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Original Article

Evaluation of dietary quality of patients with severe cerebrovascular disease by diet balance index-16

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Abstract: Objective: To assess the dietary quality of patients with severe cerebrovascular disease using Diet Balance Index-16 (DBI-16) and to provide scientific evidence for the establishment of targeted dietary intervention and related dietary nutritional education for patients. Methods: The general information of 214 hospitalized patients with severe cerebrovascular disease, including gender and age etc., were investigated by a self-made questionnaire on health risk factors, and the dietary quality conditions of patients was evaluated by DBI-16 scoring method. Results: The dietary quality of patients with severe cerebrovascular disease had low levels of imbalanced conditions, accompanied with low levels of inadequate intake and excessive intake. The degree of excessive intake in female patients was clearly less than that in male patients. The degree of inadequate intake and total scores in patients younger than 55 years old was lower than those in the other two groups. The intake of vegetables, fruits, milk and soybeans in most of patients did not reach the recommended nutrient intake and the animal product amount was insufficient. In addition, the intake of low quality food and condiments such as oil and salt were excessive in patients with severe cerebrovascular disease. Dietary pattern A was the main model. Conclusions: The overall diet structure of patients with severe cerebrovascular disease is not rational. It is recommended to appropriately balance the intake of grains and animal products, increase the intake of milk, soybeans, vegetables and fruits, and strictly control the amount of oil and salt.

Keywords: Dietary balance index, severe cerebrovascular disease, dietary quality

Introduction

Nutritional support for patients with cerebrovascular disease, especially for severe cerebrovascular disease, has received widespread attention in the field of clinical nutritional support [1, 2]. These patients are usually accompanied by dysphagia and disturbance of consciousness due to neurological deficits in the early stage, and metabolic disorders due to acute stress response, which may lead to nutritional metabolic disorders. Early nutritional support has played an extremely important role in reducing protein consumption, decreasing the incidence of infection and enhancing immune function in critically ill patients. Nutritional support has become a part of routine treatment for critically ill patients. Many studies have shown that the prognosis of patients with severe cerebrovascular disease was closely associated with each patients' own dietary status [3, 4]. It has been reported that good dietary quality can improve quality of life and reduce the rate of recurrence and mortality in patients with severe cerebrovascular disease [5, 6]. Therefore, it is of great significance to explore the dietary intake and dietary quality for improving prognosis in patients with severe cerebrovascular disease.

At present, there are few studies on dietary quality evaluation in patients with severe cerebrovascular disease, and most studies are confined to traditional dietary evaluation methods, not fully disclosing diet complexity. Diet balance index (DBI) based on the dietary guidelines for Chinese residents and the balanced diet pagoda, are combined with the dietary characteristics of Chinese residents, and this is considered as a scoring system that could better reflect the

overall dietary quality of the population [7, 8]. Among them, diet balance index-16 (DBI-16) is known as a good tool for comprehensive evaluation of population diet and it is widely used in China. Many studies have shown that the application of DBI-16 can find the dietary problem and quantify the degree of severity, thus better evaluating the dietary quality [9]. He et al found by DBI-16 method, that unfavorable dietary quality was obviously associated with an increased risk of prediabetes [10]. Gao et al reported that DBI-16 provided the most comprehensive assessment of the overall diet balance and quality for optimizing cardiometabolic health among hyperlipidemic individuals [11]. Wang et al showed that the Chinese diet balance index was used to assess the correlation of ischemic stroke with dietary quality [12]. However, there is no study regarding DBI-16 evaluating the dietary conditions of patients with severe cerebrovascular disease. In this context, DBI-16 was exploited in this study to comprehensively evaluate the dietary quality of patients with severe cerebrovascular disease. The results of this study provide clinical evidence for scientific and targeted dietary guidance.

Materials and methods

Subjects

A total of 225 subjects with severe cerebrovascular disease in Shanghai Pudong New Area Gongli hospital from June 2020 to June 2021 were enrolled in the current study. This research was approved by the Ethics Committee of Shanghai Electric Power Hospital (No. 2020-106), and all the included patients or their families signed the informed consent. Inclusion criteria: ① Patients were diagnosed as having severe cerebrovascular disease such as cerebral infarction, cerebral hemorrhage and etc, and were admitted to the intensive care unit of neurology department. ② Age was more than 18 years old. ③ The estimated hospitalization time was more than 7 days. ④ Patients actively cooperated with the performance of this study. ⑤ The collected data regarding subjects was complete. Exclusion criteria: ① Patients had digestive system diseases, chronic renal insufficiency or renal failure, thyroid disease or malignant tumor. ② Patients were in a confused state of mind. ③ Patients were expected to be in hospital for less than 7 days. ④ Patients dropped out during the period of study. ⑤ Severe hepatic and renal dysfunction or death occurred during the monitoring process.

Dietary survey

A self-made health risk factor assessment questionnaire was used to investigate the information including general demographic characteristics and health-related behaviors in patients with severe cerebrovascular disease. The investigators used the common food map combined with the food frequency questionnaires to record the conditions of food intake within the past year. The daily intake of various kinds of food per person were calculated according to the number of diners.

Diet balance index-16

According to the daily food intake of the individuals and food composition table, the energy intake was calculated. The scores of DBI index for the individuals were calculated according to the evaluation method of DBI-16. The three indicators such as higher bound score (HBS), lower bound score (LBS) and diet quality distance (DQD) were further calculated. The DBI-16 indicator consisted of grains, vegetables, fruits, milk, soybeans, animal foods, empty energy foods, condiments, diet variety and water. The values of various single indicators were scored by sectional evaluations. The definition of sectional evaluations was performed according to the dietary guidelines for Chinese residents and the recommended amount of the balanced diet pagoda [13].

The evaluation criterion for DBI was as follows [10]: a score of 0 suggested no problems (excellent dietary intake), a score which is less than 20% of the total score suggested almost no problems (good dietary intake), a score which was 20%-40% of the total score suggested low level of problems (acceptable dietary intake), a score which was 40%-60% of the total score suggested moderate level of problems (poor dietary intake), a score which was more than 60% of the total score suggested high level of problems (worst dietary intake).

The total scores (TS) reflected the average level of dietary quality, which was the sum of various single index scores. The ranges of total scores

Table 1. The definition of dietary patterns divided by DBI

Patterns	Definition	Significances
A	LBS≤20, HBS≤10	The optimal pattern, less inadequate intake and excessive intake
B	LBS≤40, HBS≤10	Few excessive intake and a certain extent of inadequate intake
C	LBS>40, HBS≤10	Severely inadequate intake
D	LBS≤20, 10<HBS≤20	Less inadequate intake and a certain extent of excessive intake
E	20<LBS≤40, 10<HBS≤20	A certain extent of inadequate intake and excessive intake
F	LBS>40, 10<HBS≤20	A certain extent of excessive intake and a high level of inadequate intake
G	LBS≤20, HBS>20	Excessive intake
H	20<LBS≤40, HBS>20	Severely excessive intake and a certain extent of inadequate intake
I	LBS>40, HBS>20	Severely inadequate intake and excessive intake

Note: DBI: Diet balance index; LBS: Lower bound score; HBS: Higher bound score.

were -72 to 44. A positive value tended towards excessive intake. A negative value tended towards insufficient intake. A score of 0 indicated excessive intake and insufficient intake cancelled each other out, which was considered as dietary balance.

LBS was considered as the absolute value of the sum of all negative scores, which reflected the degree of insufficient intake. The range of LBS was 0-72 points and the significance of LBS was as follows: Zero indicated not inadequate intake. LBS between 1 and 14 indicated approaching inadequate intake. LBS between 15 and 29 indicated low level of inadequate intake. LBS between 29 and 43 indicated moderate level of inadequate intake. LBS between 43 and 72 indicated high level of inadequate intake. HBS was considered as the sum of all positive scores, which reflected the degree of excessive intake. The ranges of HBS were 0-44 and the significance of HBS was as follows: Zero indicated not excessive intake. HBS between 1 and 9 indicated approaching excessive intake. HBS between 10 and 18 indicated low level of excessive intake. HBS between 19 and 27 indicated moderate level of excessive intake. HBS between 27 and 44 indicated high level of excessive intake. The DQD was considered as the sum of the LBS and HBS, which was used to assess whether the individual's food intake was balanced. The range of DQD was 0-96 and the significance of DQD was as follows: Zero indicated balanced intake. DQD between 1 and 19 indicated approaching an unbalanced dietary intake. DQD between 20 and 38 indicated low level of unbalanced dietary intake. DQD between 39 and 57 indicated moderate level of unbalanced dietary intake. DQD between 57 and 96 indicated high level of unbalanced dietary intake.

The division of dietary patterns

HBS and LBS were divided into 3-degree scales, respectively. Nine dietary patterns were defined by the different combinations of DBI-HBS and DBI-LBS scores, and each dietary pattern corresponded to a kind of dietary conditions, as seen in **Table 1**.

Statistical analysis

EpiData software version 3.1 was used to input the original data, and SPSS software version 24.0 was used for statistical analysis. The daily intake of each nutriment in every subject was calculated using the Nutrition Calculator V2.60c (standard version), and the results were compared with the foods intake recommended by 2016 Chinese Balanced Diet Pagoda. The measurement data were described in the form of Mean ± Standard deviation and t test was used for the comparison; while the enumeration data was expressed in the form of percentages/cases and χ^2 test was used for the comparison. One-way ANOVA following Bonferroni's post-hoc test was employed for differences among at least three groups. A *P* value of less than 0.05 indicated statistical significance.

Results

Characteristics of the subjects

A total of 225 questionnaires were given out in this study, and 214 valid questionnaires were collected, with an effective recovery rate of

Table 2. Distribution of diet quality (%)

	Indicator	Scores ($\bar{x}$±s)	Degree of balanced diet				
			No problem	Almost no problem	Low level	Moderate level	High level
Inadequate intake	LBS	19.32±6.63	-	32.4	57.3	9.8	0.5
Excessive intake	HBS	8.24±5.12	0.3	28.3	51.4	15.1	4.9
Overall unbalance	DQD	26.57±8.57	-	11.6	66.5	21.5	0.4

Note: LBS: Lower bound score; HBS: Higher bound score; DQD: Diet quality distance.

Table 3. Scores for the DBI-16 components and the percentages of subjects with each score in patients with severe cerebrovascular disease (%)

Range of score	Cereals	Vegetables and Fruits	Dairy and Soybean	Animal foods	Empty energy foods	Condiments	Diet variety	Water
-12~-11	0.8	-	2.3	0.8	-	-	-	-
-10~-9	1.2	1.2	5.4	4.3	-	-	1.1	0.4
-8~-7	2.1	6.8	7.2	27.3	-	-	1.3	0.9
-6~-5	6.3	10.5	37.8	20.4	-	-	12.7	0.3
-4~-3	16.7	24.4	20.3	25.2	-	-	51.2	13.4
-2~-1	10.6	25.9	15.6	13.8	-	-	31.6	0.8
0~1	14.3	31.2	11.4	5.2	1.4	2.1	2.1	84.2
2~3	11.1	-	-	1.6	15.5	13.4	-	-
4~5	13.9	-	-	1.4	18.4	19.2	-	-
6~7	8.2	-	-	-	14.0	11.7	-	-
8~9	2.4	-	-	-	49.3	53.2	-	-
10~11	1.2	-	-	-	1.4	0.3	-	-
12	11.2	-	-	-	-	0.1	-	-

Note: DBI: Diet balance index.

95%. Finally, 214 subjects were included in this study. There were 110 males and 104 females. There subjects were divided into three groups according to the different ages. There were 68 subjects under 55 years old, 100 subjects between 55-70 years old and 46 subjects over 70 years old.

Distribution of diet quality

The distribution of DBI-16 indicators among the subjects is shown in **Table 2**. LBS scores suggested inadequate intake levels, with 57.3% of subjects with severe cerebrovascular disease having a low prevalence of inadequate dietary intake. HBS suggested that 51.4% of the subjects with severe cerebrovascular disease had a low level of excessive dietary intake. DQD scores indicated the overall unbalance in dietary intake levels, suggested that 66.5% of subjects with severe cerebrovascular disease had a low level of unbalanced dietary intake.

Scores for the DBI-16 components and the percentages of subjects with each score in patients with severe cerebrovascular disease

Table 3 presents the scores for the DBI-16 components and the percentage of subjects with each score. Excessive intake was shown in the types of grains, empty energy foods, and condiments, with 48.0%, 98.6% and 97.9%, respectively. Inadequate intake of vegetables and fruits, dairy and soy, animal foods, diet variety and water were 68.8%, 88.6%, 91.8%, 97.9% and 15.8%, respectively, was found in subjects with severe cerebrovascular disease.

Comparison of DBI scores between males and females

As shown in **Table 4**, there were no statistical differences in LBS and DQD scores between males and females. HBS scores in males were significantly higher than that in females, while TS in females was obviously higher than that in

Table 4. Comparison of DBI scores between males and females ($\bar{x}$±s)

Indicators	Total subjects (n=214)	Males (n=110)	Females (n=104)	*t* value	*P* value
LBS	18.38±6.69	17.06±6.32	19.47±7.33	-1.872	0.051
HBS	8.85±4.72	9.73±4.91	8.59±3.76	2.683	0.025
DQD	28.35±8.41	27.64±8.13	28.22±8.78	-0.634	0.579
TS	-9.08±8.34	-7.63±7.92	-11.32±9.16	2.882	0.003

Note: DBI: Diet balance index.

Table 5. Comparison of DBI scores among different ages ($\bar{x}$±s)

Indicators	Age less than 55 years old (68)	Age between 55 and 70 years old (100)	Age more than 70 years old (46)	F value	*P* value
LBS	15.89±7.53	19.54±6.74	19.23±8.87	2.761	0.083
HBS	9.16±3.98	9.73±5.31	7.96±3.54	1.380	0.422
DQD	25.89±7,56	27.67±9.32	27.32±9.58	2.563	0.214
TS	-7.32±7.88	-9.87±6.59	-11.12±10.87	3.152	0.043

Note: LBS: Lower bound score; HBS: Higher bound score; DQD: Diet quality distance; DQD: Diet quality distance; TS: Total scores.

Table 6. The average intake of various foods in patients with severe cerebrovascular disease under different dietary patterns (g/d)

Patterns	Numbers	Percentage (%)	Cereals	Vegetables	Fruits	Dairy	Soybean	Meats	Fishes	Eggs	Oils	Salt
A	100	46.7	320	695	380	170	140	75	20	32	54	18
B	55	25.7	290	440	255	42	96	30	4	23	110	23
C	2	0.9	1021	55	32	1	33	21	0	0	4	7
D	40	18.7	652	865	357	163	154	74	15	39	72	20
E	8	3.7	596	385	148	21	75	18	5	11	155	21
G	6	2.8	923	1162	276	175	269	316	65	23	133	21
H	3	1.4	751	632	465	25	69	93	23	24	172	26

males. The significant differences for HBS and TS were observed between males and females (all P<0.05). The overall dietary quality in males and females subjects with severe cerebrovascular disease was under a low level of imbalance.

Comparison of DBI scores among different ages

As shown in **Table 5**, subjects with severe cerebrovascular disease under 55-year-old had the lowest intake inadequacy (LBS: 15.89±7.53) and the total scores were also the lowest (TS: -7.32±7.88) among the three age groups. Significant differences were found for TS among three age groups (P=0.04). TS from subjects between 50 and 70 years old or subjects more than 70 years old was significantly more than that from subjects less than 55 years old (P<0.05). The overall dietary quality in the three age groups was under a low level of imbalance.

Analysis of dietary patterns results

As shown in **Table 6**, the model A was the main dietary pattern, accounting for 46.7% of patients with severe cerebrovascular disease. Model B accounted for 25.7%. The number of patients with model C, E, G and H were low, accounting for 0.9%, 3.7%, 2.8% and 1.4%, respectively. Patients with model D accounted for 18.7%. There were no patients with model F or I in this study.

As shown in **Table 7**, the proportion of female patients with the model A was the most, accounting for 48.7%. The proportion of male patients with the model A and model D were higher, accounting for 45.7% and 23.9%, respectively. Chi-square test showed that there

Table 7. The relationship of gender and ages with dietary models in patients with severe cerebrovascular disease [Cases (%)]

Dietary models	Gender		Age (year)		
	Males	Females	<55	55~70	>70
A	63 (45.7)	37 (48.7)	36 (52.9)	45 (45.0)	25 (54.3)
B+C	29 (21.0)	28 (36.)	11 (16.2)	30 (30.0)	10 (21.7)
D	33 (23.9)	7 (9.2)	17 (25)	14 (14.0)	9 (19.6)
E	6 (4.3)	2 (2.6)	3 (4.4)	3 (3.0)	2 (4.3)
G	4 (2.9)	2 (2.6)	1 (1.5)	2 (2.0)	-
H	3 (2.2)	-	-	6 (6.0)	-

were significant differences in different dietary patterns between male and female patients ($P<0.05$). Among patients who were less than 55 years old, the proportion of patients with the model A was the most, accounting for 52.9%, followed by model D, accounting for 25%. Among patients between 55 and 70 years old, the proportion of patients with the model A was the greatest, accounting for 45.0%, followed by the model B+C accounting for 30%. Among patients with more than 70 years old, the proportion of patients with the model A was the highest. Chi-square test showed that there were no significant differences for dietary patterns among three age groups ($P<0.05$).

Discussion

The results of this study showed that the dietary quality of patients with severe cerebrovascular disease were under low levels of imbalanced conditions. These patients also had low levels of inadequate intake and excessive intake. The dietary quality of patients with severe cerebrovascular disease was unsatisfactory.

In the term of gender, the degree of excessive intake in male patients was more than that in female patients, which was similar with the results reported by O'Connell et al [14]. The possible reasons were that there were physiological, psychological and social differences between men and women, poor figure management in men, partying and dining resulting in poor diet control and excessive heat energy ingestion for men. In addition, the TS value raised with the increasing age, and the degree of insufficient dietary intake became more and more serious. The reasons may be associated with the physiological state. With the increase of age, the functional status of various organs gradually declined, and the abilities of chewing and digesting also decreased, which could lead to the gradual reduction of food intake in elderly patients [15]. Therefore, dietary interventions for male and elderly subjects are needed.

In the aspect of diet structure, the distribution of food intake in patients with severe cerebrovascular disease was imbalanced. Most of the patients did not meet the recommended intake of vegetables, fruits, milk and soybeans. Only 31.2% of patients reached the recommended amount of fruits and vegetables, which may be related with the decline of chewing and digestion ability in the elderly patients, and the lack of the nutritional understanding of vegetables and fruits, resulting in lower intake [16]. Only 11.4% of patients met the recommended amount of milk and soybeans. Milk was an important source of calcium supplementation, which could effectively prevent osteoporosis and fractures [17]. However, most patients had low intake of milk due to the lack of the nutritional understanding of milk, poor taste, lactose intolerance, decreased purchasing power and insufficient consumption and instead they chose health care products. Soybeans foods were rich in high-quality protein and phytochemicals such as soy isoflavones and soy lecithin, which were beneficial to improve blood lipids and protect the cardiovascular system [18]. Patients with severe cerebrovascular disease should increase intake of soybeans to slow the progression of the disease. In additional, there were imbalance intakes of grains and animal food in patients with severe cerebrovascular disease, who also had inadequate and excessive intake. Among nutrient components, a large proportion of insufficient intake of animal foods was conducted. Long-term insufficient intake of animal foods would lead to serious complications including nutritional deficiencies and sarcopenia. Moreover, exces-

sive intake of animal foods could result in excessive protein and fat, aggravating the load of the cardiocerebral vascular system. The reason for the insufficient intake of animal foods in such patients may be that after understanding nutritional knowledge they decreased their intakes of animal foods to avoid aggravation of the disease. It also may also be related to the lack of purchasing power for fish and shrimp. Most of patients ingested too much empty energy food and condiments such as oil, alcohol, sugar and salt, and it this was consistent with the results of Hlebowicz et al [19]. Long-term intake of excessive oil and salt could easily lead to cardiovascular and cerebrovascular diseases such as hypertension and heart disease. Thus, it was necessary to further carry out "low salt and less oil" education and popularize the application of salt spoons and oil pots for controlling the use amount, in order to accurately and quantitatively control the intake of oil and salt. In the term of diet variety and water, the average intake conditions in patients with severe cerebrovascular disease were better. Most patients had rich diet variety and good drinking water status. It was reported that the intake of adequate water could increase circulating blood volume and reduce blood viscosity, which was conducive to the prevention of cardiovascular and cerebrovascular diseases and had a positive effect on improving the prognosis of patients with severe cerebrovascular diseases.

In terms of dietary patterns, patients with severe cerebrovascular disease were mainly in the model A, B, and D. Among them, patients in dietary pattern A accounted for 46.7%, indicating the largest proportion, and this was the optimal mode, revealing that there were fewer problems of insufficient intake and excessive intake. There were also serious excessive intake of vegetables and soybeans and inadequate intake of dairy and fish. Moreover, the proportion of patients in dietary pattern B was 25.7%, which was relatively large, indicating that less excessive intake and a certain degree of insufficient intake. Among them, the intake of grains, vegetables, fruits, milk, soybeans, meat, fish, eggs in model B were significantly lower than those in the model A. a total of 18.7% of patients were in dietary pattern D. This pattern had fewer problems of insufficient intake and a certain degree of excessive intake. The intake of grains, vegetables, soybeans, eggs, oil, and salt were significantly more than those in dietary pattern A, while the intake of fruits, milk, meat and fish in dietary pattern D were lower than those in dietary pattern A. Dietary patterns C, E, G, and H reflected the dietary imbalances and seriously excessive intake of oil and salt. This study also showed that there were statistical differences for the comparison of dietary patterns between male and female patients ($P<0.05$), indicating that gender was a factor affecting the diet structure in patients with severe cerebrovascular disease. Further, there was no significant difference for the comparison of dietary patterns among patients in the three age groups ($P>0.05$). Therefore, when providing guidance and propaganda of diet for patients with severe cerebrovascular disease, it is necessary to pay attention to different dietary patterns in different genders, and carry out targeted individualized propaganda and education.

The current study has some limitations that should be recognized. First, it was retrospective research, which could not perform blind, randomized studies or power calculations. Second, the sample size was not large, which may influence the findings. Third, the collected data were obtained from a single center, which may influence the generalization to other organizations. Therefore, in the future it is needed to verify this through increasing the sample size and adopting a multi-center and randomized prospective study.

In conclusion, the dietary structure of patients with severe cerebrovascular disease was irrational. Relevant medical staff can strengthen nutrition education, and guide patients to eat a healthy balanced diet, properly regulate the intake of grains and animal foods, increase the intake of milk, soybeans, vegetables and fruits, and strictly control the amount of salt and oil to actively improve the prognosis of such patients.

Disclosure of conflict of interest

None.

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References

[1] Ogawa Y, Inagawa M, Kimura M, Iida T, Hirai A, Yoshida T, Ito N, Kawahara Y, Ueda R, Morohoshi A, Sekine S, Shiozawa Y, Koyama Y, Funakoshi H, Sakamoto K, Kanai M, Tanaka T, Ogawa T, Kakizaki S and Naganuma A. Nutritional intervention after an early assessment by a flexible endoscopic evaluation of swallowing is associated with a shorter hospital stay for patients with acute cerebral infarction: a retrospective study. Asia Pac J Clin Nutr 2021; 30: 199-205.

[2] Gong L, Wang Y and Shi J. Enteral nutrition management in stroke patients: a narrative review. Ann Palliat Med 2021; 10: 11191-11202.

[3] Afolayan AJ and Wintola OA. Dietary supplements in the management of hypertension and diabetes - a review. Afr J Tradit Complement Altern Med 2014; 11: 248-258.

[4] Zhao F, Guo J and Chen H. Studies on the relationship between changes in dietary patterns and health status. Asia Pac J Clin Nutr 1995; 4: 294-297.

[5] Cho IY, Lee KM, Lee Y, Paek CM, Kim HJ, Kim JY, Lee K, Han JS and Bae WK. Assessment of dietary habits using the diet quality index-international in cerebrovascular and cardiovascular disease patients. Nutrients 2021; 13: 542.

[6] Dearborn JL, Khera T, Peterson M, Shahab Z and Kernan WN. Diet quality in patients with stroke. Stroke Vasc Neurol 2019; 4: 154-157.

[7] Zhang Q, Qin G, Liu Z, Li Z, Li J, Varma DS, Wan Q, Zhao J, Min X, Han X and Liu M. Dietary balance index-07 and the risk of anemia in middle aged and elderly people in Southwest China: a cross sectional study. Nutrients 2018; 10: 162.

[8] Zhang Q, Ruan Y, Hu W, Li J, Zhao J, Peng M, Wan R, Min X, He S and Liu Z. Perceived social support and diet quality among ethnic minority groups in Yunnan Province, Southwestern China: a cross-sectional study. BMC Public Health 2021; 21: 1726.

[9] Su X, Zhu W, Li N, Sun J, Zhu Y, Liu T, Xia H, Dai Z, Zhang Y, Pan L and Jiang W. Adjusting DBI-2016 to dietary balance index for Chinese maternal women and assessing the association between maternal dietary quality and postpartum weight retention: a longitudinal study. PLoS One 2020; 15: e0237225.

[10] He D, Qiao Y, Xiong S, Liu S, Ke C and Shen Y. Association between dietary quality and prediabetes based on the diet balance index. Sci Rep 2020; 10: 3190.

[11] Gao X, Tian Z, Zhao D, Li K, Zhao Y, Xu L, Wang X, Fan D, Ma X, Ling W, Meng H and Yang Y. Associations between adherence to four a priori dietary indexes and cardiometabolic risk factors among hyperlipidemic patients. Nutrients 2021; 13: 2179.

[12] Wang Y, Su X, Chen Y, Wang Y, Zhou J, Liu T, Wang N and Fu C. Unfavorable dietary quality contributes to elevated risk of ischemic stroke among residents in Southwest China: based on the Chinese Diet Balance Index 2016 (DBI-16). Nutrients 2022; 14: 694.

[13] Wang J, Yang L, Li H, Li Y and Wei B. Dietary selenium intake based on the Chinese food pagoda: the influence of dietary patterns on selenium intake. Nutr J 2018; 17: 50.

[14] O'Connell ML, Coppinger T, Lacey S, Arsenic T and McCarthy AL. The nutritional status and dietary intake of free-living seniors: a cross-sectional study. Clin Nutr ESPEN 2021; 43: 478-486.

[15] Kim YM, Kim JD and Jung H. A cross-sectional study of the effects of physical activity and nutrient intakes on blood glucose control rates in middle-aged and elderly diabetes patients: Korean national health and nutrition examination survey 2015-2017. Inquiry 2021; 58: 469580211035727.

[16] Silveira EAD, Vieira LL, Jardim TV and Souza JD. Obesity and its association with food consumption, diabetes mellitus, and acute myocardial infarction in the elderly. Arq Bras Cardiol 2016; 107: 509-517.

[17] Lee JT, Moore CE and Radcliffe JD. Consumption of calcium-fortified cereal bars to improve dietary calcium intake of healthy women: randomized controlled feasibility study. PLoS One 2015; 10: e0125207.

[18] Chatterjee C, Gleddie S and Xiao CW. Soybean bioactive peptides and their functional properties. Nutrients 2018; 10: 1211.

[19] Hlebowicz J, Drake I, Gullberg B, Sonestedt E, Wallstrom P, Persson M, Nilsson J, Hedblad B and Wirfalt E. A high diet quality is associated with lower incidence of cardiovascular events in the Malmo diet and cancer cohort. PLoS One 2013; 8: e71095.