FACTORS INFLUENCING DIETARY BEHAVIORS OF ADULTS WITH RECURRENT KIDNEY STONES IN WENZHOU, CHINA

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Abstract

Recurrent kidney stones pose a significant global health concern, emphasizing the crucial role of appropriate dietary practices in their prevention. This research, grounded in the Health Belief Model, delves into the dietary behaviors and underlying factors influencing individuals with recurrent kidney stones. The study cohort comprised 110 adults with recurrent kidney stones, selected via simple random sampling from the First Affiliated Hospital of Wenzhou Medical University in Wenzhou, Zhejiang Province, China. Utilizing instruments such as demographic questionnaires, the Health Belief Scale, and the Dietary Behaviors Scale, data analysis was conducted employing descriptive statistics and multivariate regression analysis.

The findings underscored a mean dietary behavior score of 55 out of 95 (*SD* = 8.6), indicating a moderate level of adherence to recommended dietary guidelines. Notably, perceived threat, perceived benefits, perceived barriers, and perceived self-efficacy collectively elucidated 20.4% of the variance in dietary behaviors among adults with recurrent kidney stones. Particularly, perceived threat and perceived barriers emerged as significant predictors of dietary behaviors (β = .287, p < .001; β = -.409, p < .001, respectively). These results underscore the importance of targeted interventions aimed at enhancing dietary behaviors among this demographic. Nurses and healthcare providers are urged to furnish tailored information that addresses specific barriers and heightens perceived threat, thereby fostering preventive measures against recurrent kidney stones.

Key words: adults; dietary behaviors; recurrent kidney stones; health beliefs

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Significance of the study

Kidney stones are a common urological problem worldwide, and it is caused by genetic, environmental, dietary behaviors, fluid intake, and geographical factors. Kidney stones will cause lumbar acid, swelling pain, and activity of dull pain. The incidence of kidney stones is increasing globally. In Asia, the incidence of kidney stones was about 1%-19% (Liu et al., 2018). While in China, the incidence of kidney stones was 9.6% in men, and 7.7% in women, which are relatively high levels (Lou et al., 2020). It is noteworthy that the incidence of kidney stones was higher in Zhejiang Province, China, at nearly one in ten population (Wang et al., 2017).

Adults with recurrent kidney stone refers to people who are diagnosed by physician with kidney stone then return with new stone formation or the original stones enlarged. According to a review, the recurrence rate ranges from 6% to 7% after 1 year, 21%-53% within 3 to 5 years, and the lifetime recurrence rate can reach 60%-80% (Liu et al., 2018). A survey conducted in the USA revealed that the recurrence rate, including symptomatic recurrence and radiographic recurrence, within five years was 67%, and this figure is higher than other studies (D'Costa et al., 2019). Another study found that 24.5% of recurrent stone formers underwent repeat operation (Iremashvili, Li, Best, Hedican, & Nakada, 2019). A study conducted in the coastal area of China found that the recurrence rate of kidney stones within 1 year after surgery was 19.5% (Lei et al., 2018).

There is evidence that the process of kidney stones treatment with lifestyle improvement can reduce the health-related quality of life of patients (Khan et al., 2016). Younger patients with kidney stones have lower health-related quality of life than their older counterparts, and female patients have lower health-related quality of life than male patients. Moreover, if stones cause urinary obstruction, that can lead to irreversible loss of renal function (Fontenelle & Sarti, 2019). Researchers found that patients with kidney stones had a 60% higher risk of chronic kidney disease and a 40% higher risk of end-stage kidney disease (Sofia, Manickavasakam, & Walter, 2016). In addition to the adverse physical and mental impact to the patient, kidney stones may take time away from the patient's normal work life or daily routine. In China, the cost of treating single kidney stone size of 2-3 cm is estimated at RMB 1,857-1,999 yuan ($261-279).

Treatment of kidney stones can be either by surgery or medication. Although surgery is used to remove the stones, it cannot prevent recurrence and, as noted above, the recurrence rate of kidney stones is still high. Thus, prevention of stones formation is important. Several guidelines recommend that improving dietary behaviors can prevent the stones recurrence (Huang, 2019). Dietary behaviors refer to people's daily food and drink selection and the amount consumed (Marijn Stok et al., 2018). According to the Chinese Urological Association (CUA) and evidence-based practice (Huang, 2019), the recommended dietary behaviors to prevent the recurrence of kidney stones include: (1) Having daily fluid intake above 2.5 to 3.0L, so that the daily urine output can be maintained above 2.0~2.5L; (2) Limiting intake of animal protein, including meat, fish, seafood, poultry and eggs; (3) Limiting sodium intake, consumption of packaged foods, ready-to-eat foods, and fast foods, and dining in restaurant meals high in sodium; (4) Eating calcium-rich foods, including milk, dairy products,

calcium-fortified foods and beverages, fish canned with bones, to maintain normal calcium consumption; (5) Limiting high-oxalate foods, including spinach, okra, beets, Swiss chard, star fruit, rhubarb, dried figs, peanuts, tree nuts, soybeans, black tea, wheat bran, buckwheat and dark chocolate; (6) Taking vitamin C supplement in an amount < 1000 milligrams per day; and (7) Avoiding alcohol. However, in reality, this recommended diet is often not adopted by patients with kidney stones, even though they may receive this guidance from physicians after they are diagnosed with kidney stones.

According to Jiafeng et al. (2023), Chinese people prefer a high-salt diet, and that preference shows a rising trend, year on year. In addition, a high-salt diet is considered a risk factor for stone formation (Huang, 2019). A study conducted in the coastal areas of China examined dietary behaviors of patients with kidney stones and found that 73% prefer a high-fat diet, 77% prefer animal innards, and 75% prefer seafood (Cheng & Han, 2019). To sum up, the majority of the patients with kidney stones have poor dietary behaviors. Thus, having a better understanding of factors which influence dietary behaviors in people with kidney stones is important.

In fact, dietary behaviors play an important role in prevention of various diseases. Given the importance of dietary behaviors to the prevention or control of disease, many theories or models of behavior change have been developed, such as the Health Belief Model, the Theory of Planned Behavior, and the Social-cognitive Theory. As mentioned earlier, poor dietary behaviors persist even when patients with kidney stones understand the importance of appropriate dietary behaviors. Similarly, the Health Belief Model was developed in order to improve understanding of the failure of people to adopt disease prevention strategies (Champion & Skinner, 2008), and that quest is consistent with the objective of this study.

According to the Health Belief Model (HBM) proposed by Champion and Skinner (2008), four individual beliefs (perceived threat, perceived benefits, perceived barriers, and perceived self-efficacy) influence preventive behaviors. As the major components of the HBM, individual beliefs are considered as a strong related factor behind an individual's actions (Champion & Skinner, 2008). Modifying factors (e.g., age, gender, ethnicity, personality, socioeconomic status, knowledge, etc.) are generally uncontrollable factors. These factors, among others, and cues to action in the HBM have been confirmed to be influential (Liu, Feng, Li, Ma, & Ma, 2022). Thus, in this study, the researcher focused on the influence of individual beliefs on dietary behaviors.

A study by Doan and Preechawong (2014) found that perceived benefits (r = .826, p < .05), perceived barriers (r = -.717, p < .05), and perceived self-efficacy (r = .722, p < .05) were related to dietary behaviors in patients with kidney stones. However, Tarplin et al. (2016) concluded that there was no significant difference in perceived threat among different groups of patients who were successful or unsuccessful in improving fluid intake (Tarplin et al., 2016). These findings are inconsistent and undermine the contention that health beliefs can influence the dietary behaviors of patients with kidney stones.

Zhejiang province, China has a large population and a high incidence of kidney stones, and Wenzhou is a coastal city in Zhejiang Province. There are many risk factors in the traditional dietary

habits of the citizens, such as preferring seafood and having an insufficient intake of healthy fluids. Thus, it could be illuminating to study the dietary behaviors of local patients with recurrent kidney stones and explore ways to help them modify their dietary behavior to reduce recurrent stones. Also, there is limited information of the relationship between individual beliefs and dietary behaviors in adults with recurrent kidney stones in Wenzhou, Zhejiang province, China. Therefore, the aims of this study were to describe dietary behaviors and to examine its influence on adults with recurrent kidney stones in Wenzhou, China. The results of this study should be beneficial for nurses in providing health education to adults with recurrent kidney stone about their dietary behaviors, not only to teach patients about healthy dietary behaviors, but also to modify their beliefs so that they adopt healthier dietary behaviors.

Objectives of the study

1. To describe dietary behaviors among adults with recurrent kidney stones in Wenzhou, China.
2. To examine influencing factors of dietary behaviors among adults with recurrent kidney stones in Wenzhou, China.

Conceptual Framework

This study was based on the Health Belief Model (HBM) (Champion & Skinner, 2008). The HBM is comprised of three components, which are modifying factors, individual beliefs, and action. Individual beliefs (perceived threat, perceived benefits, perceived barriers, perceived self-efficacy) are theorized to be influenced by modifying factors (e.g., age, gender, ethnicity, personality, socioeconomic status, knowledge), and individual beliefs may predict individual behaviors. As the major components of HBM, individual beliefs are considered as the strong related factors to people's action (Champion & Skinner, 2008).

This study focused on dietary behavior and its influencing factors among adults with recurrent kidney stones. The researcher hypothesized that, if individuals perceived they were at risk of having recurrence kidney stones, but had perceived benefits, high confidence in, and low barriers in preventing kidney stones recurrence, they would perform good dietary behaviors to prevent the recurrent of kidney stones. The research framework of this study is shown in Figure 1.

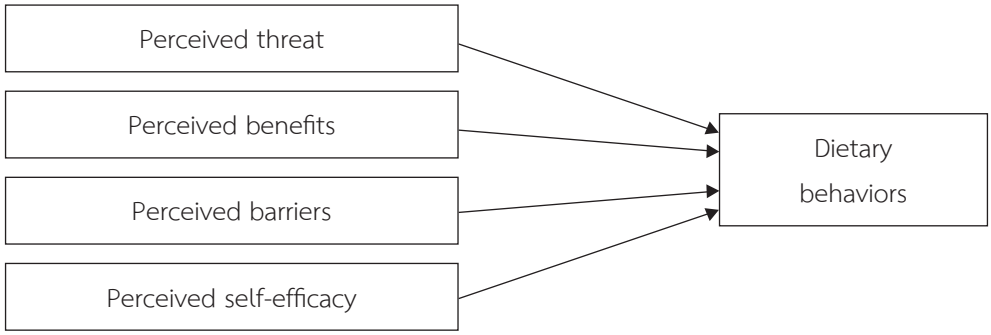

Figure 1 Research Framework

Methods

Research Design

A predictive correlational study was used to examine whether perceived threat, perceived benefits, perceived barriers, and perceived self-efficacy could predict dietary behaviors among adults with recurrent kidney stones in Wenzhou, China.

Population

The population of interest was adults with recurrent kidney stone who were diagnosed and returned with a new stone formation, or had enlargement of the original stones at the Urological Department of the First Affiliated Hospital of Wenzhou Medical University during March 21 to May 31, 2022.

Sample and Sample size

The sample was recruited from the target population following the inclusion criteria: (1) Age between 18 and 60 years old; (2) Have a good orientation to place and time, and no history of mental illness; (3) Able to understand, read, write, and speak Chinese; (4) Have a stable clinical condition (if they have comorbidities).

The sample size was calculated by R 4.2.2 software in tests for regression analysis. The statistical specifications in this study were: α = .05, power =.80, moderate effect size was f^2 = 0.15 (Cohen, 1977). A sample size of 92 was prescribed based on this calculation. Considering the possibility of invalid information, 20% was added, resulting in a final sample size of 110 participants.

Sampling

Simple random sampling by lottery was used to recruit participants who met the inclusion criteria. Five to six participants were randomly selected every working day (Monday to Friday) until reaching the prescribed sample size of 110.

Research Instruments

1. Demographic information questionnaire

The demographic information questionnaire included 17 items, divided in 2 parts: individual characteristics and health information of the participants. The individual characteristics included gender, age, marital status, highest level of education, average individual income, occupation, living arrangement. The health information included family history of kidney stones, number of diagnoses

of kidney stones, time since the first diagnosis with kidney stone, any treatment for kidney stones, co-morbidities, alcohol drinking status, history of receiving information on kidney stone prevention, consumption of nutritional supplements, cooking mode, and body mass index (BMI).

2. The health belief scale

The health belief scale was used to measure the perception of the prevention of recurrent kidney stones. This scale was developed by researchers in English based on the Health Belief Model (Champion & Skinner, 2008). The English version was translated into Chinese, and then back-translated into English by the Brislin (1976) translation - back translation method.

In this study, there were 37 items with 4 subscales, including perceived threat, perceived benefits, perceived barriers, and perceived self-efficacy. The answers to items were coded according to a 5-point Likert scale, with the following response options: “5 = strongly agree”, “4 = agree”, “3 = neutral”, “2 = disagree” and “1 = strongly disagree”. The ***perceived threat*** subscale consisted of 9 items: Items 1, 2, 3, 4, 5, 6, 7, 8, 9. The total score was calculated by summation of the 9 items, with a potential score ranging from 9 to 45. The Cronbach’s α in this study was .75. The ***perceived benefits*** subscale consisted of 12 items: Items 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21. The total score was calculated by summation of the 12 items, with a potential score ranging from 12 to 60. The Cronbach’s α in this study was .83. The ***perceived barriers*** subscale consisted of 13 items: Items 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34. The total score was calculated by summation of the 13 items, with a potential score ranging from 13 to 65. The Cronbach’s α in this study was .78. The ***perceived self-efficacy*** subscale consisted of 3 items: Items 35, 36, 37. The total score was calculated by summation of the 3 items, with potential scores ranging from 3 to 15. The content validity of the scale was evaluated by six experts in kidney stones disease. The content validity index score of this scale was .97. The Cronbach’s α, using 110 persons in this study, was .84. The higher score reflects a higher level of perception.

3. Dietary behaviors scale

The dietary behaviors scale was developed in English by the researcher based on the Chinese Urological Association (CUA) guidelines (Huang, 2019). The English version was translated into Chinese by using Brislin’s translation - back translation method (Brislin, 1976).

The dietary behaviors scale, Chinese version, consisted of 19 items. The answers were indicated by applying a 5-point Likert scale with the following response options for positive items: “5 = routinely”, “4 = frequently”, “3 = sometimes”, “2 = seldom” and “1 = never”, and with the following response options for negative items: “1 = routinely”, “2 = frequently”, “3 = sometimes”, “4 = seldom” and “5 = never”. Positive scoring items were Items 1, 5, 6, 11, 12 and 19, while negative scoring items were Items 2, 3, 4, 7, 8, 9, 10, 13, 14, 15, 16, 17 and 18. The total score was calculated by summation of the 19 items, with potential score ranging from 19 to 95. A higher score reflects a higher level of dietary behaviors. The content validity of the scale was evaluated by six experts in kidney stones disease. The content validity index score of this scale was 0.94. The Cronbach’s α, using 110 persons in this study, was .87.

Ethical considerations

The protocol for this study was approved by the Institutional Review Board of Burapha University (Protocol code G-HS077/2564) and the Ethics Committee of the First Affiliated Hospital of Wenzhou Medical University (Protocol code KY2022-027).

Participants were informed about the aim and the procedures of this study in detail before obtaining their consent, and they had the right to participate or to refuse to participate in this study. Participants were informed that they had the right to not answer any question that made them uncomfortable, and they also had the right to withdraw from this study at any time for any reason. All collected information was anonymous and only used in this research. All the collected information was kept in a safe place where only the researcher could access it, and it would be destroyed one year after the study is published.

Data Collection

The researchers recruited eligible participants by simple random sampling from the Urological Department of the participating hospital. Patients who indicated their willingness to participate in the study were asked to sign a consent form and fill out the study questionnaire independently in a private setting. Completeness of the response to the questionnaire was checked by the researcher on site. The data collection process was repeated until the prescribed sample size was reached.

Data Analysis

Data were analyzed using a statistical software package. The alpha (α) level of statistical significance was set at 0.05. Descriptive statistics, including frequency, mean, standard deviation were used to describe characteristics of the participants. Assumptions of multivariate regression were examined. Standard multivariate regression analysis was employed using the Enter Method to determine statistically-significant predictors of dietary behaviors among patients with recurrent kidney stones in Wenzhou, China.

Results

Part 1 Demographic characteristics of sample

More than half of the participants were male (64.5%). The overall age ranged from 28 to 60 years (M = 48, SD = 7.7), with the highest proportion of participants age between 51 and 60 years (41.8%). The majority of the participants were married (89.1%). Most of the participants were poorly educated, 14.5% were illiterate, and 83.6% had no more than nine years of formal education. Over half (53.6%) of participants had a middle income, which was between 2,000 to 5,000 yuan per month. The vast majority (n=104) of the participants were employed with private company, staff accounting for the largest proportion (27.3%). Most of the participants were living with family members or others (92.7%). Only 23.6% of participants had a family history of kidney stones. More than half of the participants (56.4%) had been diagnosed with kidney stones three or more times. Most of the participants (61.8%) were found to have had kidney stones for more than five years. Of all

110 participants, 34.5% received surgical treatment, and 24.5% had undergone a combination of surgery and medicinal treatment. Nearly two in five had an underlying disease (39.1%), with hypertension as the most common (55.8%). Over three in five participants (64.5%) had no history of drinking alcohol. Two out of five had not received information about kidney stones prevention, and 57.2% did not consume nutritional supplements. More than half (58.1%) of participants' meals were prepared by their family. In addition, nearly half of the participants were overweight (45.5%) and 7.3% were obese.

Part 2 Description of perceived threat, perceived benefits, perceived barriers, perceived self-efficacy, and dietary behaviors among adults with recurrent kidney stones

The mean scores and standard deviation were used to describe the variables of this study. The mean scores of perceived threats were 35.35 (*SD* = 4.46), perceived benefits was 39.96 (*SD* = 6.01), perceived barriers was 35.32 (*SD* = 6.41), and perceived self-efficacy was 10.55 (*SD* = 2.11). The mean score of dietary behaviors was 55 out of 95 (*SD* = 8.61). The detailed description of perceived threat, perceived benefits, perceived barriers, perceived self-efficacy is shown in Table 1.

Table 1: Health Belief Scale Scores (n = 110)

Variables	Possible score	Actual score	*M*	*SD*
Perceived threat	9-45	23-45	35.35	4.46
Perceived benefits	12-60	27-54	39.96	6.01
Perceived barriers	13-65	22-48	35.32	6.41
Perceived self-efficacy	3-15	6-15	10.55	2.11

Table 2 presents a description of dietary behaviors. Overall, the mean score of dietary behaviors was 55 out of 95 (*SD* = 8.61). Among 19 items, the five behaviors with the lowest scores were controlling weight through diet (2.53 ± 1.24), eating coarse grains and fiber (2.54 ± 1.10), drinking alcohol (2.62 ± 1.64), consuming high calcium milk or yoghurt, tofu, or small fish (2.65 ± 1.12), and drinking enough water (2.69 ± 1.24). The above five behaviors were the most prominent dietary behaviors among participants that increased the risk of stone recurrence.

Table 2: Dietary Behaviors Scale and the Items of the Dietary Behaviors Scale (n = 110)

	Routinely (5) n (%)	Frequently (4) n (%)	Sometimes (3) n (%)	Seldom (2) n (%)	Never (1) n (%)	*M*	*SD*
Dietary behaviors (total): Possible score = 19-95, Actual score = 38-78: *Mean* = 54.9, *SD* = 8.61							
1) I drink water more than 2.5L per day (equivalent to the mount of 5 bottles of mineral water).	12(10.9)	17(15.5)	25(22.7)	37(33.6)	19(17.3)	2.69	1.24
2) I drink a cup of coffee, black tea, or carbonate drink (such as cola).	30(27.2)	9(8.2)	19(17.3)	35(31.8)	17(15.5)	3.00	1.46
3) I drink a glass of grape juice or apple juice.	32(29.1)	12(10.9)	24(21.8)	22(20.0)	20(18.2)	3.13	1.48
4) I drink a glass of red wine or a can of beer.	11(10.0)	15(13.6)	41(37.3)	18(16.4)	25(22.7)	2.89	1.65
5) I drink a glass of orange juice, cranberry juice, or lemonade.	8(7.3)	17(15.4)	29(26.4)	41(37.3)	15(13.6)	2.72	1.24
6) I drink high calcium milk or yoghurt, eat tofu, or small fish.	13(11.8)	21(19.1)	40(36.3)	18(16.4)	18(16.4)	2.65	1.12
7) I eat kale, almonds, peanuts, beets, parsley, spinach, rhubarb, mushroom or chocolate.	10(9.1)	30(27.3)	22(20.0)	36(32.7)	12(10.9)	2.94	1.22
8) I eat salty food or add more than a teaspoon (2g) of salt in my meal.	13(11.8)	21(19.1)	30(27.3)	29(26.4)	17(15.4)	2.91	1.19
9) I eat processed food such as processed meat or processed fish.	13(11.8)	14(12.7)	39(35.5)	24(21.8)	20(18.2)	2.85	1.24
10) I eat red meat (such as poultry meat, beef, pork) more than 80 g (equivalent to the weight of two eggs) per day.	12(10.9)	20(18.2)	19(17.3)	42(38.2)	17(15.4)	2.78	1.23
11) I eat fruits and vegetables (except cabbage, beets, parsley, spinach, rhubarb).	7(6.4)	14(12.7)	27(24.5)	45(40.9)	17(15.5)	2.71	1.24
12) I eat coarse grains and fiber (such as rice bran).	21(19.1)	34(30.9)	35(31.8)	12(10.9)	8(7.3)	2.54	1.10
13) I take supplement vitamin C.	29(26.3)	42(38.2)	29(26.4)	6(5.5)	4(3.6)	3.44	1.14
14) I take supplement vitamin D.	15(13.6)	17(15.6)	25(22.7)	26(23.6)	27(24.5)	3.78	1.02
15) I take additional calcium daily (by yourself, not by prescription)	11(10.0)	22(20.0)	48(43.6)	19(17.3)	10(9.1)	2.70	1.36
16) I eat animal offal such as liver or kidney and poultry skins.	20(18.2)	24(21.8)	21(19.1)	24(21.8)	21(19.1)	3.05	1.07

Table 2: (Cont.)

	Routinely (5) n (%)	Frequently (4) n (%)	Sometimes (3) n (%)	Seldom (2) n (%)	Never (1) n (%)	*M*	*SD*
17) I eat seafood such as crab, shrimp, skinned herring, sardines, or anchovies.	26(23.7)	11(10.0)	13(11.8)	15(13.6)	45(40.9)	2.98	1.39
18) I drink alcohol.	10(9.1)	15(13.7)	23(20.9)	37(33.6)	25(22.7)	2.62	1.64
19) I control my body weight by eating more fruits, vegetables and foods high in fiber instead of high calorie foods (such as chocolate and fat eat).	12(10.9)	17(15.5)	25(22.7)	37(33.6)	19(17.3)	2.53	1.24

Part 3 Factors influencing dietary behaviors among adults with recurrent kidney stones

The assumptions in applying multiple regression analysis were examined, and all assumptions were met. The results of the multiple regression analysis indicate that perceived threat, perceived benefits, perceived barriers, and perceived self-efficacy explained 20.4% of the variance in dietary behaviors among adults with recurrent kidney stones (Adj R^2 = .204, F = 8.001, p < .001). The results also show that perceived threat (β = .287, p = .001), and perceived barriers (β = -.409, p = .001) can significantly predict the dietary behaviors of adults with recurrent kidney stones. However, perceived benefits (β = -.059, p = .506), and perceived self-efficacy (β = .094, p = .287) could not significantly predict the dietary behaviors of adults with recurrent kidney stones. The summary results of regression analysis are shown in Table 3.

Table 3: Summary of Regression Analysis of Predictors of Dietary Behaviors among Adults with Recurrent Kidney Stones (n = 110)

Predicting variables	*B*	*SE*	β	*T*	*p*-value
Perceived threat	.867	.264	.287	3.29	.001
Perceived benefits	-.132	.198	-.059	-.668	.506
Perceived barriers	-.861	.184	-.409	-4.689	.001
Perceived self-efficacy	.601	.561	.094	1.071	.287
Constant = 53.604, R^2 = .234, Adj R^2 = .204, F = 8.001, P < .001					

Discussion

1. Dietary behaviors of adults with recurrent kidney stones

The mean score of the response to the dietary behaviors scale was 55 out of 95 (*SD* = 8.6), which reflects that the dietary behaviors of the participants in this study were fair (not overly low or

high). Rodrigues, Lima, Zambrano, and Heilberg (2020), comparing the diets of patients with and without kidney stones, the results show that the intake of sodium chloride and protein in patients with kidney stones was significantly higher than in patients without kidney stones. Furthermore, compared with patients without kidney stones, patients with kidney stones consumed more vegetables and beans, while the consumption of fruits and low-fat dairy products was relatively low in the latter group. Similarly, a meta-analysis of risk factors for Chinese adult urinary calculi found that, compared with patients with non-urinary calculi, the dietary behaviors of those with urinary calculi is worse. Those poor dietary behaviors are drinking less water, high salt intake, smoking, drinking alcohol, eating less vegetables, high consumption of protein, eating less fruits, drinking less tea, and being overweight (Zhang, Gao, Yang, & Luo, 2018). The above findings could explain that more than half of the patients in this study (56.4%) had three or more episodes of recurrent kidney stones.

2. Factors influencing dietary behaviors among adults with recurrent kidney stones

The analysis confirms that the four beliefs of the HBM combined explained 20.4% of the variance in individual dietary behaviors of the study population (Adj R^2 = 20.4%, F = 8.001, $p < .001$). The results also showed that perceived threats are predictive of dietary behaviors (β = .287, p = .001), and perceived barriers can predict dietary behaviors significantly (β = -.409, p = .001). This finding is consistent with previous research. It was found that higher perception of threat can predict better dietary behaviors (Akokuwebe, Odimegwu, & Omololu, 2020). Other studies found that the more barriers that patients with recurrent kidney stones perceived, the less likely they were to modify their diet to prevent the occurrence of kidney stones (Morovati Sharifabad, Pirouzeh, Hemayati, & Askarshahi, 2015; Tarplin et al., 2016). Research has shown that if people perceive the benefits of a healthy diet and actively plan their diet, the desired behavioral outcome is more likely to be achieved (Doan & Preechawong, 2014).

However, this study also found that perceived benefits and perceived self-efficacy cannot predict dietary behaviors. This finding is consistent with previous studies (Doan & Preechawong, 2014; Tarplin et al., 2016). According to the HBM, people's perception of threats, benefits, barriers and self-efficacy can all affect behavioral outcomes, among which the perceived barriers have the greatest effect (Champion & Skinner, 2008). In this study, perceived benefits and perceived self-efficacy were not statistically significant in predicting dietary behaviors of the sample, which may be due to the fact that perceived barriers have greater impact on behavioral outcomes, and the impact counteracts the influence of perceived benefits and self-efficacy.

Implications for Nursing and Recommendations

The results of this study show that the dietary behaviors of patients with recurrent kidney stones were not overly low or high. Thus, clinical nurses should strengthen health education in these aspects. The study found that 58.1% of patients' meals were prepared by their family, so it is important to educate the patient's family about the preventive diet to avert kidney stones. It is important that the health education be easily understood and in an attractive format, since those

with low education level could stand to benefit the most from prevention of kidney stones. In addition, this study found that perceived barriers have the greatest impact on dietary behaviors of adults with recurrent kidney stones. Therefore, clinical nurses should communicate more with the patients themselves. The nurses need to instill a sense of importance about proper dietary behaviors to prevent kidney stones, as well as probe to determine the obstacles patients face in dietary modification. Then, together they can develop a behavior and dietary plan that is tailored to the patient's risk level and needs.

There is a limitation in the current study. The participants in this study were limited to two sites in one part of China. Future research should include more sites across a range of environments to make the results potentially more representative of the large population.

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Conflict of Interests:

The authors declare no conflict of interest.

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