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AIMS AND SCOPE

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WJH mainly publishes articles reporting research results and findings obtained in the field of hepatology and covering a wide range of topics including chronic cholestatic liver diseases, cirrhosis and its complications, clinical alcoholic liver disease, drug induced liver disease autoimmune, fatty liver disease, genetic and pediatric liver diseases, hepatocellular carcinoma, hepatic stellate cells and fibrosis, liver immunology, liver regeneration, hepatic surgery, liver transplantation, biliary tract pathophysiology, non-invasive markers of liver fibrosis, viral hepatitis.

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ORIGINAL ARTICLE

Randomized Controlled Trial

Effects of nocturnal snacks on body composition in patients with liver cirrhosis

Yong-Bo Yu, Xiu-Juan Fu, Guo-Fen Xu, Ling-Yun Niu, Ruo-Nan Duan, Jia Yao, Ning-Hui Zhao

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Abstract

BACKGROUND

Patients with liver cirrhosis are universally malnourished and the nocturnal snacks intervention is the currently recommended nutritional intervention for patients with liver cirrhosis. Body composition is an important indicator for the assessment of nutritional conditions. We investigated the effects of nocturnal snacks (200 kcal/day) for 3 months on body composition in patients with liver cirrhosis.

AIM

To investigate the effect of nocturnal snacks on body composition in patients with cirrhosis.

METHODS

Seventy patients with liver cirrhosis and 30 healthy controls were enrolled, and differences in body composition were detected using InBody 720, a body composition analyzer. The patients were further randomized into a normal diet group (three meals a day) and nocturnal snacks group (three meals a day + nocturnal snacks). The effect of nocturnal snacks on the body composition of patients with cirrhosis was assessed after 3 months of intervention.

RESULTS

Body fat mass (BFM), skeletal muscle mass (SMM), fat free mass, visceral fat area (VFA), and body cell mass (BCM) were significantly lower in the liver cirrhosis patients than in the healthy controls. After 3 months' intervention, BFM, VFA and BCM were significantly higher in the nocturnal snacks group than in the normal diet group, with no significant differences in total caloric intake and daily activity. However, there was no significant difference in SMM between the nocturnal snacks and normal diet groups.

CONCLUSION

Long-term nocturnal snacks may improve body composition indices such as BFM, VFA and BCM in patients with cirrhosis. However, the improvement was minor for SMM.

Key Words: Liver cirrhosis; Malnutrition; Nocturnal snacks; Body composition; Nutritional intervention

Core Tip: This randomized controlled study compared the effects of nocturnal snacks in patients with liver cirrhosis. The body composition of 70 cirrhotic patients, including the normal diet group and the nocturnal snacks group, and 30 healthy controls, were detected using the InBody 720 body composition analyzer. The results showed that the long-term nocturnal snacks may improve body composition indices such as body fat mass, visceral fat area and body cell mass to some extent in patients with cirrhosis.

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INTRODUCTION

Patients with liver cirrhosis are universally malnourished, and the incidence of malnutrition can be as high as 50%-90%, which is closely related to the prognosis of patients with liver cirrhosis and the occurrence of complications such as ascites, hepatic encephalopathy, spontaneous peritonitis, hepatorenal syndrome and poor quality of life[1,2]. The treatment of liver cirrhosis is an ongoing treatment process because its cannot be completely cured. It has been shown in patients with liver cirrhosis at nutritional risk that individualized nutritional support therapy can improve clinical regression and increase survival[3].

Nocturnal snacks are the currently recommended nutritional intervention for patients with liver cirrhosis[4]. Previous studies have confirmed that, as a glycogen storage organ in the body, the liver plays a role in energy supply during starvation, and the liver glycogen reserve capacity is reduced in patients with liver cirrhosis. Short-term nocturnal snacks can improve the fasting respiratory quotient and improve abnormal substrate metabolism in patients with liver cirrhosis [5,6]. However, there have been few studies on the effects of long-term nocturnal snacks on body composition [*e.g.*, fat mass and skeletal muscle mass (SMM)] in patients with liver cirrhosis. Long-term nocturnal snacks do not improve fat free mass (FFM), but they can improve quality of life as measured by the SF-36 score[7]. However, Plank *et al*[8] showed that long-term nocturnal snacks can improve FFM, but the supplemental calorie count of 710 kcal/day was significantly higher than the recommended amount (approximately 200 kcal/day). Therefore, the effects of long-term nocturnal snacks on body composition in patients with liver cirrhosis still needs to be further explored.

As an important nutritional assessment of body composition[9], in recent years, there has been a gradual focus on the relationship between body composition (*e.g.*, fat mass and muscle mass,) and disease. Patients with liver cirrhosis have varying degrees of altered body composition that are strongly associated with disease progression and mortality[10,11]. Our previous studies have shown that sarcopenia is strongly associated with the progression and prognosis of liver cirrhotic disease[12]. Low subcutaneous fat mass is associated with high mortality in women with liver cirrhosis, while low SMM is associated with high mortality in men with liver cirrhosis[13]. Whether nocturnal snacks increase body composition indices such as fat mass and muscle mass in patients with liver cirrhosis is still under debate[5]. In this study, we assessed using a multi-frequency bioelectrical impedance analysis (MFBIA) the effect of long-term nocturnal snacks (3 months) on body composition in patients with liver cirrhosis.

MATERIALS AND METHODS

Research objects

In this prospective study, we selected 75 patients with liver cirrhosis; of whom, five were withdrawn, and 70 patients eventually completed all tests. According to chronic hepatitis B guidelines[14], patients who were positive for hepatitis B virus DNA received antiviral therapy with entecavir or tenofovir, while abstinence was advised in patients with alcoholic hepatitis. And patients with abnormal liver function were given symptomatic treatment with hepatoprotective drugs. Diagnosis of liver cirrhosis was based on clinical data, blood biochemical indices, imaging data and liver histopathology [15]. Exclusion criteria were: (1) Of tumor, diabetes, thyroid dysfunction or other acute or chronic diseases; (2) Fever, hepatic encephalopathy, ascites or gastrointestinal bleeding; and (3) Severe respiratory, heart or kidney disease. We also enrolled a control group of healthy volunteers. Each participant gave signed informed consent at the beginning of the study. All human studies have been reviewed by the appropriate ethics committee and have therefore been performed in accordance with the ethical standards laid down in an appropriate version of the Declaration of Helsinki.

Research design

This study was implemented from March 2022 to May 2024 at Shanxi Bethune Hospital. Before the intervention, the 24 hours food intake of all patients and healthy controls was assessed by the 24 hours food record retrospective method, and the daily activity level was assessed using the international physical activity questionnaire[16]. By blocked randomization, patients with cirrhosis were randomly divided into a normal diet group (three meals a day) and a nocturnal snacks group (three meals a day + nocturnal snacks) with nutrition support therapy intervention for 3 months, the main observation was to observe the effects of different dietary modalities on the body composition of patients with cirrhosis in both groups. In the three meals a day group, participants ate at 08:00, 12:00 and 18:00. In the nocturnal snacks group, additional meals (approximately 200 kcal) were taken at night from 20:00 to 21:00 on the basis of the normal diet, which comprised 60%-65% carbohydrate, 20%-25% fat and 10%-15% protein, and body composition was measured before enrollment and 3 months after the intervention by InBody 720 (Biospace Co., Ltd., Seoul, Korea; 1-1000 kHz). Throughout the study period, two dietitians provided nutritional guidance according to the clinical nutrition guidelines for end-stage liver disease and the dietary nutrient reference intakes of the Chinese population. Nutritional guidance was given through telephone and online video.

Body composition measurement

Body composition includes body mass index (BMI), total body water, intracellular water, extracellular water, total body protein, mineral, body fat mass (BFM), FFM, SMM, percent body fat, waist-to-hip fat ratio, visceral fat area (VFA) and body cell mass (BCM). These indices are measured by a body composition meter, InBody 720, using MFBIA. For patients with a large amount of ascites, abdominal puncture and drainage were adopted in addition to diuretics. After improving ascites, human body composition test was performed. Therefore, there was no ascites in the patients at the time of bioelectrical impedance analysis. The participants wore light clothing and stood with the palms of their hands and feet in contact with eight electrodes. The procedure took < 2 minutes.

Daily dietary intake and activity survey

The enrolled patients received dietary intervention weekly by dietitians according to the principle of total calorie intake of 30-35 kcal/kg/day, protein intake of 1.2-1.5 g/kg/day and fat energy ratio 20%-25%. Dietary caloric intake and macronutrient intake (carbohydrates, fats and proteins) were surveyed by dietitians based on the 24 hours retrospective method, and calculations were based on the Chinese standard food calorie table. The 24 hours retrospective method is the most commonly used dietary survey method for population nutrition surveys and cohort studies of Chinese residents. The investigators directly asked the participants about the types of food they consumed 24 hours before the survey, Finally, nutrient intake can be calculated according to the food composition table. Food quantity is usually used household gauges, food models or food maps for estimation. The 24 hours retrospective method was done by an open form or coding in advance questionnaires[17]. Daily activity was assessed using the international physical activity questionnaire. We classified daily activity into three levels: Low or resting, moderate and high physical activity. During the follow-up process, we dynamically evaluated activity level and analyzed the average activity level for 3 months.

Clinical biochemical parameter testing

Demographic data, clinical data, laboratory tests and severity of liver disease were recorded, and all tests were performed in the morning on an empty stomach. Blood biochemical parameters were measured using an Olympus automated biochemical analyzer AU5400 (Olympus, Tokyo, Japan). The severity of liver disease was assessed by Child-Turcotte-Pugh classification, which included ascites, hepatic encephalopathy, prothrombin time, total bilirubin and albumin indicators.

Statistical analysis

The main objective of this study was to analyze the effect of nocturnal snacks on the body composition of patients with cirrhosis. All participants were randomly assigned to the normal diet and nocturnal snacks groups. We selected 10 cases with BFM (21.3 ± 1.33 kg) in the nocturnal snacks group and 10 (20.2 ± 1.44 kg) in the normal diet group. To analyze the differences between the two groups, a minimum of 21 patients per group were required for enrollment ($\alpha = 0.05$, power = 0.8) according to the PASS-11 software (NCSS, LLC, United States). The data were analyzed using Statistical Product and Service Solutions (SPSS) 26.0 statistical software (SPSS Inc., Chicago, IL, United States). The Kolmogorov-Smirnov test was performed. The variables with normal distribution were usually presented as mean ± SD and non-normal variables as median (interquartile range). The variables conforming to a normal distribution in continuous data were tested using the independent samples *t* test. The Kruskal–Wallis test was used for variables that were not normally distributed. The categorical variables were tested using the χ^2 test or Fisher's exact test. Paired *t* test or Wilcoxon signed rank test was performed for data with normal or non-normal distribution, respectively, and compared before and after intervention in both groups. The differences were considered statistically significant at $P < 0.05$.

RESULTS

Basic characteristics of patients and healthy controls

There were 70 patients with cirrhosis and 30 healthy controls. There were no significant differences in age, sex or BMI between cirrhosis patients and healthy controls, but energy intake was lower in patients with cirrhosis (P = 0.031) (Table 1). BFM, SMM, FFM, VFA and BCM were significantly lower in the cirrhosis group than in healthy controls (all P < 0.05), suggesting that body composition was altered in the cirrhosis patients (Table 1).

Baseline characteristics of patients with liver cirrhosis in the normal diet and nocturnal snacks groups

All patients with liver cirrhosis were randomly divided into the normal diet (n = 35) and nocturnal snacks (n = 35) groups. At baseline level, no significant differences were found between the two groups for indicators of demographic data, laboratory tests, etiology, and disease severity (Table 2). There were also no significant differences for body composition indicators between the two groups (Table 3).

Survey of dietary intake and daily activities during intervention

We analyzed the effect of dietary intake and daily activity on body composition, and compared dietary caloric intake and percentage of macronutrients between the two groups. There was no significant difference in dietary caloric intake between the normal diet (2102 ± 235 kcal) and nocturnal snacks (2204 ± 187 kcal) groups (P = 0.233) (Figure 1A). There was no significant difference in percentage of macronutrients between the two groups (P > 0.05) (Figure 1B). There was no significant difference in the level of daily activity between the two groups (Table 4).

Basic conditions after intervention and effect of nocturnal snacks on body composition in patients with liver cirrhosis

There was no significant difference in laboratory tests and disease severity between the normal diet and nocturnal snacks groups (Table 5). Compared with before intervention, the nocturnal snacks group showed significant increases in BFM (23.18 ± 2.63 *vs* 15.71 ± 3.16, P = 0.029), VFA (73.22 ± 2.07 *vs* 65.93 ± 2.67, P = 0.021), and BCM (35.92 ± 1.56 *vs* 32.16 ± 1.21, P = 0.033).

However, there was no significant difference in SMM (21.22 ± 1.79 *vs* 20.38 ± 2.65, P = 0.157). BFM (14.18 ± 2.94 *vs* 13.72 ± 2.23, P = 0.189), VFA (67.33 ± 1.23 *vs* 67.12 ± 1.17, P = 0.814), BCM (30.51 ± 1.14 *vs* 30.33 ± 1.02, P = 0.598) and SMM (22.03 ± 1.57 *vs* 22.19 ± 2.19, P = 0.412) in patients with liver cirrhosis in the normal diet group did not differ significantly from before the intervention. After further intervention, BFM (23.18 ± 2.63 *vs* 14.18 ± 2.94, P = 0.006), VFA (73.22 ± 2.07 *vs* 67.33 ± 1.23, P = 0.039) and BCM (35.92 ± 1.56 *vs* 30.51 ± 1.14, P = 0.025) were significantly higher in the nocturnal snacks group than in the normal diet. However, there was no significant difference in SMM values between the nocturnal snacks and normal diet groups (21.22 ± 1.79 *vs* 22.03 ± 1.57, P = 0.903) (Figure 2). Further stratified analysis revealed that there was no significant difference in SMM between the nocturnal snacks and normal diet groups in Child grade A and B patients (21.51 ± 1.62 *vs* 22.52 ± 1.31, P = 0.871). There was no significant difference in SMM between the two groups in Child grade C patients (20.35 ± 1.93 *vs* 21.64 ± 1.57, P = 0.748). There was no significant difference in SMM between the nocturnal snacks and normal diet groups in patients without ascites (24.33 ± 1.43 *vs* 25.26 ± 1.18, P = 0.692), or with ascites (18.68 ± 1.25 *vs* 19.36 ± 1.36, P = 0.417).

DISCUSSION

Body composition is an important indicator for the assessment of nutritional conditions. In this study, we collected indicators such as liver function, coagulation, and child grading of the cirrhosis patients to evaluate their disease severity. These indicators showed no significant differences between the two groups, reducing the impact of disease severity. At 3 months follow-up, the patient's liver function was better than before, which was considered to be related to the antiviral therapy, abstinence and the use of hepatoprotective drugs. After 3 months' intervention with nocturnal snacks, BFM, VFA and BCM of patients with liver cirrhosis were significantly higher than those in the normal diet group. However, SMM did not change significantly from that in the normal diet group, suggesting that long-term nocturnal snacks improved body composition of patients with liver cirrhosis.

Previously, computed tomography was used to assess changes in body composition in patients with liver cirrhosis[18], but the radiation exposure makes it unsuitable for use as a monitoring tool. MFBIA uses the different impedances encountered by the current passing through the cells and intercellular mass to calculate the intracellular and extracellular fluid content of the subject and to derive the protein, fat, skeletal muscle content, body cell count, and mineral content, and has been widely used for detection of many diseases, even in patients on long-term dialysis[19]. MFBIA was used in this study and showed that BFM, SMM, FFM, VFA and BCM were significantly lower in patients with liver cirrhosis compared with healthy controls.

Studies on the beneficial mechanisms of nocturnal snacks have included increasing nocturnal energy-supplying substances, reducing lipid oxidation and improving nitrogen balance[20]. Long-term (3 months) oral supplementation with a branched-chain amino acid mixture improved the serum albumin level and energy metabolism in patients with

Table 1 Baseline characteristics of enrolled patients with liver cirrhosis and healthy controls

Variable	Healthy control subjects	Liver cirrhosis patients	*P* value
Participants (*n*)	30	70	-
Age (year)	53 ± 6.2	56.1 ± 5.1	0.199
Women, *n* (%)	14 (46.7)	31 (44.3)	0.826
BMI (kg/m^2)	24.8 ± 4.1	22.5 ± 3.7	0.413
Energy intake (kcal/day)	2443 ± 473	2264 ± 642	0.031
TBW (L)	40.04 ± 6.67	40.25 ± 9.38	0.221
ICW (L)	26.84 ± 6.36	25.62 ± 6.32	0.316
ECW (L)	14.81 ± 2.50	14.63 ± 3.41	0.332
TBP (kg)	10.91 ± 1.80	11.09 ± 2.73	0.153
Mineral (kg)	3.67 ± 0.61	4.03± 1.07	0.341
BFM (kg)	21.27 ± 6.74	14.38 ± 6.63	< 0.001
SMM (kg)	33.91 ± 5.49	21.42 ± 8.22	< 0.001
FFM (kg)	54.63 ± 3.08	48.02 ± 3.85	< 0.001
PBF (%)	27.77 ± 7.50	20.37 ± 8.13	0.227
WHR	0.90 ± 0.05	0.83 ± 0.14	0.612
VFA (cm^2)	95.61 ± 3.78	66.32 ± 3.50	< 0.001
BCM (kg)	36.16 ± 3.04	31.72 ± 2.02	< 0.001

BMI: Body mass index; TBW: Total body water; ICW: Intracellular water; ECW: Extracellular water; TBP: Total body protein; BFM: Body fat mass; SMM: Skeletal muscle mass; FFM: Fat-free mass; PBF: Percentage body fat; WHR: Waist-to-hip fat ratio; VFA: Visceral fat area; BCM: Body cell mass.

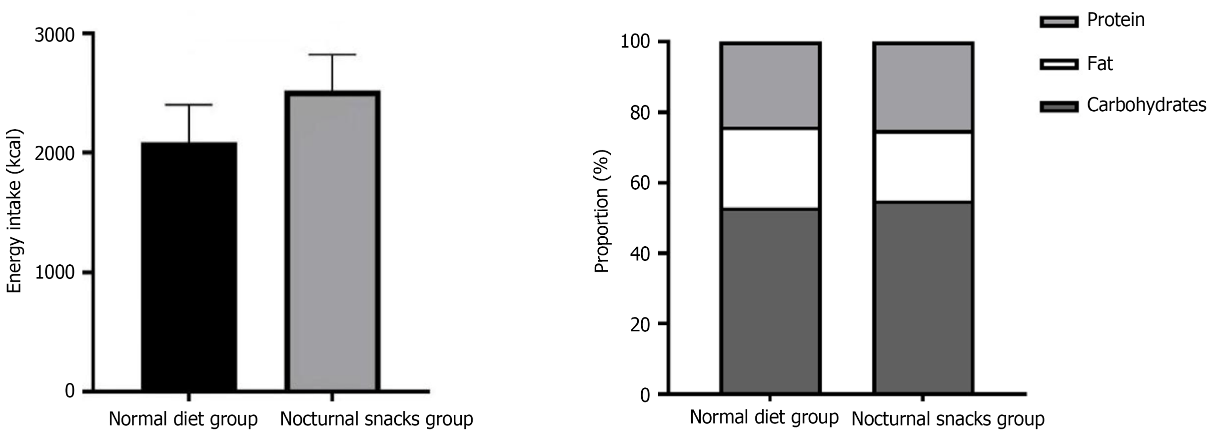

Figure 1 Comparison of dietary energy intake and macronutrient intake between the two groups. A: Energy intake; B: Macronutrient intake (protein, fat, carbohydrates).

cirrhosis[21]. A 12 months study of an evening meal intervention showed a significant increase in FFM and total body protein stores at 3, 6, and 12 months from baseline in cirrhosis patients who ate at night. However, that study had an intervention calorie intake of 710 kcal/day for a nocturnal meal, which was significantly higher than in our study (approximately 200 kcal/day). It is therefore unclear whether an evening meal higher in calories or carbohydrate/protein, may produce greater improvement in fat mass, FFM and clinical outcomes[8]. A retrospective cohort study showed that nocturnal branched-chain amino acid supplementation was associated with a significant reduction in the risk of death in patients with liver cirrhosis[20]. Nocturnal snacks has been used as a recommended nutritional intervention for patients with liver cirrhosis, but the effects on body composition have been less well studied. One study showed that nocturnal snacks did not improve body-composition-related indicators of cirrhosis, but limitations of the study were that only patients with child grade A cirrhosis were selected and the sample size was small[7]. In all the patients who underwent the child–Turcotte–Pugh test, BFM, VFA and BCM were significantly higher after 3 months' nocturnal snacks intervention, whereas BFM, VFA and BCM of patients in the normal diet group were unaffected. Previous studies have shown

Table 2 Basic information of patients with liver cirrhosis in the normal diet and nocturnal snacks groups

Variable	Normal diet group	Nocturnal snacks group	*P* value
Patients (*n*)	35	35	-
Age (year)	54.8 ± 4.9	57.3 ± 4.7	0.173
Women, *n* (%)	13 (37.1)	18 (51.4)	0.229
BMI (kg/m^2)	24.8 ± 3.9	24.60 ± 2.9	0.611
Pathogenesis, *n* (%)			0.444
HBV	21 (60.0)	26 (74.3)	
HCV	6 (17.1)	4 (11.4)	
Alcoholic	8 (22.9)	5 (14.3)	
ALT (IU/L)	72.3 ± 64.7	89.6 ± 73.5	0.586
AST (IU/L)	89 (37,153)	82 (41,160)	0.510
Albumin (g/L)	35.6 ± 6.8	35.1 ± 6.5	0.824
Total bilirubin (μmol/L)	129 (43,215)	112 (41,224)	0.786
Prothrombin time (s)	16.8 ± 7.4	15.5 ± 6.1	0.572
INR	1.48 ± 0.6	1.37 ± 0.5	0.578
Urea nitrogen (mmol/L)	8.0 ± 2.3	6.0 ± 2.1	0.520
Serum creatinine (μmol/L)	56.9 ± 11.3	59.9 ± 15.1	0.509
Ascites, *n* (%)	24 (68.6)	27 (77.1)	0.420
Child-Turcotte-Pugh, *n* (%)			0.939
A	5 (14.3)	6 (17.1)	
B	15 (42.9)	14 (40.0)	
C	15 (42.9)	15 (42.9)	

BMI: Body mass index; ALT: Alanine aminotransferase; AST: Aspartate transferase; HBV: Hepatitis B virus; HCV: Hepatitis C virus; INR: International normalized ratio.

that fat mass is negatively associated with portal pressure in liver cirrhosis[22], and low fat mass is associated with high mortality[23], which suggests that nocturnal snacks im-prove the progression and prognosis of liver cirrhosis by improving the amount of fat.

Some studies have suggested that sarcopenia has a higher sensitivity and specificity than other methods of evaluating nutritional status[24]; therefore, whether nocturnal snacks is sufficient to improve muscle status is of interest[25]. Due to the lack of a generally accepted definition coupled with the difficulty of adopting common diagnostic criteria for sarcopenia, it is often difficult for physicians to establish any kind of therapeutic approach[26]. Similar to the results of previous studies[27], we found that SMM was significantly lower in cirrhosis patients than in healthy controls. However, no significant improvement in SMM was seen in patients with liver cirrhosis after 3 months of nocturnal snacks, indicating that snacks had a limited effect on SMM. It has been shown that SMM is associated with physical activity, chronic inflammatory response and dysbiosis of the intestinal flora[28,29]. Therefore, overall improvement of the nutritional conditions of patients with liver cirrhosis may need to be accompanied by physical activity. Other studies have shown that physical inactivity is a contributing factor to sarcopenia in patients with liver cirrhosis, suggesting walking more than 5000 steps per day as a reference recommendation for activity in patients with liver cirrhosis[30].

The present study had some limitations. Firstly, the small sample size may limit its value. Secondly, this study was carried out with outpatients. Precise dietary calculations may be difficult, but we ensure that the intake of total calories and macronutrient intake (protein, fat, carbohydrates) are accurate. Thirdly although we found significant improvement in body composition, further intervention studies on the effects of nocturnal snacks on body composition are needed.

CONCLUSION

In conclusion, long-term nocturnal snacks can improve nutritional indicators such as BFM, VFA and BCM in patients with liver cirrhosis, but they have limitations in improving SMM.

Table 3 Comparison of body composition before intervention between the normal diet and nocturnal snacks groups

Body composition indexes	Normal diet group (*n* = 35)	Nocturnal snacks group (*n* = 35)	*P* value
TBW (L)	39.73 ± 7.14	41.80 ± 7.10	0.414
ICW (L)	25.14 ± 4.33	26.24 ± 2.64	0.309
ECW (L)	14.59 ± 2.41	15.56 ± 2.79	0.229
ECW/TBW (%)	37.62 ± 3.22	37.22 ± 4.17	0.332
TBP (kg)	12.09 ± 2.73	10.73 ± 1.88	0.479
Mineral (kg)	7.07 ± 3.12	5.97 ± 2.68	0.872
BFM (kg)	13.72 ± 2.23	15.71 ± 3.16	0.178
SMM (kg)	22.19 ± 2.19	20.38 ± 2.65	0.520
FFM (kg)	50.21 ± 2.17	47.52 ± 2.64	0.509
PBF (%)	21.19 ± 7.19	19.48 ± 4.16	0.711
WHR	0.81 ± 0.24	0.84 ± 0.06	0.332
VFA (cm^2)	67.12 ± 1.17	65.93 ± 2.67	0.175
BCM (kg)	30.33 ± 1.02	32.16 ± 1.21	0.648

TBW: Total body water; ICW: Intracellular water; ECW: Extracellular water; TBP: Total body protein; BFM: Body fat mass; SMM: Skeleton muscle mass; FFM: Fat-free mass; PBF: Percentage body fat; WHR: Waist-to-hip fat ratio; VFA: Visceral fat area; BCM: Body cell mass.

Table 4 Survey of daily activity levels of the two groups during the intervention, *n* (%)

Daily activity volume	Normal diet group (*n* = 35)	Nocturnal snacks group (*n* = 35)	*P* value
Low-level activity	9 (25.7)	9 (25.7)	0.921
Medium-level activity	23 (65.7)	22 (62.9)	
High-level of activity	3 (8.6)	4 (11.4)	

Table 5 Comparison of basic information of patients with liver cirrhosis in the normal diet and nocturnal snacks groups at the end of the observation

Variable	Normal diet group (*n* = 35)	Nocturnal snacks group (*n* = 35)	*P* value
ALT (IU/L)	31.5 ± 10.6	29.0 ± 11.2	0.615
AST (IU/L)	38.1 ± 19.2	39.1 ± 13.3	0.894
Albumin (g/L)	34.6 ± 4.3	34.1 ± 4.7	0.762
Total bilirubin (μmol/L)	29.9 ± 25.8	19.2 ± 10.2	0.238
Prothrombin time (s)	13.5 ± 2.6	13.5 ± 1.7	0.732
INR	1.2 ± 0.2	1.3 ± 0.2	0.723
Urea nitrogen (mmol/L)	5.4 ± 2.7	4.9 ± 0.9	0.582
Serum creatinine (μmol/L)	69.1 ± 12.1	65.7 ± 12.0	0.537
Ascites, *n* (%)	22 (62.9)	23 (65.7)	0.803
Child–Turcotte–Pugh, *n* (%)			0.945
A	7 (20.0)	6 (17.1)	
B	15 (42.9)	15 (42.9)	
C	13 (37.1)	14 (40.0)	

ALT: Alanine aminotransferase; AST: Aspartate transferase; INR: International normalized ratio.

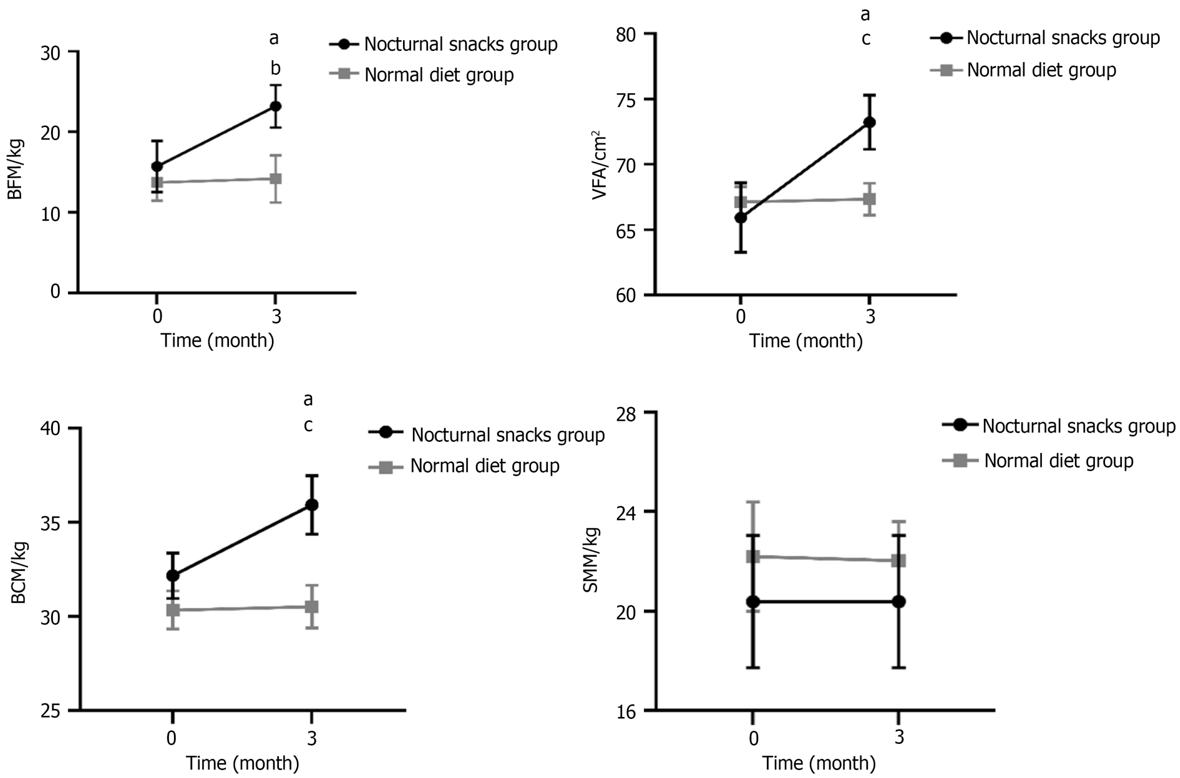

Figure 2 Comparison of body composition between the nocturnal snacks and normal diet groups. $^aP < 0.05$. $^bP < 0.01$ *vs* normal diet group. $^cP < 0.05$ *vs* normal diet group. BFM: Body fat mass; VFA: Visceral fat area; BCM: Body cell mass; SMM: Skeletal muscle mass.

FOOTNOTES

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