Original Article

Nutritional Status of Patients with Different Types of Cancer Undergoing Outpatient Chemotherapy Using Dietary Records Taken over Two Days with Photographs

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Abstract:

Purpose

This study was conducted to elucidate the individual nutrient intake in order to perform effective nutritional management for outpatients undergoing chemotherapy for different types of cancer.

Methods

The subjects were 27 outpatients undergoing chemotherapy at a university hospital, from October 2015 to April 2016. There were 10 breast cancer, 11 gastrointestinal cancer, and 6 blood

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cancer patients included in the study. Each patient was asked to take photographs and keep a food record with photography for two non-consecutive days. The dietary records and camera were collected on the patient's next hospital visit, and were calculated nutrient intake. The Kruskal-Wallis test was used to determine the difference among types of cancer.

Results

There were no significant differences in nutrient intake between the types of cancer in terms of the energy ratios of protein (PER), fats (FER), and carbohydrates (CER); but the vitamin D intake ($p = 0.01$) and the fish and shellfish intake ($p = 0.03$) were significantly different among the three types of cancer. Furthermore, these median intake were lower in patients with breast cancer than others.

Conclusion

Vitamin D intake was the lowest in patients with breast cancer, possibly due to decreased fish and shellfish intake in these patients.

Key Words: Dietary records, Nutrition assessment, Patients with cancer, Outpatient chemotherapy.

Introduction

According to a patient survey conducted by the Japanese Ministry of Health, Labour and Welfare (MHLW) in the fiscal year 2014, there were 129,400 hospitalized patients with cancer and 171,400 patients with cancer who received outpatient treatment[1]. Another survey conducted by the MHLW on the number outpatient chemotherapy treatments performed in a month revealed that the number of patients was 210,000 in the fiscal year 2015 and the number has increased every year[2]. Some reasons for this increase include the addition of outpatient chemotherapy treatment approved under the revision of the medical payment system in the fiscal year 2002, consideration regarding the quality of life of these patients, and the availability of more opportunities for patients to select their own treatment after being informed of their cancer. The development of novel drugs that prevent adverse events associated with chemotherapy has also contributed to the increase in the number of patients receiving outpatient chemotherapy. In cases of adverse events occurring during outpatient chemotherapy, patients need to care for themselves at home.

More than 90% of the adverse events that occur in patients with cancer undergoing chemotherapy affect the diet[3], and the second common adverse event in these patients is a loss of appetite[4)5)]. Loss of appetite also occurs in all patients with metastasized cancer[6)7)]. Accordingly, nutritional management is important to prevent weight loss due to loss of appetite in patients with cancer undergoing outpatient chemotherapy.

In our previous study[8], we conducted a nutritional evaluation of patients with cancer undergoing outpatient chemotherapy using the revised Simplified Nutritional Appetite Questionnaire (SNAQ) developed in the Netherlands. In the revised SNAQ, age and body mass index (BMI) were added to the traditional SNAQ score. In the revised SNAQ, patients are classified into three categories as follows; "no undernourished", "moderate undernourished", and "severe undernourished". Through the simplified nutritional assessment with the revised SNAQ, we found that 98 (42.8%) patients were "severe undernourished", 23 (10.0%) were "moderate undernourished", and 108 (47.2%) were "no undernourished". These results

indicated that slightly over half of the patients required nutritional intervention.

This finding confirmed the need to elucidate the nutrients and food groups in the diet intake to provide specific requirements for nutritional management in patients with cancer undergoing outpatient chemotherapy. While Torii et al.[9] previously surveyed dietary intake by nutrient and food groups in the diet of the patients with cancer undergoing outpatient chemotherapy using the Food Frequency Questionnaire, no prior studies have used photography with dietary records as the research method.

Therefore, the purpose of this study was to elucidate the intake of nutrients and food groups in the diet of the patients based on the type of cancer to optimize nutritional management for patients undergoing chemotherapy on an outpatient basis.

Subjects and Methods

This study was conducted as a cross-sectional study. Subjects comprised 27 patients undergoing chemotherapy on an outpatient basis in the Department of Chemotherapy, A University Hospital, during the survey period from October 2015 to April 2016.

Written consent to participate in the study was obtained from the patients after informing them of the nature of the study, that data would be collected from their medical charts, and that personal information would be handled with confidentiality. Dietary record sheets and digital cameras were distributed to the patients who gave their consent, and they were requested to record their meals for two days, i.e., Day three and day five after treatment, with the day of treatment set as day one. Takei et al[5]. reported that the loss of appetite was remarkable within one week after treatment, especially on day three and day five. The dietary record sheet consisted by breakfast, lunch, dinner, snacks, meal time, menu, food ingredient, estimated quantities, and additional comments (Fig. 1). The subjects were asked to use the digital camera to take

Dietary intake chart

Recode date

	Time	Menu	Ingredients (quantity)	Notes
Breakfast	AM9:00	For Example Bread Margarine Apple	6 slices of white bread (One slice, but I can't eat crust) Margarine (a spoonful) A half of a medium apple	
Snack				
Lunch	PM12:00	Curry and rice Red Pickles	A bowl of rice A half of a potato A quarter of a onion A quarter of a carrot Beef100mg	
Snack		Candy	3 pieces of caramel	
Dinner	PM19:00	Rice Miso soup Grilled fish Boiled spinach	A bowl of rice Miso 10g Eggplant 20g Sea bream Spinach	
Snack				
Note	I felt nauseous all day. I didn't have an appetite because I didn't feel like it is delicious.			

Fig. 1 Dietary intake record chart were completed to the subjects.

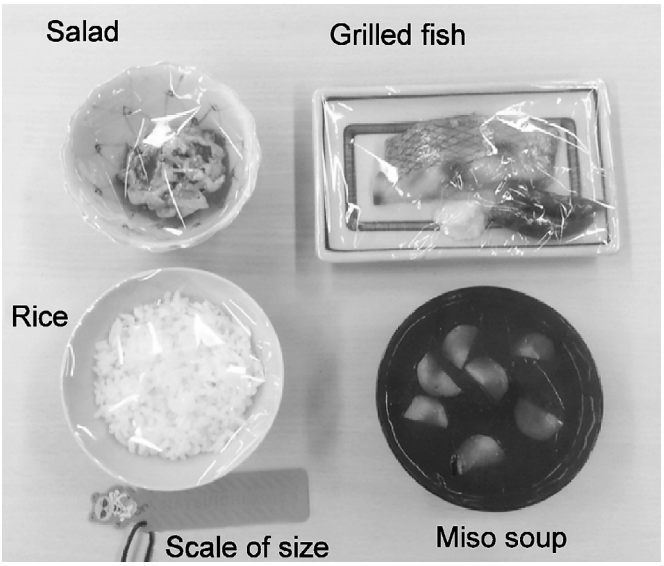

Fig. 2 Dietary intake camera record was measured using a scale of 10 cm in length.

pictures of all meals (Fig. 2).

The dietary record sheet and digital camera were collected at the following outpatient visit. At the same time, a registered dietitian checked the quantities and the possibility of missing data (e.g., ingredients) by comparing the dietary record sheets to the photographs.

The patient characteristics, such as sex, age, disease, regimen, Performance Status Scale by the Eastern Cooperative Oncology Group (ECOG PS), adverse events (e.g., stomatitis, taste disorder), and physical measurements (weight and height) were collected from their medical charts. The BMI was calculated as weight divided by height squared.

Adverse events were evaluated on a five-grade scale based on Common Terminology Criteria for Adverse Events ver. 4.0 (CTCAE4.0), in which adverse events were classified as follows: Grade 0 = asymptomatic, Grade1 = mild but no intervention indicated, Grade 2 = mild-to-moderate symptoms with intervention indicated, Grade 3 = moderate-to-severe symptoms requiring urgent intervention.

The biochemical blood test included the number of peripheral lymphocytes, and the level of hemoglobin (Hb), total protein, serum albumin (ALB), and C-reactive protein. Furthermore, the SNAQ survey was used to provide a simple nutritional assessment. The questions and respective scores for the items in the SNAQ were as follows: three points for body weight loss of $\geq$ 6 kg in the last six months, two points for body weight loss of $\geq$ 3 kg in the last month, one point for reduced appetite in the last month, and one point for nutritional supplements and/or tube feeding used in the last month.

Statistical analysis

The patients were classified based on their type of cancer. Intergroup differences were tested using the chi-squared test for categorical data for continuous data. Nutrient intake was calculated using the Excel add-in software Excel Eiyou-kun Ver. 7.0, (Kenpakusha Co., Ltd). Because the nutrient intake distribution was not normal, the median and 25th and 75th percentiles were calculated. The Kruskal-Wallis test was per-

formed to identify intergroup differences between the three types of cancer (breast, gastrointestinal, and blood cancer). SPSS Version 23 (IBM Corp.) was used for values, and p-values of < 0.05 were considered significant.

Ethical considerations

Patients signed a form stating their consent to participate in the study after receiving an explanation of the nature of the study, necessary data would be collected from their patient charts, and that personal information would be handled with confidentiality and would not be used for any purpose other than this study. This study was conducted after being approved by the Independent Ethics Committee of the Kyoto Prefectural University of Medicine (Approval no. ERB-E-292-2) and the Kyoto Prefectural University (Approval no. 117).

Results

Patient characteristics

Among the patients with gastrointestinal cancer, one patient had gastric cancer and ten patients had colorectal cancer. Among patients with blood cancer, four patients had malignant lymphomas.

Table 1 shows the patient characteristics classified by the type of cancer. In terms of sex, there were significantly more women among the patients with breast cancer (90.0%); however, no other significant differences were observed. Among the patients with gastrointestinal cancer, we found that 18.2% of the patients with a weight loss of 6 kg or more in six months and 9.1% of the patients with a weight loss of 3 kg or more within one month.

Physical measurements and biochemical data of the patients based on the cancer type

Table 2 shows the patients' physical measurements and biochemical data based on the cancer type. The median Hb level was significantly lower in the patients with blood cancer (10.9 g/dl), compared with the patients with gastrointestinal or breast cancer ($p = 0.05$). No significant statistical differences shown in the BMI of the patients has been observed according to the different types of cancer.

Nutrient intake based on the cancer type

Table 3 shows the nutrient intake of patients based on the cancer type. As a reference value, the average value of the National Health and Nutrition Survey (NHNS) in 2015 was also shown in Table 3. There were no significant differences in the protein energy ratio, fat energy ratio and carbohydrate energy ratio between the three different cancer groups. However, the vitamin D intake was significantly different among the three types of cancer ($p = 0.01$). Furthermore, median vitamin D intake was lower in patients with breast cancer (2.0 μg/day) than in those with gastrointestinal (7.0 μg/day) or blood cancer (6.4 μg/day).

Food intake based on the cancer type

Table 4 shows the intake of food based on the cancer type. As a reference value, the average value of NHNS in 2015 was also shown in Table 4. The median intake of fish and shellfish for patients with breast, gastrointestinal, and blood cancer was 9.3, 77.8, and 39.6 g/day, respectively, indicating a significant statistical difference ($p = 0.03$). Furthermore, the median fish and shellfish intake of breast and blood cancer patients was low when compared with the average value of NHNS in 2015. There were no significant differences found in terms of the intake of other foods, although lower quantities of milk and dairy products were consumed by patients with breast cancer (84.5 g/day), compared by those with gastrointestinal or blood cancer.

Table 1 Patient characteristics based on the type of cancer.

	Breast cancer n = 10	Gastrointestinal cancer n = 11	Blood cancer n = 6	n = 27 *P* value
Age (years)				
Age < 65	5 (50.0)	4 (36.36)	0 (0.0)	0.12
Age ≥ 65	5 (50.0)	7 (63.64)	6 (100.0)	
Sex				
Male	1 (10.0)	6 (54.5)	5 (83.3)	0.01
Female	9 (90.0)	5 (45.5)	1 (16.7)	
BMI category				
BMI < 18.5	1 (10.0)	0 (0.0)	1 (16.7)	0.15
BMI = 18.5-25	6 (60.0)	11 (100.0)	3 (50.0)	
BMI ≥ 25.0	3 (30.0)	0 (0.0)	2 (33.3)	
Weight loss > 6kg in the six months				
Yes	0 (0.0)	2 (18.2)	0 (0.0)	0.21
No	10 (100.0)	9 (81.8)	6 (100.0)	
Weight loss > 3kg in the last month				
Yes	0 (0.0)	1 (9.1)	0 (0.0)	0.47
No	10 (100.0)	10 (90.9)	6 (100.0)	
Revised SNAQ score				
No undernourished (0-1)	7 (70.0)	3 (27.3)	3 (50.0)	0.24
Moderate undernourished (2)	1 (10.0)	3 (27.3)	0 (0.0)	
Severe undernourished (3 ≤)	2 (20.0)	5 (45.5)	3 (50.0)	
Stage				
Ⅰ	1 (10.0)	0 (0.0)	0 (0.0)	0.01
Ⅱ	6 (60.0)	1 (9.1)	0 (0.0)	
Ⅲ	0 (0.0)	4 (36.4)	0 (0.0)	
Ⅳ	2 (20.0)	6 (54.5)	1 (16.7)	
Unknown	1 (10.0)	0 (0.0)	6 (83.3)	
Emetic risk				
High emetic risk	1 (10.0)	0 (0.0)	2 (33.3)	0.01
Moderate emetic risk	6 (60.0)	11 (100.0)	1 (16.7)	
Low emetic risk	3 (30.0)	0 (0.0)	1 (16.7)	
Minimal emetic risk	0 (0.0)	0 (0.0)	2 (33.3)	
ECOG—PS*				
0	2 (20.0)	6 (54.5)	6 (100.0)	0.01
1	8 (80.0)	5 (45.5)	0 (0.0)	
2	0 (0.0)	0 (0.0)	1 (1.0)	
3	0 (0.0)	0 (0.0)	2 (2.0)	
4				
Adverse events				
Nausea Grade				
Grade0	10 (100.0)	9 (81.8)	6 (100.0)	0.22
Grade1	0 (0.0)	2 (18.2)	0 (0.0)	
Grade2	0 (0.0)	0 (0.0)	0 (0.0)	
Grade3	0 (0.0)	0 (0.0)	0 (0.0)	
Vomiting Grade				
Grade0	9 (90.0)	11 (100.0)	6 (100.0)	0.41
Grade1	1 (10.0)	0 (0.0)	0 (0.0)	
Grade2	0 (0.0)	0 (0.0)	0 (0.0)	
Grade3	0 (0.0)	0 (0.0)	0 (0.0)	
Fatigue Grade				
Grade0	4 (40.0)	7 (63.6)	2 (33.3)	0.40
Grade1	6 (60.0)	4 (36.4)	4 (66.7)	
Grade2	0 (0.0)	0 (0.0)	0 (0.0)	
Grade3	0 (0.0)	0 (0.0)	0 (0.0)	
Stomatitis Grade				
Grade0	7 (70.0)	7 (63.6)	6 (100.0)	0.49
Grade1	3 (30.0)	2 (18.2)	0 ( )	
Grade2	0 (0.0)	1 (9.1)	0 (0.0)	
Grade3	0 (0.0)	1 (9.1)	0 (0.0)	
Taste disorder Grade				
Grade0	6 (60.0)	8 (72.7)	4 (66.7)	0.89
Grade1	3 (30.0)	2 (18.2)	2 (33.3)	
Grade2	1 (10.0)	1 (9.1)	0 (0.0)	
Grade3	0 (0.0)	0 (0.0)	0 (0.0)	

Data are presented as n (%) .
Chi-square test test
*ECOG-PS：Performance Status Scale of Eastern Cooperative Oncology Group
The percentage shows the number of nutritional evaluation using the SNAQ and the revised S
Adverse events were evaluated using CTCAE ver. 4.0 (Grades 0 to 3).

Table 2 Physical measurements and biochemical data based on the type of cancer.

n=27

	Breast cancer n=10			Gastrointestinal cancer n =11			Blood cancer n=6			
	median	25%tile	75%tile	median	25%tile	75%tile	median	25%tile	75%tile	*P* value
Physical measurements										
Height (cm)	153.0 (	149.1 ,	160.6)	165.5 (	154.5 ,	168.2)	162.4 (	154.1 ,	170.2)	0.06
Weight (kg)	57.5 (	45.3 ,	62.0)	56.0 (	47.0 ,	63.0)	63.6 (	44.8 ,	69.3)	0.63
Body mass index (kg/m^2)	22.6 (	19.9 ,	26.6)	20.6 (	19.3 ,	20.9)	22.8 (	18.9 ,	25.5)	0.40
Biochemical data										
Hemoglobin (Hb) (g/dl)	13.0 (	12.5 ,	13.8)	12.9 (	10.5 ,	13.4)	10.9 (	9.2 ,	12.4)	0.05
Peripheral blood lymphocytes	1.2 (	1.0 ,	1.7)	1.7 (	1.2 ,	1.9)	1.2 (	0.7 ,	1.6)	0.15
Total protein (TP) (g/dl)	6.6 (	6.3 ,	6.9)	6.7 (	5.9 ,	7.3)	6.3 (	6.0 ,	7.1)	0.73
Albumin (ALB) (g/dl)	4.1 (	3.8 ,	4.2)	4.0 (	3.6 ,	4.2)	4.0 (	3.7 ,	4.3)	0.99
CRP (mg/dl)	0.1 (	0.0 ,	0.3)	0.2 (	0.0 ,	0.3)	0.1 (	0.1 ,	0.6)	0.76

Median value (25, 75tile)
Kruskal-Wallis test

Table 3 Daily nutrient intake based on the type of cancer. As a reference value, the average value of the National Health and Nutrition Survey (NHNS) in 2015 was also shown.

		Breast cancer n = 10			Gastrointestinal cancer n = 11			Blood cancer n = 6			
	mean	median	25%tile	75%tile	median	25%tile	75%tile	median	25%tile	75%tile	*P* value
Energy (kcal)	1700 *	1693 (	1335 ,	2062)	1542 (	1345 ,	1716)	1824 (	1668 ,	2136)	0.18
Energy /weight(kcal/kcal)		29.3 (	22.3	41.7)	27.2 (	27.2	30.6)	32.8 (	27.1	27.1)	0.53
Protein/Energy (%)		16.0 (	14.2 ,	18.6)	16.7 (	15.4 ,	18.4)	15.6 (	13.0 ,	18.6)	0.89
Fat/Energy (%)	27.2 *	27.0 (	23.6 ,	31.9)	29.9 (	25.1 ,	33.2)	28.2 (	24.7 ,	31.2)	0.72
Carbohydrates/ Energy (%)	57.6 *	52.0 (	45.8 ,	61.6)	51.9 (	47.1 ,	57.4)	56.3 (	44.3 ,	61.3)	0.77
Salt intake (g/day)	8.9 *	7.3 (	5.6 ,	10.0)	6.8 (	6.3 ,	9.2)	6.7 (	5.6 ,	14.1)	0.92
Sodium (mg)	3610 *	2884 (	2215 ,	3961)	2730 (	2462 ,	3620)	2653 (	2220 ,	5533)	0.94
Potassium (mg)	2291 *	2626 (	1742 ,	2916)	2144 (	1956 ,	2738)	2974 (	2583 ,	3140)	0.19
Calcium (mg)	506 *	505 (	432 ,	604)	469 (	327 ,	667)	685 (	536 ,	834)	0.13
Magnesium (mg)	238 *	255 (	173 ,	283)	201 (	156 ,	298)	266 (	244 ,	306)	0.37
Phosphorus (mg)	933 *	854 (	705 ,	1205)	924 (	764 ,	1100)	1157 (	897 ,	1454)	0.23
Iron (mg)	7.5 *	7.5 (	5.4 ,	9.6)	7.8 (	4.8 ,	8.6)	7.9 (	6.8 ,	9.7)	0.79
Zinc (mg)	7.3 *	7.3 (	5.8 ,	9.5)	6.5 (	5.1 ,	7.8)	8.1 (	6.7 ,	10.3)	0.40
Copper (mg)	1.07 *	1.07 (	0.87 ,	1.27)	0.81 (	0.71 ,	1.27)	1.09 (	1.04 ,	1.17)	0.45
Retinol (μg)	520 *	518 (	394 ,	1366)	436 (	369 ,	859)	675 (	506 ,	1186)	0.38
Vitamin D (μg)	7.5 *	2.0 (	0.8 ,	3.7)	7.0 (	4.7 ,	10.0)	6.4 (	3.5 ,	11.8)	0.01
α-tocopherol (mg)	6.6 *	6.8 (	5.8 ,	7.9)	7.2 (	5.7 ,	9.4)	7.7 (	7.5 ,	8.2)	0.41
Vitamin K (μg)	249 *	239 (	119 ,	413)	176 (	128 ,	260)	252 (	165 ,	275)	0.52
Vitamin B_1 (mg)	0.81 *	1.16 (	0.67 ,	1.46)	0.75 (	0.62 ,	0.89)	0.77 (	0.73 ,	1.29)	0.36
Vitamin B_2 (mg)	1.13 *	1.02 (	0.77 ,	1.49)	1.04 (	0.73 ,	1.21)	1.56 (	1.38 ,	1.66)	0.04
Niacin (mg)	13.8 *	25.3 (	18.6 ,	36.8)	25.8 (	23.1 ,	32.0)	27.3 (	23.2 ,	43.6)	0.63
Vitamin B_6 (mg)	1.08 *	1.35 (	0.76 ,	1.71)	1.23 (	0.90 ,	1.52)	1.44 (	1.17 ,	1.56)	0.66
Vitamin B_{12} (μg)	5.6 *	2.4 (	1.5 ,	5.4)	4.1 (	2.3 ,	10.3)	6.3 (	2.4 ,	11.1)	0.20
Folate (μg)	285 *	281 (	219 ,	367)	232 (	196 ,	372)	344 (	312 ,	439)	0.34
Pantothenic acid (mg)	5.18 *	5.02 (	4.03 ,	7.47)	5.05 (	4.40 ,	6.87)	6.50 (	6.18 ,	7.45)	0.23
Vitamin C (mg)	101 *	80 (	68 ,	110)	109 (	52 ,	149)	120 (	72 ,	181)	0.44
Total Dietary fiber (g)	14.7 *	14.7 (	11.7 ,	18.6)	11.0 (	8.6 ,	17.6)	16.8 (	14.7 ,	18.1)	0.31
n-3 polyunsaturated fat (g)	2.08 *	1.28 (	1.07 ,	2.40)	2.92 (	1.14 ,	3.29)	1.49 (	1.12 ,	4.44)	0.32
n-6 polyunsaturated fat (g)	8.76 *	9.05 (	6.93 ,	11.53)	7.51 (	6.25 ,	10.83)	7.51 (	6.49 ,	10.37)	0.69
Saturated Fatty acids (g)	14.14 *	16.68 (	9.02 ,	22.21)	15.67 (	11.36 ,	17.84)	18.41 (	13.56 ,	22.01)	0.33
Cholesterol (mg)	290 *	286 (	170 ,	434)	370 (	261 ,	502)	480 (	330 ,	513)	0.17

*Indicate average value of the National Health and Nutrition Survey conducted by the MHLW in 2015
Median Value (25, 75tile)
Kruskal-Wallis test

Table 4 Daily food intake based on the type of cancer. As a reference value, the average value of the National Health and Nutrition Survey (NHNS) in 2015 was also shown.

n = 27

(g/day)	mean	Breast cancer n = 10 median	25%tile	75%tile	Gastrointestinal cancer n = 11 median	25%tile	75%tile	Blood cancer n = 6 median	25%tile	75%tile	*P* value
Cereals	432.7 *	274.0	238.1	337.9	317.5	222.5	377.5	311.3	250.9	485.7	0.65
Potatoes and starches	51.0 *	41.3	8.5	57.6	20.0	3.0	30.0	13.8	0.0	40.3	0.30
Sugars	6.9 *	14.5	6.8	19.9	5.2	1.5	13.5	8.8	2.6	14.6	0.29
Nuts and seeds	2.5 *	1.3	0.0	2.9	0.0	0.0	1.5	0.8	0.0	3.1	0.49
Green and yellow vegetables	99.4 *	155.8	90.9	199.7	123.0	58.5	249.5	158.8	126.9	175.8	0.94
Pickled vegetables	293.6 *	87.5	57.1	154.3	89.4	67.5	125.0	117.8	83.4	174.6	0.48
Fruit	112.3 *	101.8	57.3	160.6	182.5	68.5	258.0	200.0	81.9	420.3	0.38
Fungi	16.6 *	15.8	4.1	24.4	6.5	0.0	7.5	15.0	1.9	26.6	0.12
Algae	10.7 *	1.8	0.0	13.6	0.3	0.0	6.5	0.7	0.2	5.1	0.63
Pulses	63.8 *	105.0	51.9	122.5	50.0	12.5	87.0	70.0	33.8	113.1	0.31
Fish and shellfish	74.2 *	9.3	0.4	59.0	77.8	47.8	137.0	39.6	18.8	98.1	0.03
Meats	88.8 *	76.8	31.9	216.1	60.0	37.5	67.5	66.3	38.8	103.0	0.53
Eggs	35.4 *	36.9	5.6	51.9	37.5	20.0	80.0	75.8	51.1	80.6	0.13
Milk and dairy product	110.4 *	84.5	34.1	153.3	130.0	62.5	165.0	165.0	145.6	323.1	0.06
Fats and oils	10.7 *	7.0	3.6	12.4	6.0	4.0	8.5	8.3	2.5	11.1	0.77
Confectioneries	25.1 *	10.0	0.0	33.9	25.0	0.0	37.5	17.5	1.1	35.6	0.80
Beverage	861.5 *	101.9	4.3	225.6	100.0	5.0	150.0	88.5	57.5	290.4	1.00
Seasonings spices	90.0 *	44.8	28.2	65.7	33.5	18.8	47.9	33.3	17.5	53.9	0.39

*Indicate average value of the National Health and Nutrition Survey conducted by the MHLW in 2015
Median value (25, 75tile)
Kruskal-Wallis test

Discussion

There were no significant differences shown in the protein energy ratio, fat energy ratio and carbohydrate energy ratio between the three cancer groups in this study.

In 2006, Van et al.[10] reported that daily energy intake in patients with head and neck cancer was 33 kcal/kg before commencing therapy and that it decreased to 19 kcal/kg during therapy. Furthermore, a meal and nutrient intake survey on hospitalized Japanese patients with head and neck cancer revealed that compared to energy, protein, and fat intake before initiating therapy, the corresponding intakes decreased by approximately 70%, 80%, and 90%, respectively, while they were undergoing chemotherapy[11]. A report on a 24-h recall method survey on energy and protein intake in Finnish patients with head and neck, esophageal, gastric, and colorectal cancer revealed that energy intake was lower in patients with head and neck and esophageal cancer compared with those with the other types of cancer[12]. However, in our study, the daily energy intake for meals was not significantly different. This may explain why these patients had fewer adverse events and were able to ingest orally because they don't have esophageal cancer or cancer of the head and neck.

Besides, when the antiemetic therapy was insufficient, it has a great influence not only on the type of cancer but also the nutritional intake of patients during chemotherapy. However, patients had been treated with standard antiemetic therapy. Consequently, Table 1 shows vomiting was grade 0 in 26 out of 27 patents. This may explain the reason why the daily energy intake for meals was not significantly different.

In this study, the comparison of nutrient intake based on the cancer type revealed that the median vitamin D intake was the lowest in patients with breast cancer (2.0 μg/day). According to the National Health and Nutrition Survey in Japan 2015[13], the adequate intake of vitamin D is 5.5 μg/day, which is less than the average vitamin D intake of 7.5 μg/day for men and women aged $\geq$ 20 years, as mentioned in the

National Health and Nutrition Survey conducted by the MHLW in 2016[14].

In their meta-analysis, Gissel et al.[15] reported that a higher vitamin D intake (400 IU/day) may decrease the risk of the onset of breast cancer. In addition, in their cohort study on Canadian patients with early breast cancer, Goodwin et al.[16] reported that the group with insufficient serum vitamin D levels had a higher risk of distant metastasis or recurrence than the group with sufficient serum vitamin D levels. Subsequently, in their meta-analysis, Rose et al.[17] reported that low serum vitamin D levels increased the risk of recurrence and mortality in patients with early breast cancer.

There are several reports on the relationship between breast cancer and serum vitamin D or vitamin D intake; however, the mechanism explaining the relationship between the risk of breast cancer onset, breast cancer prognosis, and vitamin D remains to be elucidated.

Our results on dietary intake indicated that the median intake of fish and shellfish was low for patients with breast cancer (9.3 g/day), which was remarkably lower than the average intake of fish and shellfish (74.2 g/day) among men and women aged ≥ 20 years, as provided by the National Health and Nutrition Survey conducted by the MHLW in 2015[14]. In addition, nine out of ten patients with breast cancer were female and they made meals for themselves. Furthermore, fishes and shellfish were rarely included in dietary records for breast cancer patients. In 2011, Kano et al.[18], As a result of asking cancer patients during chemotherapy about how to eat meals, there was avoidance of smell, specifically there was a report that they avoided fish. Therefore, it is necessary for breast cancer patients to examine the influence on meal content and odor. However, in our study, Table 1 shows vomiting was grade 0 in 9 out of 10 breast cancer patents, nausea was grade in 10 out of breast cancer patents. Eggs, mushrooms, some types of meats, and all fish are rich in vitamin D. In contrast, grains, potatoes, beans, nuts, vegetables, fruit, seaweeds, and shellfish do not contain vitamin D. Therefore, we considered that the vitamin D intake of patients with breast cancer was low, due to their low intake of fish. In this study, no drug including vitamin D (Alfacalcidol etc.) was administered to patients according to their medical record.

A Japanese Public Health Center-based Prospective Study followed 49,552 Japanese women for 15 years and found that 718 of the women were diagnosed with breast cancer. An investigation on the relationship between three types of dietary patterns and the risk of breast cancer revealed that the risk of breast cancer for the “Western” dietary pattern was 1.32-times higher than that for the “healthy” or “traditional” patterns[19]. The most notable pattern was the “Healthy” diet, which was characterized by an abundant intake of fruit, vegetables, potatoes, soy products, mushrooms, seaweeds, oil-rich fish, and green tea, which are assumed to markedly increase vitamin D levels through meals. Farvid et al.[20] conducted a prospective cohort study on 88,803 young adult women for 20 years to survey the relationship between factors associated with breast cancer onset and dietary habits and reported that the higher the intake of red meat, the greater the risk of breast cancer.

Furthermore, Zheng et al.[21] reported that the risk of breast cancer decreased as the intake of marine-based n-3 polyunsaturated fatty acids increased. However n-3 polyunsaturated fatty acids was not significantly different among the three groups in our study.

As the present research was a dietary survey based on information collected over only two days, the data may be insufficient for concluding that patients with breast cancer habitually lack vitamin D in their diet. However, previous studies[22][23] have also suggested that insufficient vitamin D intake is a risk factor for breast cancer. Therefore, it is essential to guide patients with breast cancer to have a good balance of meat and fish in their diet.

Similarly, the median fish and shellfish intake of blood cancer patients was low when compared with the average value of NHNS in 2015. However there were no characteristic parameters in the nutrient intake of patients with blood cancer compared to breast cancer.

This time, we conducted a survey of daily records in combination with photography, and reviewed the contents of meals with patients. We believe that there is a possibility that it will be self-management support to the patient's dietary life, leading to dietary guidance along the patient.

Limitations

The following are the limitations of the study: [1] the sample size was small (only 27 patients). [2] The nutrient intake of patients during chemotherapy has a great influence not only according to the type of cancer but also the progress and symptoms of the cancer. [3] We did not collect social factors as attributes of the target. [4] The cross-sectional study design of this survey did not demonstrate a causal relationship between breast cancer and vitamin D intake. [5] Although the vitamin D intake of patients with breast cancer was low, we cannot conclude that this intake in these patients was habitually low as this was a dietary record survey performed for only two days. Therefore, further case collection is required.

Conclusion

The PER, FER and CER did not show any significant differences among the three groups. However, we found that of the analyzed cancer type, the intake of fish was particularly low among patients with breast cancer, which may be the cause for their lower vitamin D intake.

Therefore, for breast cancer patients, we believe that guidance is required that considers that dietary balance is necessary in order to avoid the advent of a deficiency of vitamin D intake.

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Conflict of interest

All authors declare that they had no conflict of interest.

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〈和文抄録〉

外来化学療法中のがん患者における疾患毎の栄養状態
―2日間の写真撮影と食事記録による調査―

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目的：研究の目的は，外来化学療法中のがん患者に対して，効果的な栄養管理を行うために，疾患毎の栄養素・食品群別摂取量の実態を明らかにすることである．

方法：2015年10月～2016年4月に，A大学附属病院において外来化学療法を受けたがん患者のうち，調査協力が得られた27人である．疾患内訳は，乳がん患者10人，消化器系がん患者11人，血液系がん患者6人である．各患者には，2日間の食事の写真撮影と食事記録を依頼した．次回，受診日に食事記録用紙とカメラを回収し，栄養素・食品群別摂取量を算出した．また，3群間の差はKruskal-Wallisの検定を行った．

結果：栄養素摂取量を疾患別に比較すると，たんぱく質，脂質，炭水化物エネルギー比率に有意差を認めなかった．しかし，ビタミンDの摂取量（$p = 0.01$）と魚介類の摂取量（$p = 0.03$）は，3つの疾患群間に有意な差がみられた．さらに，ビタミンDと魚介類の摂取量の中央値比較で，乳がんは他のがんに比べて低い値を示した．

結論：疾患別においては，乳がん患者は，魚介類の摂取量が低下しているために，ビタミンD摂取量が低下している可能性が示唆された．

キーワード：食事記録法，栄養アセスメント，がん患者，外来化学療法．