



Review

Knowledge, attitudes and behaviors toward healthy eating among Chinese cancer patients treated with chemotherapy: A systematic review



Han Tang^{a,b,1}, Yuhai Zhang^{a,1}, Baohua Cao^b, Ying Liang^a, Ren Na^a, Zhe Yang^a, Hongjuan Lang^{b,*}, Lei Shang^{a,*}

^a Department of Health Statistics, School of Public Health, The Fourth Military Medical University, Xi'an, Shaanxi, China

^b Department of Clinical Nursing, School of Nursing, The Fourth Military Medical University, Xi'an, Shaanxi, China

ARTICLE INFO

Keywords:

Behavior
Drug therapy
Eating
Knowledge
Neoplasms
Systematic review

ABSTRACT

Side effects from chemotherapy may disturb healthy eating. There are many food taboos among Chinese patients with cancer treated with chemotherapy; they may be conservative in food intake and seek help from traditional Chinese medicine to adjust to healthy eating. Differences in eating cultures may lead Chinese patients with cancer to generate different knowledge, attitudes, and behaviors toward healthy eating. This systematic review explored the knowledge, attitudes, and behaviors toward healthy eating and summarized influencing factors among Chinese patients with cancer treated with chemotherapy. Two English and three Chinese databases were searched since 2007. The eligibility criteria were quantitative descriptive studies, participants who were adult Chinese patients with cancer who received chemotherapy, and primary outcomes that included knowledge, attitudes, or behaviors toward healthy eating. A total of 12 studies were identified. The 11-item tool from the Agency for Healthcare Research and Quality was used to assess quality. All studies were of moderate quality. Narrative qualitative analysis was considered to summarize the findings, and the results were reported by scores or percentages. Four studies measured knowledge, and the information about what to eat and how much to eat was contradictory and confused patients, with little known about Chinese food therapy. Ten studies involved attitudes, and patients were aware of the importance and willingness for eating guidance before, during, and after chemotherapy. Strategies to relieve vomiting and nausea, engage in healthy food choices, and seek food therapy were the main behaviors. The influencing factors were found only in behaviors, including demographic and psychological factors. Knowledge, attitudes, and behaviors toward healthy eating are not satisfactory and need to be improved. More high-quality studies should regard health behavior as a distal outcome and explore the influences of knowledge and attitudes on behaviors.

Introduction

China is at the stage of transitioning to the cancer profiles of developed countries, characterized by a high incidence of cancer. According to an authoritative prediction based on GLOBOCAN 2020 of the worldwide data and Chinese data from cancer registry reports, there will be approximately 4,820,000 new Chinese cancer cases in 2022.¹ Despite the higher incidence, the 5-year relative survival rate for cancer in China is approximately 9.6% higher than that a decade ago,² and the number of patients with cancer is expanding. Given such a large population and

long-term care tasks, quality of life of patients with cancer should be emphasized, not just the improvement of treatment effect or prolongation of survival time. Furthermore, modifiable lifestyle-related factors play an important role in optimizing the quality of life, and patients with cancer need to participate in their own health management by adjusting their lifestyles.³ Among these factors, eating is one of the indispensable lifestyle factors, and after being diagnosed, patients with cancer become more conscious of eating because they believe this has a link to prognosis and recurrence risk.⁴⁻⁶ The American Cancer Society also highlighted the value of adopting healthy foods to help manage adverse effects during

* Corresponding author.

E-mail addresses: shanglei@fmmu.edu.cn (L. Shang), langhj@fmmu.edu.cn (H. Lang).

¹ These authors contributed equally to the study.

the treatment of patients with cancer.⁷ In addition, according to the results of the nutritional assessment, patients with cancer are given priority to regulate and maintain their nutritional status through eating to maintain gastrointestinal function, followed by nutritional support.⁸ Previous studies^{9,10} reported that lifestyle changes involving eating modification could significantly improve nutritional status such as body mass index (BMI), body composition, quality of life, prolong survival and reduce recurrence.

Eating is not only an important part of lifestyle but also a human health behavior that involves interactions among physiological, psychological, environmental, social, cultural, and other elements.¹¹ Individuals are obviously capable of attending to and modifying their own eating toward healthier foods that are proven safe, acceptable and feasible.^{4,11} The goal of healthy eating includes the type and amount of food patients consume.^{6,11} For the former, the recommendation from the American Cancer Society (ACS) is a diet that is high in vegetables, fruits, and whole grains, while limiting consumption of red meat and processed foods.⁷ For the latter, a study the importance of appropriate proportions of nutrients (ie, carbohydrates, proteins, and fats) to support energetic and physiologic needs without excess or inadequate consumption.¹² However, being diagnosed with cancer and treatment side effects can interfere with daily healthy eating and generate unhealthy eating, which may lead to negative health outcomes.¹³ The common unhealthy eating habits included overconsumption of fats and eating too much or too little. To achieve the goal of healthy food consumption and appropriate proportions, patients with cancer need to change their behaviors from unhealthy eating to healthy eating. "Knowledge, Attitude, and Practice" (KAP)¹⁴ is one of the models that focuses on changes to human health. It divides the change in human practices into three continuous processes: knowledge acquisition, belief generation, and behavior formation. Among them, "knowledge" refers to the understanding and explanation of relevant knowledge, "attitudes" refers to appropriate beliefs and positive attitudes, and "practice" refers to behaviors that change to achieve a health goal. Thus, only when patients with cancer acquire healthy eating knowledge and have a strong sense of desire can it be possible to engage in behaviors toward healthy eating.

Among a variety of treatments, the number of people receiving chemotherapy is large and occupies an important position. Compared with chemotherapy, the side effects of radiotherapy are relatively local and short-term, such as difficulty swallowing and chewing, which mostly occur in patients with head and neck cancer.¹⁵ Surgery is more common in esophageal and gastric cancers and is characterized by anatomical changes that lead to difficulty swallowing and eating obstruction.¹⁶ Studies have shown that patients with cancer who receive these two treatments mainly carry out swallowing training and learn about gradual eating, and symptoms can usually be restored within a month. For chemotherapy, the side effects are systemic and serious, differing depending on the chemotherapy regimen, including short-term and long-term effects.^{17,18} The short-term effects are mainly gastrointestinal reactions, such as nausea, vomiting, fatigue,¹⁹ and taste changes.²⁰ Long-term side effects include energy loss, weight gain,²¹ adverse changes in body composition (increased fat mass and decreased muscle mass),²² and loss of muscle strength.²³ Among them, weight gain and changes in body composition may have profound negative effects on the quality of life and self-esteem of patients with cancer.²⁴ Of particular note are patients with lung cancer, breast cancer, gynecological cancer, and lymphoma. Many patients with these cancers receive chemotherapy, the effect of chemotherapy is better in these patients, and the chemotherapy cycles are longer than those in patients with other cancers. However, the results on the knowledge, attitudes, and behaviors of these patients toward healthy eating are not conclusive. Some studies reported that many patients with breast cancer were shocked and afraid of weight gain after chemotherapy,²⁵ some of them sought information about healthy eating to maintain their body image,²⁶ but some may increase the intake of sweets and fats to relieve stress.²⁷ Further exploration of more types of cancer should be considered.

Social influence is a major determinant of eating.¹¹ Differences in Eastern and Western eating cultures may lead to the generation of different knowledge, attitudes, and behaviors toward healthy eating among patients with cancer undergoing chemotherapy. The differences are mainly manifested in two aspects: the concept of eating and food therapy from traditional Chinese medicine (TCM). For the former, the Chinese may hold more conservative concepts regarding eating when they are diagnosed with cancer and after treatment.²⁸ After chemotherapy, Chinese patients with cancer are more cautious about food choices. There are many foods that are considered taboo, which are called "fawu" in China and may increase the risk of relapse, including seafood, mutton, and leeks.²⁸ However, Western patients do not have many taboos about eating; they prefer to try new recipes, eat strongly flavored foods, and drink sweet beverages to promote the goal of healthy eating.²⁹ With respect to TCM, Chinese patients with cancer tend to seek the help of food therapy from TCM after chemotherapy because it is believed that edible food and medicine are from the same origin, and the treatment of the disease by eating and medicine may be similar.³⁰ Furthermore, they believe that food therapy can not only ensure the type and amount of food intake during treatment but also help to treat the disease and accelerate recovery, and it is safe, without toxic side effects. However, there are limited reports about Chinese cancer patients' knowledge, attitudes, and behaviors toward healthy eating under specific eating cultures.

The current evidence shows that modifiable lifestyle-related factors play an important role in optimizing quality of life of patients with cancer. Among them, eating is an indispensable lifestyle factor, and modified eating could significantly improve nutritional status and quality of life. Individuals are also capable of attending to and modifying their own eating toward healthier habits. Being diagnosed with cancer and chemotherapy side effects can interfere with daily healthy eating and generate unhealthy eating. Patients with cancer need to acquire knowledge, have positive attitudes, and adopt behaviors to transform unhealthy eating behaviors into healthy eating. Moreover, social influence is a major determinant of eating; differences in Eastern and Western eating cultures may make patients generate different knowledge, attitudes, and behaviors toward healthy eating, and this effect is unclear among Chinese patients with cancer treated with chemotherapy. The aim of this systematic review was to summarize the specific knowledge, attitudes, and behaviors toward healthy eating among Chinese patients with cancer treated with chemotherapy; determine which patients perform well or poorly in terms of specific knowledge, attitudes, or behaviors; and try to support a healthy eating transition among these patients. This study provides a reference for the development of targeted and localized dietary intervention to facilitate the patients' transition to healthy eating and improve their quality of life.

Methods

The Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines³¹ were used to conduct this review and have been preregistered in PROSPERO (Registration No. CRD 42022312414).

Criteria for considering studies for this review

The eligibility criteria were based on the principles of PICOS. However, the aim of this review was to explore knowledge, attitudes, and behaviors toward healthy eating, and quantitative descriptive studies were the main studies included. The eligibility criteria were designed from three aspects: types of studies, types of participants, and types of outcomes.

Types of studies

We included quantitative descriptive studies in which the results were measured and reported by specific number (percentage or score), mainly

cross-sectional studies with or without follow-up. The contents were about cognitive/psychological/behavioral research, providing quantitative results (score or percentage) of measurements of knowledge, attitudes, or behaviors toward healthy eating. The publication language was English or Chinese, regardless of blinding or publication status.

Types of participants

Study participants were included if they were ≥ 18 years old, had Chinese nationality, and lived in Mainland China, Taiwan, Hong Kong, or Macao. In addition, they were receiving or had received chemotherapy with or without combined therapy and were able to eat by mouth independently. Moreover, they were able to freely express their thoughts, attitudes, and ideas about healthy eating and apply this knowledge to strategies to promote healthy eating.

Studies were excluded if participants were Chinese immigrants or living in other countries or at the terminal stage with an estimated survival period of less than 6 months.

Types of outcomes

We classified primary and secondary outcomes in this review. The primary outcomes were knowledge, attitudes, and behaviors toward healthy eating. Studies with at least one of three outcomes were included. The secondary outcomes included the influencing factors of knowledge, attitudes, or behaviors. We included studies in which the results were measured and reported by a specific number (percentage or score). For measurement tools that assessed the score, we intended to include tools in which the score was rated according to a Likert-type scale and could indicate the degree/level or frequency of knowledge, attitudes, or behaviors. The findings had to be validated and reported for validity and reliability. In addition, the criteria for healthy eating in this review were roughly defined as a healthy type and amount of food consumed, specifically including high consumption of vegetables, fruits, and whole grains, while limiting the consumption of red meat and processed foods, as well as appropriate proportions of nutrients (ie, carbohydrates, proteins, and fats) to support energetic and physiologic needs without excess or inadequate consumption.

Primary outcomes. The initial concept of knowledge was derived from the KAP model. "Knowledge" in the KAP model refers to the understanding and explanation of relevant information.¹⁴ Patients treated with chemotherapy need to know the negative effects of disease and chemotherapy on normal eating, the benefits and necessity of healthy eating changes, and methods to obtain scientific information on healthy eating. Studies that used scores or percentages to quantitatively assess the quantity or quality of healthy eating knowledge that patients mastered and sources patients used to obtain scientific information on healthy eating were included in this review.

The meaning of "attitudes" was also instructed by the KAP model. "Attitude" in the KAP model refers to the right faith and positive beliefs.¹⁴ After knowing the benefits of healthy eating and possessing enough information about how to change to healthy eating, whether patients believe in the positive effects of healthy eating and are willing to make change to promote healthy eating are important components of attitude. The studies that used scores or percentages to quantitatively assess the degree to which patients recognize the importance of healthy eating and willingness to seek help were included in this review.

"Behavior" in the KAP model is a broad concept that refers to manners and actions that contribute to achieving a healthy goal.¹⁴ The goal of healthy eating refers to a healthy type and amount of food consumed, specifically including a diet high in vegetables, fruits, and whole grains, while limiting consumption of red meat and processed foods, as well as appropriate proportions of nutrients (ie, carbohydrates, proteins, and fats) to support energetic and physiologic needs without excess or inadequate consumption. Healthy eating in patients treated with chemotherapy may be disturbed by side effects, leading to negative changes in daily normal eating

patterns and habits. Thus, patients need to make changes to relieve uncomfortable physiological reactions and adjust to daily healthy eating. In this review, any reactions and strategies that patients adopted to improve the type and amount of food consumed were included.

Studies were excluded if they only measured nutritional assessment indicators, such as body composition index (eg, weight, BMI, hemoglobin), food intake (eg, meat, vegetables, energy, protein, vitamins), or functional status (eg, muscle strength, grip strength, physical activity); only measured the incidence and severity of chemotherapy-induced adverse symptoms; or only measured the application and effect of nutritional support, such as enteral nutrition.

Secondary outcomes. Many factors can influence knowledge, attitudes, and behaviors toward healthy eating, such as patients' demographic or disease and treatment factors, psychological factors, and health status. Studies that quantitatively measured the relationship between influencing factors and knowledge, attitudes or behavior and showed specific statistical data of significant differences ($P < 0.05$) were included.

Search methods for the identification of studies

Electronic searching

Initial preretrieval helped us search the English databases. Although the targeted population was Chinese patients, some studies from Taiwan, Hong Kong or Macao may be published in English. The best way to find relevant published work is to carefully search at least two different electronic databases.³² Therefore, to improve the efficiency of English database search, we first selected PubMed and Web of Science (WOS), which are relevant to our topic area, and the number of studies included was large. Then, other English databases (Embase, PsycInfo, CINAHL, and Cochrane) were also searched to determine whether there was a certain amount of valuable literature, and most of the studies were not targeted in Chinese or were also included in the literature from PubMed and WOS. Finally, we decided to select PubMed and WOS for the English literature search in the final retrieval. In terms of publication years, we discovered that targeted articles that focused on the knowledge, attitudes, and behaviors toward healthy eating emerged after 2007, with an increasing number of researchers paying attention to patients' eating status and starting experimental studies during preretrieval. To maintain consistency with the English databases, we limited the time period to after 2007 in all databases.

In the final retrieval, two English-language electronic databases (PubMed and WOS) and three Chinese common databases (CNKI, WANFANG, and VPCS) were selected, and the publication year was after 2007. In terms of search strategy, based on the definition and specific contents pertaining to healthy eating (Table 1) and the principle of PICOS,³³ we combined subject words and random words,³² including country (eg, China, Chinese), cancer (eg, tumor, neoplasms), and outcomes (eg, eating knowledge, attitudes, and eating behavior) (Appendix A). Due to the variety of chemotherapy regimens and study types, the eligibility criteria were limited rather than the search strategy. The list of references in the included literature was also hand-searched to supplement additional eligible literature.

Data collection and analysis

Selection of studies

After removing duplicate literature, two researchers (YZ and NR) independently screened the title and abstract of the literature in order of relevance. Then, the literature that initially met the inclusion criteria was assessed after full-text screening. If the full-text literature was not available or relevant data information was missing, the authors were contacted by email. If the authors were not available, the study was excluded from this review. The third researcher (CB) adjudicated any disagreements that could not be resolved by discussion.

Table 1
Concepts of outcomes and specific contents pertaining to Chinese patients with cancer treated with chemotherapy.

Outcome	Definition from KAP model	Specific contents pertaining to healthy eating	Summarized aspects in this review	Number of studies involved	Included studies
Knowledge	Understanding and explanation of relevant information	Information about what should be eaten and how much should be eaten can promote health after chemotherapy	Quantity, quality, source of knowledge, specific TCM knowledge	4	(Cong et al., 2018), (Zhang et al., 2014), (Wang et al., 2014), (Luo et al., 2011)
Attitudes	The right faith and positive beliefs	Perception of the importance of healthy types and amount of food consumed and willingness to do something to improve the type and amount of food consumed	Perception of importance and willingness to engage in healthy eating	9	(Cong et al., 2018), (Hu et al., 2012), (Jiao et al., 2020), (Luo et al., 2011), (Wu et al., 2017), (Xu et al., 2017), (Zhang et al., 2010), (Zhang et al., 2014), (Zhu et al., 2009)
Behaviors	Habits and actions that change to a kind of healthy goal	Any reactions and strategies that patients adopted to improve the type and amount of food consumed	–	4	(Cong et al., 2018), (Hung et al., 2018), (Lou et al., 2014), (Zhang et al., 2014)

Data extraction and management

After an initial literature screening, another two researchers (TH and LY) independently double-coded and entered information from each selected study into data extraction forms (Table 2). The following information, including the basic information of the study and outcomes about knowledge, attitudes, or behaviors toward healthy eating, was obtained from the included literature:

Study details: first author, literature, publication year, and research location.

Population details: participants' cancer type, treatment (only chemotherapy or combined with other therapy), sample size, and age range (mean \pm SD).

Questionnaire details: assessment tool and assessment method (prevalence or scoring).

Primary outcome details: knowledge, attitudes, or behaviors toward healthy eating and follow-up period (if relevant).

Secondary outcome details: influencing factors of knowledge, attitudes, or behaviors toward healthy eating that showed the specific statistical data of significant differences.

Assessment of methodological quality

Quality assessment was conducted using the 11-item tool designed by the Agency for Healthcare Research and Quality (AHRQ) for Cross-sectional Studies.³⁴ Each item was scored as 1 point for "Yes", 0 points for "no" or "unclear" and the scores for each study were summed for a total quality score ranging from 0 to 11 points. A score of 0–3 was classified as low quality, 4–7 as moderate quality, and 8–11 as high quality. Two researchers (TH and YZ) independently evaluated the quality of the included studies according to the 11-item tool. Any disagreements were resolved after discussion, and a third researcher (LY) provided advice to reach a final consensus.

Data analysis

According to our preretrieval, there was a large heterogeneity of cancer types, age range, and indicators of outcomes in different studies. In addition, assessment tools of questionnaires varied, and the results were also scored differently. Given these differences, narrative qualitative analysis was mainly employed to summarize the findings of the included studies initially. Based on the definition from the KAP model and specific contents pertaining to healthy eating, we extracted the results from the included literature that conformed to the contents of Table 1 and classified them into three separate categories of knowledge, attitudes, and behaviors. The scores or percentages of the three outcomes for healthy eating were reported and discussed. We planned to roughly divide the results into these three categories first; then, if they were available and of sufficient quality and similarity, we considered summarizing the data statistically.

Results

Search results

A total of 17,761 records were provided in the initial literature search. After removal of duplicates, 14,471 articles (2690 in English, 11,781 in Chinese) remained. In addition, 14,324 records were excluded after title and abstract screening. Then, 148 articles, including 1 study, were added after manual screening in which the full text was assessed for eligibility. Finally, 12 studies (3 in English, 9 in Chinese) were included in this review to carry out qualitative synthesis (Fig. 1).

Study characteristics

The characteristics of all 12 included studies are shown in Table 2. We reported the study characteristics following the framework of "Data extraction and management" described in the Methods section. The publication years with the most published studies were 2014 (3 studies), 2018, and 2017 (each with 2 studies), and only one study was published in other years. The research location spanned 10 provinces, municipalities, and autonomous regions in China that covered the eastern, western, northern, and southern parts of the country. For population details, there was one study each for lung cancer,³⁵ esophageal cancer,³⁶ rectal cancer,³⁷ breast cancer,³⁸ and the remaining studies included patients with many kinds of cancer. Seven studies^{38–44} reported that patients received only chemotherapy, and in other studies, patients received combined therapy in addition to chemotherapy. Among them, one study³⁸ targeted neoadjuvant chemotherapy, and one targeted nonfirst chemotherapy,⁴² and the remaining studies were mainly for the first adjuvant chemotherapy. The sample sizes ranged from 48 to 1027, with a total of 2841, and the ages ranged from 18 to 86 years. For questionnaire details, 11 studies used a self-designed assessment tool and the assessment method of prevalence. Only one study³⁵ used a 5-point Likert-type scale to measure scores of behavior outcomes, which was named the Self-Care Behavior Scale (SCBS). All measurements were patient-reported and cross-sectional.

Primary outcomes of studies

Knowledge of healthy eating

Knowledge refers to the understanding and explanation of relevant information from the KAP model. In terms of healthy eating, knowledge refers to information about what should be eaten and how much should be eaten to promote health after chemotherapy. Accordingly, we summarized the outcome of knowledge from four aspects: quantity, quality, source of knowledge, and specific TCM knowledge. A total of four studies^{39,41,44,45} involved knowledge. Among them, two studies^{44,45} measured knowledge of TCM, and one measured quantity,⁴¹ quality,³⁹

Table 2
Study characteristics and findings of eating-related outcomes (alphabetically ordered).

First author, year	Research location	Sample size/Age range (mean \pm SD)	Population	Treatment	Assessment tool	Assessment method	Primary outcomes (mean \pm SD, if relevant)			Secondary outcome ($P < 0.05$)
							Knowledge (quantity, quality, source, TCM)	Attitude (perception of importance, willingness)	Behavior	Related factor
Cong et al., 2018	Multicenter	535/(55.81 \pm 12.20) Y	Not specific	Chemotherapy	Self-designed	Prevalence ^{a,b}	1. Quality: ① 70.7% of participants had dubious information; they did not know what kinds of foods belonged to scientific dietary guidelines; ② 81.7% of participants had contradictory information about how much to eat; ③ 99.6% of participants received incorrect information, such as instructions to avoid crab, chicken, lamb, fish, and prawns, considered as "fawu", which can lead to relapse and increase the severity of side effects of chemotherapy in China. 2. Source: 26% of participants acquired eating knowledge from physicians versus 18.5% from internet.	Perception of importance: 95.2% of participants thought it was important to have good eating habits, such as eating more protein and low-fat food, as well as keeping a good appetite to maintain enough intake.	1. 89.2% of participants took Chinese food therapy to maintain a balanced diet and enough food intake. 2. 23.8% of participants took food for special medical purposes (FSMP). 3. 33.2% of cancer patients would visit nutrition clinics to improve the type and amount of food consumed.	
Hu et al., 2012	Binzhou, Shandong Province	84/NA	Not specific	Chemotherapy	Self-designed	Prevalence ^a		Willingness: 90.5% of participants were willing to receive eating guidance before chemotherapy.		
Hung et al., 2018	Taiwan	159/42–86 (65.03 \pm 11.05) Y	Lung cancer	Chemotherapy with or without combined therapy	Self-Care Behavior Scale (SCBS)	Scoring ^{c,d}			Food choice and nutrition maintenance (3.57 \pm 0.51)	
Jiao et al., 2020	Luoyang, Henan Province	100/60-70 Y	Esophagus cancer	Chemotherapy with combined therapy	Self-designed	Prevalence ^a		Willingness: 52.0% of participants were willing to receive eating guidance during chemotherapy in hospital.		
Lou et al., 2014	Hangzhou, Zhejiang Province	255/18–77 (49.12 \pm 11.73) Y	Not specific	Chemotherapy with or without combined therapy	Self-designed	Prevalence ^b			1. 92.16% of participants had diet modification to relieve symptoms which can help patients increase appetite, and	1. Demographic or disease and treatment factors; 2. Psychological factors

(continued on next page)

Table 2 (continued)

First author, year	Research location	Sample size/Age range (mean ± SD)	Population	Treatment	Assessment tool	Assessment method	Primary outcomes (mean ± SD, if relevant)			Secondary outcome (P < 0.05)
							Knowledge (quantity, quality, source, TCM)	Attitude (perception of importance, willingness)	Behavior	Related factor
Luo et al., 2011	Fuzhou, Fujian Province	210/28-70 Y	Not specific	Chemotherapy	Self-designed	Prevalence ^a	Quantity: 75.7% of participants knew that increasing intake of vegetables, fruits, and grains can maintain their nutrition status after disruption by the side effects of chemotherapy.	Willingness: 98.5% of participants were willing to receive home-based eating guidance after discharge.	consume enough amount of food. 2. 5.1% of participants took ginger or ginger brown sugar fluid. 3. 22.4% of patients sucked on peppermint, etc.	
Wang et al., 2014	Shijiazhuang, Hebei Province	1027/18-86 Y	Not specific	Chemotherapy with combined therapy	Self-designed	Prevalence ^a	TCM: 41.8% of participants knew the eating precautions when taking TCM decoctions, such as avoiding food that is raw, cold, greasy, smelly, not easy to digest and has acrimony excitant properties and that it is better not to drink beverages.			
Wu et al., 2017	Shanghai	108/22-82 Y	Not specific	Chemotherapy	Self-designed	Prevalence ^a		Willingness: 97.2% of participants were willing to receive eating guidance during chemotherapy in hospital.		
Xu et al., 2017	Shenyang, Liaoning Province	188/23-75 (54.72)Y	Not specific	Chemotherapy	Self-designed	Prevalence ^a		Willingness: 59.6% of participants were willing to receive eating guidance before chemotherapy.		
Zhang et al., 2010	Jinmen, Hubei Province	48/48-69 Y	Rectal cancer	Chemotherapy with combined therapy	Self-designed	Prevalence ^a		Willingness: 89.6% of participants were willing to receive eating guidance during chemotherapy in hospital.		
Zhang et al., 2014	Suzhou, Jiangsu Province	67/36-77 Y	Not specific	Chemotherapy	Self-designed	Prevalence ^a	TCM: 10.4% of participants knew what they should to eat in	Willingness: 98.5% of participants were willing to receive	98.5% of participants were taking or	

(continued on next page)

Table 2 (continued)

First author, year	Research location	Sample size/Age range (mean ± SD)	Population	Treatment	Assessment tool	Assessment method	Primary outcomes (mean ± SD, if relevant)	Secondary outcome (P < 0.05)	Related factor
							Knowledge (quantity, quality, source, TCM)	Attitude (perception of importance, willingness)	Behavior
Zhu et al., 2009	Nanjing, Jiangsu Province	60/26–72 (49) Y	Breast cancer	Chemotherapy (neoadjuvant)	Self-designed	Prevalence ^a	Chinese food therapy; most of them did not know what kinds of food can increase appetite or what they should eat to relieve constipation or diarrhea.	eating guidance about TCM after chemotherapy.	had taken Chinese food therapy to increase appetite.
							Willingness: 90.0% of participants were willing to receive eating guidance during chemotherapy in hospital (90.0%).		

^a The prevalence of eating-related knowledge, attitudes, and practices was assessed based on a “yes” or “no” question.

^b The prevalence was presented as the percentage of the total population.

^c Measurement data are presented as the mean of all items from the eating-specific dimensions.

^d The outcomes were scored on a 5-point Likert-type scale (responses were recorded using the following scale: 1 = never do it, 5 = always do it).

and source³⁹ of knowledge. In one study,⁴¹ 75.7% of patients reported that they were aware that increasing vegetables, fruits, and grains could maintain their nutrition status after disruption by the side effects of chemotherapy. Another study³⁹ demonstrated that 70.7% of participants had doubtful information; they did not know what kinds of foods belonged to scientific diets, with an especially poor understanding about protein-rich foods. In addition, 81.7% of participants had contradictory information about how much they should eat; many patients thought their appetite was not too bad and that they consumed enough food, whereas they did not reach the target requirements from physicians. In addition, 99.6% of participants received incorrect information, such as instructions to avoid crab, chicken, lamb, fish, and prawns because they are considered “fawu” for patients with cancer and are widely believed to lead to relapse and increase the severity of side effects of chemotherapy in China. For the source of information, 26.0% of participants acquired eating knowledge from attending physicians rather than from the network (18.5% of participants).³⁹ Regarding knowledge of TCM, 41.8% of participants were aware of the eating precautions when taking TCM decoctions,⁴⁵ such as avoiding food that is raw, cold, greasy, smelly, not easy to digest or has acrimony excitant properties, and that it is better not to drink beverages because the additives and preservatives in the beverages will also affect the absorption of the effective components of TCM and reduce the efficacy. Furthermore, only 10.4% of participants knew what should be eaten in Chinese food therapy,⁴⁴ and most of them did not know what kinds of food can increase appetite and what should be eaten to relieve constipation or diarrhea.

Attitudes toward healthy eating

The concept of attitudes from the KAP model refers to the right faith and positive beliefs. The specific content pertaining to healthy eating can be defined as the perception of the importance of consuming a healthy type and amount of food and the willingness to make changes to improve the type and amount of food consumed. In this review, we classified the outcome of attitude into two aspects: perception of importance and willingness to eat healthy. A total of nine studies investigated attitude, one investigated the perception of importance,³⁹ and eight studies measured willingness.^{36–38,40–44} A total of 95.2% of patients with cancer thought it was important to have good eating habits, such as eating more protein and low-fat food, as well as keeping a good appetite to maintain enough intake.³⁹ The results on willingness to make changes to promote healthy eating varied in different populations and with different characteristics of chemotherapy. Because what should be eaten and how much should be eaten during chemotherapy complex and confusing, eating-related guidance can directly improve the type and amount of food consumed. Four studies showed that more than half of the patients were willing to receive eating guidance during chemotherapy in the hospital, including one study of patients with esophageal cancer after surgery (52.0% of participants),³⁶ one for nonfirst chemotherapy (97.2% of participants),⁴² one among patients with rectal cancer after colostomy (89.6%),³⁷ and one among neoadjuvant chemotherapy patients (90.0% of participants).³⁸ In addition, two studies^{40,43} reported willingness to obtain eating guidance before chemotherapy (59.6% and 90.5% of participants). One remaining study⁴¹ showed that 98.5% of participants were willing to receive home-based eating guidance after discharge, and another⁴⁴ reported that 98.5% of patients with cancer were willing to receive eating guidance about TCM after chemotherapy.

Behaviors toward healthy eating

The concept of behaviors from the KAP model refers to habits and actions that can help to reach a healthy goal. In this review, behavior refers to reactions and strategies that patients adopted to improve the type and amount of food consumed. A total of four studies^{35,39,44,46} assessed the outcomes of behavior. One study³⁹ showed that 89.2% of participants were treated with Chinese food therapy to maintain a balanced type of food and enough food intake, 23.8% of participants took food for special medical purposes (FSMP), and 33.2% of patients with

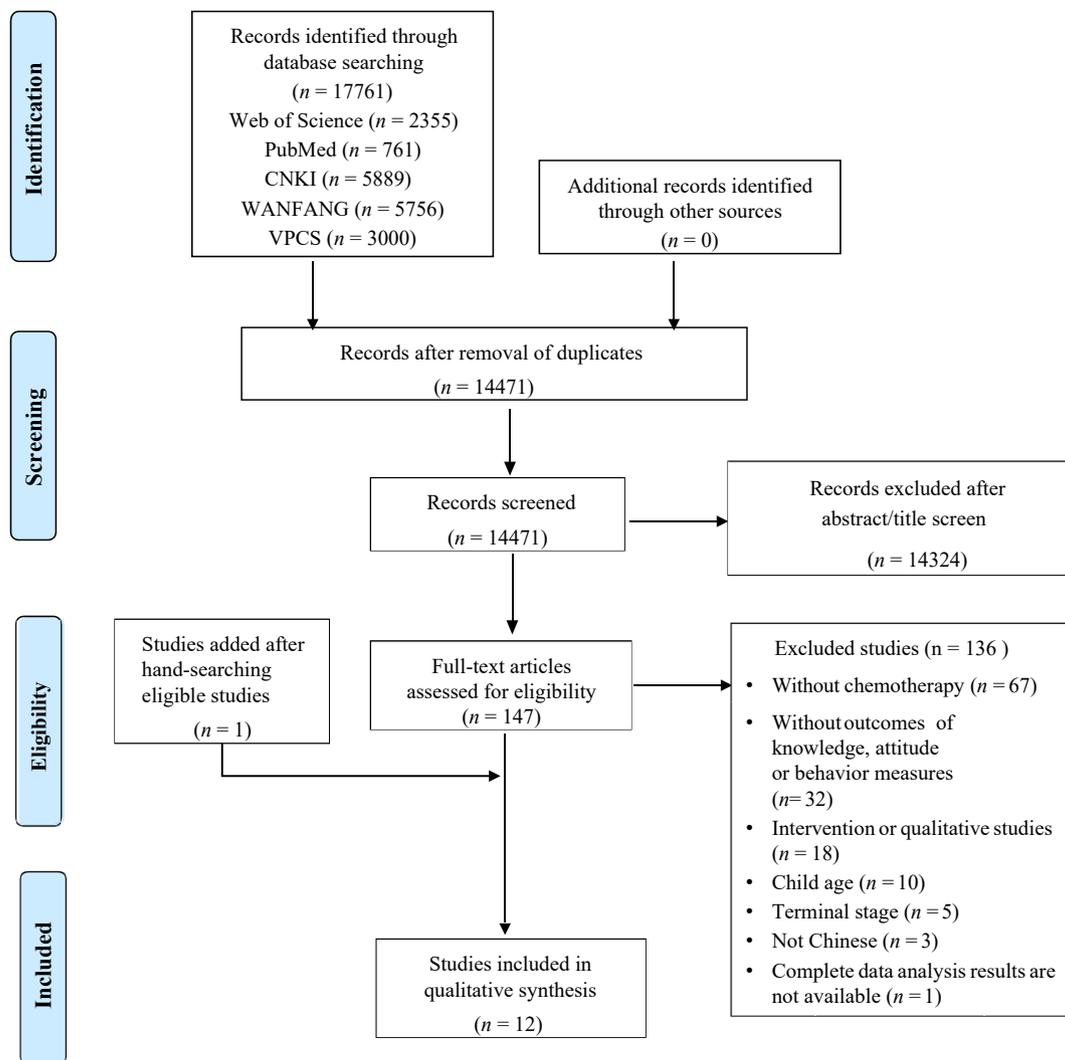


Fig. 1. Flow diagram of study selection process for this review.

cancer would see nutrition clinics to improve the type and amount of food consumed. One study³⁵ demonstrated that the score of the dimension of dietary modification behaviors from the Self-Care Behavior Scale (SCBS) was 3.57 ± 0.51 , indicating that eating light food is more common than usual. Another study⁴⁶ targeting symptom relief showed that 92.16% of participants underwent diet modifications to relieve symptoms, which can help patients increase appetite and consume enough food, including 5.1% of participants who took ginger or ginger brown sugar fluid and 22.4% of patients who sucked on peppermint. Another study⁴⁴ reported that most patients were taking or had taken Chinese food therapy (98.5% of participants) to increase appetite, and the therapeutic prescriptions were mainly pork rib soup (68.7% of participants), black fish soup (65.7% of participants), and pigeon soup (58.2% of participants).

Secondary outcomes of studies

One study⁴⁶ demonstrated the influencing factors of behavior toward healthy eating and showed specific statistical data revealing significant differences ($P < 0.05$). The factors included demographic or disease and treatment factors as well as psychological factors. Patients living in urban areas were more likely than those living in rural areas to engage in environmental modification behaviors to cope with nausea and vomiting ($P < 0.05$), such as avoiding the sight or smell of food and smelling the flavor of orange or lemon when nauseous. In the same study, outpatients,

participants with many past vomiting experiences, nonserious delayed nausea, and short periods of delayed vomiting had lower environmental modification behaviors ($P < 0.05$). A higher distress level (DT) was associated with lower modification behavior ($P < 0.05$). Apart from DT, a higher level of perceived available resources from health professionals was associated with a higher likelihood of reporting modification behaviors ($P < 0.05$). Moreover, higher perceived support from neighborhood and media/policy was associated with higher modification behavior ($P < 0.05$).

Results of quality assessment

The quality ratings of each included study are presented in Table 3. All studies were rated as of moderate quality. All included studies reported that the source of information was from surveys, subjects were population-based, and the studies clearly described the content and use of assessment tools. No studies explained how missing data were handled, and no studies provided clarifying or follow-up information to address the missing data. Four studies^{35,36,39,46} clearly listed inclusion and exclusion criteria for subjects. Eight studies^{36-38,40,41,43-45} indicated the time period used for identifying patients. Ten studies³⁶⁻⁴⁵ indicated whether evaluators of subjective components of the study were masked to other aspects of the status of the participants. Only one study³⁵ explained any patient exclusions from the analysis. Nine studies^{35,37,38,40-45} summarized patient response rates and completeness of data collection.

Discussion

In Asian cultures, many foods are considered taboo for patients with cancer treated with chemotherapy. Chinese patients show conservative eating habits and are more eager to seek help from TCM to relieve the side effects of chemotherapy and adjust to healthy eating. Differences in eating cultures may lead Chinese patients with cancer undergoing chemotherapy to generate different knowledge, attitudes, and behaviors toward healthy eating from those of their Western counterparts.

Quality of included studies

The quality of all included studies was moderate, and well-designed studies are lacking. Deficiencies were mainly reflected in several aspects. First, most of the studies did not clearly state the inclusion and exclusion criteria of participants, such as disease stage or chemotherapy characteristics, which may make the results less representative. For example, at the early stage and the first time that patients with cancer received chemotherapy, they were more interested in eating knowledge about how to prevent or relieve vomiting and nausea.^{47,48} However, patients who have undergone several sessions may become accustomed to side effects and pay less attention to the intake of healthy food because of poor palatability. Second, only one study³⁵ explained how many patients were excluded from items. Other studies reported only participants in the final analysis, and it is not clear whether there were any excluded patients. Third, most of the studies did not describe how confounding factors were assessed or controlled. Confounders commonly influence eating-related outcomes, such as the quality of sleep,⁴⁹ drugs,⁵⁰ and the level of hormones.⁵¹ Moreover, no studies explained how missing data were handled in the analysis, but some of them checked for missing data and asked patients to fill in the missing field. Finally, no follow-up information was reported in the included studies. To improve the quality of the study and keep the results scientific, clear inclusion and exclusion criteria about population, treatment, and measurements are highlighted. In addition, explicit statements of patient exclusion for analysis, confounders, and techniques to handle missing data should be considered in the study design.

Primary outcomes for healthy eating

Knowledge of healthy eating

Being diagnosed with cancer can cause individuals to break their healthy eating habits, and receiving chemotherapy is considered an opportunity to gain timely healthy eating information.⁵² In this review,

knowledge of healthy eating referred to information about what should be eaten and how much should be eaten to promote health after chemotherapy. We analyzed knowledge from four aspects: quantity, quality, source, and TCM. The results showed that 75.7% of participants reported that they were aware that increasing the intake of vegetables, fruits, and grains can maintain their nutrition status after disruption by the side effects of chemotherapy. These results were higher than that reported in another study⁵³ that 57.1% of young breast cancer survivors thought they received nutritional information from healthy professionals. The main reason could be that the former study was conducted among inpatients who were undergoing chemotherapy. Due to the suffering of side effects from chemotherapy, these patients are eager to seek information about what to eat and how much to eat to relieve side effects and maintain nutrition. In addition, health professionals can more easily and frequently provide them with eating information and health education face to face. The former study targeted populations who were cancer survivors, and professional information support from hospitals about eating and diet may be lacking after treatment and discharge.

For sources of information, one included study showed that most inpatients would like to acquire eating knowledge from physicians rather than from networks, but evidence from another study⁵⁴ reported that more cancer survivors sought knowledge from websites than physicians. The reason may be that dietary information from health professionals is readily available for inpatients, whereas outpatient cancer survivors rely more on the internet for what to eat and how much to eat. Through the internet, patients can acquire eating knowledge that they are able to understand by text, pictures, or videos according to their educational level, which expands the amount and sources of eating knowledge. Thus, information support toward healthy eating should continue to be provided to patients with cancer after treatment, and the knowledge should be modified and targeted based on patients' treatment trajectory.

One included study³⁹ showed that the quality of eating information that patients with cancer received cannot be guaranteed. A total of 99.6% of Chinese participants received incorrect information because the researcher formulated the standard of right or wrong from the perspective of TCM, namely, that crab, chicken, lamb, and seafood were regarded as the wrong types of food to eat because they are all "fawu" in China, which can lead to recurrence. In addition, 70.7% of participants received dubious information, and they did not know what kinds of foods belonged to scientific diets, with an especially poor understanding about protein-rich foods. These results were different from Western studies, which showed that there were few food taboos, and the intake of adequate high-quality protein foods such as fish, eggs, and shrimp was emphasized,⁵⁵ and the related information was provided to patients, such

Table 3
Critical appraisal of included studies.

Study (Reference)	Item 1	Item 2	Item 3	Item 4	Item 5	Item 6	Item 7	Item 8	Item 9	Item 10	Item 11	Total score	Quality rating
Hung et al., 2018 ³⁵	1	1	0	1	0	1	1	0	0	1	0	6	Moderate
Jiao et al., 2020 ³⁶	1	1	1	1	1	1	0	0	0	0	0	6	Moderate
Zhang et al., 2010 ³⁷	1	0	1	1	1	1	0	0	0	1	0	6	Moderate
Zhu et al., 2009 ³⁸	1	0	1	1	1	1	0	0	0	1	0	6	Moderate
Cong et al., 2018 ³⁹	1	1	0	1	1	1	0	0	0	0	0	5	Moderate
Hu et al., 2012 ⁴⁰	1	0	1	1	1	1	0	0	0	1	0	6	Moderate
Luo et al., 2011 ⁴¹	1	0	1	1	1	1	0	0	0	1	0	6	Moderate
Wu et al., 2017 ⁴²	1	0	0	1	1	1	0	0	0	1	0	5	Moderate
Xu et al., 2017 ⁴³	1	0	1	1	1	1	0	0	0	1	0	6	Moderate
Zhang et al., 2014 ⁴⁴	1	0	1	1	1	1	0	0	0	1	0	6	Moderate
Wang et al., 2014 ⁴⁵	1	0	1	1	1	1	0	0	0	1	0	6	Moderate
Lou et al., 2014 ⁴⁶	1	1	0	1	0	1	0	1	0	0	0	5	Moderate

Item 1: Define the source of information (survey, record review); Item 2: List inclusion and exclusion criteria for exposed and unexposed subjects (cases and controls) or refer to previous publications; Item 3: Indicate time period used for identifying patients; Item 4: Indicate whether or not subjects were consecutive if not population-based; Item 5: Indicate if evaluators of subjective components of study were masked to other aspects of the status of the participants; Item 6: Describe any assessments undertaken for quality assurance purposes (eg, test/retest of primary outcome measurements); Item 7: Explain any patient exclusions from analysis; Item 8: Describe how confounding was assessed and/or controlled; Item 9: If applicable, explain how missing data were handled in the analysis; Item 10: Summarize patient response rates and completeness of data collection; Item 11: Clarify what follow-up, if any, was expected and the percentage of patients for which incomplete data or follow-up was obtained.

as what kinds of foods are high in protein and how to make protein shakes to supplement extra protein according to patients' interests.⁵⁶ In terms of the amount of food intake, most Chinese patients with cancer thought they ate enough food, whereas their intake did not meet the physicians' requirements for basic energy intake for the day. The result was similar to another study²¹ from Australia in which a number of patients reported that the recommended servings were poorly understood or remembered, and patients could never truly quite work out how much should be eaten with five servings, which always seemed slightly indistinct to them. Thus, knowledge about the type and amount of food intake, especially for high-protein food and the recommended servings for each meal, should be specific and expressed clearly.

After chemotherapy, Chinese patients with cancer were keen to seek help from TCM, such as food therapy and TCM decoctions, but only 10.4% of participants knew what to eat in accordance with Chinese food therapy. Although the positive effect of TCM on eating has been recognized in recent years, due to the complexity of TCM and food therapy, it is difficult to know and understand professional information. A qualitative study⁵⁷ showed that when Chinese patients with cancer received chemotherapy, the misunderstanding of food therapy often led them to overly consume tonics, including chicken soup and donkey-hide gelatin because they thought it could help them to quickly recover. However, another survey⁵⁸ from Scotland showed that over 30% of participants agreed that patients should only use complementary and alternative medicines recommended by doctors, pharmacists, or nurses. Thus, patients with cancer should learn about food therapy with the guidance of health professionals and treat this information objectively.

Attitudes toward healthy eating

In this review, attitudes included the perception of the importance of eating healthy types and amounts of food and the willingness to make changes to improve the type and amount of food consumed. First, one study showed that 95.2% of inpatients realized it was important to have good eating habits, such as eating more protein and low-fat food, as well as keeping up a good appetite to maintain enough intake. The result was higher than that of another study⁵⁹ from Iceland among adult cancer survivors. The probable reason could be that chemotherapy seriously affects the nutritional status of patients. Eating is a determinant of health, and it is also an important modifiable factor that can reduce the risk of malnutrition,⁶⁰ so inpatients pay more attention to the effect of appropriate types and amounts of food to adjust their nutritional status compared to survivors who have finished their treatments.

The results of patients' willingness to make changes to improve the types and amounts of food they ate varied with different characteristics of chemotherapy. One included study reported that 98.5% of participants had a willingness to receive TCM-related eating guidance. In addition, two included studies showed that patients with cancer wanted eating guidance before chemotherapy, and one of the studies that targeted chemotherapy for the first time had a higher percentage of patients who were willing to receive eating guidance (90.5%). Another study demonstrated that many patients also wanted home-based eating guidance after discharge (98.5%). These results are slightly different from those of another study,⁶¹ in which patients with cancer expressed a need for eating support during chemotherapy, and the unmet need for supportive care was highest during treatment. The main reason could be that in this review, we included patients who received the first or nonfirst chemotherapy treatment. Before their first chemotherapy, patients experience fears related to the unknown aspects of chemotherapy. Most of them may have to face chemotherapy without having fully come to terms with their diagnosis, and after the description of side effects from social networks or other patients, they hope to obtain eating knowledge in advance to prepare their mind and better cope with the disturbance. For patients who have finished many rounds of chemotherapy, home-based eating is new and challenging, and they also worry about their ability to handle this task and need to receive specific guidance.⁶² Thus, health professionals should pay attention to

willingness of patients with cancer to receive dietary guidance before, during, and after treatment and provide dietary guidance according to patients' preferences and characteristics to better promote healthy eating.

Behaviors toward healthy eating

Behaviors toward healthy eating refer to any reactions and strategies that patients adopt to improve the type and amount of food consumed. In this review, four studies measured behavior toward healthy eating, which exhibited large heterogeneity. First, the percentage of Chinese cancer participants who adopted food therapy from the included studies was high (89.2%–98.5%), which is higher than a study⁶³ from Malaysia, in which 31.7% of cancer survivors used dietary supplements. In addition, another included study showed that 23.8% of participants used FSMP, and the percentage was also lower than that of patients taking Chinese food therapy. The probable reason may be that there are many specialized TCM hospitals and departments in China that make food therapy easily available. Moreover, compared to other dietary supplements, such as vitamins, minerals, herbs, or FSMP, Chinese patients believe more strongly in a positive and safe effect of food on disease.⁶⁴ Food therapy uses common foods in daily life and exerts its natural effects to help the human body obtain health. However, patients with cancer need to treat food therapy objectively according to their own disease and treatment characteristics and then take food therapy with the guidance of professional TCM doctors.

Chinese patients with cancer engage more in their own food choices and nutrition maintenance, which was contrary to another study²⁶ from the Netherlands about the self-management of weight and nutrient intake during and after chemotherapy. The main reason could be that Chinese patients attach great importance to the type of food intake and matching of three meals a day. Their families are also very willing to participate in their food selection process.⁶⁵ Choosing healthy and fresh ingredients with family members and eating them together can help patients better improve the type of food they eat. Therefore, health professionals should stimulate social support for Chinese patients with cancer, especially family support, to enhance their confidence in selecting food and maintaining nutrition.

Another included study assessed strategies to relieve nausea and vomiting on eating. Most of the participants would modify their diet to relieve symptoms (92.16%), and some of them would suck on peppermint and take ginger or ginger brown sugar fluid. The results were consistent with other studies^{29,66} about taste or smell alterations after chemotherapy. Since chemotherapy can have a negative effect on the mucosa of the mouth or tongue, it reduces the cells of taste buds that sense taste, changes taste and smell, and ultimately affects the preference for type of food and amount of food intake.²⁰ To fully promote healthy eating, patients with cancer also need to have diet modification to relieve symptoms caused by chemotherapy, which may deeply interfere with eating, especially vomiting, nausea, and taste alteration.

Influencing factors of knowledge, attitudes, or behaviors toward healthy eating

The influencing factors were found only in behaviors, which were demographic or disease and treatment factors, as well as psychological factors. First, patients living in rural areas may have higher environmental modification behavior. This result was the opposite of another study⁶⁷ that found that rural cancer survivors did not eat a wide variety and amount of food with limited assistance. The main reason could be that the relationship and interaction between neighbors are closer in rural Chinese patients, they usually have a relatively simple living environment, and many suggestions of daily eating-related modifications are also from the surroundings. Moreover, inpatients had higher modification behavior, which was different from another qualitative study⁶⁸ that showed that cancer survivors exhibit highly individualized approaches to self-management integration. The probable reason could be that inpatients often undergo chemotherapy, so the eating problems

caused by side effects are obvious and severe, and patients tend to actively be motivated to do something to modify the type and amounts of food. Additionally, the included study showed that patients who experienced more serious and longer delayed vomiting and nausea were more likely to adapt modification behavior. Obviously, the more severe adverse reactions a patient experiences, the more likely he or she will be to adjust behaviors to relieve discomfort and improve nutritional status.

Psychological factors play an important role in eating. Psychological status can affect behavior toward healthy eating directly.⁶⁹ One included study showed that a low level of DT and high perceived available sources from others (health professionals, neighborhood, and media) were linked with high modification behavior. Apparently, patients with a high level of distress would be more afraid of disease, pay excessive attention to the negative effects of adverse reactions on eating, and fail to respond with the appropriate and objective behavior to cope with it.⁷⁰ However, patients with a low level of distress are more positive about self-management and feel confident that they can adjust their eating to improve their health. Apart from psychological distress, patients with cancer also need external support for healthy eating.⁷¹ Eating is not only an important part of lifestyle but also a human health behavior that involves interactions among physiological, psychological, environmental, social, cultural, and other elements. With the development of information technology and the improvement of medical levels, the combination of various sources of support will help patients make the transition to healthy eating.

Clinical implications

This review has provided some opportunities for future directions. It is recommended to assess associations between knowledge, attitudes, and behaviors toward healthy eating. Within the included literature, most studies chose one of the outcomes and explored its influencing factors. In future studies, behavior should be regarded as the distal outcome. A preliminary check using bivariate correlations between knowledge/attitudes and behaviors can be tested based on the KAP model and then the moderating effect of other factors can be tested. Unraveling the relationship of associations will help identify eating-related intervention strategies. Moreover, validated and tested assessment tools targeting knowledge, attitudes, and behaviors toward healthy eating are needed. This would increase the scientific rigor of the measurement results and narrow the heterogeneity of the results. Furthermore, more high-quality studies are needed to identify knowledge/attitudes/behaviors toward healthy eating changes following different chemotherapy cycles, as this is important to determine the time point of intervention and the specific content of intervention.

Knowledge about the type and amount of food intake, especially for high-protein food and the recommendation servings each meal, should be provided and explained clearly by health professionals. Additionally, patients with cancer should learn professional information about food therapy with the guidance of health professionals and treat it objectively. In terms of attitudes, health professionals should provide eating guidance before, during, and after chemotherapy according to patients' willingness and needs. Behaviors toward healthy eating suggest that health professionals should stimulate social support for Chinese patients with cancer, especially family support, to help them select the type and amounts of food. In addition, patients with cancer need to have diet modifications (such as ginger or ginger brown sugar fluid, peppermint) to relieve symptoms caused by chemotherapy, which may deeply interfere with eating, especially vomiting, nausea, and taste alteration.

Strengths and limitations

This systematic review had the following strengths: In the research method, we conducted preretrieval and then modified the study design and search strategy. In addition, we defined the eligibility criteria and extracted information following the principles of PICOS to improve the scientific and normative rigor of the review. In the data analysis, we

summarized the included studies in percentages or scores to help quantify and compare the results. In addition to the strengths, this study still has some limitations that should be noted. First, the PRISMA checklist is normally used for systematic reviews of intervention studies. Although it is widely used in various study designs, targeted checklists for cross-sectional studies should be considered further. Second, in view of the workload and to improve efficiency, we searched two common English-language electronic databases, although the population of this review was Chinese patients with cancer, and we initially retrieved another four English-language electronic databases. Third, we designed the cutoff search date to be 2007, mainly according to the preretrieval results of Chinese literature. Finally, quantitative and intervention studies were not included. This is our initial exploration, and the purpose of this review was to determine the assessment tool and the specific percentage or score of different outcomes, which can allow us to better compare and analyze the results. Quantitative and intervention studies that follow targeted research aims will be included and analyzed in the future.

Conclusions

To our knowledge, this systematic review is the first to explore and summarize knowledge, attitudes, and behaviors toward healthy eating and to provide insight into cognitive, psychological, and behavioral aspects of eating among Chinese patients with cancer treated with chemotherapy. The findings showed that the quality of knowledge about healthy eating is not satisfactory, and the information about what patients should to eat and how much they should eat is contradictory and confusing. In addition, many Chinese patients with cancer did not know the specific information about what should be eaten in accordance with Chinese food therapy, and they should learn about food therapy with the guidance of health professionals and treat it objectively. In terms of attitudes, many Chinese patients with cancer were aware of the importance of healthy eating during treatment with chemotherapy and had a willingness to receive eating guidance before, during, and after chemotherapy. More eating guidance about the type and amount of food is needed throughout the chemotherapy cycle. In terms of behaviors, Chinese patients with cancer used food therapy in TCM, changed their food choices, and modified their diets to relieve symptoms to improve the type and amount of food consumed. More high-quality studies are needed that consider health behavior as the distal outcome and explore the relationships of knowledge and attitudes on behaviors toward healthy eating.

Author contributions

Zhe Yang and Ren Na: Data curation, Software. Baohua Cao and Ying Liang: Conceptualization, Methodology. Han Tang and Yuhai Zhang: Writing – Original draft preparation, data curation. Lei Shang and Hongjuan Lang: Writing – Reviewing and editing.

Declaration of competing interest

None declared.

Funding

This work was supported by the National Natural Science Foundation of China (Grant No. 82173627). Because this is a review, the funding is only used for publication fees in the future. The authors were not excluded from accessing data in the study, and they accept responsibility to submit for publication.

Appendix A

Supplementary data related to this article can be found at <https://doi.org/10.1016/j.apjon.2022.100163>.

References

- Xia C, Dong X, Li H, et al. Cancer statistics in China and United States, 2022: profiles, trends, and determinants. *Chin Med J (Engl)*. 2022;135:584–590. <https://doi.org/10.1097/CM9.0000000000002108>.
- Zeng H, Chen W, Zheng R, et al. Changing cancer survival in China during 2003–15: a pooled analysis of 17 population-based cancer registries. *Lancet Global Health*. 2018;6:e555–e567. [https://doi.org/10.1016/S2214-109X\(18\)30127-X](https://doi.org/10.1016/S2214-109X(18)30127-X).
- Bergengren O, Enblad AP, Garmo H, et al. Changes in lifestyle among prostate cancer survivors: a nationwide population-based study. *Psycho Oncol*. 2020;29:1713–1719. <https://doi.org/10.1002/pon.5513>.
- Greenlee H, Santiago-Torres M, McMillen KK, Ueland K, Haase AM. Helping patients eat better during and beyond cancer treatment: continued nutrition management throughout care to address diet, malnutrition, and obesity in Cancer. *Cancer J*. 2019;25:320–328. <https://doi.org/10.1097/PP0.0000000000000405>.
- Tang J, Lam W, Ma A, et al. Dietary changes adopted by Chinese colorectal cancer patients: a qualitative study. *Eur J Cancer Care (Engl)*. 2019;28:e13159. <https://doi.org/10.1111/ecc.13159>.
- Corbett T, Cheetham T, Müller AM, et al. Exploring cancer survivors' views of health behaviour change: "Where do you start, where do you stop with everything?". *Psycho Oncol*. 2018;27:1816–1824. <https://doi.org/10.1002/pon.4732>.
- Rock CL, Doyle C, Demark-Wahnefried W, et al. Nutrition and physical activity guidelines for cancer survivors. *CA A Cancer J Clin*. 2012;62:243–274. <https://doi.org/10.1080/01635581.2016.1170169>.
- Muscaritoli M, Arends J, Bachmann P, et al. ESPEN practical guideline: clinical nutrition in cancer. *Clin Nutr*. 2021;40:2898–2913. <https://doi.org/10.1016/j.clnu.2021.02.005>.
- Pakiz B, Flatt SW, Bardwell WA, Rock CL, Mills PJ. Effects of a weight loss intervention on body mass, fitness, and inflammatory biomarkers in overweight or obese cancer survivors. *Int J Behav Med*. 2011;18:333–341. <https://doi.org/10.1007/s12529-010-9079-8>.
- Van Blarigan EL, Fuchs CS, Niedzwiecki D, et al. Association of survival with adherence to the American cancer society nutrition and physical activity guidelines for cancer survivors after colon cancer diagnosis: the CALGB 89803/alliance trial. *JAMA Oncol*. 2018;4:783–790. <https://doi.org/10.1001/jamaoncol.2018.0126>.
- Cruwys T, Bevelander KE, Hermans RC. Social modeling of eating: a review of when and why social influence affects food intake and choice. *Appetite*. 2015;86:3–18. <https://doi.org/10.1016/j.appet.2014.08.035>.
- Cena H, Calder PC. Defining a healthy diet: evidence for the role of contemporary dietary patterns in health and disease. *Nutrients*. 2020;12:334. <https://doi.org/10.3390/nu12020334>.
- Aoyama N, Asano S, Shingu M, et al. Changes in appetite, nutrition, and oxidative stress reaction of cancer patients during chemotherapy. *Gan To Kagaku Ryoho*. 2015;42:961–965.
- Cleland J. A critique of KAP studies and some suggestions for their improvement. *Stud Fam Plann*. 1973;4:42–47.
- Messing BP, Ward EC, Lazarus CL, et al. Prophylactic swallow therapy for patients with head and neck cancer undergoing chemoradiotherapy: a randomized trial. *Dysphagia*. 2017;32:487–500. <https://doi.org/10.1007/s00455-017-9790-6>.
- Reece L, Hogan S, Allman-Farinelli M, Carey S. Oral nutrition interventions in patients undergoing gastrointestinal surgery for cancer: a systematic literature review. *Support Care Cancer*. 2020;28:5673–5691. <https://doi.org/10.1007/s00520-020-05673-w>.
- Zraik IM, Heß-Busch Y. Management of chemotherapy side effects and their long-term sequelae. *Urologe A*. 2021;60:862–871. <https://doi.org/10.1007/s00120-021-01569-7>.
- Hsu HT, Lin KC, Wu LM, et al. Symptom cluster trajectories during chemotherapy in breast cancer outpatients. *J Pain Symptom Manag*. 2017;53:1017–1025. <https://doi.org/10.1016/j.jpainsymman.2016.12.354>.
- Fox RS, Ancoli-Israel S, Roesch SC, et al. Sleep disturbance and cancer-related fatigue symptom cluster in breast cancer patients undergoing chemotherapy. *Support Care Cancer*. 2020;28:845–855. <https://doi.org/10.1007/s00520-019-04834-w>.
- Drareni K, Bensafi M, Giboreau A, Dougkas A. Chemotherapy-induced taste and smell changes influence food perception in cancer patients. *Support Care Cancer*. 2021;29:2125–2132. <https://doi.org/10.1007/s00520-020-05717-1>.
- Terranova CO, Lawler SP, Spathonis K, Eakin EG, Reeves MM. Breast cancer survivors' experience of making weight, dietary and physical activity changes during participation in a weight loss intervention. *Support Care Cancer*. 2017;25:1455–1463. <https://doi.org/10.1007/s00520-016-3542-2>.
- Godinho-Mota J, Mota JF, Gonçalves LV, et al. Chemotherapy negatively impacts body composition, physical function and metabolic profile in patients with breast cancer. *Clin Nutr*. 2021;40:3421–3428. <https://doi.org/10.1016/j.clnu.2020.11.020>.
- Klassen O, Schmidt ME, Ulrich CM, et al. Muscle strength in breast cancer patients receiving different treatment regimes. *J Cachexia Sarcopenia Muscle*. 2017;8:305–316. <https://doi.org/10.1002/jcsm.12165>.
- Vance V, Campbell S, McCarar L, Hanning R. The voice of experience: diet and weight change in women with breast cancer associate with psychosocial and treatment-related challenges. *Can J Diet Pract Res*. 2017;78:74–80. <https://doi.org/10.3148/cjdr-2016-034>.
- de Kruijf AJ, Westerman MJ, Winkels RM, et al. Exploring changes in dietary intake, physical activity and body weight during chemotherapy in women with breast cancer: a Mixed-Methods Study. *J Hum Nutr Diet*. 2021;34:550–561. <https://doi.org/10.1111/jhn.12843>.
- de Kruijf J, Scholtens MB, van der Rijt J, et al. Perceptions of Dutch health care professionals on weight gain during chemotherapy in women with breast cancer. *Support Care Cancer*. 2019;27:601–607. <https://doi.org/10.1007/s00520-018-4347-2>.
- Carlucci PC, Cremonesi JC, Borges DAL, Diez-Garcia RW. Eating experiences, sweet preference, and weight gain in women during chemotherapy for breast cancer: a mixed methods study. *Nutr Cancer*. 2019;71:594–604. <https://doi.org/10.1080/01635581.2018.1529249>.
- Cai YJ, Masaki H, Shi TY. Supportive care needs of Chinese women with newly diagnosed breast cancer prior to adjuvant chemotherapy. *Oncol Nurs Forum*. 2021;48:341–349. <https://doi.org/10.1188/21.ONF.341-349>.
- Speck RM, DeMichele A, Farrar JT, et al. Taste alteration in breast cancer patients treated with taxane chemotherapy: experience, effect, and coping strategies. *Support Care Cancer*. 2013;21:549–555. <https://doi.org/10.1007/s00520-012-1551-3>.
- Tang WM, Chan E, Kwok CY, et al. A review of the anticancer and immunomodulatory effects of Lycium barbarum fruit. *Inflammopharmacology*. 2012;20:307–314. <https://doi.org/10.1007/s10787-011-0107-3>.
- Liberati A, Altman DG, Tetzlaff J, et al. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. *PLoS Med*. 2009;6:e1000100. <https://doi.org/10.1371/journal.pmed.1000100>.
- Siddaway AP, Wood AM, Hedges LV. How to do a systematic review: a best practice guide for conducting and reporting narrative reviews, meta-analyses, and meta-syntheses. *Annu Rev Psychol*. 2019;70:747–770. <https://doi.org/10.1146/annurev-psych-010418-102803>.
- Schardt C, Adams MB, Owens T, Keitz S, Fontelo P. Utilization of the PICO framework to improve searching PubMed for clinical questions. *BMC Med Inf Decis Making*. 2007;7:16. <https://doi.org/10.1186/1472-6947-7-16>.
- Li C, Cheng G, Sha T, Cheng W, Yan Y. The relationships between screen use and health indicators among infants, toddlers, and preschoolers: a meta-analysis and systematic review. *Int J Environ Res Publ Health*. 2020;17:7324. <https://doi.org/10.3390/ijerph17197324>.
- Hung H, Wu L, Chen K. Determinants of quality of life in lung cancer patients. *J Nurs Scholarsh*. 2018;50:257–264. <https://doi.org/10.1111/jnu.12376>.
- Jiao H, Guo Y, Zhang L. Health education needs of patients with esophageal cancer undergoing chemotherapy for the first time. *Int J Nurs*. 2020;39:3297–3300. <https://doi.org/10.3760/cma.j.cn221370-20190201-01017>.
- Zhang Q, Li J, Gong G. Investigation on health education needs of patients with rectal cancer after colostomy during adjuvant chemotherapy. *Today Nurse*. 2010;10:159–160. <https://doi.org/10.3969/j.issn.1006-6411-B.2010.10.107>.
- Zhu C. Investigation on health education needs of inpatients with breast cancer during neoadjuvant chemotherapy. *Chin J Mod Nurs*. 2009;15:908–909. <https://doi.org/10.3760/cma.j.issn.1674-2907.2009.36.031>.
- Cong M, Wang J, Fang Y, et al. A multi-center survey on dietary knowledge and behavior among inpatients in oncology department. *Support Care Cancer*. 2018;26:2285–2292. <https://doi.org/10.1007/s00520-018-4057-9>.
- Hu X, Feng P, Wang S. Psychological needs analysis and nursing countermeasures of cancer patients undergoing chemotherapy for the first time. *J Qilu Nurs*. 2012;18:115–116. <https://doi.org/10.3969/j.issn.1006-7256.2012.22.079>.
- Luo H, Liu A, Zhang Y. Investigation on demands of health education on cancer patients and families in intra day ward. *Int J Nurs*. 2011;30:1393–1395. <https://doi.org/10.3760/cma.j.issn.1673-4351.2011.09.056>.
- Wu M, Yang L, Xu P. Investigation on health education needs and satisfaction of patients undergoing re-chemotherapy. *Health Vocat Edu*. 2017;35:139–140.
- Xu H. Survey of demand for health education of nausea and vomiting in cancer chemotherapy patients. *Chin Nurs Res*. 2017;31:4278–4280. <https://doi.org/10.3969/j.issn.1009-6493.2017.33.031>.
- Zhang D. Survey on diet therapy behavior and requirement of patients in oncology department. *Contemporary Med Forum*. 2014;12:158. <https://doi.org/10.3969/j.issn.2095-7629.2014.02.167>.
- Wang C, Ma L, Hao L. Cognitive status and guidance of taking traditional Chinese medicine decoction in cancer patients treated with chemoradiotherapy Hebei. *J Tradit Chin Med*. 2014;36:994–995.
- Lou Y, Yates P, McCarthy A, Wang HM. Self-management of chemotherapy-related nausea and vomiting: a cross-sectional survey of Chinese cancer patients. *Cancer Nurs*. 2014;37:126–138. <https://doi.org/10.1097/NCC.0b013e318291b6f5>.
- Rha SY, Park M, Lee J. Stability of symptom clusters and sentinel symptoms during the first two cycles of adjuvant chemotherapy. *Support Care Cancer*. 2019;27:1687–1695. <https://doi.org/10.1007/s00520-018-4413-9>.
- Custódio ID, Marinho EC, Gontijo CA, Pereira TS, Paiva CE, Maia YC. Impact of chemotherapy on diet and nutritional status of women with breast cancer: a prospective study. *PLoS One*. 2016;11:e157113. <https://doi.org/10.1371/journal.pone.0157113>.
- Rogers LQ, Courneya KS, Oster RA, et al. Physical activity and sleep quality in breast cancer survivors: a randomized trial. *Med Sci Sports Exerc*. 2017;49:2009–2015. <https://doi.org/10.1007/s00520-020-05363-7>.
- Poff A, Koutnik AP, Egan KM, Sahebjam S, D'Agostino D, Kumar NB. Targeting the Warburg effect for cancer treatment: ketogenic diets for management of glioma. *Semin Cancer Biol*. 2019;56:135–148. <https://doi.org/10.1016/j.semcancer.2017.12.011>.
- Dev R, De Fel, Dalal S. Endocrinopathies and cancer cachexia. *Curr Opin Support Palliat Care*. 2019;13:286–291. <https://doi.org/10.1097/SPC.0000000000000464>.
- Kelly KM, Bhattacharya R, Dickinson S, Hazard H. Health behaviors among breast cancer patients and survivors. *Cancer Nurs*. 2015;38:E27–E34. <https://doi.org/10.1097/NCC.0000000000000167>.
- Miyashita M, Ohno S, Kataoka A, et al. Unmet information needs and quality of life in young breast cancer survivors in Japan. *Cancer Nurs*. 2015;38:E1–E11. <https://doi.org/10.1097/NCC.0000000000000201>.

54. Chua GP, Tan HK, Gandhi M. Information sources and online information seeking behaviours of cancer patients in Singapore. *Ecancermedicalsecience*. 2018;12:880. <https://doi.org/10.3332/ecancer.2018.880>.
55. Rinninella E, Mele MC, Cintoni M, et al. The facts about food after cancer diagnosis: a systematic review of prospective cohort studies. *Nutrients*. 2020;12:2345. <https://doi.org/10.3390/nu12082345>.
56. Fazzino TL, Sporn NJ, Befort CA. A qualitative evaluation of a group phone-based weight loss intervention for rural breast cancer survivors: themes and mechanisms of success. *Support Care Cancer*. 2016;24:3165–3173. <https://doi.org/10.1007/s00520-016-3149-7>.
57. Liang F, Li HP. Adaptive behavior among patients with breast cancer during treatment period: qualitative research. *Chin J Prac Nurs*. 2011;27:11–15. <https://doi.org/10.3760/cma.j.issn.1672-7088.2011.04.004>.
58. McLay JS, Stewart D, George J, Rore S, Heys SD. Complementary and alternative medicines use by Scottish women with breast cancer. What, why and the potential for drug interactions. *Eur J Clin Pharmacol*. 2012;68:811–819. <https://doi.org/10.1007/s00228-011-1181-6>.
59. O'Callaghan N, Douglas P, Keaver L. Nutrition practices among adult cancer survivors living on the island of Ireland: a cross-sectional study. *Nutrients*. 2022;14:767. <https://doi.org/10.3390/nu14040767>.
60. McQuestion M, Fitch M, Howell D. The changed meaning of food: physical, social and emotional loss for patients having received radiation treatment for head and neck cancer. *Eur J Oncol Nurs*. 2011;15:145–151. <https://doi.org/10.1016/j.ejon.2010.07.006>.
61. Kwok A, Palermo C, Boltong A. Dietary experiences and support needs of women who gain weight following chemotherapy for breast cancer. *Support Care Cancer*. 2015;23:1561–1568. <https://doi.org/10.1007/s00520-014-2496-5>.
62. Forbes CC, Swan F, Greenley SL, Lind M, Johnson MJ. Physical activity and nutrition interventions for older adults with cancer: a systematic review. *J Cancer Surviv*. 2020;14:689–711. <https://doi.org/10.1007/s11764-020-00883-x>.
63. Yong HY, Zalilah MS, Nurfaizah S, Yong HW, Mirnalini K, Zailina H. Health & nutrition behaviors of cancer survivors in Malaysia. *HealthMED*. 2012;6:2671–2680.
64. Leng JCF, Gany F. Traditional Chinese medicine use among Chinese immigrant cancer patients. *J Cancer Educ*. 2014;29:56–61. <https://doi.org/10.1007/s13187-013-0542-5>.
65. Williams PD, Lopez V, Ying CS, et al. Symptom monitoring and self-care practices among oncology adults in China. *Cancer Nurs*. 2010;33:184–193. <https://doi.org/10.1097/NCC.0b013e3181c29598>.
66. Ingersoll GL, Wasilewski A, Haller M, et al. Effect of Concord grape juice on chemotherapy-induced nausea and vomiting: results of a pilot study. *Oncol Nurs Forum*. 2010;37:213–221. <https://doi.org/10.1188/10.ONF.213-221>.
67. Befort CA, Austin H, Klemp JR. Weight control needs and experiences among rural breast cancer survivors. *Psycho Oncol*. 2011;20:1069–1075. <https://doi.org/10.1002/pon.1828>.
68. Dunne S, Coffey L, Sharp L, et al. Integrating self-management into daily life following primary treatment: head and neck cancer survivors' perspectives. *J Cancer Surviv*. 2019;13:43–55. <https://doi.org/10.1007/s11764-018-0726-4>.
69. Braden A, Musher-Eizenman D, Watford T, Emley E. Eating when depressed, anxious, bored, or happy: are emotional eating types associated with unique psychological and physical health correlates. *Appetite*. 2018;125:410–417. <https://doi.org/10.1016/j.appet.2018.02.022>.
70. Winger JG, Adams RN, Mosher CE. Relations of meaning in life and sense of coherence to distress in cancer patients: a meta-analysis. *Psycho Oncol*. 2016;25:2–10. <https://doi.org/10.1002/pon.3798>.
71. León-Salas B, Zabaleta-Del-Olmo E, Llobera J, et al. Health status, lifestyle habits, and perceived social support in long-term cancer survivors: a cross-sectional study. *BMC Res Notes*. 2020;13:376. <https://doi.org/10.1186/s13104-020-05218-8>.