

## Original Article

# Self-care and associated factors of patients with permanent colostomies: A structural equation model



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## ARTICLE INFO

## Keywords:

Self-care

Colostomy

Colorectal cancer

Structural equation model

## ABSTRACT

**Objective:** To investigate the structural relationships between eHealth literacy, health-promoting behaviors, depression, disease stigma, self-efficacy and self-care in Chinese patients with permanent colostomies.

**Methods:** A cross-sectional multi-stage random sampling study was conducted between October 2022 and July 2023. The study involved 280 participants with permanent colostomies recruited from four general hospitals in Yancheng City, China. Data were collected using a questionnaire package to assess model variables, including health-promoting behaviors, eHealth literacy, depression, disease stigma, self-efficacy and self-care. Structural equation modeling was employed to analyze the data.

**Results:** The model explained 81.8% of the total variance. Health-promoting behaviors ( $\beta = 0.41$ ,  $P < 0.001$ ), eHealth literacy ( $\beta = 0.16$ ,  $P < 0.001$ ), and depression ( $\beta = -0.17$ ,  $P < 0.001$ ) influenced self-care directly. On the other hand, health-promoting behaviors, depression and disease stigma influenced self-care indirectly through self-efficacy mediation. The total, direct, and indirect effects of health-promoting behaviors and depression on self-care were 0.53 and  $-0.26$ , 0.41 and  $-0.17$ , and 0.12 and 0.09, respectively, in patients with colostomies.

**Conclusions:** This study highlights the importance of improving health-promoting behaviors, eHealth literacy, and self-efficacy in patients with colostomies. The study also suggests that reducing depression and disease stigma could enhance patients' self-care. Health care professionals can leverage these findings to develop appropriate programs to improve patients' self-care.

## Introduction

A permanent colostomy is a surgical procedure used primarily for treating colorectal cancer. During the surgery, an opening called a stoma is made by diverting the colon end through an opening in the abdominal wall and stitching the colon edges to the abdominal wall. The stool then drains from the stoma into an abdomen-attached collection pouch or bag.<sup>1</sup> The rising colorectal cancer prevalence has led to a corresponding increase in permanent colostomies. In China, an estimated 100,000 new colostomy procedures have been performed yearly since 2005. This has resulted in a growing population of colostomy patients to over 1.5 million by 2023, with a trend toward younger patients.<sup>2</sup> Colostomy is a life-changing experience for most patients and has long-term effects on physical, psychological, and social-psychological well-being.<sup>3</sup> Studies have shown a decrease in overall quality of life for these patients,

impacting daily activities, including eating habits, choice of clothing, sexuality, social interactions, employment, recreation, travel, sports, and intimate relationships. These patients may also experience complications, such as peristomal irritant dermatitis, stoma bleeding, and stoma stenosis.<sup>4</sup> Depression, disease stigma, anxiety, self-inferiority, and other psychosocial problems may also occur.<sup>5</sup> By adopting self-care practices, patients with colostomies can manage their symptoms, reduce complications, control risks, and improve their overall well-being and quality of life.<sup>6</sup>

The concept of self-care, as outlined in the Middle Range Theory of Self-care in Chronic Illness (ScCI), emphasizes the interaction between patients, their families, friends, and health care providers. It involves monitoring behaviors, maintaining physiologic and psychological stability, and actively managing symptoms to promote overall health.<sup>7</sup> Self-care encompasses three key components: monitoring, management,

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<https://doi.org/10.1016/j.apjon.2025.100666>

Received 18 November 2024; Accepted 5 February 2025

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and maintenance. Self-care is crucial for recovery;<sup>8</sup> however, patients with colostomies often have limited capacity for self-care. Worldwide, health care providers recognize that self-care education is a key challenge for patients.<sup>9</sup> Similarly, in China, studies revealed that only 12.5% of patients with colostomy mastered self-care. Additionally, the limited self-care knowledge and skills hindered postoperative recovery. Over 60% of patients required assistance with colostomy care.<sup>10</sup> Most existing research have focused on individual factors or cross-sectional analysis, with a gap in scientific nursing theory-based holistic studies. To address this gap, this study utilizes Riegel's self-care theory and a structural equation model to conduct a multidimensional investigation and analysis of self-care behaviors in patients with colostomies. By examining these behaviors and related factors, this research aims to inform the development of effective nursing interventions for patients with colostomies.

### Literature review

Self-care can lead to significant benefits, including reduced medical costs, improved quality of life, better clinical outcomes, and prevention and early detection of health status changes.<sup>11</sup> However, studies reveal that only half of European patients achieve adequate self-care skills after discharge. Patients with permanent colostomies in China exhibit lower self-care capability than patients in Western countries.<sup>12,13</sup> Studies have identified several factors limiting self-care abilities in patients with colostomies. Du et al.<sup>14</sup> highlighted the impact of disease stigma, where concerns about effluent odor, sound, and other body changes can negatively influence patients' self-care ability, quality of life, and overall well-being. In contrast, patients with higher self-efficacy were more confident, suffered less stigma, and had better prognoses.<sup>15</sup> eHealth literacy refers to the ability to find, understand, and apply health information from electronic sources.<sup>16</sup> Additionally, research suggests that eHealth literacy is crucial to successful self-care. Patients with adequate eHealth literacy demonstrated higher self-efficacy and engaged in key self-care behaviors.<sup>17,18</sup> Research by Li<sup>19</sup> suggested a strong link between patients' health-promoting behaviors and the development of colostomy complications. The findings indicated that good health behaviors promote patients' postoperative self-care abilities. Individuals with chronic illnesses often experience mental health challenges, primarily stress, anxiety, and depression, which can exacerbate the illness and make self-care more difficult.<sup>20</sup> Furthermore, studies have shown a negative correlation between depression and self-efficacy.<sup>21</sup> Studies show that higher self-efficacy results in better outcomes. Thus, having more self-confidence in the handling process and a greater sense of control would lead to less depression. However, few studies have systematically investigated self-care behaviors in patients with permanent colostomies, particularly regarding the interplay of multiple variables, as outlined in the ScCI theory. To address this gap, our study aimed to develop and test a hypothetical model that examines self-care in patients with colostomies. The model will identify factors that directly, indirectly, and in total contribute to patient self-care.

### Structural equation model

This study was guided by the ScCI theory proposed by Riegel, which emphasizes congruency between patients' demands and the requirements of their chronic conditions when making health decisions.<sup>7</sup> Riegel's self-care theory distinguishes itself from Orem's by focusing primarily on individuals. According to the ScCI theory, several factors influence self-care in chronic illness, including self-efficacy, habits, access to care, and psychological well-being. Health-promoting behaviors encompass the healthy habits that individuals incorporate into their daily routines. Depression and disease stigma are psychological factors that contribute to negative emotional responses in patients with colostomies. Access to care refers to the timely availability and adequacy of health care services for patients to achieve optimal health outcomes.<sup>22</sup> Individuals' eHealth literacy levels impact access to care and directly affect their self-care

ability in ill health. It reflects their capability to obtain and utilize health care network resources.<sup>23</sup> In the current study's model framework, eHealth literacy, health-promoting behaviors, depression, and disease stigma were classified as exogenous variables. Self-efficacy and self-care were identified as the mediating and outcome variables, respectively.

The relationship between the variables in the model was established based on existing research findings. These findings revealed that health-promoting behaviors increased patients' self-efficacy, with positive health habits leading to a greater capacity for self-care. Furthermore, sufficient eHealth literacy empowers individuals to leverage the Internet's capabilities for acquiring health information and skills, communicating with health care providers, seeking health services, and participating in self-care programs.<sup>24</sup> Conversely, depression and disease stigma can act as barriers to self-care by diminishing patients' self-efficacy. The current model incorporates paths representing the potential influences between these variables. This study proposed a hypothesis model based on previous studies and the ScCI theory (Fig. 1). The study hypothesized that (1) health-promoting behaviors and eHealth literacy had positive direct effects, and indirect effects through self-efficacy on self-care; (2) depression and disease stigma negatively impacted self-care, and self-efficacy mediated the relationships between depression, disease stigma and self-care.

### Purpose

This study aimed to create and utilize a structural equation model to elucidate the factors influencing self-care in patients with permanent colostomies in China. The study also aimed to clarify the relationships between these factors to provide health care professionals with a theoretical foundation for developing appropriate interventions.

### Methods

#### Study design

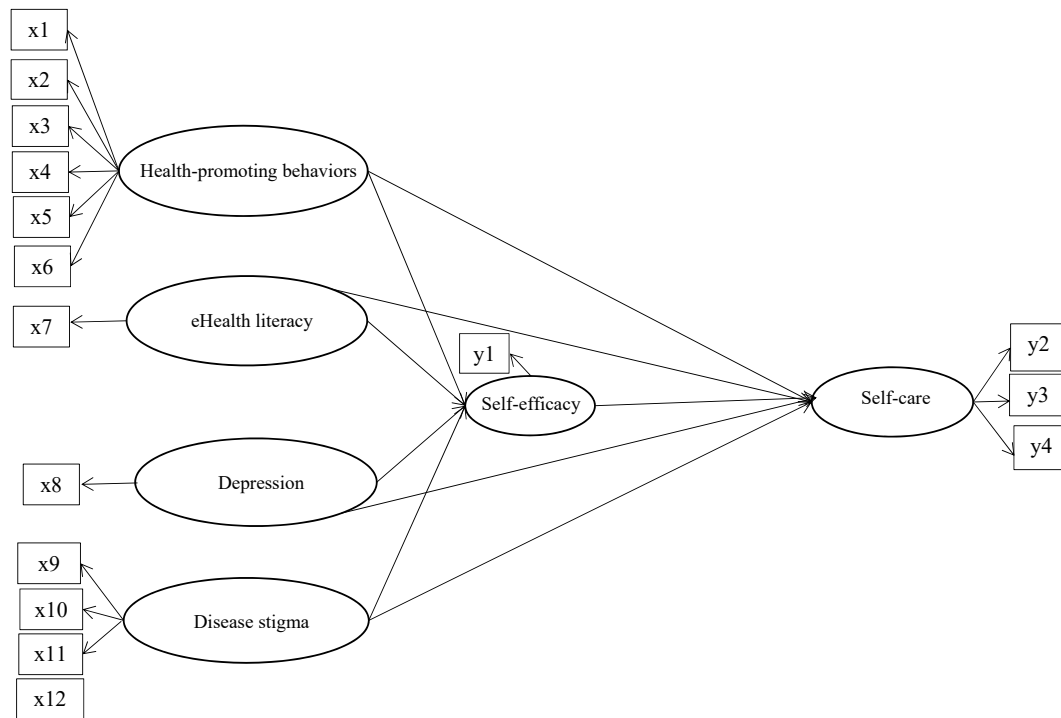
A descriptive model-testing, cross-sectional study was conducted to test the hypothesized self-care model in patients with permanent colostomy in Yancheng City, China, between October 2022 and July 2023.

#### Participants and data collection

This study was conducted in Yancheng, a city in Jiangsu province, Eastern China. A multi-stage random sampling technique was employed to recruit participants. First, four general hospitals were selected out of nine from a numerically arranged list using a simple random sampling method. The selected facilities were Yancheng No.1 People's Hospital, Yancheng No.3 People's Hospital, Dafeng People's Hospital, and Dongtai People's Hospital. Second, 290 patients with permanent colostomies who came to visit the clinics of the four general hospitals and met the inclusion criteria, were willing to participate in the study, and provided signed consent forms were randomly recruited. Third, the researcher distributed questionnaires to these patients, providing guidance on how to complete them. Each patient took an average of 20 minutes to fill out all questionnaires. Regardless of the hospital from which they were recruited, the participants met the same inclusion criteria.

Individuals aged 40 years or older, who were literate in Chinese, resident in Yancheng and underwent permanent colostomy at least one month before discharge met the inclusion criteria. Patients with a history of mental illness, mental disorder, severe chronic disease, familial hereditary disease, and communication difficulties were excluded from the study.

Structured equation modeling (SEM) recommends sample sizes around 200 or 5–20 times the number of parameters; To account for an anticipated 10% rate of abnormal and missing data, a sample size of 290 participants was deemed sufficient for this study.<sup>25</sup> The sample size calculation considered the 28 parameters estimated in the model based



**Fig. 1.** The hypothesis model. x1–x6: Health-promoting behaviors (x1: Spiritual growth; x2: Health responsibility; x3: Physical activity; x4: Interpersonal relations; x5: Nutrition; x6: Stress management); x7: eHealth literacy; x8: Depression; x9–x12: Disease stigma (x9: Social exclusion; x10: Economic insecurity; x11: Internal shame; x12: Social isolation); y1: Self-efficacy; y2–y4: Self-care (y2: Self-care maintenance; y3: Self-care monitoring; y4: Self-care management).

on 22 loadings of six observed variables and six measurement errors.<sup>26</sup> However, 280 participants were included in the final analysis, as 10 were excluded due to incomplete data. The effective recovery was 96.55%.

### Instruments

#### Health-promoting lifestyle profile

The Chinese version of the Health-Promoting Lifestyle Profile II (HPLP II)<sup>27</sup> was used to measure patients' health-promoting behaviors. This instrument has 52 items across six dimensions—spiritual growth, health responsibility, physical activity, interpersonal relationships, nutrition, and stress management. Each item uses a four-point Likert scale, with the higher scores indicating more frequent practice of health behaviors. Cronbach's alpha, a measure of internal consistency for the scale, was 0.94, with a correlation coefficient of 0.84 for each domain. The construct validity of the questionnaires in this study was tested using confirmatory factor analysis, and the overall model fit was adequate.

#### eHealth literacy scale

The Chinese version of the eHealth literacy scale (eHEALS)<sup>28</sup> was used to measure patients' eHealth literacy. Patients were assessed for their comfort level, knowledge, and aptitude to find, assess, and utilize eHealth information for addressing health-related issues. A five-point Likert scale was employed to assess the scale's eight items, with higher scores indicating higher levels of eHealth literacy. This study reported the scale's Cronbach's alpha as 0.94.

#### Self-rating depression scale

The severity and variation of depressive symptoms were assessed using the self-rating depression scale (SDS) developed by William W.K. Zung.<sup>29</sup> This 20-item Likert scale evaluates psychological and physiological symptoms identified in factor-analytic depression studies using a 4-point scoring method. It demonstrates good internal consistency (Cronbach's alpha = 0.845) and validity (coefficient = 0.837).

#### Social impact scale

Disease stigma was measured using the Social Impact Scale (SIS). This 24-item instrument assesses stigma across four domains: social exclusion, economic insecurity, internal shame, and social isolation.<sup>30</sup> Participants' responses are rated on a four-point scale, with higher scores indicating greater disease stigma. The SIS demonstrates good internal consistency (Cronbach's alpha = 0.85), with a correlation coefficient of 0.85 for each domain.

#### Ostomy self-care self-efficacy

The Ostomy Self-care Self-efficacy Scale, a component of the Ostomy Self-Care Index (OSCI), assesses the self-efficacy levels of colostomy patients.<sup>31</sup> This 10-item scale employs a 5-point Likert scale, with higher scores indicating superior self-care self-efficacy. The scale demonstrates good reliability, with a reported Cronbach's alpha of 0.962.

#### Ostomy self-care index

The OSCI was used to measure self-care practices among patients with permanent colostomies.<sup>31</sup> This self-administered instrument assesses three key dimensions of self-care: maintenance, monitoring, and management.<sup>32</sup> Participants respond using a five-point Likert scale, with higher scores denoting superior self-care practices. The scale demonstrates excellent internal consistency, with a Cronbach's alpha of 0.975 for the total scale and 0.965, 0.953, and 0.930 for the maintenance, monitoring, and management subscales, respectively. This indicates that the OSCI is a valid and reliable tool for evaluating self-care behaviors in patients with ostomy.

#### Data analysis

Data were collected from two sources: online questionnaires with backend export and offline data entry directly into the statistical software (IBM SPSS Statistics version 26 and IBM SPSS AMOS version 28). Descriptive statistics were used to describe participant characteristics, and data normality was tested using skewness and kurtosis. The

internal consistency of each variable was evaluated using Cronbach's alpha coefficient. The SEM comprised the hypothesis model and the final modified model. The hypothesis model was evaluated for validity and reliability using a confirmatory factor analysis (CFA) and a Pearson correlation coefficient calculation. The final modified model had an acceptable value of Chi-Square (CMIN) statistics divided by degree of freedom (df) (CMIN/ df) < 2 and a reasonable value of < 5.0. Goodness-of-fit index (GFI), adjusted goodness-of-fit (AGFI), and comparative fit index (CFI) values close to 0.90 or 0.95 indicate a good fit, and root mean square error of approximation (RMSEA) values of 0.05–0.08 suggest a fair fit.<sup>33</sup> Bootstrapping was used to estimate direct, indirect, and total effects. *P* values less than 0.05 were considered significant.

Ethical considerations

Ethical approval for this study was granted by the Institutional Review Board (IRB) for Graduate Studies at the Faculty of Nursing, Burapha University, Thailand (IRB No. G-HS058/2565), and the Human Research Ethics Committees of the participating general hospitals in China. All participants received detailed information about the study objectives, data collection procedures, time commitment, potential benefits and risks, and their right to decline or withdraw from the study at any time without any consequences. All participant information will be confidentially destroyed upon publication of the study findings.

Results

Characteristics of the participants

A larger proportion of the participants (58.2%) identified as male, and 41.8% as female. The mean age was 67.78 ± 10.04, and most participants (*n* = 218, 77.5%) were older than 60. Nearly half (*n* = 127, 45.4%) of the participants had middle school education, followed by primary school (*n* = 99, 35.4%). Approximately 41.8% of the participants lived with their spouses and children, and 40.7% lived with their spouses alone. About one-third (36.4%) reported a monthly family income between 6001 and 10,000 RMB. About 31.4% were farmers before their illness, followed by workers (23.9%) and businessmen (6.4%). The majority of participants (85.7%) experienced complications. The time from surgery also varied, with 21.1% being 3–6 months post-surgery and 19.6% being 2–5 years post-surgery (Table 1).

Descriptive statistics

The mean, standard deviation, range, kurtosis, and skewness values of the variables used in this research model are presented in Table 2. Kurtosis and skewness values less than ± 1.96 indicate satisfaction with the normal distribution assumption.<sup>34,35</sup>

Measurement model

A confirmatory factor analysis was conducted to confirm whether the latent variables, health-promoting behaviors, disease stigma, and self-care fit the measurement model acceptably. The minimum average variance extracted (AVE) for the factors was 0.569, which was greater than the acceptable threshold of 0.5. Additionally, the minimum construct reliability (CR) was 0.825, exceeding the recommended threshold of 0.7, an indication of good data convergent validity<sup>36,37</sup> (Table 3).

The Pearson correlation analysis indicated that self-care was significantly and positively associated with health-promoting behaviors (*r* = 0.744, *P* < 0.01), eHealth literacy (*r* = 0.567, *P* < 0.01), and self-efficacy (*r* = 0.643, *P* < 0.01). However, there was a negative association between self-care and depression (*r* = −0.581, *P* < 0.01) as well as disease stigma (*r* = −0.593, *P* < 0.01). Findings from the measurement model's

Table 1  
Demographic characteristics of the participants (*N* = 280).

Participants' characteristics	<i>n</i>	%
Gender		
Female	117	41.8
Male	164	58.2
Age (year) ( <i>M</i> = 67.78, <i>SD</i> = 10.04, range = 40–92)		
≤ 60	62	22.1
61–70	104	37.1
≥ 71	114	40.7
Education level		
Primary school	99	35.4
Middle school	127	45.4
High school	33	11.8
College or higher	21	7.5
Living with		
Spouse	114	40.7
Children	39	13.9
Spouse and children	117	41.8
Alone	10	3.6
Family income (Yuan/month)		
≤ 2000	47	16.8
2001–4000	57	20.4
4001–6000	49	17.5
6001–10,000	102	36.4
≥ 10,000	25	8.9
Occupation (prior to illness)		
Worker	81	31.1
Farmer	118	42.1
Public officer	32	11.4
Businessman	36	12.9
Other	7	2.1
Complications		
Yes	40	14.3
No	240	85.7
Post-surgery duration		
1–3 months	50	17.9
3–6 months	59	21.1
6 months to 1 year	43	15.4
1–2 years	50	17.9
2–5 years	55	19.6
> 5 years	23	8.2

discriminant validity test revealed less than AVE squared correlation coefficients between latent variables, indicating good discriminant validity of the model (Table 4).

Structural equation model

The hypothesized model's fit index showed: CMIN = 610.74 (*P* = 0.000, df = 98), CMIN/df = 6.23, GFI = 0.77, AGFI = 0.68, CFI = 0.83, and RMSEA = 0.137. These results showed that the hypothesized model did not fit the empirical data, indicating a need for further modification. After removing two paths between eHealth literacy and self-efficacy, as well as disease stigma and self-care, the final modified model demonstrated a satisfactory fit with the data. The values were: CMIN = 230.44 (*P* = 0.000, df = 87), CMIN/df = 2.65, GFI = 0.91, AGFI = 0.85, CFI = 0.95 and RMSEA = 0.077 (Fig. 2).

The findings indicated that seven out of nine pathways were statistically significant. However, statistically significant relationships were not found between eHealth literacy and self-efficacy or disease stigma and self-care. Of these results, health-promoting behaviors, eHealth literacy, depression, and self-efficacy explained 81.8% of the variance in self-care. Additionally, health-promoting behaviors, disease stigma, and depression explained 40.0% of the variance in self-efficacy.

Effects

Table 5 presents the direct, indirect, and total effects of various factors on the self-care behaviors of patients with permanent colostomies. Of these factors, health-promoting behaviors exerted the strongest direct

**Table 2**Descriptive statistics of the observed variables ( $N = 280$ ).

Variables	Mean $\pm$ SD	Range	Skewness	Kurtosis
Health-promoting behaviors	142.11 $\pm$ 22.11	78–200	0.25	0.47
Spiritual growth	24.94 $\pm$ 4.33	13–36	−0.21	0.66
Health responsibility	24.65 $\pm$ 4.17	10–36	−0.17	0.81
Physical activity	20.74 $\pm$ 4.89	9–32	0.62	0.16
Interpersonal relations	25.24 $\pm$ 3.91	15–35	0.06	−0.23
Nutrition	23.78 $\pm$ 4.10	13–36	0.56	0.05
Stress management	22.46 $\pm$ 4.07	13–32	0.46	0.23
eHealth literacy	25.50 $\pm$ 7.44	8–40	−0.46	−0.20
Depression	57.32 $\pm$ 6.23	33–75	0.00	1.49
Disease stigma	57.39 $\pm$ 9.29	24–87	−0.61	1.57
Social exclusion	19.00 $\pm$ 3.95	9–32	0.01	0.85
Economic insecurity	8.01 $\pm$ 1.86	3–12	−0.01	0.35
Internal shame	12.69 $\pm$ 2.76	5–20	−0.39	0.71
Social isolation	18.17 $\pm$ 3.10	7–28	−0.71	1.94
Self-efficacy	72.86 $\pm$ 15.62	25–100	−0.83	1.02
Self-care	69.58 $\pm$ 12.99	25–100	−0.18	1.36
Self-care maintenance	73.31 $\pm$ 14.64	25–100	−0.42	0.89
Self-care monitoring	69.12 $\pm$ 15.29	25–100	0.06	0.27
Self-care management	63.41 $\pm$ 15.32	10–100	0.31	0.83

positive effect on self-care (0.41) and a total effect of 0.53 when the indirect effect (0.12) is considered. Self-efficacy also had a positive direct effect of 0.34 on self-care. In contrast, depression had a total negative effect of −0.26 on self-care, comprising a direct (−0.17) and indirect effect (−0.09).

## Discussion

This study offers a comprehensive model illustrating the interplay between various factors affecting self-care in patients with permanent colostomies, including health-promoting behaviors, eHealth literacy, depression, disease stigma, and self-efficacy. The findings revealed that health-promoting behaviors, eHealth literacy, and depression directly influence self-care. Additionally, health-promoting behaviors,

depression, and disease stigma indirectly affect self-care with self-efficacy acting as a mediating factor.

This study's findings highlight the positive direct and indirect effects of health-promoting behaviors on self-care mediated by self-efficacy. This aligns with research on health-promoting behaviors as a key element of chronic disease prevention. By improving lifestyle, health-promoting behaviors contribute to increased life expectancy and improved quality of life.<sup>38</sup> Patients with colostomies must adopt post-surgery lifestyle changes that support self-care, including weight management, smoking cessation, dietary adjustments, stoma bag replacements, regular physical activity, and effective stress management to maintain good health.<sup>39</sup> Therefore, high levels of health-promoting behaviors enhance self-care ability, reduce the risk of complications, and decrease mortality rates. Furthermore, health-promoting behaviors

**Table 3**Results of confirmatory factor analysis ( $N = 280$ ).

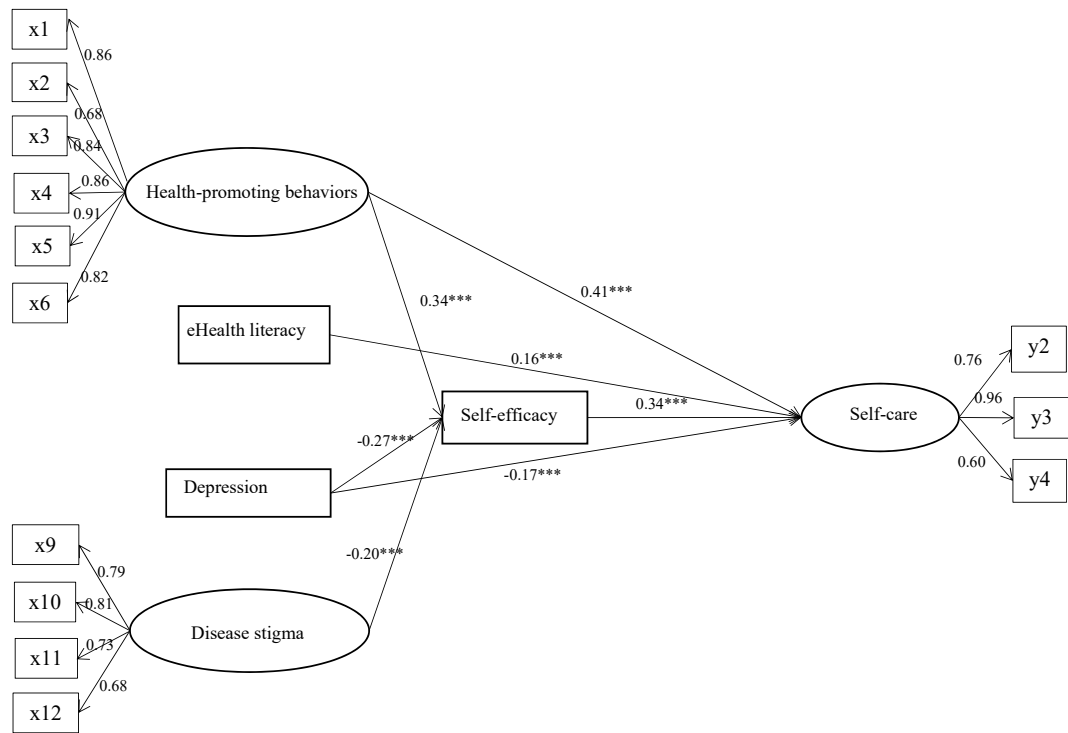
Latent variable	Item	Factor load (FL)	Average variance extracted (AVE)	Construct reliability (CR)
Health-promoting behaviors	x1	0.86	0.691	0.930
	x2	0.68		
	x3	0.84		
	x4	0.86		
	x5	0.91		
	x6	0.82		
Disease stigma	x9	0.79	0.569	0.840
	x10	0.81		
	x11	0.73		
	x12	0.68		
Self-care	y2	0.76	0.620	0.825
	y3	0.96		
	y4	0.60		

x1–x6: Health-promoting behaviors (x1: Spiritual growth; x2: Health responsibility; x3: Physical activity; x4: Interpersonal relations; x5: Nutrition; x6: Stress management); x9–x12: Disease stigma (x9: Social exclusion; x10: Economic insecurity; x11: Internal shame; x12: Social isolation); y2–y4: Self-care (y2: Self-care maintenance; y3: Self-care monitoring; y4: Self-care management).

**Table 4**Discriminant validity and Pearson correlation coefficient ( $N = 280$ ).

	Health-promoting behaviors	eHealth literacy	Depression	Disease stigma	Self-efficacy	Self-care
Health-promoting behaviors	0.831					
eHealth literacy	0.498**	0.754				
Depression	−0.439**	−0.418**	0.754			
Disease stigma	−0.505**	−0.475**	0.437**	0.754		
Self-efficacy	0.506**	0.350**	−0.513**	−0.471**	0.754	
Self-care	0.744**	0.567**	−0.593**	−0.581**	0.634**	0.787

\* $P < 0.05$ , \*\* $P < 0.01$ , \*\*\* $P < 0.001$ . Values below the diagonal are Pearson correlation coefficients, and numbers above the diagonal represent AVE square root values. If the AVE square root value is higher than the correlation coefficients of the associated variable, it indicates good discriminant validity of the measured variable. AVE, average variance extracted.



**Fig. 2.** The final modified self-care model in patients with colostomies. x1–x6: Health-promoting behaviors (x1: Spiritual growth; x2: Health responsibility; x3: Physical activity; x4: Interpersonal relations; x5: Nutrition; x6: Stress management); x9–x12: Disease stigma (x9: Social exclusion; x10: Economic insecurity; x11: Internal shame; x12: Social isolation); y2–y4: Self-care (y2: Self-care maintenance; y3: Self-care monitoring; y4: Self-care management). \* $P < 0.05$ , \*\* $P < 0.01$ , \*\*\* $P < 0.001$ .

**Table 5**  
Direct, indirect, and total effects in the final modified model ( $N = 280$ ).

Dependent variables	Independent variables	Direct effect	Indirect effect	Total effect
Self-care	Health-promoting behaviors	0.41***	0.12***	0.53***
	eHealth literacy	0.16***	–	0.16***
	Depression	–0.17***	–0.09***	–0.26***
	Self-efficacy	0.34***	–	0.34***
	Health-promoting behaviors	0.34***	–	0.34***
Self-efficacy	Depression	–0.27***	–	–0.27***
	Disease stigma	–0.20***	–	–0.20***
	–	–	–	–

\* $P < 0.05$ , \*\* $P < 0.01$ , \*\*\* $P < 0.001$ .

actively maintain health, prevent disease, and independently strengthen patients' self-efficacy. Previous studies found that patients who practiced health-promoting behaviors more frequently had higher self-efficacy levels.<sup>40</sup> Thus, implementing health education programs that specifically focus on health-promoting behaviors for patients with colostomies can potentially improve self-efficacy and self-care in this population. The current study revealed a direct association between eHealth literacy and self-care but without an association with self-efficacy. This suggests that patients with higher eHealth literacy may be more adept at finding health information online, enhancing their self-care skills and knowledge. Higher eHealth literacy levels also improve patient prognosis.<sup>41</sup> Due to its accessibility and affordability, eHealth literacy is a valuable tool for patients to obtain health knowledge and skills and actively manage their health. Digitalization can enhance medical care for difficult-to-reach patients in rural, structurally weak, or socioeconomically disadvantaged regions of modern countries. Previous research indicates a positive correlation between self-care and eHealth literacy.<sup>42,43</sup> However, that relationship was not confirmed in this study. This may be because colostomy care information abounds on the Internet—some positive and others negative—with no means for patients without medical backgrounds to verify the information. Hence, no apparent causal link exists between the two variables.

The current study found a negative direct relationship between depression and self-care, with an additional indirect effect mediated by self-efficacy. The core symptoms of depression, such as fatigue, lack of energy, hopelessness, and low motivation, can cause patients to lose interest and engagement in self-care activities and health behaviors.<sup>44,45</sup> Patients with major depression also lacked self-care activities more frequently compared to those without depression, which is consistent with previous studies.<sup>46</sup> Self-efficacy empowers patients to proactively utilize their own measures to manage challenges and maintain their well-being. However, depression, which is a negative emotion, can hinder self-efficacy.<sup>47,48</sup> Body image changes associated with colostomy can contribute to depression in some patients, further lowering their self-efficacy. This negative cycle aligns with existing research demonstrating a well-established negative association between depression and self-efficacy, where higher levels of depression correspond with lower self-efficacy.<sup>49,50</sup> This study also demonstrated that although disease stigma directly influenced self-efficacy, it did not directly affect self-care. Similar to previous studies,<sup>51</sup> this study demonstrated a negative correlation between disease stigma and self-efficacy. Patients with colostomies are sometimes referred to as ostomates, a term that produces negative effects on their mental health and can make them feel stigmatized. This stigma

can manifest as feelings of shame, hopelessness, and isolation, ultimately contributing to lower self-efficacy in managing their self-care needs.<sup>52</sup> However, some studies presented results that were inconsistent with ours. These studies suggested that most patients with colostomy were elderly with a lower sensitivity to stigma and a higher acceptance of colostomy, resulting in no significant impact of disease stigma on self-efficacy.<sup>53</sup> Our study also showed that the lack of a direct correlation between disease stigma and self-care, disease stigma could lower self-care activities through lowered self-efficacy. From these findings, we interpret that disease stigma is associated with lower self-efficacy in patients with colostomies. This, in turn, decreases treatment adherence, ultimately affecting self-care. The results are consistent with the study by Seo,<sup>54</sup> which did not find a direct correlation between self-care and disease stigma in patients with diabetes.

This study found a direct correlation between self-efficacy and self-care. It also revealed that self-efficacy mediated the impact of health-promoting behaviors, depression, and disease stigma on self-care. Numerous studies have demonstrated that self-efficacy is important for improving self-care in patients with chronic diseases.<sup>55–57</sup> Our study demonstrated that three exogenous variables—health-promoting behaviors, depression, and disease stigma—indirectly influenced self-care in patients with permanent colostomies, with self-efficacy acting as the mediator. Thus, health care departments and professionals should implement multifaceted strategies to improve patients' health-promoting behaviors and reduce depression and disease stigma. This could then increase patients' self-efficacy and ultimately promote self-care.

#### Implications for nursing practice and research

Based on the results of this study, a deeper understanding of the factors affecting self-care in Chinese patients with permanent colostomies is provided. There is a profound impact on nursing practice and research. First, this study validated the theory of Self-care in Chronic Illness and provided an experimental basis for its further deepening. The research could be expanded to include populations with other chronic diseases. Second, the study helps nurses and health care professionals develop practical interventions to enhance the self-care capabilities of Chinese patients with permanent colostomies that target perceived eHealth literacy, health-promoting behaviors, depression, disease stigma and self-efficacy.

#### Limitations

This study acknowledges several limitations. First, the participant enrollment was restricted to Yancheng City, China. This may limit the generalizability and diversity of the findings to patients with colostomies in other geographic locations. A wide range of sample types and ranges should be used in future studies to maximize universality and persuasiveness. Second, this was a cross-sectional study, so we could not establish causal relationships. Future research utilizing a longitudinal study design is required. Third, the study collected information about the demographic characteristics, such as education level, gender of the participants, but did not analyze the associations between them and self-care. A future study will be expected to evaluate the relationship between these factors and self-care by incorporating them into the model. Four, the self-reported measures might lead to potential biases, future research would take other measurement.

#### Conclusions

Based on the ScCI theory and findings from previous studies, we constructed and validated a structural equation model highlighting the causality of self-care in patients with permanent colostomies. Our study findings reveal that improving patients' health-promoting behaviors, eHealth literacy, and self-efficacy, as well as reducing depression, directly contributed to enhanced self-care. Further, self-efficacy was

found to play a mediating role in the relationships between health-promoting behaviors, depression, disease stigma, and self-care.

#### CRedit authorship contribution statement

**Longyan Bian:** Conceptualization, Methodology, Data curation, Data collection, Formal analysis, Writing. **Pornchai Jullamate:** Conceptualization, Formal analysis. **Poonpong Suksawang:** Methodology, Software. **Chanandchidadussadee Toonsiri:** Conceptualization, Methodology, and Revised draft preparation. All authors had full access to all the data in the study, and the corresponding author had final responsibility for the decision to submit for publication. The corresponding author attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted.

#### Ethics statement

The study was approved by the Institutional Review Board (IRB) for Graduate Studies at the Faculty of Nursing, Burapha University, Thailand (IRB No. G-HS058/2565), and the Human Research Ethics Committees of the participating general hospitals in China. All participants provided written informed consent.

#### Funding

This study was supported by Jiangsu Medical College Teaching Masters and Teaching Innovation Team Support Project (Grant No. 202419); Jiangsu Medical College Professional Leader Training Object Support Project (Grant No. 202255); Jiangsu Provincial Health Vocational and Technical Education Research Project (Grant No. WJ202109). The funders had no role in considering the study design or in the collection, analysis, interpretation of data, writing of the report, or decision to submit the article for publication.

#### Declaration of competing interest

The authors declare no conflict of interest.

#### Data availability statement

The data that support the findings of this study are available from the corresponding author, Prof. Pornchai Jullamate, upon reasonable request.

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

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

#### References

1. Tao H, Songwathana P, Isaramalai Sa, Wang Q. Taking good care of myself: a qualitative study on self-care behavior among Chinese persons with a permanent colostomy. *Nurs Health Sci.* 2014;16(4):483–489. <https://doi.org/10.1111/nhs.12166>.
2. Hao J, Xu Y, Li H. The value of applying a continuous nursing model based on virtual platforms for patients with colostomy or ileostomy. *Adv Skin Wound Care.* 2023; 36(4):206–212. <https://doi.org/10.1097/01.ASW.0000919960.94295.53>.
3. Restorick Roberts A, Betts Adams K, Beckett Warner C. Effects of chronic illness on daily life and barriers to self-care for older women: a mixed-methods exploration. *J Women Aging.* 2017;29(2):126–136. <https://doi.org/10.1080/08952841.2015.1080539>.
4. Recalla S, English K, Nazarali R, Mayo S, Miller D, Gray M. Ostomy care and management: a systematic review. *J Wound, Ostomy Cont Nurs.* 2013;40(5):489–500. <https://doi.org/10.1097/WON.0b013e3182a219a1>.
5. Jin Y, Ma H, Jiménez-Herrera M. Self-disgust and stigma both mediate the relationship between stoma acceptance and stoma care self-efficacy. *J Adv Nurs.* 2020;76(10):2547–2558. <https://doi.org/10.1111/jan.14457>.
6. Ausili D, Masotto M, Dall'Ora C, Salvini L, Di Mauro S. A literature review on self-care of chronic illness: definition, assessment and related outcomes (Una revisione

- della letteratura sul self-care nelle malattie croniche: definizione, valutazione e outcomes associati). *Prof Inferm.* 2014;67(3). <https://doi.org/10.7429/pi.2014.673180>.
7. Riegel B, Jaarsma T, Strömberg A. A middle-range theory of self-care of chronic illness. *Adv Nurs Sci.* 2012;35(3):194–204. <https://doi.org/10.1097/ANS.0b013e318261b1ba>.
  8. Santos RDP, Fava SMCL, Dázio EMR. Self-care of elderly people with ostomy by colorectal cancer. *J Coloproctol.* 2019;39(3):265–273. <https://doi.org/10.1016/J.JCOL.2019.01.001>.
  9. Riegel B, Dunbar SB, Fitzsimons D, et al. Self-care research: where are we now? Where are we going? *Int J Nurs Stud.* 2021;116:103402. <https://doi.org/10.1016/j.nurstu.2019.103402>.
  10. Abdelmohsen SA. Effectiveness of structured education on patient's knowledge and practice regarding colostomy care. *Asia-Pacif J Oncol Nurs.* 2020;7(4):370–374. <https://doi.org/10.4103/apjon.apjon.24.20>.
  11. Jovicic A, Holroyd-Leduc JM, Straus SE. Effects of self-management intervention on health outcomes of patients with heart failure: a systematic review of randomized controlled trials. *BMC Cardiovasc Disord.* 2006;6(1):1–8. <https://doi.org/10.1186/1471-2261-6-43>.
  12. Luo AJ, Mao P, Yang JF. Effect of incentive intervention on self-efficacy and quality of life in patients with permanent colostomy after laparoscopic rectal cancer surgery. *Chin J Endosc.* 2015;21(5):6. <https://doi.org/CNKI:SUN:ZGNJ.0.2015-05-005>.
  13. Xiao. Effect of collaborative nursing on postcolostomy nursing effect and self-care ability of colorectal cancer patients. *J Pract Clin Med.* 2016;30(2):97–101. <https://doi.org/10.7619/jcmp.201616041>.
  14. Du XX, Qu XJ, Zhu L, Li YY, Chen Y, Lan YD. Relationship between stigma, self-care ability and quality of life of patients with permanent colostomy. *J Nurs.* 2016;45(3):114–115. [http://manu68.magtech.com.cn/Jwk3\\_hlxb/CN/abstract/article\\_3347.sht ml](http://manu68.magtech.com.cn/Jwk3_hlxb/CN/abstract/article_3347.sht ml).
  15. Zhang Kwekkeboom K, Petrini M. Uncertainty, self-efficacy, and self-care behavior in patients with breast cancer undergoing chemotherapy in China. *Cancer Nurs.* 2015;38(3):E19–E26. <https://doi.org/10.1097/NCC.0000000000000165>.
  16. Kim K, Shin S, Kim S, Lee E. The relation between eHealth literacy and health-related behaviors: systematic review and meta-analysis. *J Med Internet Res.* 2023;25:e40778. <https://doi.org/10.2196/40778>.
  17. Macabasco-O'Connell A, DeWalt DA, Broucksou KA, et al. Relationship between literacy, knowledge, self-care behaviors, and heart failure-related quality of life among patients with heart failure. *J Gen Intern Med.* 2011;26(9):979–986. <https://doi.org/10.1007/s11606-011-1668-y>.
  18. Moser DK, Watkins JF. Conceptualizing self-care in heart failure: a life course model of patient characteristics. *J Cardiovasc Nurs.* 2008;23(3):205–218. <https://doi.org/10.1097/01.JCN.0000305097.09710.a5>.
  19. Li C. Study on the correlation of self-care agency and healthy behaviors in patients with colostomy. *J Nurs Adm.* 2006;6(9):3–5. <https://api.semanticscholar.org/CorpusID:148560655>.
  20. Huang Y, Loux T, Huang X, Feng X. The relationship between chronic diseases and mental health: a cross-sectional study. *Ment Health Prev.* 2023;32:200307. <https://doi.org/10.1016/j.mhp.2023.200307>.
  21. Ding Huang, Feng Yang, Zhang. The present situation of depression and its relationship with self-efficacy in the standardized training of residents. *J Cent S Univ.* 2017;42(1):83–87. <https://doi.org/10.11817/j.issn.1672-7347.2017.01.014>.
  22. Nao Sciences, Division M. *Services BoHC, Utilization CoHC, Disabilities Aw. Health-care Utilization as a Proxy in Disability Determination.* Washington (DC): National Academies Press (US); 2018. <https://doi.org/10.17226/24969>.
  23. Chen J, Duan Y, Zhang Y, et al. Self-care behavior and associated factors of nursing students with dysmenorrhea: a structural equation model. *J Nurs Manag.* 2023;2023. <https://doi.org/10.1155/2023/8820772>.
  24. Wang C, Wu X, Qi H. A comprehensive analysis of e-health literacy research focuses and trends. *Healthcare (Basel, Switzerland).* 2021;10(1):66. <https://doi.org/10.3390/healthcare10010066>.
  25. Kline RB. *Principles and Practice of Structural Equation Modeling.* 4th ed. New York, NY, US: Guilford Press; 2016.
  26. Lei PW, Wu Q. Introduction to structural equation modeling: issues and practical considerations. *Educ Meas.* 2007;26(3):33–43. <https://doi.org/10.1111/j.1745-3992.2007.00099.x>.
  27. Walker SN, Sechrist KR, Pender NJ. The health-promoting lifestyle profile: development and psychometric characteristics. *Nurs Res.* 1987;36(2):76–81. <https://doi.org/10.1097/00006199-198703000-00002>.
  28. Koo M, Norman CD, Hsiao-Mei CJ. Psychometric evaluation of a Chinese version of the eHealth literacy scale (eHEALS) in school age children. *Global J Health Educ Promot.* 2012;15(1). <https://link.gale.com/apps/doc/A331687518/HRCA?u=ano&tile&a10464b0&sid=googleScholar&id=3f2665ef>.
  29. Zung W. A self-rating depression scale. *Arch Gen Psychiatry.* 1965;12(1):63–70.
  30. Fife BL, Wright ER. The dimensionality of stigma: a comparison of its impact on the self of persons with HIV/AIDS and cancer. *J Health Soc Behav.* 2000;50–67. <https://doi.org/10.1001/archpsyc.1965.01720310065008>.
  31. Villa G, Vellone E, Sciarra S, et al. Two new tools for self-care in ostomy patients and their informal caregivers: psychosocial, clinic al, and operative aspects. *Int J Urol Nurs.* 2019;13(1):23–30. <https://doi.org/10.1111/ijun.12177>.
  32. Villa G, Manara DF, Brancato T, et al. Life with a urostomy: a phenomenological study. *Appl Nurs Res.* 2018;39:46–52. <https://doi.org/10.1016/j.apnr.2017.10.005>.
  33. Schumacker RE, Lomax RG. *A Beginner's Guide to Structure Equation Modeling.* 3 ed. New York: Routledge/Taylor & Francis Group; 2010.
  34. Van Tongerloo A, De Paep A. Psychosocial adaptation in adolescents and young adults with Marfan syndrome: an exploratory study. *J Med Genet.* 1998;35(5):405–409. <https://doi.org/10.1136/jmg.35.5.405>.
  35. Wanson L, Godfroid IO. Psychiatric symptoms and Marfan: part of the syndrome or incidental to it? *World J Biol Psychiatr.* 2002;3(4):229–230. <https://doi.org/10.3109/15622970209150627>.
  36. Abós Á, Sevil J, Martín-Albo J, Aibar A, García-González L. Validation evidence of the motivation for teaching scale in secondary education. *Spanish J Psychol.* 2018;21: E9. <https://doi.org/10.1017/sjp.2018.11>.
  37. Yoon Y, Gursay D, Chen JS. Validating a tourism development theory with structural equation modeling. *Tour Manag.* 2001;22(4):363–372. [https://doi.org/10.1016/S0261-5177\(00\)00062-5](https://doi.org/10.1016/S0261-5177(00)00062-5).
  38. Tabrizi JS, Doshmangir L, Khoshmaram N, Shakibazadeh E, Abdolahi HM, Khabiri R. Key factors affecting health promoting behaviors among adolescents: a scoping review. *BMC Health Serv Res.* 2024;24(1):58. <https://doi.org/10.1186/s12913-023-10510-x>.
  39. Kara B, İşcan B. Predictors of health behaviors in Turkish female nursing students. *Asian Nurs Res.* 2016;10(1):75–81. <https://doi.org/10.1016/j.anr.2015.12.001>.
  40. Mohamad N, Mulud ZA, Ibrahim M, Damanhuri NF. The relationship between self-efficacy and health promoting behaviour among older adults with chronic illness. *Environ-Behav Proc J.* 2019;4(11):73–78. <https://doi.org/10.21834/e-bpj.v4i11.1725>.
  41. Cramer A, Keinki C, Saur F, Walter S, Hübner J. Ehealth literacy, internet and eHealth service usage: a survey among a German municipality. *J Public Health.* 2023: 1–12. <https://doi.org/10.1007/s10389-023-01997-z>.
  42. Wang Y, Song Y, Zhu Y, Ji H, Wang A. Association of eHealth literacy with health promotion behaviors of community-dwelling older people: the Chain mediating role of self-efficacy and self-care ability. *Int J Environ Res Publ Health.* 2022;19(10):6092. <https://doi.org/10.3390/ijerph19106092>.
  43. Chuang H-W, Kao C-W, Lin W-S, Chang Y-C. Factors affecting self-care maintenance and management in patients with heart failure: testing a path model. *J Cardiovasc Nurs.* 2019;34(4):297–305. <https://doi.org/10.1097/JCN.0000000000000575>.
  44. Bryant J, Winer ES, Salem T, Nadorff MR. Struggling toward reward: recent experience of anhedonia interacts with motivation to predict reward pursuit in the face of a stressful manipulation. *PLoS One.* 2017;12(3):e0173439. <https://doi.org/10.1371/journal.pone.0173439>.
  45. Daniai SS, Sarani FM, Tavassoli E, Afshari A, Forouzandeh F, Eslami AA. The prevalence of depression and its association with self-management behaviors in chronic disease patients. *Iran J Psychiatr Behav Sci.* 2019;13(1). <https://doi.org/10.5812/ijpbs.10161>.
  46. Kurdi SM, Alamer A, Albaggal A, et al. The association between self-care activities and depression in adult patients with type 2 diabetes in Saudi Arabia: a cross-sectional web-based survey study. *J Clin Med.* 2024;13(2):419. <https://doi.org/10.3390/jcm13020419>.
  47. Scott WD, Dearing E. A longitudinal study of self-efficacy and depressive symptoms in youth of a North American Plains tribe. *Dev Psychopathol.* 2012;24(2):607–622. <https://doi.org/10.1017/S0954579412000193>.
  48. Tak YR, Brunwasser SM, Lichtwarck-Aschoff A, Engels RC. The prospective associations between self-efficacy and depressive symptoms from early to middle adolescence: a cross-lagged model. *J Youth Adolesc.* 2017;46:744–756. <https://doi.org/10.1007/s10964-016-0614-z>.
  49. Rosas MA, de Carvalho Cordeiro TD, da Silva TdPS, et al. Self-efficacy assessment tools for individuals with depression: protocol for a systematic review of the literature. *BMJ Open.* 2019;9(6):e021895. <https://doi.org/10.1136/bmjopen-2018-021895>.
  50. Xu Zhang Z, Wang A, Zhu J, Tang H, Zhu X. Effect of self-efficacy intervention on quality of life of patients with intestinal stoma. *Gastroenterol Nurs.* 2018;41(4):341. <https://doi.org/10.1097/SGA.0000000000000290>.
  51. Bullard KM. Prevalence of diagnosed diabetes in adults by diabetes type—United States, 2016. *MMWR Morbid Mortal Week Rep.* 2018;67. <https://doi.org/10.15585/mmwr.mm6712a2>.
  52. Mills H, Mulfinger N, Raeder S, Rüsch N, Clements H, Scior K. Self-help interventions to reduce self-stigma in people with mental health problems: a systematic literature review. *Psychiatry Res.* 2020;284:112702. <https://doi.org/10.1016/j.psychres.2019.112702>.
  53. Wang Y, Li S, Gong J, et al. Perceived stigma and self-efficacy of patients with inflammatory bowel disease-related stoma in China: a cross-sectional study. *Front Med.* 2022;9:813367. <https://doi.org/10.3389/fmed.2022.813367>.
  54. Seo K. The effects of self-efficacy and self-stigma on self-care in people with diabetes. *J Kor Acad Commun Health Nurs.* 2021;32(1):86–94. <https://doi.org/10.12799/jkachn.2021.32.1.86>.
  55. Peyman N, Shahedi F, Abdollahi M, Doosti H, Zadehahmad Z. Impact of self-efficacy strategies education on self-care behaviors among heart failure patients. *J Tehran Univ Heart Cent.* 2020;15(1):6. <https://doi.org/10.18502/jthc.v15i1.3332>.
  56. Qin W, Blanchette JE, Yoon M. Self-efficacy and diabetes self-management in middle-aged and older adults in the United States: a systematic review. *Diabetes Spectr.* 2020;33(4):315–323. <https://doi.org/10.2337/ds19-0051>.
  57. Tan FCJH, Oka P, Dambha-Miller H, Tan NC. The association between self-efficacy and self-care in essential hypertension: a systematic review. *BMC Fam Pract.* 2021;22: 1–12. <https://doi.org/10.1186/s12875-021-01391-2>.