A practical approach to nutritional intervention for people with chronic kidney disease in Vietnam

doi: 10.6133/apjcn.202404/PP.0001
Published online: April 2024

Running title: Nutritional intervention in patients with CKD

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ABSTRACT

Background and Objectives: A comprehensive nutritional management is necessary for favourable outcomes in patients with chronic kidney disease (CKD). We aimed to assess the changes in nutritional status and disease progression with nutritional management where renal replacement therapy (RRT) was not in place. **Methods and Study Design:** A quasi-experiment intervention was conducted on 70 CKD patients at stages 3-5 from July to December 2022. Participants were excluded if they underwent RRT, including dialysis (hemodialysis or peritoneal dialysis), or kidney transplantation. The nutritional regimen covered nutritional counseling, samples of the dietary menu, and supplement products. We evaluated nutritional status using Subjective Global Assessment (SGA) scale and sub-clinical blood test at T0 (hospital admission) and T1 (two weeks after the admission or 24 hours before the discharge). **Results:** After the intervention, the number of patients classified as malnutrition or at risk of malnourished reduced significantly (65.7% to 54.3% and 25.7% and 5.7%, respectively). The serum concentration of urea, creatinine and parathyroid hormone decreased remarkably, especially in patients receiving nutritional management. In the intervention group, the dietary pattern provided increased intakes of calcium and iron at T1, while phosphorus, sodium and potassium decreased after follow-up. Nausea/vomiting, loss of appetite, tiredness and sleep disorders were improved in the intervention compared to the control group. **Conclusions:** Nutritional therapy enhanced the nutritional status, and quality of dietary and renal function in CKD patients without RRT. Applying nutrition education and treatment at an early stage can slow CKD progression, which should be applicable elsewhere in Vietnam.

Key Words: chronic kidney disease, nutritional intervention, nutritional counselling, Vietnam

INTRODUCTION

The global burden of chronic kidney diseases (CKD) is significantly growing, and currently, CKD is one of the leading causes of death worldwide. In 2017, it was estimated that 700 million patients were living with CKD worldwide, accounting for 9.1% of the global population, ranking the 12th among the leading causes of death globally.[1] Therefore, early diagnosis and treatment are vital to slow the progression of the end-stage of kidney diseases, increase patients' quality of life, and decrease healthcare expenditure.[2]

Nutritional therapy is critical in CKD treatment, which includes restricting intakes of protein, sodium, potassium, and phosphorus to limit complications and cardiovascular

events.[3] However, strict dietary patterns can be overwhelming and challenging for CKD patients, which may lead to poor adherence.[4] Previous studies demonstrated a high prevalence of malnutrition amongst CKD patients. A study by Campbell et al. (2008) showed that 18% of CKD patients were malnourished assessed by the Subjective Global Assessment (SGA).[5] Additionally, a previous study (2014) also presented that among 922 CKD patients without dialysis, the prevalence of malnutrition was 11%.[6]

According to the results of the Global Burden of Disease (GBD) in Vietnam, the number of CKD patients is gradually increasing, in which the figures for prevalence and incident rate in 2019 were 10.74% and 0.04, respectively.[7] Malnutrition is also a common problem in patients with kidney failure in Vietnam, especially muscle wasting, defined by simultaneous loss of body protein and energy stores.[8] A study conducted on 467 CKD patients without kidney replacement therapy at Cho Ray Hospital in Ho Chi Minh City showed that the prevalence of malnutrition was 36.2%.[9] Another study focused on elderly people with CKD at Huu Nghi Hospital found a relatively high prevalence of malnutrition, ranging from 13.2 to 23.6%, depending on the assessment tools.[10] However, the majority of studies assess the nutritional status of CKD patients based on patients with hemodialysis or peritoneal dialysis. Little attention is paid to the evaluation of the condition of CKD patients at the non-dialysis stage, although malnutrition prior to dialysis in the CKD end-stage adversely affects the treatment prognosis at the initiation of renal replacement therapy.[11, 12] Thus, this study aimed to assess the changes in nutritional status and disease progression of CKD patients without renal replacement after receiving nutritional treatment therapy.

MATERIALS AND METHODS

Study settings and subjects

We designed a quasi-experiment in which intervention and control groups were not randomly classified into both groups. We also conducted the assessment at T0 (pre-evaluation) and T1 (two weeks after the T0). The study was carried out in the inpatient treatment department at Saint Paul General Hospital, Hanoi, Vietnam, from July to December 2022. Participants were patients with CKD who received treatment in the study setting. The inclusion criteria for selecting participants were (1) aged 18 to 65 years old; (2) diagnosed CKD at stage three to five without renal replacement therapy; (3) indicated for parenteral nutrition; (4) agreed to participate in the study. We excluded participants if they (1) underwent renal replacement therapy, including dialysis (hemodialysis or peritoneal dialysis), or kidney transplantation; (2)

with contraindications to enteral nutrition; (3) had incomplete medical records according to the research medical record form.

In this study, the ratio of sample size in the intervention and control group was equal at 1:1. Group 1 was the intervention group receiving the intervention protocol developed by the research team. Group 2 was the control group undergoing the standard procedure at the hospital, not using the nutritional regimen developed by the research team. We applied the convenience sampling technique to recruit participants until the number reached 35 patients in each group. In the first stage, patients who met the inclusion criteria were selected for the intervention group. In the next stage, we continued choosing participants in the control group, and participants in two groups were paired together based on age group, gender, and disease stages.

The regimen of nutritional intervention programs

At the time of admission (T0), all participants were assessed by professional dietitians regarding anthropometry indicators, clinical characteristics, and nutritional status evaluated using the SGA scale.

Regarding the control group, patients with CKD had dietary patterns according to their preferences and demands. In the intervention group, nutritional intervention regimens were applied, which consisted of several components:

- Nutritional counseling

- Specific dietary and menus were prepared by our nutritional experts in the hospital and applied to each patient in the intervention group during the research time. The prescribed nutritional care regimen covered the recommended energy and protein as follows:

(1) Energy: 25-35kcal/kg/day

(2) Protein: 0.55-0.6 g/kg/day for CKD patients without diabetes and 0.6-0.8 g/kg/day for CKD patients with diabetes

(3) Sodium <2.3g/day

(4) Phosphorus <800mg/day (26mmol/day) and avoiding processed foods due to high phosphorus/protein ratio.

(5) Daily elemental calcium intake of 800 - 1000 mg (20 to 25 mmol per day)

(6) Supplement oral nutritional products (In 250mL, there was 300 Kcal of energy; 7g Protein; 9.9g Lipid; 44.6g Carbohydrate)

- Health personnel and dietitians assessed the diet of each patient daily and noted all information in the medical record. To ensure the tolerability to meet the recommended energy

and protein of patients, practical adjustments compared to the intervention protocol can be made by dieticians. The changes should be considered based on eating preferences, the ability of digestion, and absorption of patients.

- Two weeks after the admission or 24 hours before the discharge (T1), all patients were assessed using a similar questionnaire to the T0. The assignment of study participants at T0 and T1 is described in Figure 1.

Measurements and instruments

We used a structured questionnaire to collect information on all participants. Participants self-reported their age, gender, living area, educational level, co-morbidities, and CKD characteristics, such as disease stages and time of having CKD.

Anthropometric indices of patients were evaluated, including height, weight, muscle mass, mid-upper arm circumference (MUAC), and subcutaneous fat thickness.

In addition, we used the SGA to determine the nutritional status of patients with CKD. The SGA is widely used in clinical settings for diagnosing malnutrition and identifying those who need to start nutrition care. Different from other tools, the SGA covers a range of patients' characteristics, such as the history of recent dietary intake and loss of weight, clinical parameters of gastrointestinal symptoms, and functional impairments associated with nutrition and physical examinations. The nutritional status of CKD patients was classified into three groups: (A) well-nourished; (B) mild malnourished and (C) malnutrition. Prior studies demonstrated that SGA was a tool that strongly identified CKD patients with malnutrition and individuals who benefit from nutrition intervention.[13-15]

Fasting blood samples were collected and analyzed by routine methods at the Department of Laboratory Medicine, Saint Paul General Hospital, Hanoi, Vietnam. Blood tests consisted of total red blood cells, hemoglobin, glucose, urea, creatinine, total blood calcium, phosphorus, vitamin D, and parathyroid hormone (PTH).

The 24-hour recall dietary assessment was used to assess dietary intake. This method included all meals, snacks, and beverages which participants consumed within the past 24 hours. Energy (kcal), macronutrients and micronutrients were extracted from the dietary patterns.

Data analysis

STATA software version 14 (Stata Corp. LP, College Station, United States of America) was utilized to analyse collected data. In terms of the descriptive method, Fisher’s exact test or

Chi-squared test was applied for qualitative variables, and T-test or Wilcoxon sign-rank test was used for quantitative variables between the control and intervention groups. To compare the differences between T0 and T1, McNemar's Chi-squared was the statistical test applied for paired categorical data. In addition, we used T - paired sample t-test to compare mean values before and after the intervention. Regarding 24-hour recall, daily intakes of food items and nutrients were calculated using Access software and the Vietnamese food composition table (2007).[16]

Ethical approval

All patients and their guardians received information about the participant information sheet which stated the objectives, benefits and risks of taking part in the study. Participating in this study was voluntary, study participants signed the informed consent form as a form of agreeing to take part. Participants can withdraw at any time during the study or refuse to answer any questions that did not affect their treatment course at the hospital. The study was approved by the Institutional Review Board for Ethics in Biomedical Research - Hanoi Medical University on July 4, 2022, decision number 753/GCN-HDĐNCYSH-ĐHYHN, code number IRB-VN01.001/IRB00003121/FWA00004148.

RESULTS

Table 1 shows the characteristics of all participants before the nutritional intervention. The mean age and percentage of male participants in the control and intervention groups were similar (60.7 ± 5.3 and 61.8 ± 8.1, respectively; 51.4% and 57.1%, respectively). In addition, the distribution of CKD stages in the two groups was consistent, in which the number of patients with stage IV was the highest, followed by stage III and stage V had the lowest percentage. Regarding blood tests, the mean glucose, urea, creatinine and parathyroid hormone were 7.1 ± 3.8 mmol/L, 11.2 ± 3.4 mmol/L, 358.3 ± 143.4 µmol/L and 268.7 ± 147.9 pg/mL.

Figure 2 presents the changes in the percentage of malnourished participants in both groups. Regarding the intervention group, the number of patients classified as SGA-B and SGA-C reduced significantly after the nutritional treatment regimen (65.7% to 54.3% and 25.7% and 5.7%, respectively). In addition, at T1, patients who were well-nourished in the intervention group were higher than those in the control group (40.0% and 20.0%, respectively).

The effectiveness of the nutritional intervention is depicted in Table 2. We found that the concentration of urea and creatinine significantly decreased after the intervention, especially in patients receiving nutritional treatment (from 11.7 ± 3.6 to 8.7 ± 3.2; from 401.7 ± 151.1 to 300.8 ± 120.9, respectively). Besides, parathyroid hormone also significantly decreased in the intervention group, from 301.0 ± 145.8 to 268.7 ± 130.9 (pg/mL).

Table 3 describes the improvement in energy and balance of dietary intake of all participants. The level of protein intake of patients receiving intervention reduced at T1 compared to T0 (52.6 ± 16.0 and 45.2 ± 8.1, respectively), while the figure for carbohydrate increased significantly after intervention in this group. The amount of calcium and iron also increased in the dietary pattern at T1 among patients of the intervention group. By contrast, there was a decreasing trend in phosphorus, sodium, and potassium after the nutritional treatment in this group. However, we did not find significant changes in vitamins and minerals in the control group after follow-up.

Changes in clinical symptoms of patients with CKD at T1 were assessed in both groups and illustrated in Table 4. Nausea/ vomiting and loss of appetite were symptoms that were improved in the intervention group (31.4% and 42.9%) compared to the control group. In addition, symptoms related to mental health, such as tiredness and sleep disorders, were also reported with improvement in the group receiving nutrition treatment (40.0% and 34.2%).

DISCUSSION

Intervention in dietary patterns is one of the management strategies for patients with CKD. The beneficial effects of a protein-restricted diet in CKD have been recognized in many clinical guidelines, but non-adherence to this diet may reduce its effectiveness on CKD progression and prognosis.[17] In this study, by applying the nutritional treatment regimen, including nutritional counseling and prescribed specific dietary, the percentage of malnourished patients was reduced, and the function of kidneys was improved. In addition, several clinical symptoms markedly ameliorated in the group of patients after receiving the intervention. Findings from our study provide helpful insights regarding the critical role of nutritional treatment in the improvement of CKD progression based on current dietary guidelines.

Although assessing the effectiveness of nutritional therapy on patients with CKD is currently a controversial issue, nutritional intervention still plays a critical role in clinical practice, with several goals as follows.[18] Initially, reducing the intake of protein with high biological value decreases endogenous urea production and symptoms of uremia. Then, the

focus shifts to the ability to delay the progression of CKD and some possible outcomes.[19] A low-protein diet also allows for the regulation of phosphorus concentration, and consuming adequate fruits and vegetables will provide enough bicarbonate to modify metabolic acidosis and slow the CKD stages.[19, 20] A very low protein diet may allow a reduction in the dose of erythropoietin.[21] Previous studies suggested the beneficial metabolic effect induced by nutritional therapy and its role in delaying the progression of CKD.[19, 21]

Our study determined that a high prevalence of CKD patients were malnourished or at risk of being malnourished before the intervention. However, the proportion of well-nourished patients increased significantly, especially in the intervention group, after receiving nutritional therapy. The elevating of Protein Energy Wasting (PEW) syndrome is associated with the decline of the glomerular filtration rate.[22] Prior research found that PEW occurred in 2% of patients with stage 1-2 CKD, 16% in stage 3-4 CKD patients, 31% in stage 5 CKD patients, and up to 44% of patients who were on dialysis.[22-24] This suggests the need to evaluate the nutritional status of patients with CKD at the early stage using appropriate assessment scales.[15] The severity of PEW is also important in predicting the prognosis of patients experiencing end-stage renal diseases.

According to our study, the reduction of urea and creatinine in the intervention group was higher than that in the control group after the intervention. If the amount of protein intake in the diet of patients was appropriate, it can limit ammonia production and acid secretion.(20) Consuming a high-protein diet means increasing the glomerular filtration rate due to repeated filtration courses, which may contribute to structural damage to the glomeruli in individuals with a reduced number of nephrons.[25] In the long term, this condition may lead to glomerular filter deterioration or progression to a higher stage of CKD.[26] Secondary hyperparathyroidism (with serum PTH >65 pg/mL) is common in CKD patients, and the majority of patients experiencing reduced glomerular filter (>80%) have a PTH >150 pg/mL.[27] This is consistent with our study, which showed that patients had elevated PTH and low vitamin D. Secondary hyperparathyroidism is associated with vascular calcification, increased bone turnover, higher fracture rates, and higher mortality.[28]

Our study showed that the dietary intake of calcium and iron of the intervention group significantly increased after the nutritional treatment. Patients with CKD are more likely to have low vitamin D levels due to proteinuria, less outdoor physical activity, and dietary restrictions.[29, 30] Previous studies indicated that adding Calcitriol and activated Vitamin D may reduce PTH (−196 pg/mL) but increase serum calcium and phosphorus concentrations.[31]

In addition, using activated vitamin D supplements can elevate creatinine concentration, and it should be closely monitored when vitamin D is administered to patients with CKD.[30, 31]

Chronic kidney disease is a complex condition in which people often experience fatigue and reduced physical activity levels that affect an individual's ability to perform activities of daily living.[32, 33] After receiving nutritional therapy, we found that patients in the intervention group had markedly improved symptoms of fatigue, nausea, sleep disturbance, and loss of appetite. This can be explained by the fact that when patients were consulted and developed a nutritional regimen, the energy intake met the recommended needs with the amount of protein in accordance with the glomerular filtration rate. Thus, nutrition intervention plans can be developed parallel with rehabilitation to assist in reducing fatigue and maximizing the patient's activity level.[34]

Our study is one of the very first studies in Vietnam which presented evidence of superiority regarding individualized nutritional intervention on the improvement of disease progression among CKD patients. These favourable health outcomes may help to reduce the healthcare expenses related to CKD treatment. Therefore, it is recommended that an interdisciplinary approach should be carried out, which covers an overall physical examination, nutritional therapy, and nutrition education to deliver the best healthcare treatment for patients with CKD. During the treatment process, health personnel should take the nutritional status assessment regularly, combined with the laboratory test results, thereby modifying the appropriate dietary patterns. Further randomized controlled studies with higher sample sizes should be conducted in the future, which focus on the multidimensional evaluation of CKD patients. One of our study's limitations is the lack of randomization. Thus, to overcome this limitation, we paired the participants in the intervention and control groups by age group, gender, and disease stages. In addition, assessing the body composition and physical function of participants using DXA was not performed in the study.

Conclusion

In conclusion, findings from our study emphasized the positive role of nutritional therapy in enhancing the nutritional status, and quality of dietary and renal function of CKD patients without RRT. Despite limitations, this research provided helpful insights into applying nutritional education and treatment to slow the progression of CKD, which should be applicable in other medical facilities across Vietnam.

ACKNOWLEDGEMENTS

We would like to sincerely thank patients with chronic kidney disease and their caregivers in study settings who agreed to participate in this study. We also appreciate the contributions of all staff in the research team and staff members of study settings, who participated in the implementation of the interviews in a professional manner and with a sense of responsibility to ensure that participants were treated according to the guidelines of the ethical research standards.

CONFLICT OF INTEREST AND FUNDING DISCLOSURE

The authors declare that the research was conducted without any commercial or financial relationships that could constitute a potential conflict of interest.

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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Table 1. Baseline characteristics of participants

General characteristics	Control group (n = 35)	Intervention group (n = 35)
Age (mean ± SD)	60.7 ± 5.3	61.8 ± 8.1
Gender; n (%)		
Male	18 (51.4)	20 (57.1)
Female	17 (48.6)	15 (42.9)
Occupation		
Office workers	11 (31.4)	13 (37.1)
Farmers	1 (2.9)	7 (20.1)
Self-employed	8 (22.8)	6 (17.1)
Others	15 (42.9)	9 (25.7)
Educational level		
Primary school	4 (11.4)	4 (11.4)
Secondary school	14 (40.0)	10 (28.6)
High school	12 (34.3)	15 (42.9)
Above highschool	5 (14.3)	6 (17.1)
Comorbidities		
Diabetes	12 (34.3)	13 (37.1)
Heart failure	8 (22.9)	5 (14.3)
Dyslipidemia	11 (31.4)	2 (5.7)
Hypertension	28 (80.0)	27 (77.1)
Chronic kidney disease stages n (%)		
III	13 (37.1)	15 (42.9)
IV	17 (48.6)	16 (45.7)
V	5 (14.3)	4 (11.4)
Blood test characteristics (mean ± SD)	All participants (n=70)	
Red blood cells (T/L)	3.4 ± 0.9	
Hemoglobin (g/L)	98.0 ± 8.1	
Glucose (mmol/L)	7.1 ± 3.8	
Urea (mmol/L)	11.2 ± 3.4	
Creatinine (µmol/L)	358.3 ± 143.4	
Parathyroid Hormone (pg/mL)	268.7 ± 147.9	
Vitamin D (ng/mL)	22.1 ± 7.2	
Total calcium (mmol/L)	1.9 ± 0.2	
Phosphorus (mmol/L)	1.8 ± 0.6	

√, The project was taken on that day.

Table 2. Effectiveness of the nutritional intervention on participants' nutritional status

Variables	Control group (n=35)		p-value	Intervention group (n=35)		p-value
	T0	T1		T0	T1	
Weight (kg)	56.3 ± 5.5	54.2 ± 7.9	0.08	54.0 ± 6.9	52.4 ± 6.2	0.06
Boday mass index (BMI)	21.5 ± 2.5	20.8 ± 2.6	0.41	22.4 ± 2.3	21.2 ± 2.3	0.11
Muscle mass	16.9 ± 3.5	15.6 ± 6.1	0.83	17.5 ± 3.7	17.8 ± 4.3	0.79
Urea (mmol/L)	10.6 ± 3.1	8.7 ± 2.6	0.01*	11.7 ± 3.6	8.7 ± 3.2	0.01*
Creatinine (µmol/L)	314.9 ± 122.2	252.0 ± 107.3	0.01*	401.7 ± 151.1	300.8 ± 120.9	0.01*
Vitamin D (ng/mL)	23.1 ± 7.2	23.1 ± 7.5	0.91	21.0 ± 6.7	21.5 ± 6.8	0.82
Parathyroid hormone (pg/mL)	236.7 ± 147.8	228.3 ± 133.9	0.56	301.0 ± 145.8	268.7 ± 130.9	0.04*

*Significant value (Paired - T-test), $p<0.05$.

Table 3. Changes in dietary intake, vitamins and minerals intake of participants

Variables (mean ± SD)	Intervention group (n=35)		p-value	Control group (n=35)		p-value
	T0	T1		T0	T1	
Energy (kcal/day)	1489.2 ± 212.6	1564.3 ± 189.0	0.12	1580.9 ± 208.6	1594.9 ± 246.4	0.79
Protein (g/day)	52.6 ± 16.0	45.2 ± 8.1	<0.01*	55.1 ± 16.1	49.9 ± 11.1	0.03*
Lipids (g/day)	38.1 ± 7.6	40.0 ± 6.8	0.29	40.5 ± 7.7	40.8 ± 8.4	0.87
Carbohydrate (g/day)	233.9 ± 38.2	259.6 ± 38.4	<0.01*	249.1 ± 39.5	255.6 ± 43.1	0.51
Calcium (mg/day)	397.8 ±109.2	699.0 ± 135.3	<0.01*	360.3 ± 103.9	387.1 ± 106.5	0.29
Phosphorus (mg/day)	879.1 ± 172.9	786.9 ± 153.8	0.02*	929.7 ± 210.8	869.1 ± 183.6	0.20
Iron (mg/day)	9.6 ± 3.2	13.3 ± 2.8	<0.01*	11.4 ± 3,8	9.8 ± 3,7	0.08
Sodium (mg/day)	2046.5 ± 384.6	1816.5 ± 374.3	0.01*	2056.4 ± 418.4	2039.5 ± 401.5	0.86
Potassium (mg/day)	1824.6 ± 260.9	1538.9 ± 249.3	<0.01*	1852.9 ± 296.5	1684.3 ± 330.9	0.02*

*Significant value (Paired - T-test), p<0.05

Table 4. Changes in the clinical symptoms of participants

Symptoms	Intervention group (n=35)			Control group (n=35)			p-value
	Worsen (n,%)	Stable (n,%)	Improved (n,%)	Worsen (n,%)	Stable (n,%)	Improved (n,%)	
Tiredness	0 (0)	21 (60.0)	14 (40.0)	2 (5.7)	19 (54.3)	14 (40.0)	-
Nausea, vomiting	0 (0)	24 (68.6)	11 (31.4)	0 (0)	27 (77.1)	8 (22.9)	-
Distention	3 (8.6)	23 (65.7)	9 (25.7)	7 (20.0)	18 (51.4)	10 (28.6)	0.32
Sleep disorders	6 (17.1)	17 (48.6)	12 (34.2)	3 (8.6)	26 (74.3)	6 (17.1)	0.08
Loss of appetite	2(5.7)	18(51.4)	15 (42.9)	3 (8.6)	24 (68.6)	8 (22.9)	0.20
Constipation	1(2.9)	30 (85.7)	4 (11.4)	5 (14.3)	24 (68.6)	6 (17.1)	0.15
Diarrhea	3 (8.6)	25 (71.4)	7 (20.0)	7 (20.0)	21 (60.0)	7 (20.0)	0.37

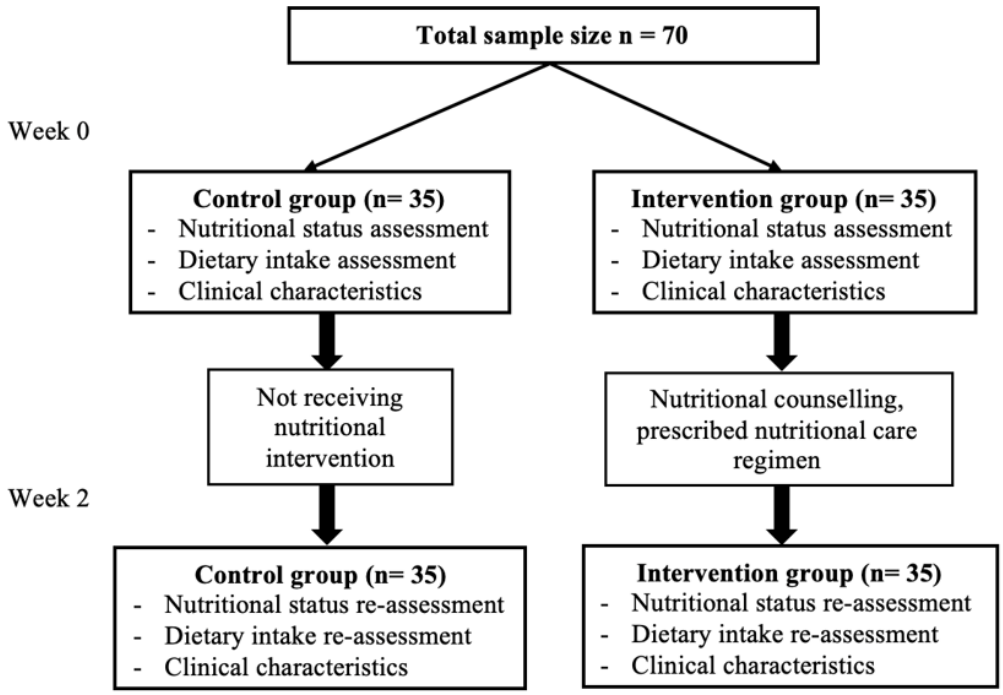

Figure 1. Flowchart of study patient assignment

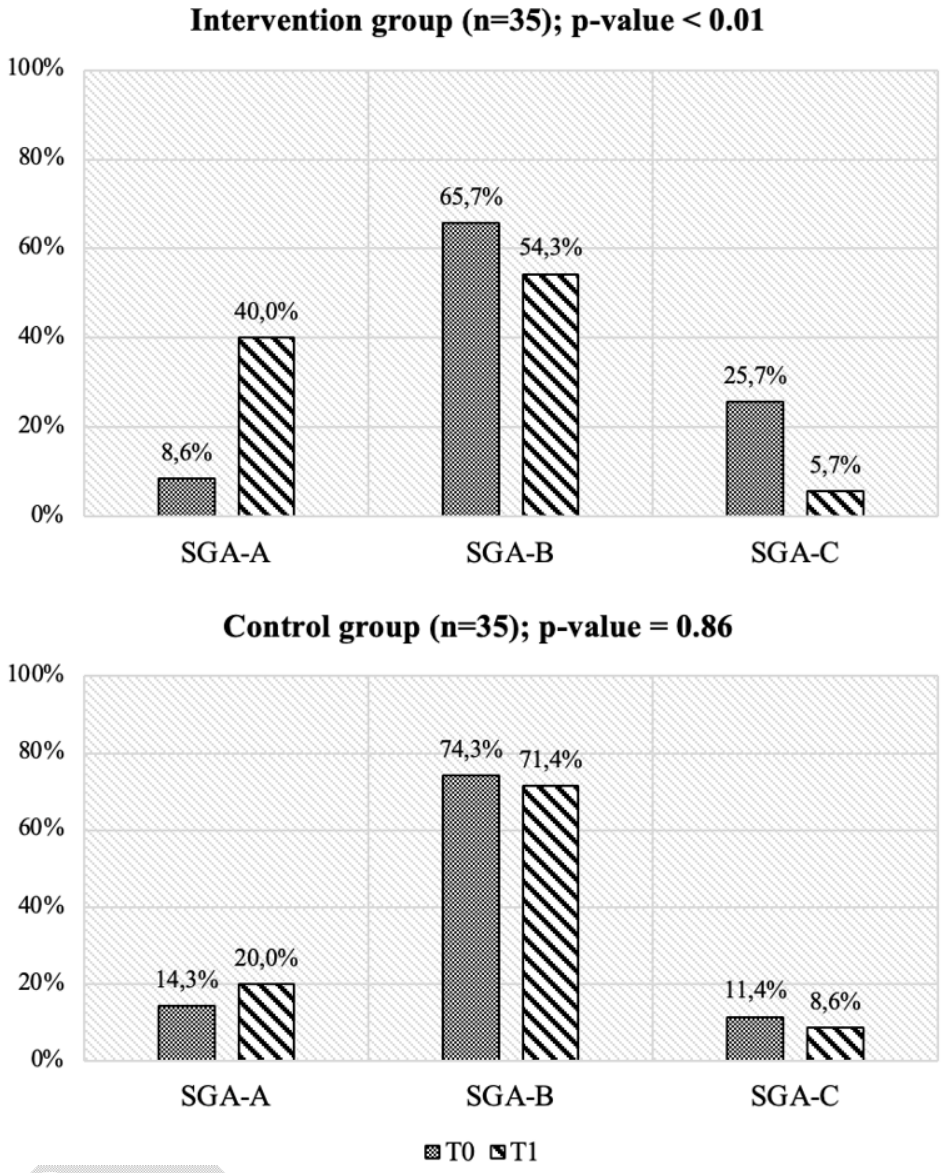

Figure 2. Changes in the nutritional status of the control and intervention group assessed by the Subjective global assessment (SGA) at T0 and T1