |
|                                     | Psychological pain             | 1–5   | 4.07 $\pm$ 0.67 | –0.04    | –1.15    |     |
|                                     | Sexual life                    | 1–5   | 3.65 $\pm$ 0.64 | 0.40     | –0.21    |     |
| Quality of life                     | Functional domain              | 1–4   | 3.39 $\pm$ 0.51 | –1.01    | 1.11     | .67 |
|                                     | Symptomatic domain             | 1–4   | 3.23 $\pm$ 0.52 | –0.80    | 0.59     |     |
|                                     | Overall health/Quality of life | 1–7   | 4.82 $\pm$ 1.07 | –0.10    | 0.00     |     |

Note. AVE = average variance extracted; M  $\pm$  SD = mean  $\pm$  standard deviation.

**Table 2** Correlation and Multicollinearity Between Measurement Variables ( $N = 297$ ).

| Variables                              | 1      | 2      | 3      | 4     | 5     | 6     | 7 | Tolerance | VIF       |
|--|--------|--------|--------|-------|-------|-------|---|-----------|-----------|
| 1. Perceived gastrointestinal symptoms | 1      |        |        |       |       |       |   | .78       | 1.28      |
| 2. Self-efficacy                       | -.24** | 1      |        |       |       |       |   | .80       | 1.25      |
| 3. Anxiety                             | .41**  | -.21** | 1      |       |       |       |   | .60       | 1.66      |
| 4. Social support                      | -.25** | .33**  | -.37** | 1     |       |       |   | .57       | 1.77      |
| 5. Spiritual well-being                | -.20*  | .32**  | -.42** | .39** | 1     |       |   | .69       | 1.46      |
| 6. Adaptation                          | -.42** | .43**  | -.63** | .71** | .55** | 1     |   | .39       | 2.59      |
| 7. Quality of life                     | -.52** | .32**  | -.68** | .47** | .47** | .78** | 1 | .39–.80   | 1.25–2.59 |

Note. VIF = variation inflation factor. \* $p < .01$ , \*\* $p < .001$ .

**Figure 1.** Effect analysis in the hypothetical model.

Note. Perceived GI symptoms = perceived gastrointestinal symptoms; QoL = quality of life; z1 = overall health management; z2 = occupational environment; z3 = family environment; z4 = extended family relationship; z5 = leisure environment; z6 = psychological pain; z7 = sexual life; z8 = functional domain; z9 = symptomatic domain; z10 = overall health/quality of life.

\* $p < .05$ , \*\* $p < .001$ .

recommended range, demonstrating that the model was appropriate. The model had a relatively low goodness of fit, with  $\chi^2 = 248.04$  ( $p < .001$ ),  $\chi^2/df = 3.35$ , RMR = .03, RMSEA = .09, GFI = .90, adjusted goodness of fit index (AGFI) = .84, normed fit index (NFI) = .89, TLI = .88, and CFI = .92. According to path analysis of the hypothesis, among a total of 11 paths, the following 2 paths were not significant: path from self-efficacy to quality of life ( $\beta = -.01$ ,  $p = .770$ ) and path from spiritual well-being to quality of life ( $\beta = .05$ ,  $p = .312$ ) (Figure 1).

The paths that were found to be nonsignificant in the hypothetical model were removed, and the error terms between the following domains of adaptation were connected through modification index (MI): between “overall health management” and “leisure environment” (MI = 12.97), between “family environment” and “extended family relationship” (MI = 12.68), and between “overall health management” and “occupational environment” (MI = 7.66) (Table 3).

#### Test of final model and estimation of path coefficients

When the goodness of fit of the modified model was tested, all coefficients except  $\chi^2$  were appropriate:  $\chi^2 = 212.11$  ( $p < .001$ ),  $\chi^2/df = 2.91$ , RMR = .03, RMSEA = .08, GFI = .92, AGFI = .86, NFI = .91,

TLI = .91, and CFI = .94. As the modified model had an improved goodness of fit, it was selected as the final model (Table 4).

All nine paths were statistically significant in the final model. Perceived gastrointestinal symptoms ( $\beta = -.13$ ,  $p = .004$ ), self-efficacy ( $\beta = .13$ ,  $p = .002$ ), anxiety ( $\beta = -.32$ ,  $p < .001$ ), social support ( $\beta = .45$ ,  $p < .001$ ), and spiritual well-being ( $\beta = .17$ ,  $p < .001$ ) explained 73.5% of adaptation. Perceived gastrointestinal symptoms ( $\beta = -.16$ ,  $p < .001$ ), anxiety ( $\beta = -.21$ ,  $p < .001$ ), social support ( $\beta = -.17$ ,  $p = .007$ ), and adaptation ( $\beta = .73$ ,  $p < .001$ ) explained 73.9% of quality of life (Figure 2).

#### Analysis of the effects of the final model

Table 5 shows direct, indirect, and total effects of the final model. Perceived gastrointestinal symptoms (total effect =  $-.13$ ,  $p = .004$ ) and anxiety (total effect =  $-.32$ ,  $p < .001$ ) exerted significant negative effects on adaptation, whereas self-efficacy (total effect =  $.13$ ,  $p = .002$ ), social support (total effect =  $.45$ ,  $p < .001$ ), and spiritual well-being (total effect =  $.17$ ,  $p < .001$ ) exerted significant positive effects.

Perceived gastrointestinal symptoms, self-efficacy, anxiety, social support, spiritual well-being, and adaptation were found to exert significant influences on the quality of life. As perceived

**Table 3** Modified Index for Error Term Connections ( $N = 297$ ).

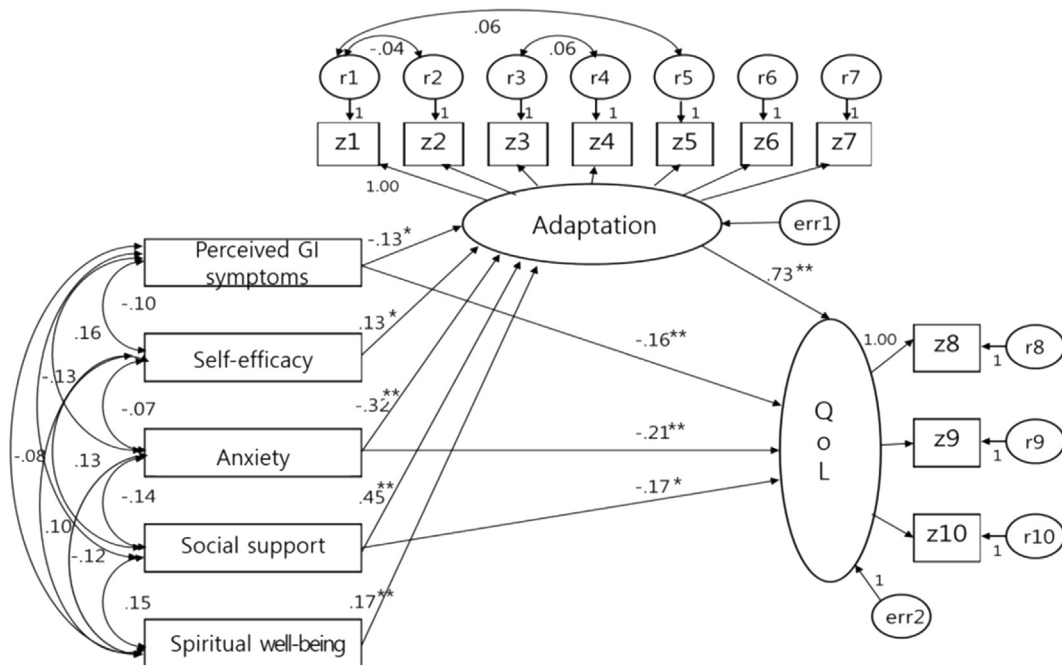
| Error term connections |   |            |  | MI    |
|------------------------|---|------------|--|-------|
| Z1                     | ↔ | Z5         | Between “overall health management” and “leisure environment”      | 12.97 |
| Error term             |   | Error term |  |       |
| Z3                     | ↔ | Z4         | Between “family environment” and “extended family relationship”    | 12.68 |
| Error term             |   | Error term |  |       |
| Z1                     | ↔ | Z2         | Between “overall health management” and “occupational environment” | 7.66  |
| Error term             |   | Error term |  |       |

Note. MI = modification index.

**Table 4** Fit Index of Hypothetical Model and Final Model ( $N = 297$ ).

| Model              | $\chi^2$ ( $p$ )      | $\chi^2/\text{df}$ | RMR        | RMSEA      | GFI        | AGFI       | NFI        | TLI        | CFI        |
|--------------------|-----------------------|--------------------|------------|------------|------------|------------|------------|------------|------------|
| Criteria           | $p > .05$             | $\leq 3.00$        | $\leq .05$ | $\leq .08$ | $\geq .90$ | $\geq .85$ | $\geq .90$ | $\geq .90$ | $\geq .90$ |
| Hypothetical model | 248.04 ( $p < .001$ ) | 3.35               | .03        | .09        | .90        | .84        | .89        | .88        | .92        |
| Final model        | 212.11 ( $p < .001$ ) | 2.91               | .03        | .08        | .92        | .86        | .91        | .91        | .94        |

Note. AGFI = adjusted goodness of fit index; CFI = comparative fit index; df = degree of freedom; GFI = goodness of fit index; NFI = normed fit index; RMR = root mean square residual; RMSEA = root mean square error of approximation; TLI = Tucker–Lewis index.

**Figure 2.** Effect analysis in the modified model.

Note. Perceived GI symptoms = perceived gastrointestinal symptoms; QoL = quality of life; z1 = overall health management; z2 = occupational environment; z3 = family environment; z4 = extended family relationship; z5 = leisure environment; z6 = psychological pain; z7 = sexual life; z8 = functional domain; z9 = symptomatic domain; z10 = overall health/quality of life.

\* $p < .05$ , \*\* $p < .001$ .

**Table 5** Standardized Direct, Indirect, and Total Effects for Hypothetical Model ( $N = 297$ ).

| Endogenous variables | Exogenous variables                 | Direct effect ( $p$ ) | Indirect effect ( $p$ ) | Total effect ( $p$ ) | SMC ( $R^2$ ) |
|----------------------|-------------------------------------|-----------------------|-------------------------|----------------------|---------------|
| Adaption             | Perceived gastrointestinal symptoms | -.13 (.004)           | —                       | -.13 (.004)          | .735          |
|                      | Self-efficacy                       | .13 (.002)            | —                       | .13 (.002)           |               |
|                      | Anxiety                             | -.32 (<.001)          | —                       | -.32 (<.001)         |               |
|                      | Social support                      | .45 (<.001)           | —                       | .45 (<.001)          |               |
|                      | Spiritual well-being                | .17 (<.001)           | —                       | .17 (<.001)          |               |
| Quality of life      | Perceived gastrointestinal symptoms | -.16 (<.001)          | -.09 (.003)             | -.25 (<.001)         | .739          |
|                      | Self-efficacy                       | —                     | .10 (<.001)             | .10 (<.001)          |               |
|                      | Anxiety                             | -.21 (<.001)          | -.24 (<.001)            | -.45 (<.001)         |               |
|                      | Social support                      | -.17 (.007)           | .33 (<.001)             | .16 (<.001)          |               |
|                      | Spiritual well-being                | —                     | .13 (.002)              | .13 (.002)           |               |
|                      | Adaptation                          | .73 (<.001)           | —                       | .73 (<.001)          |               |

Note. SMC = squared multiple correlation.

gastrointestinal symptoms exerted a negative direct effect ( $\beta = -.16, p < .001$ ) and a negative indirect effect through adaptation ( $\beta = -.09, p = .003$ ) on the quality of life, the total effect was negative ( $\beta = -.25, p < .001$ ). Anxiety exerted a negative direct effect ( $\beta = -.21, p < .001$ ) and a negative indirect effect through adaptation ( $\beta = -.24, p < .001$ ) on the quality of life, with the total effect being negative as well ( $\beta = -.45, p < .001$ ). Although social support exerted a negative direct effect on the quality of life ( $\beta = -.17, p = .007$ ), it exerted a positive indirect effect through adaptation ( $\beta = .33, p < .001$ ); therefore, the total effect was positive ( $\beta = .16, p < .001$ ). Self-efficacy (total effect = .10,  $p < .001$ ) and spiritual well-being (total effect = .13,  $p = .002$ ) exerted positive indirect effects on the quality of life through adaptation, whereas adaptation exerted a positive direct effect on the quality of life (total effect = .73,  $p < .001$ ).

## Discussion

The present study established and tested a model based on the CSA model [9] and a literature review to investigate the paths and effects of factors that influence the quality of life of patients with stomach cancer undergoing surgery, using adaptation as a mediating variable. Perceived gastrointestinal symptoms were considered to be physical characteristics of patients with stomach cancer undergoing surgery, whereas self-efficacy and anxiety were the psychological characteristics. Social support from family members and medical staff were the social characteristics, and spiritual well-being was the spiritual characteristic. Using adaptation as a mediating variable, a hypothetical model to explain the quality of life of patients with stomach cancer undergoing surgery was established.

In the final model, which used adaptation as a mediator, perceived gastrointestinal symptoms, self-efficacy, anxiety, social support, and spiritual well-being explained 73.9% of the quality of life of patients with stomach cancer undergoing surgery and adaptation alone explained 73.5% of the quality of life.

It is difficult to simply compare the explanatory power between the results of previous studies and the result of this study because of the differences in number of participants and the kinds of variables. In spite of such problems, comparison of the results of this study with the results of previous studies is as follows. The power of findings of this study was slightly lower than that (79.2%) reported in the previous model of quality of life, which used health-promoting behaviors as mediating variables [12]. However, it is important to note that the study of Oh and Hong [12] was reported in 1996. Now, compared to 20 years ago, the 5-year survival rate of patients with stomach cancer has improved by more than 30% [1], and patients with stomach cancer undergoing surgery are often regarded as those with chronic diseases [9]. Therefore, the said study has limitations in explaining the quality of life of patients with stomach cancer of present day undergoing surgery, and it is thus difficult to compare the models solely based on explanatory power.

Compared to the explanatory power of 67.9% reported in a model of quality of life of patients with stomach cancer undergoing surgery used in a recent study conducted in 2014 [13], our model had a higher explanatory power and revealed the following characteristics. In the final model of this study, we expanded the scope to include those who underwent surgery within 5 years after the initial treatment because these individuals are known to be afraid of recurrence until complete remission and suffer from sequelae of treatment, which can influence their quality of life [15]. Moreover, although spiritual characteristics are major factors that can explain the quality of life of patients with cancer [18], the previously mentioned study [13] did not include such variables in their quality of life model; therefore, we included

spiritual characteristics in our model. However, most important of all, despite good treatment results, patients with gastric cancer undergoing gastrectomy inevitably experience permanent physical changes. In addition, psychological, social, and spiritual factors influence the adaptation process in a continuous, integrative manner, and adaptation are reflected in the quality of life. Therefore, we chose a comprehensive perspective of adaptation, which is a factor influencing physical and psychological adaptation and was used as a mediating variable in a previous study, as a mediating variable, rather than self-care behaviors [12,13]. According to this study, self-efficacy and spiritual well-being, which are psychological characteristics, did not have a direct effect on the quality of life but had indirect effects through adaptation. Thus, in the structural model of this study, adaptation is an important parameter to gauge the quality of life in patients with gastric cancer who underwent gastrectomy. In other words, this study's final model improved the power to explain the quality of life of patients with stomach cancer undergoing surgery when compared to the model reported in a previous study [13] through more comprehensive and multidisciplinary research that has physical, psychological, social, and spiritual values.

We found that the quality of life of patients with stomach cancer undergoing surgery was influenced most by adaptation, followed by anxiety, perceived gastrointestinal symptoms, social support, spiritual well-being, and self-efficacy. Adaptation of patients with stomach cancer undergoing surgery directly influenced their quality of life with a total effect of .73 ( $p < .001$ ); thus, it was a factor that strongly influenced the quality of life. Simultaneously, it influenced the quality of life as a mediating variable for anxiety, perceived gastrointestinal symptoms, social support, spiritual well-being, and self-efficacy. Perceived gastrointestinal symptoms, anxiety, and social support exerted direct and indirect effects through adaptation on the quality of life, whereas self-efficacy and spiritual well-being only exerted indirect effects through adaptation. In other words, we confirmed that adaptation to the diagnosis of stomach cancer and changes experienced after surgery for stomach cancer are factors that can influence patients' quality of life.

Such findings support the theory of Naus et al [9], suggesting that successful or unsuccessful adaptation to changes experienced during cancer diagnosis and treatment appear as differences in the quality of life of patients with cancer' quality of life. Through successful adaptation, patients with cancer can manage not only the physical symptoms they experience during cancer diagnosis and treatment but also their psychological and social changes to minimize the interference of cancer with their roles as parents, spouses, or professionals. This allows them to actively participate in their daily lives and manage their emotions regarding cancer, including hopelessness and guilt. These changes ultimately exert positive influences on their quality of life [9,18].

According to our findings, social support, anxiety, spiritual well-being, self-efficacy, and perceived gastrointestinal symptoms exerted direct effects on the adaptation of patients with stomach cancer undergoing surgery in the order presented, and they explained 73.5% of adaptation. Furthermore, social support, spiritual well-being, and self-efficacy exerted positive influences on the adaptation of patients with stomach cancer undergoing surgery, whereas perceived gastrointestinal symptoms and anxiety exerted negative influences.

First, social support, which was the variable with the strongest direct effect on adaptation, also exerted a direct effect on the quality of life as well as an indirect effect through adaptation. In particular, social support had the greatest correlation to family environment ( $r = .62, p < .001$ ) and overall health management ( $r = .60, p < .001$ ) among the subdomains of adaptation. Family environment includes

the relationship between the patient and his or her family members, as well as the family members' adaptation to the patient's disease. Overall health management refers to adaptation to the disease and treatment options [21]. In a crisis, when a patient gets diagnosed with cancer and is required to perform a new "disease task" [25], family members can understand and support the patient by adapting themselves to the disease and helping the patient effectively perform his or her "disease task." Moreover, medical staff can help patients with cancer adapt to such "disease tasks" by supporting them in adapting to the diseases and treatment methods. Nursing intervention from advanced practice nurses who are recognized by patients as care providers who know them best and are trustworthy [26] will be especially helpful.

Next, spiritual well-being and self-efficacy exerted positive direct effects on the adaptation of patients with stomach cancer undergoing surgery but only exerted indirect effects on the quality of life through adaptation. Spiritual well-being is attained by finding the purpose and meaning of life through interactions with a transcendental being, such as God, or through interactions between the self, neighbors, and the environment [22,27]. Therefore, rather than directly influencing the quality of life of patients with stomach cancer undergoing surgery, spiritual well-being is thought to help patients find the purpose and meaning of their lives and think in positive, hopeful ways, which would help them overcome the diagnosis and surgery and successfully adapt to the crisis, ultimately positively influencing their quality of life [18,22,25]. High self-efficacy, which allows patients to actively cope with their situations on their own [13], would help patients with stomach cancer undergoing surgery manage their perceived gastrointestinal symptoms and health effectively, thus leading to successful adaptation, which, as a result, would positively influence patients' quality of life [13,16]. Considering previous findings regarding the effectiveness of programs that promote self-efficacy of patients with cancer, introducing and implementing nursing intervention programs through individual education, phone consultations, and online education to improve the self-efficacy of patients with stomach cancer could promote successful adaptation and improve their quality of life [28].

In contrast to the aforementioned variables, anxiety and perceived gastrointestinal symptoms exerted negative direct effects on the adaptation and quality of life of patients with stomach cancer undergoing surgery and exerted indirect effects on the quality of life through adaptation. Anxiety in patients with cancer is defined as vague discomfort from worry, fear, and helplessness caused by unspecified risks experienced in dangerous situations involving cancer [17,20]. Therefore, higher anxiety in patients with stomach cancer undergoing surgery leads to difficulties in taking problem-centered approaches to face and cope with problems, thereby resulting in difficulties in adapting to changes experienced after the cancer diagnosis and surgery [17] and ultimately influencing the patients' quality of life. Moreover, as serious perceived gastrointestinal symptoms would increase stress in patients with stomach cancer undergoing surgery, they would find it difficult to adapt to previously unexperienced physical symptoms, which would also influence their quality of life [6,9]. Higher levels of anxiety and perceived gastrointestinal symptoms in patients with stomach cancer undergoing surgery can cause them to feel frustrated with themselves and their daily lives. This can influence and cause functional deficits in their family relationships, interpersonal relationships, and professional activities; these outcomes would then prevent successful adaptation, thereby negatively influencing the quality of life [4–9].

In particular, anxiety ( $F = 3.82, p = .005$ ) and perceived gastrointestinal symptoms ( $F = 3.82, p = .005$ ) differed significantly according to the participants' age, unlike other general and

disease-related characteristics. These two symptoms were highest in participants younger than 50 years and second highest in participants aged between 50 and 59 years. Such results are similar to previous findings, according to which younger patients experienced more symptoms and more anxiety than older patients with cancer [5]. Middle-aged patients prioritize economic or social activities owing to their roles and responsibilities at work and home [29]. Therefore, they are likely to feel anxious that they might experience difficulties in family and interpersonal relationships, as well as in their professional lives. Owing to this, they might become more sensitive to perceived gastrointestinal symptoms and find the symptoms more uncomfortable. However, in clinics, middle-aged patients with cancer cannot participate in group education or postdischarge education programs as often as individuals of other age groups can because they cannot make the time or are not relaxed enough because of their family and professional responsibilities. Accordingly, nursing interventions that can alleviate postsurgery anxiety and perceived gastrointestinal symptoms are necessary to help with the adaptation of patients with stomach cancer undergoing surgery; in particular, active nursing interventions should be provided to such middle-aged patients.

In conclusion, the present study established a model of quality of life of patients with stomach cancer undergoing surgery based on the CSA model [9] and a literature review while including physical, psychological, social, and spiritual characteristics. We confirmed that the variables of self-efficacy and spiritual well-being, which are known to have a significant effect on the quality of life of patients with gastric cancer undergoing gastrectomy, indirectly affect the quality of life through adaptation. Through this model, we tested the effects of adaptation as a mediating variable on the quality of life. In addition, as assisting the successful postoperative adaptation of patients with stomach cancer who have undergone gastrectomy is a way to improve their quality of life. In this study, perceived gastrointestinal symptoms and anxiety exerted negative effects on adaptation and quality of life, whereas self-efficacy, social support, and spiritual well-being exerted positive effects on adaptation and quality of life. Therefore, we suggest the necessity of strengthening social support, spiritual well-being, and self-efficacy and the reduction of anxiety and gastrointestinal symptom experiences. This study is significant in that it established a model with an improved explanatory power on the quality of life while overcoming the limitations of previous studies. The present study also prepared basic data that can contribute to establishing theories on the quality of life and adaptation to changes experienced after stomach cancer diagnosis and surgery in patients who undergo surgery for stomach cancer. In terms of nursing, this study will contribute to confirming the order in which nursing interventions should be prioritized to help patients' successful adaptation to changes caused by stomach cancer diagnosis and surgery to improve their quality of life, which is an important treatment index, and will be able to contribute to the development and provision of nursing intervention programs.

## Conclusion

Based on the CSA model and a literature review, the present study established a predictive model of quality of life in patients with stomach cancer undergoing surgery, using adaptation as a mediating variable while including physical, psychological, social, and spiritual characteristics; moreover, we also tested the paths between variables.

We confirmed that in patients with stomach cancer who experience permanent physical, psychological, social, and spiritual

changes, adaptation after gastrectomy exerts the strongest influence on the quality of life while also serving as an important mediating variable to explain the quality of life. Social support exerted the greatest influence on the adaptation of patients with stomach cancer undergoing surgery, followed by anxiety, spiritual well-being, self-efficacy, and perceived gastrointestinal symptoms. Therefore, nursing intervention programs that can improve social support, spiritual well-being, and self-efficacy while alleviating anxiety and perceived gastrointestinal symptoms should be developed and implemented to help patients with stomach cancer adapt successfully to changes caused by diagnosis and surgery. Such nursing interventions to aid successful adaptation would ultimately exert positive influences and improve the patients' quality of life.

The present cross-sectional study on patients with stomach cancer undergoing surgery could not confirm time-dependent differences in the relationships and effects of factors influencing adaptation and quality of life. Therefore, we suggest conducting longitudinal studies to confirm these aspects and studies that can develop and confirm the effects of nursing intervention programs on the successful adaptation of patients with stomach cancer undergoing surgery.

### Conflicts of interest

This article is a part of the doctoral thesis written by Lee, Kyung Eun. For the rest, there are no potential conflicts of interest.

### Acknowledgment

This article is a part of the doctoral written by Lee, Kyung Eun and approved by Keimyung University. The authors wish to express appreciation to the participants of this study.

### Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.anr.2019.01.001>.

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