Postprint: Association Between Chinese Healthy Dietary Patterns and Sarcopenia in Colorectal Cancer Patients

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Abstract

Background Sarcopenia has a significant impact on the treatment and prognosis of colorectal cancer patients, and dietary patterns are significantly associated with sarcopenia. Clarifying the relationship between Chinese healthy dietary patterns and sarcopenia is of great significance for implementing sarcopenia interventions based on Chinese healthy dietary patterns.

Objective To investigate the association between Chinese healthy dietary patterns and sarcopenia in colorectal cancer patients using the Chinese Healthy Eating Index (CHEI).

Methods From July 2024 to May 2025, 326 colorectal cancer patients admitted to Tangshan People' s Hospital, the Affiliated Hospital of North China University of Science and Technology, and Kailuan General Hospital were selected as study subjects. CHEI and various indicators for sarcopenia diagnosis were collected. Binary logistic regression analysis and restricted cubic spline models were used to analyze the associations between CHEI total score and various dietary components with muscle mass loss, physical function decline, and sarcopenia in colorectal cancer patients.

Results Among the 326 patients, 195 were male (59.82%) and 131 were female (40.18%), with a mean age of (64.0$±$8.8) years. Among them, 49 patients (15.03%) had muscle mass loss, with a CHEI score of 50 (40, 55); 220 patients (67.48%) had reduced muscle strength, with a CHEI score of 55 (45, 60); 217 patients (66.56%) had physical function decline, with a CHEI score of 55 (45, 60); and 46 patients (14.11%) had sarcopenia, with a CHEI score of 47.5 (40, 55). Binary logistic regression analysis showed that CHEI score was negatively associated with the risk of muscle mass loss (OR=0.934, 95%CI=0.891-0.979, P=0.004), physical function decline (OR=0.968, 95%CI=0.942-0.995, P=0.020), and sarcopenia (OR=0.931,

95%CI=0.889-0.975, P=0.003). Restricted cubic spline model results showed that CHEI had a linear dose-response relationship with the occurrence of muscle mass loss (P-overall=0.019, P-nonlinear=0.216, P-linear=0.004), physical function decline (P-overall=0.095, P-nonlinear=0.617, P-linear=0.020), and sarcopenia (P-overall=0.038, P-nonlinear=0.467, P-linear=0.002). Analysis of the association between various dietary components and muscle mass loss, physical function decline, and sarcopenia showed that scores for fruits (OR=0.880, 95%CI=0.786-0.985, P=0.026), legumes (OR=0.480, 95%CI=0.290-0.794, P=0.004), poultry intake (OR=0.799, 95%CI=0.644-0.991, P=0.041), and sodium (OR=0.897, 95%CI=0.805-1.000, P=0.049) were negatively associated with the risk of muscle mass loss; whole grains (OR=0.839, 95%CI=0.714-0.986, P=0.033) and seafood (OR=0.848, 95%CI=0.730-0.985, P=0.031) were negatively associated with the risk of physical function decline, while red meat (OR=1.256, 95%CI=1.048-1.506, P=0.014) was positively associated with the risk of physical function decline; grains (OR=1.608, 95%CI=1.115-2.317, P=0.011) were significantly positively associated with the risk of sarcopenia; and scores for fruits (OR=0.886, 95%CI=0.788-0.996, P=0.043), legumes (OR=0.409, 95%CI=0.238-0.703, P=0.001), and poultry (OR=0.731, 95%CI=0.584-0.916, P=0.007) were negatively associated with the risk of sarcopenia.

Conclusion Chinese healthy dietary patterns are positively associated with reduced risks of muscle mass loss, physical function decline, and sarcopenia in colorectal cancer patients, with a linear dose-response relationship. Adequate intake of fruits, legumes, poultry, whole grains, and seafood, appropriately relaxing restrictions on red meat intake, and controlling excessive intake of sodium and grains can all help reduce the risk of sarcopenia in colorectal cancer patients.

Full Text

Study on the Correlation Between Chinese Healthy Dietary Pattern and Sarcopenia in Colorectal Cancer Patients

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Abstract Background: Sarcopenia significantly influences treatment outcomes and prognosis in colorectal cancer patients, and dietary patterns show a notable correlation with sarcopenia. Elucidating the characteristics of Chinese healthy dietary patterns and their association with sarcopenia is crucial for developing targeted nutritional interventions based on traditional Chinese dietary practices.

Objective: To explore the correlation between Chinese healthy dietary pat-

tern and sarcopenia in colorectal cancer patients, utilizing the Chinese Healthy Eating Index (CHEI).

Methods: From July 2024 to May 2025, a total of 326 colorectal cancer patients from Tangshan People' s Hospital, North China University of Science and Technology Affiliated Hospital, and Kailuan General Hospital were enrolled as study subjects. The Chinese Healthy Eating Index (CHEI) and various diagnostic indicators of sarcopenia were collected. After adjusting for covariates, binary Logistic regression analysis and restricted cubic spline models were employed to examine the associations between the total CHEI score and its dietary components with low muscle mass, decreased muscle strength, impaired physical function, and sarcopenia in colorectal cancer patients.

Results: Among the 326 patients, 195 were male (59.82%) and 131 were female (40.18%), with an average age of (64.0$±$8.8) years. There were 49 cases (15.03%) with reduced muscle mass, and the CHEI score was 50 (40, 55). Muscle strength was reduced in 220 cases (67.48%), and the CHEI score was 55 (45, 60). Physical function declined in 217 cases (66.56%), with CHEI scores of 55 (45, 60). There were 46 patients (14.11%) with sarcopenia, with a CHEI score of 47.5 (40, 55). Binary Logistic regression analysis results indicated that CHEI scores were negatively associated with the risk of low muscle mass (OR=0.934, 95%CI=0.891-0.979, P=0.004), impaired physical function (OR=0.968, 95%CI=0.942-0.995, P=0.020), and sarcopenia (OR=0.931, 95%CI=0.889-0.975, P=0.003). Restricted cubic spline model showed a linear dose-response relationship between CHEI and the occurrence of low muscle mass (Poverall trend=0.019, Pnon-linear=0.216, Plinear=0.004), impaired physical function (Poverall trend=0.095, Pnon-linear=0.617, Plinear=0.020), and sarcopenia (Poverall trend=0.038, Pnon-linear=0.467, Plinear=0.002). Analysis of the correlation between various dietary components and low muscle mass, impaired physical function, and sarcopenia revealed that scores for fruits (OR=0.880, 95%CI=0.786-0.985, P=0.026), legumes (OR=0.480, 95%CI=0.290-0.794, P=0.004), poultry intake (OR=0.799, 95%CI=0.644-0.991, P=0.041), and sodium (OR=0.897, 95%CI=0.805-1.000, P=0.049) were negatively correlated with the risk of low muscle mass. Scores for whole grains (OR=0.839, 95%CI=0.714-0.986, P=0.033) and seafood (OR=0.848, 95%CI=0.730-0.985, P=0.031) were negatively correlated with the risk of impaired physical function, while red meat (OR=1.256, 95%CI=1.048-1.506, P=0.014) was positively correlated with the risk of impaired physical function. Grains (OR=1.608, 95%CI=1.115-2.317, P=0.011) showed a significant positive correlation with the risk of sarcopenia. Scores for fruits (OR=0.886, 95%CI=0.788-0.996, P=0.043), legumes (OR=0.409, 95%CI=0.238-0.703, P=0.001), and poultry (OR=0.731, 95%CI=0.584-0.916, P=0.007) were negatively correlated with the risk of sarcopenia.

Conclusion: The Chinese Healthy Eating Index is positively associated with a reduced risk of low muscle mass, impaired physical function, and sarcopenia in colorectal cancer patients, showing a linear dose-response relationship. Ad-

equate intake of fruits, legumes, poultry, whole grains, and seafood, moderate red meat consumption, and controlled intake of sodium and grains may help lower the risk of sarcopenia in colorectal cancer patients.

[**Key words**] Colorectal cancer; Chinese healthy dietary pattern; Muscle strength; Muscle mass; Physical function; Sarcopenia; Restricted cubic spline

Introduction

Colorectal cancer (CRC) patients often experience changes in dietary intake after diagnosis, such as restrictions on animal protein and dairy products, which can negatively impact muscle health. Additionally, these patients frequently experience coexisting intestinal absorption disorders, gut microbiota dysbiosis, and chronic inflammation, leading to an imbalance between catabolism and anabolism and increasing the risk of sarcopenia. Numerous studies have confirmed that sarcopenia not only affects the incidence of perioperative complications in CRC patients but also exacerbates chemotherapy toxicity and adversely impacts long-term survival prognosis. Nutritional intervention is one of the most effective approaches for sarcopenia, yet existing interventions often focus on single nutrients such as protein and energy supplementation while overlooking the role of overall dietary structure.

Dietary patterns, which consider the interactions and cumulative effects of multiple foods, can compensate for the limitations of single-nutrient approaches and help clarify dietary guidelines. Evaluating dietary intake against recommended amounts is one method for assessing dietary patterns. In 2017, Yuan developed the Chinese Healthy Eating Index (CHEI) based on the 2016 Dietary Guidelines for Chinese (DGC-2016). Since the 2022 Dietary Guidelines for Chinese (DGC-2022) have essentially the same recommended intake ranges as DGC-2016, CHEI remains applicable for evaluating individual dietary intake against DGC-2022 and serves as a reliable tool for assessing adherence to Chinese healthy dietary patterns. Considering that sociodemographic factors, treatment modalities, tumor progression, comorbid chronic diseases, medication use, and physical activity are all associated with sarcopenia risk in CRC patients, this study employed CHEI as an assessment tool and used binary Logistic regression analysis and restricted cubic spline models to adjust for these confounding factors. This approach allowed us to investigate the association between Chinese healthy dietary patterns and various food groups with sarcopenia in CRC patients, providing a theoretical basis for nutritional interventions based on Chinese dietary habits.

Methods

Study Subjects

We selected CRC patients newly diagnosed between July 2024 and May 2025 at Tangshan People' s Hospital, North China University of Science and Technology

Affiliated Hospital, and Kailuan General Hospital as study participants. Inclusion criteria were: (1) age $\geq$ 18 years; (2) pathologically confirmed stage II-IV CRC; (3) no prior chemotherapy or radiotherapy; (4) normal dietary intake resumed; (5) expected survival $>$ 6 months. Exclusion criteria included: (1) other digestive system diseases, special diets (liquid or semi-liquid), or inability to eat orally; (2) primary muscle weakness or other musculoskeletal disorders; (3) severe organ dysfunction; (4) cognitive impairment or inability to understand and communicate normally; (5) physical deformities preventing muscle strength or physical function testing. This study was approved by the North China University of Science and Technology Ethics Committee (approval number: 2024212). Using the cross-sectional sample size formula n = $\alpha/2 \times$ p $\times$ (1-p), with α = 0.05, $\delta = 0.1$, and sarcopenia prevalence of 18.2% in CRC patients, and considering a 20% attrition rate, the required sample size was calculated as 275 cases. A total of 332 questionnaires were distributed, and after excluding incomplete ones, 326 valid questionnaires remained, yielding an effective response rate of 98.19%.

Data Collection Instruments

General Information Questionnaire The general information questionnaire was designed by the researchers and included demographic data and disease-related information. Demographic data comprised age, gender, education level, monthly household income per capita, and primary caregiver (5 items). Disease-related information included time since surgery, stoma status, tumor location, tumor stage, number of metastatic lymph nodes, differentiation grade, types of chronic diseases, medication types, body mass index (BMI), smoking status, and alcohol consumption (11 items). Smoking status was categorized as: never smoked (never smoked or cumulative smoking $<$ 100 cigarettes and not currently smoking), quit smoking (cumulative smoking $\geq$ 100 cigarettes but quit $\geq$ 2 months), and currently smoking (not quit and smoking at least 1 cigarette daily). Alcohol consumption was categorized as: never drank, quit drinking (previous alcohol consumption history but completely abstinent $\geq$ 2 months).

Chinese Healthy Eating Index (CHEI) CHEI includes 12 adequate intake components (total grains, whole grains, tubers, total vegetables, dark vegetables, fruits, dairy, soybeans, fish and seafood, poultry, eggs, seeds and nuts) and 5 limited intake components (red meat, cooking oil, sodium, added sugar, alcohol). Using the 3-day 24-hour dietary recall method and based on the "Food Standard Portions" in DGC-2016, we used physical models such as standard food portion tools, reference gestures, and images to record food types and portions for each meal within 3 days. Oil and sodium intake were calculated based on the number of diners and food consumption time. We converted and categorized food intake amounts and portions, calculated scores for 17 items proportionally (each item scored up to 5 or 10 points), with a total possible score of 100. Higher scores indicated greater alignment with the Chinese healthy dietary pattern.

International Physical Activity Questionnaire-Short Form (IPAQ-SF) IPAQ-SF was developed by the International Physical Activity Measurement Working Group and validated in Chinese by Wang et al. It measures total physical activity over the past week, including vigorous-intensity activity (breathing and heart rate significantly increased, unable to speak normally, such as running, fast cycling, climbing stairs), moderate-intensity activity (breathing and heart rate slightly increased, able to speak but not sing, such as sweeping, brisk walking, social dancing), walking (at least 10 minutes per session), and sedentary time (reading, using mobile phones, listening to music/radio, watching TV/videos, daydreaming, napping, using public transportation, socializing, hobbies). Physical activity was converted to metabolic equivalents (METs), with vigorous activity = 8 METs, moderate activity = 4 METs, and walking = 3.3 METs. Individual weekly physical activity level = MET value × duration per session (min) × weekly frequency. Total weekly energy expenditure was the sum of all activities.

Physical activity grading criteria: (1) High level: either $\geq$ 3 days of vigorous activity with weekly total $\geq$ 1500 MET-min, or all three activity types $\geq$ 7 days with weekly total $\geq$ 1500 MET-min. (2) Moderate level: either $\geq$ 20 min vigorous activity daily for $\geq$ 3 days, or $\geq$ 30 min moderate activity or walking daily for $\geq$ 5 days, or all three activity types $\geq$ 5 days with weekly total $\geq$ 600 MET-min. (3) Low level: either no physical activity, or activity not meeting moderate/high level criteria.

Sarcopenia Diagnosis According to the Asian Working Group for Sarcopenia 2019 (AWGS 2019) diagnostic criteria, sarcopenia was diagnosed as low muscle mass accompanied by either reduced muscle strength or impaired physical function. We used appendicular skeletal muscle mass index (ASMI) to assess muscle mass, maximum grip strength to assess muscle strength, and 6-meter gait speed to assess physical function.

ASMI Calculation: AWGS 2019 defines ASMI as appendicular skeletal muscle mass (ASM) divided by height squared (m^2). We used anthropometric equations to estimate ASM based on participants' weight, height, gender, and age: ASM = 0.193 × weight (kg) + 0.107 × height (cm) - 4.157 × gender (male = 1, female = 2) - 0.037 × age (years) - 2.631. This equation shows good agreement with dual-energy X-ray absorptiometry (DXA) results. ASMI diagnostic thresholds are: male $<$ 7.0 kg/m^2, female $<$ 5.4 kg/m^2, indicating reduced muscle mass. Height and weight measurements followed WS/T424-2013 "Anthropometric Measurements Method in Health Surveillance," with height measured to two decimal places and weight to one decimal place.

Grip Strength Measurement: Maximum grip strength was used to represent muscle strength. Patients were instructed to stand with feet naturally shoulder-width apart, arms straight down. Using their dominant hand, they gripped the dynamometer handle with maximum force. The dynamometer was kept still without touching the body, arms remained straight without swinging, and no

additional force from leg pushing or waist bending was allowed. Two measurements were taken with the dominant hand, with intervals > 15 seconds, and the highest value was recorded in kg to one decimal place. For participants with uncertain dominant hand, both hands were measured twice and the highest value was used. Grip strength diagnostic thresholds are: male < 28 kg, female < 18 kg, indicating reduced muscle strength.

6-Meter Gait Speed Test: The 6-meter gait speed represented physical function. In a hospital corridor with barrier-free flat ground, a 6-meter distance was measured and marked. Patients were instructed to walk at normal speed without acceleration or deceleration. The time to walk 6 meters was recorded with a stopwatch to two decimal places, and the average of at least two trials was used. Gait speed < 1 m/s indicated impaired physical function.

Quality Control

All questionnaire data were collected by the researchers themselves. When filling out questionnaires, standardized instructions were used to explain content and precautions to patients. Consistent responses were provided for any questions during completion. After completion, questionnaires were checked for missing items and patients were contacted promptly to fill in any gaps.

Statistical Analysis

SPSS 22.0 was used for statistical analysis. Categorical data were expressed as relative numbers and compared between groups using ^{2} tests. Normally distributed continuous data were expressed as (x±s) and compared between two groups using independent samples t-tests. CHEI and item scores were skewed and described as M(P_{25}, P_{75}). Binary Logistic regression was used to explore associations between CHEI scores and dietary components with low muscle mass, reduced muscle strength, impaired physical function, and sarcopenia. Restricted cubic spline (RCS) curves were used to explore linear dose-response relationships between CHEI scores and these outcomes. $P < 0.05$ was considered statistically significant.

Results

General Characteristics

The cohort included 195 males (59.82%) and 131 females (40.18%), with a mean age of (64.0$±$8.8) years. Among them, 49 patients (15.03%) had reduced muscle mass with a CHEI score of 50 (40, 55); 220 patients (67.48%) had reduced muscle strength with a CHEI score of 55 (45, 60); 217 patients (66.56%) had impaired physical function with a CHEI score of 55 (45, 60); and 46 patients (14.11%) had sarcopenia with a CHEI score of 47.5 (40, 55).

Univariate analysis showed that monthly household income per capita, BMI, and alcohol consumption differed significantly between patients with and without re-

duced muscle mass ($P < 0.05$). Education level, monthly household income per capita, and medication types differed significantly between patients with and without reduced muscle strength ($P < 0.05$), see Table 1 . For impaired physical function, primary caregiver, stoma status, number of metastatic lymph nodes, physical activity level, and BMI showed significant differences ($P < 0.05$). For sarcopenia, monthly household income per capita, BMI, and alcohol consumption differed significantly ($P < 0.05$), see Table 2 .

CHEI Scores and Dietary Components

CRC patients' total CHEI scores ranged from 30-80 points, with a median score of 55 (45, 60). Patients with reduced muscle mass had CHEI scores of 30-80 (median 50 [40, 55]); those with reduced muscle strength had scores of 30-65 (median 55 [45, 60]); those with impaired physical function had scores of 30-80 (median 55 [45, 60]); and those with sarcopenia had scores of 30-65 (median 47.5 [40, 55]). Individual component scores were: total grains = 0, whole grains = 5 (5, 5), tubers = 0, vegetables = 0 (0, 5), dark vegetables = 5 (0, 5), fruits = 0 (0, 10), dairy = 5 (0, 5), legumes = 0, seafood = 0, poultry = 0 (0, 5), eggs = 5 (5, 5), nuts = 0, red meat = 5 (5, 5), oil = 10 (10, 10), sodium = 10 (0, 10), sugar = 5 (5, 5), alcohol = 5 (5, 5).

Binary Logistic Regression Analysis

Using low muscle mass, reduced muscle strength, impaired physical function, and sarcopenia as dependent variables, and CHEI score as the independent variable (continuous), binary Logistic regression analysis was performed. Model 1 (unadjusted) showed CHEI score was negatively associated with low muscle mass (OR=0.930, 95%CI=0.900-0.962, P<0.001), impaired physical function (OR=0.959, 95%CI=0.937-0.982, P<0.001), and sarcopenia (OR=0.927, 95%CI=0.895-0.960, P<0.001). Model 2 further adjusted for age, gender, education, monthly household income per capita, primary caregiver, time since surgery, stoma status, tumor location, number of metastatic lymph nodes, tumor stage, differentiation grade, chronic disease types, medication types, physical activity level, BMI, smoking status, and alcohol consumption. Results showed CHEI score remained negatively associated with low muscle mass (OR=0.934, 95%CI=0.891-0.979, P=0.004), impaired physical function (OR=0.968, 95%CI=0.942-0.995, P=0.020), and sarcopenia (OR=0.931, 95%CI=0.889-0.975, P=0.003). However, CHEI score was not significantly associated with reduced muscle strength (P>0.05) in either model, see Table 3 .

Dose-Response Relationships

RCS models using CHEI score percentiles (5%, 25%, 75%, 95%) as knots revealed linear dose-response relationships. CHEI score showed a linear relationship with low muscle mass (Poverall trend=0.019, Pnon-linear=0.216, Plinear=0.004), with no clear threshold or inflection point. As CHEI scores in-

creased, the risk of low muscle mass decreased (OR=0.933, 95%CI=0.890-0.978), see Figure 1A [Figure 1: see original paper]. Similarly, CHEI score showed a linear relationship with impaired physical function (Poverall trend=0.095, Pnon-linear=0.617, Plinear=0.020), with risk decreasing as scores increased (OR=0.968, 95%CI=0.942-0.995), see Figure 1B [Figure 1: see original paper]. For sarcopenia, a linear dose-response relationship was also observed (Poverall trend=0.038, Pnon-linear=0.467, Plinear=0.002), with risk decreasing as CHEI scores increased (OR=0.930, 95%CI=0.888-0.974), see Figure 1C [Figure 1: see original paper].

Association of Dietary Components

After adjusting for confounders, binary Logistic regression analysis of individual CHEI components showed: fruits (OR=0.880, 95%CI=0.786-0.985, P=0.026), legumes (OR=0.480, 95%CI=0.290-0.794, P=0.004), poultry (OR=0.799, 95%CI=0.644-0.991, P=0.041), and sodium (OR=0.897, 95%CI=0.805-1.000, P=0.049) were negatively associated with low muscle mass. Whole grains (OR=0.839, 95%CI=0.714-0.986, P=0.033) and seafood (OR=0.848, 95%CI=0.730-0.985, P=0.031) were negatively associated with impaired physical function, while red meat (OR=1.256, 95%CI=1.048-1.506, P=0.014) was positively associated with impaired physical function. Grains (OR=1.608, 95%CI=1.115-2.317, P=0.011) showed a significant positive association with sarcopenia risk, while fruits (OR=0.886, 95%CI=0.788-0.996, P=0.043), legumes (OR=0.409, 95%CI=0.238-0.703, P=0.001), and poultry (OR=0.731, 95%CI=0.584-0.916, P=0.007) were negatively associated with sarcopenia risk, see Table 4 .

Discussion

Sarcopenia adversely affects both short-term and long-term prognosis in CRC patients, and dietary patterns represent an effective intervention approach. While Mediterranean and ketogenic diets have been associated with sarcopenia in CRC patients, the relationship between Chinese healthy dietary patterns based on the Dietary Guidelines for Chinese Residents remains unconfirmed. This study used binary Logistic regression with confounder adjustment and restricted cubic spline models to explore dose-response relationships, examining the association between Chinese healthy dietary patterns and sarcopenia in CRC patients from a holistic dietary perspective. This approach provides evidence for developing culturally appropriate nutritional interventions for CRC patients.

The sarcopenia prevalence of 14.11% in our CRC patients was lower than reported by Zhang et al., possibly due to our cohort' s younger mean age. Monthly household income may indirectly affect sarcopenia by influencing nutritional intake and physical activity, thereby interfering with muscle protein synthesis and contraction. BMI < 23.9 kg/m^2 was associated with higher sarcopenia risk than BMI ≥ 23.9 kg/m^2, consistent with Xie et al.' s cohort study. This

may occur because cancer patients often experience simultaneous loss of fat and muscle mass, and BMI reduction from weight loss often precedes obvious muscle mass decline. Among patients with BMI < 23.9 kg/m^2, those with 18.5-23.9 kg/m^2 had higher sarcopenia risk than those with BMI < 18.5 kg/m^2, aligning with Kiss et al.' s findings, possibly because BMI may not accurately reflect fat mass and can mask reduced muscle mass and physical function. Alcohol consumption primarily affected sarcopenia through its impact on muscle mass, consistent with Coelho et al.' s findings, as chronic alcohol history can cause long-term protein synthesis/degradation imbalance and chronic inflammation, leading to muscle mass reduction and decreased muscle fiber cross-sectional area. Although all patients had stopped alcohol intake before treatment, previous drinking history may have persistent negative effects. Additionally, the high prevalence of reduced muscle strength (67.48%) in CRC patients warrants particular attention, suggesting comprehensive interventions including dietary and exercise approaches may be needed.

CRC patients' median CHEI score was 55 (45, 60), indicating poor adherence to Chinese healthy dietary patterns and lower than reported in breast cancer patients. Scores were particularly low for grains, tubers, legumes, seafood, and nuts, reflecting overall insufficient intake. This may relate to poor dietary structure and habits, as CRC patients reportedly consume far less dairy and soy products than recommended, with actual daily energy and carbohydrate intake below recommendations. Additionally, CRC patients' intestinal dysfunction may limit consumption of hard-to-chew nuts and "cold-natured" seafood considered "trigger foods" in traditional Chinese medicine, potentially increasing intestinal burden.

Adjusted binary Logistic regression showed Chinese healthy dietary patterns were significantly negatively associated with low muscle mass, impaired physical function, and sarcopenia, but not with reduced muscle strength. RCS models revealed linear dose-response relationships without clear thresholds, indicating that higher CHEI scores (greater alignment with Chinese healthy dietary patterns) were associated with lower risks. This may be attributed to adequate intake of anti-inflammatory dietary components, reasonable proportions of high-quality carbohydrates and dietary fiber, and limited excessive intake of sugars and unhealthy fats.

First, Chinese healthy dietary patterns emphasize plant-based foods like whole grains, vegetables, and fruits, considered healthy dietary patterns similar to Mediterranean and anti-inflammatory diets. Higher CHEI scores indicate greater intake of anti-inflammatory components such as vegetables, fruits, legumes, and nuts, whose phytochemicals, polyphenols, and antioxidants can inhibit oxidative stress and inflammatory cascades, reducing protein and lipid breakdown in muscle tissue, potentially benefiting muscle mass and sarcopenia prevention. Second, the pattern emphasizes high-quality grains with carbohydrates providing 50-65% of energy, the main energy source for maintaining muscle mass and mobility. Dietary fiber can alter gut microbiota,

promoting short-chain fatty acid production to alleviate inflammation and oxidative stress damage to muscle proteins, stimulating insulin production to promote skeletal muscle protein synthesis, thus preventing sarcopenia. Additionally, unlike Western dietary patterns, Chinese healthy dietary patterns recommend adequate poultry and seafood while limiting processed red meat and sugary foods, which helps reduce saturated and trans fats and added sugars while increasing monounsaturated and n-3 fatty acids, regulating inflammatory responses and skeletal muscle metabolism for muscle health protection. The lack of significant association with muscle strength may reflect that muscle strength depends not only on dietary intake but also on resistance exercise, suggesting Chinese healthy dietary patterns may need to be combined with exercise interventions to fully prevent sarcopenia.

Among dietary components, adequate fruit intake may reduce risks of low muscle mass (OR=0.880, 95%CI=0.786-0.985, P=0.026) and sarcopenia (OR=0.886, 95%CI=0.788-0.996, P=0.043), consistent with Neville et al.'s findings. Fruit diversity and adequacy are prominent features of Chinese healthy dietary patterns, providing antioxidant vitamins A, C, and E, while dietary fiber and polyphenols regulate gut microbiota structure and produce short-chain fatty acids with anti-inflammatory effects, reducing chronic inflammation and oxidative damage to skeletal muscle cells. Adequate legume intake was associated with 52.0% (95%CI=0.290-0.794) and 59.1% (95%CI=0.238-0.703) lower risks of low muscle mass and sarcopenia, respectively, aligning with DGC-2022 recommendations for regular soy consumption. As a high-quality plant protein source, legumes' isoflavones have estrogen-like effects that protect skeletal muscle through multiple pathways including improving inflammatory markers, promoting muscle satellite cell proliferation and differentiation, and alleviating oxidative stress. Poultry, with significantly less fat than red meat, is a high-quality animal protein source and important component of Chinese healthy dietary patterns. Increasing poultry intake may help provide diverse amino acids to meet muscle metabolic needs and potentially stimulate muscle anabolic potential in cancer patients.

Restricting excessive sodium intake may help reduce low muscle mass risk (OR=0.897, 95%CI=0.805-1.000, P=0.049), consistent with DGC-2022' s low-salt principle. Excessive sodium may disrupt water balance and urea cycles, affecting glucocorticoid-induced muscle protein catabolism, and may damage cell membrane integrity, inducing muscle cell oxidative stress and reducing cell viability. However, restricting red meat was associated with 1.256 times higher risk of impaired physical function (95%CI=1.048-1.506), seemingly contradicting DGC-2022 recommendations. This may be because CRC patients' impaired intestinal absorption reduces iron absorption, affecting skeletal muscle mitochondrial function. Lean red meat provides highly bioavailable heme iron, an important dietary iron source. Additionally, CRC patients often have insufficient protein and energy intake due to gastrointestinal symptoms, and moderate lean red meat consumption can increase leucine and its metabolite β-hydroxy-β-methylbutyrate levels to promote protein synthesis and delay

muscle atrophy.

Increased seafood intake was positively associated with maintaining physical function (P<0.05). Seafood provides protein and n-3 polyunsaturated fatty acids, supplying energy and protein while increasing beneficial gut bacteria and promoting short-chain fatty acid formation to improve inflammatory environments and maintain normal muscle function. Adequate whole grain intake was associated with lower risk of impaired physical function (OR=0.839, 95%CI=0.714-0.986, P=0.033), consistent with Han et al.' s findings. Whole grain fiber fermented by gut microbiota produces short-chain fatty acids that promote skeletal muscle protein synthesis and reduce pro-inflammatory cytokine release. Controlling excessive grain intake may help reduce sarcopenia risk, consistent with Sajadi et al.' s results. DGC-2022 emphasizes that Chinese healthy dietary patterns are grain-based but stresses adequate intake of whole grains and tubers. "Grains" in Chinese dietary structure often refer to refined rice and flour, which have poorer glycemic control and less fiber and vitamins than whole grains, potentially promoting systemic inflammation and impairing glucose stability and muscle protein synthesis, thereby increasing sarcopenia risk.

This study has limitations: (1) The cross-sectional design cannot establish causality; (2) No case-control study was designed to explore specific associations; (3) Limited sample size may affect external validity. In conclusion, Chinese healthy dietary patterns may help reduce risks of low muscle mass, impaired physical function, and sarcopenia in CRC patients, with linear dose-response relationships. Specifically, increasing intake of fruits, legumes, poultry, whole grains, and seafood, moderately relaxing restrictions on red meat, and controlling excessive sodium and grain intake may reduce sarcopenia risk in CRC patients. Future research should develop effective intervention protocols based on Chinese healthy dietary patterns and adjust dietary habits according to specific food components.

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