ORIGINAL ARTICLE

Impact of Dietitian Delivered Intensive Nutrition Intervention on Dietary Intake and Weight Outcome Among Gynecology Cancer Outpatient Prior to Surgery

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ABSTRACT

Introduction: This is open label randomised control trial, aimed to identify whether an early (commenced at the time of diagnosis) and intensive nutrition intervention (INI) (individualised dietary counselling, oral nutritional supplements [ONS], telephone, and home visit) can improve weight and dietary intake of gynaecological cancer (GC) patients preoperatively. **Methods:** Selected GC patients planned for surgery were randomly grouped into control group (CG) (n = 35) and intervention group (IG) (n = 34). Malnutrition screening tool (MST) was used as a screening tool, while Patient-Generated Subjective Global Assessment (PG-SGA) was used as a nutrition assessment tool. IG received an intensive individualised dietary counselling with the supply of ONS at baseline (Day 1). This continued with telephone and home visit follow-up by research dietitian (Day 3 and Day 6). Meanwhile, CG only received general nutritional counselling without supply of ONS. Final assessment was conducted on Day 14. The primary outcomes included weight changes measured using TANITA and dietary intake assessment using 24-hour diet recall. **Results:** Mean duration of INI was 14 days. At the end of the treatment period, there was a significant weight change between groups ($p < 0.001$), with 0.14% weight gain in IG and 1.3% weight reduction in CG. Mean energy and protein intake of IG were higher compared to CG by +329 kcal/day and +12.2 g/day, respectively. **Conclusion:** This study showed that INI that incorporated individualised dietary counselling, ONS, telephone counselling, and home visit can increase energy and protein intake of GC patients, resulting in weight gain.

Keywords: Gynecological cancer, Dietitian, Intensive nutrition intervention, Nutritional status, Weight

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INTRODUCTION

Surgery is one of the treatments for gynaecological cancer (GC) patients. The impacts of the disease itself and treatment on nutritional status are some of the major challenges for GC patients because certain GC patients may require chemotherapy or radiotherapy treatment after their surgery. Moreover, 62% to 88% of the GC patients were reported malnourished even at their first visit to the oncology centre (1). Preoperative malnutrition imposes negative outcomes, such as high rate of postoperative complications, medical costs, and mortality as well as longer hospital stay and loss of appetite (LOA). These findings were comprehensively reported in many studies (2-4). Postoperative complications may even delay the initiation of postoperative treatment as well as lower the patients' quality of life.

The preoperative optimisation package is rarely proposed to most patients who opt for elective surgery because the surgical pathway in cancer surgery is usually a plan with a specific purpose in mind (to improve patient care and satisfaction). Moreover, as mentioned by Malcolm et al. (5), cancer patients have limited time from the time they take to consider and decide for surgery to the actual surgical date, which makes it even more difficult to initiate preoperative interventions. According to ESPEN guidelines, short-term (7 to 10 days) nutritional conditioning is recommended for mildly malnourished patients and long-term (10 to 14 days) nutritional conditioning is recommended for severely malnourished patients (7). Thus, preoperative nutrition management is essential in the long term for malnourished cancer patients who undergo surgery (8). Identifying nutritionally insufficient patients allows appropriate preoperative interventions to be carried out and subsequently, improves their nutritional status (9).

With the recent introduction of nutrition prehabilitation, emerging studies were conducted to explore the effects of nutrition prehabilitation. Gillis et al. (10) found nutrition as a key component of prehabilitation interventions. Nutritional prehabilitation is an approach that optimises the patients' nutritional status before their major elective surgery, especially for those patients with high risk preoperative conditioning. Studies have shown that nutritional prehabilitation improves energy and protein intake of patients in the treatment group (11,12). In these studies, patients in the treatment group received dietary counselling and oral nutritional supplements (ONS). However, the colorectal cancer (CRC) patients in both studies failed to maintain or improve their weight preoperatively and were unable to manage more than 75% compliance towards the prescribed ONS. Furthermore, the provision of ONS varied individually in these studies; thus, suggesting potential bias.

Patients who received intensive nutrition intervention (INI), which incorporated individualised dietary counselling, provision of ONS, and regular follow-up, were found to exhibit greater energy and protein intake than those in the standard group (13,14). Hanna et al. (15) reported improved nutritional status and quality of life (QOL) among head and neck (HNC) patients who received INI. Meanwhile, Furness et al. (16) demonstrated that early intervention with intensively planned dietetic contact was able to enhance oral intake and showed higher global QOL as well as better functional and symptom scores.

Dietitians play an important role in nutrition intervention, particularly on their role of providing dietary counselling. According to ESPEN guidelines (2017), individualised dietary counselling is crucial in order to optimise the nutrient intake of malnourished cancer patients (17). Studies have demonstrated the effectiveness of dietary counselling in terms of nutritional status. An interventional study that involved CRC patients demonstrated the effectiveness of individualised dietary counselling in increasing the patients' nutrient intake, nutritional status, and QOL (6). Besides that, another study that involved oncology outpatients who received radiotherapy for gastrointestinal (GI) and HNC diseases concluded the benefits of individualised dietary counselling in terms of weight, nutritional status, and QOL (13¬,18). Finally, another study that involved CRC and gastric cancer patients (16) demonstrated that nutritional counselling at the (start) time of diagnosis resulted in fewer weight loss. However, the effects of individualised dietary counselling among GC patients preoperatively have been underexplored.

Nutrient requirements for surgery are higher, if compared to the normal requirements, in order to support speedy recovery. However, most of the cancer patients are not able to even achieve 50% of the energy requirements prior to their surgery, resulting in further depletion of their nutritional status. Thus, ONS is typically proposed to provide an option or alternative for these patients to acquire the recommended nutrient intake (ESPEN, 2017). Yamamoto et al. (19) documented that the provision of ONS preoperatively among gastric cancer patients resulted in higher energy and protein intake. Another study that involved colon cancer patients (11) also reported higher energy and protein intake after the provision of ONS preoperatively. However, to our knowledge, the effectiveness of the provision of ONS preoperatively among GC patients, especially those with nutritional risk, was not explored, which highlighted the need to explore the effects of the provision of ONS preoperatively among malnourished GC patients in this study.

The adherence of patients to dietary advice is also crucial in diet management. Patients' cooperation and their adherence to diet advice can help them to achieve the goals of diet management. Morey et al. (20) showed that telephone counselling and home visit are helpful in increasing the patients' adherence to dietary advice. Telephone counselling was revealed to be important in providing social support and self-efficacy, while the suggested time required for each telephone call counselling session was around 15 to 30 minutes only (20). It is more time-consuming for patients if they are required to travel to the clinic. Besides that, a research dietitian was appointed in the study to monitor the patients' progress, provide reinforcement, and explore suitable strategies to overcome barriers, especially regarding the patients' diet (20). Lastly, the future direction or goals were also discussed during the telephone counselling. Considering that greater adherence to the prescribed ONS and dietary advice serves as a critical component for a successful nutrition intervention, the best pathway of interventions (e.g. face-to-face counselling, ONS, and telephone counselling as follow-up) that can improve the nutritional outcomes (e.g. weight and diet intake) should be critically explored in order to improve the current practices, especially in managing cases that involve malnourished cancer patients.

Various studies demonstrated patients with weight loss would experience higher complication risk postoperatively. Aahlin et al. (21) found that patients with weight loss of more than 5% preoperatively were linked to lower survival. On the other hand, Makela et al. (22) found a significantly higher rate of complication among CRC patients with weight loss of above 5%. In addition, Andreoli et al. (23) suggested body weight and body mass index (BMI) as important features of a nutrition assessment, where large studies demonstrated a strong correlation between weight loss and survival (24). Hence, the use of body weight and BMI as an outcome measure of intervention is necessary for the benefits of patients.

Recently, nutrition pre-habilitation with the aim of

improving the nutritional outcomes of cancer patients was extensively assessed. The concept of nutrition pre-habilitation involves capitalising time for patients, especially malnourished patients or those with the risk of malnutrition, to improve their nutritional status during the preoperative phase. However, past studies were not able to demonstrate weight changes among patients preoperatively and none of these studies sampled malnourished GC patients, particularly within the local settings. Therefore, the current study aimed to improve the weight and energy and protein intake of GC patients during the preoperative phase and identify effective strategies that improve their nutritional outcomes. The obtained results of this study documented the significance of screening for risk of malnutrition in the early clinic visit and involving a research dietitian to provide nutrition intervention as early as possible.

MATERIALS AND METHODS

Study design and subjects:

Adopting an open label randomised control trial, this study involved GC outpatients at the National Cancer Institute (NCI) preoperatively. This study was carried out from December 2017 to September 2018 in a multidisciplinary clinic (MDC) of NCI. For this study, 69 patients who satisfied the following inclusion criteria were recruited: (1) 18 years of age or older; (2) diagnosed with GC (stage 1 to stage 4); (3) present for diagnosis or therapy or follow-up at MDC; (4) malnutrition screening tool (MST) recorded 2 and above (MST ≥ 2). Additionally, patients were excluded if they took part in any other study. MST ≥ 2 refers to the weight loss within the last six months and poor eating habits due to decreased appetite (25). MST was used as a screening tool in this study considering that this important nutrition screening tool has been widely validated in the population under study. MST is a valid screening tool to identify nutritional risk in cancer patients (26).

Randomisation

Eligible subjects were randomly grouped into control group (CG) and intervention group (IG). Randomisation was performed by an appointed research dietitian using a computer-generated random number list. The subjects were assigned into the respective group according to their registered Medical Record Number (MRN) in NCI.

Ethical approval

For this study, the ethical approval was given by the Medical Research and Ethics Committee, Ministry of Health (NMRR-17-1113-36196). A written and fully informed consent was obtained from each subject.

Intervention group (IG)

IG patients received intensive counselling that included face-to-face counselling and supply of ONS during their first visit at the diet clinic (T0). During the first counselling session, patients were individually counselled by the same research dietitian using the medical nutrition therapy (MNT) guidelines for cancer patients. In the same session, the 24-hour dietary recall technique was used to capture the dietary intake of these patients. Based on the estimated dietary intake, the research dietitian determined whether these IG patients meet the nutrient requirements. In particular, the energy requirement of each patient was calculated based on their actual body weight, ranging between 30 kcal/kg/day and 35 kcal/kg/day. Meanwhile, the protein requirement of each patient was calculated according to the MNT guidelines, ranging between 1.2 g/kg/day and 1.5 g/kg/day (27). Each face-to-face counselling session took about 45 minutes or more with respect to the MNT guidelines for initial consultation (27).

IG patients were instructed to consume four scoops of the prescribed ONS diluted with 150 ml of water, three times daily. They were provided with extra 432 kcal and 18 g of protein, which were proven adequate based on the results in clinical benefit (28). This advice was then continued with telephone counselling on Day 3 (T1) and home visit on Day 6 (T2) by the research dietitian. At this point, the research dietitian provided more intense dietary management. The dietary intake was modified to suit the needs and requirements of each patient. The final assessment on Day 14 (T3) at the clinic involved a post-intervention assessment using the same method used in the baseline assessment, including dietary counselling. The details of the study design are presented in Figure 1.

Control group (CG)

The research dietitian provided less intense general counselling to CG patients. CG patients were also prescribed with ONS (when needed) but without the supply of ONS. In this case, they were required to acquire ONS on their own.

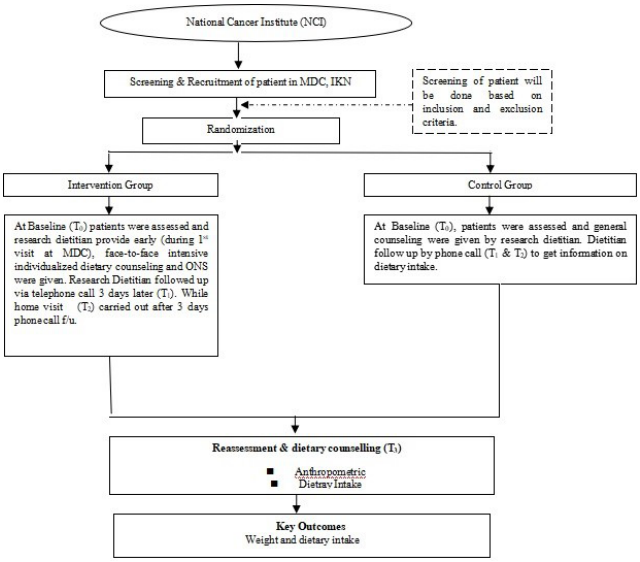

Figure 1: Study flow chart. T_0 indicate day 1intervention; T_1 indicate 1st follow-up by phone; T_2 indicate 2nd follow up by home visit; and T_3 indicate final assessment (post intervention)

Telephone counselling
Each telephone counselling session took about 15 to 30 minutes. The main purpose of telephone counselling is to enhance social support and self-efficacy. For each telephone call, the research dietitian monitored the progress of all patients in terms of their diet intake and ONS compliance. Following that, the research dietitian provided reinforcement, explored effective strategies that can overcome the highlighted barriers, and established future goals for all patients.

Prior to each telephone counselling session, the research dietitian informed each patient on the follow-up procedure and scheduled the date and time for the telephone counselling session. Based on the agreed schedule, the research dietitian individually called the patients to gather information on their diet intake and adherence to the prescribed ONS intake. Patients were also informed on the target and agreement to adhere to specific dietary goals for the next follow-up.

Home visit
After telephone counselling, the research dietitian performed home visit to monitor the patients' groceries and provide suitable menu suggestions in order to achieve the required energy and protein intake. In addition, patients who were not able to meet the recommended nutrient intake were provided with tips on how to increase their energy (energy density) and protein intake. During the home visit, the research dietitian also motivated the patients on how to achieve adequate energy and protein intake.

Measured outcomes:

Anthropometrics measurement
The research dietitian measured the weight and height of patients according to the standard techniques described by Gibson (29). Body weight was measured in light clothes using a calibrated TANITA electronic weighing scale and recorded to the nearest 0.1 kg whereas height was measured to the nearest 0.1 cm using SECA stadiometer. For the height measurement, patients were required to stand erect with their feet together (without shoes) and eyes in a parallax state. BMI of each patient was computed as weight (in kg) divided by squared height (in m^2).

Dietary intake
The 24-hour dietary recall technique was applied in this study to measure the dietary intake of patients. The first dietary recall was conducted at the diet clinic during the face-to-face interview session, which was on the same day the surgeon and patients met (T0). The second and third dietary recalls were performed during the telephone counselling session (T1) and home visit (T2) for the IG patients. Meanwhile, the diet intake of each CG patient was obtained during the telephone counselling session only. Their last dietary recall was conducted again when they were at the diet clinic (T3) before they were admitted to the ward. Overall, four 24-hour dietary recalls were conducted for every patient in both groups at different points of time. During a face-to-face interview session, it is very important for the patients, especially elderly patients, to have the presence of their next of kin, as the patients may not be able to recall what they consumed in details. The nutritional counselling session for each patient during the first interview session took about 45 to 60 minutes.

IG patients received individualised dietary counselling and advices on how to implement and achieve high-calorie and high-protein diet. The research dietitian also explained good sources of protein and encouraged the patients to have at least two to three exchange protein per meal. As for vegan or vegetarian, the patients were reminded to have adequate alternative sources of protein. Besides that, based on the calculated energy and protein requirements for each IG patient, a specific diet plan was individually provided and explained in details. Meanwhile, CG patients only received related pamphlets and general explanation on the required diet without any individualised dietary counselling.

Basically, the 24-hour dietary recall technique, which is frequently used as a part of the dietary assessment method, is a structured interview that captures detailed information of all foods and beverages consumed by a patient in the past 24 hours. The interview session is designed to allow the patient to provide a more detailed and comprehensive report of all foods and beverages consumed. For example, when a patient informs that she consumed fish for dinner, the dietitian would further ask on the food preparation method and ingredients used. Besides that, this technique also captures the date and time as well as the detailed portion size of all foods and beverages consumed (30). Household measurements (e.g. cups, Chinese rice bowls, soup bowls, teaspoons, and tablespoons) and photographs of all foods and beverages consumed are used to assist the patients' report of the portion size and improve the accuracy of assessment (31).

The dietary intake of each patient in this study was analysed and interpreted using a computerised local dietary analysis programme, specifically Nutritionist ProTM (version 2.4.1) (First Databank Year the Hearst Corporation, USA). The dietary intake of each patient was analysed at baseline and three different points of time (based on the 24-hour dietary recall). Nutritionist ProTM contains an extensive food database from around the world, including the Malaysian Food Composition Tables (32). In the case where certain foods cannot be found in the database, standard recipes or ingredients were included in this study to acquire the nutrient intake.

Data analysis
All statistical analyses in this study were performed

using IBM SPSS (version 24.0). All data were checked for normality using the Kolmogorov-Smirnov analysis. The acquired data were found normally distributed ($p > 0.05$), unless otherwise stated. If the data were not normally distributed, non-parametric analyses were used instead.

Descriptive statistics including frequency, mean, and standard deviation were used to present the characteristics, PG-SGA, and nutritional status of the patients. An independent t-test was used to determine the difference in weight changes and dietary intake between the control and intervention groups. Repeated measures analysis of variance (ANOVA) was used to measure the effectiveness of intervention at different points of time, where $p < 0.05$ denotes statistical significance.

RESULTS

This study involved 34 IG patients and 35 CG patients. The baseline characteristics of all patients are presented in Table I, which revealed no statistical disparity in the socio-demographic characteristics between both groups. The clinical characteristics of GC patients are also summarised in Table I. The majority of GC patients had ovarian cancer (32.9%). About 43.5% of GC patients had advanced disease (stage 3 and stage 4), while 56.5% were in the early stage of their disease (stage 1 and stage 2).

The nutritional status of IG and CG patients based on the PG-SGA global rating are shown in Table I. None of the patients in this study were well-nourished. Overall, 84.1% of GC patients were either suspected or moderately malnourished whereas 15.9% were severely malnourished.

The percentage of mean weight loss in one month for IG and CG were 3.7 ± 3.2% and 2.8 ± 1.9%, respectively. The mean weight loss in one month for all 69 patients was 3.2 ± 2.7%. When it comes to weight loss in six months, IG patients recorded mean weight loss of 6.5 ± 5.4%, as compared to CG patients with mean weight loss of 5.6 ± 4.9%. The mean weight loss of patients in six months for all 69 patients was 5.5 ± 4.5%. The weight loss in one month and six months for IG patients and CG patients at baseline were comparable and not statistically significant.

As shown in Figure 2, there was a significant difference in the weight changes between both groups in the post-intervention ($p = 0.003$). Although the percentage of weight increase for GC patients in IG was small (0.14%), the proposed intervention in this study managed to prevent further weight loss among these patients preoperatively. Meanwhile, GC patients in CG revealed further weight loss, where the percentage of weight loss declined from the baseline (-1.3%).

Table I: Baseline characteristics of the GC patients (n= 69)

Characteristic	Overall (*n* = 69)	IG (*n* = 34)	CG (*n* = 35)	*p* value
Socio-demographics				
Age (years) (Mean ± SD)	52.7 ± 13.3	53.8 ± 14.3	51.6 ± 12.3	0.492
Range	24 – 81			
		n (% of patients)	*n* (% of patients)	**p* value
Gender: Female	69 (100)	34 (100)	35 (100)	-
Ethnicity:				0.552**
Malay	40 (58)	21 (61.8)	19 (54.3)	
Chinese	15 (21.7)	7 (20.6)	8 (22.9)	
Indian	12 (17.4)	5 (14.7)	7 (20)	
Others	2 (2.9)	1 (2.9)	1 (2.9)	
Marital status:				0.667**
Single	8 (11.6)	4 (11.8)	4 (11.4)	
Married	49 (71)	25 (73.5)	24 (68.6)	
Widow	12 (17.4)	5 (14.7)	7 (20)	
Education level:				0.854**
Primary	14 (20.3)	8 (23.5)	6 (17.1)	
Secondary	40 (58)	17 (50)	23 (65.7)	
Tertiary	15 (21.7)	9 (26.5)	6 (17.1)	
Clinical characteristics				
Clinical: **Diagnosis:**				
Cervical ca	16 (22.9)	7 (20.6)	9 (25.7)	-
Endometrial ca	22 (31.4)	11 (32.4)	11 (31.4)	
Ovarian ca	23 (32.9)	9 (26.5)	14 (40)	
Vaginal ca	2 (2.9)	1 (2.9)	1 (2.9)	
Uterine ca	4 (5.7)	4 (11.8)	-	
Vulvar ca	1 (1.4)	1 (2.9)	-	
Fallapion tube	1 (1.4)	1 (2.9)	-	
Cancer Stage				
Stage 1	29 (42)	16 (47.1)	13 (37.1)	-
Stage 2	10 (14.5)	3 (8.8)	7 (20)	
Stage 3	12 (17.4)	4 (11.8)	8 (22.9)	
Stage 4	18 (26.1)	11 (32.4)	7 (20)	
No of comorbid conditions				
Nil	37 (53.6)	18 (53)	19 (54.3)	
1	15 (21.7)	7 (20.6)	8 (22.9)	
≥ 2	17 (24.6)	9 (26.5)	8 (22.9)	
Type of comorbidity				
Diabetes Mellitus	21 (38.2)	12 (44.4)	9 (32)	
Hypertension	25 (45.5)	11 (40.7)	14 (50)	
Hypercholesterolemia	9 (16.4)	4 (14.8)	5 (18)	
PG-SGA Global rating				**0.708****
B (suspected or moderately malnourished)	58 (84.1)	30 (85.7)	28 (82.4)	
C (severely malnourished)	11 (15.9)	5 (14.3)	6 (17.6)	
Anthropometric parameters at baseline				
Anthropometry				
% weight loss past 6 months, mean ± SD	5.5 ± 4.5	6.5 ±5.4	5.6 ± 4.9	0.488
Weight loss in 1 month	3.2 ± 2.7	3.7 ± 3.2	2.8 ± 1.9	0.164
Body Weight (kg), mean ± SD	63.8± 14.89	62.5 ±13.9	65 ± 15.9	0.494
BMI (kg/m^2), mean ± SD	20.5± 4.62	20.0 ± 4.4	20.9 ± 4.9	0.427

*t-test analysis, no p value as all patients from both groups were female
**mann-whitney test analysis

All data for the energy and protein intake using the 24-hour diet recall technique are presented in Table II. The baseline energy intake was 951 ± 218 kcal/day for IG patients whereas CG patients recorded 989 ± 229 kcal/day. Meanwhile, the recorded protein intake was

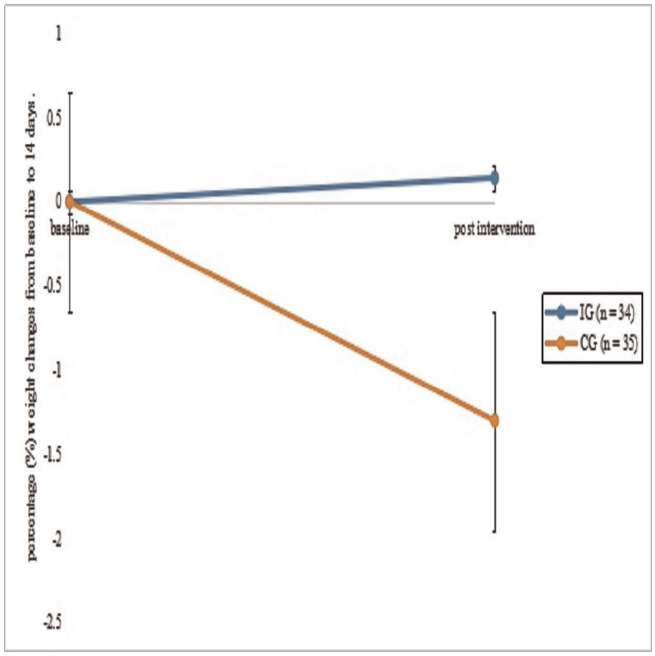

Figure 2: Percentage weight changes from baseline to 14 days

Table II: Comparisons of estimate daily nutrient intake between the intervention group (IG) and control group (CG) at baseline, as measured by 24-Hour Diet Recall

Nutrient Intake	IG (n = 34)		CG (n = 35)		p-value
	Mean ± SD	Range	Mean ± SD	Range	
Energy, kcal	951 ± 218	418 – 1385	989 ± 229	491 -1505	0.485
Protein, g	38.2 ± 9.1	17.9 – 57.2	41 ± 11.8	17.36 – 69.26	0.275
Protein, as % of energy	16.3 ± 3.0	9.7 - 25.4	16.5 ± 2.35	11.9 - 21.6	0.837

p > 0.05; not significantly different from the CG with Independent t-test

38.2 ± 9.1 g/day for IG patients and 41 ± 11.8 g/day for CG patients, respectively. The energy and protein intake were below than the average requirements for cancer patients (27). Besides that, the energy and protein intake for IG patients and CG patients at baseline were comparable and not statistically different.

After the intervention, the mean energy and protein intake of patients in both groups showed improvements from baseline (Table III). Although both groups showed increased energy and protein intake from baseline, there was a significant difference between both groups preoperatively. The mean energy and protein intake of IG patients were higher after the intervention, as compared to CG patients, despite the high energy intake of CG patients at baseline. The mean energy intake of IG patients preoperatively recorded 1469 ± 330 kcal/day whereas CG patients recorded 1140 ± 321 kcal/day. Meanwhile, the mean protein intake of IG patients preoperatively recorded 58.7 ± 11.7 g/day whereas CG patients recorded 46.5 ± 14.2 g/day. On average, IG patients had higher energy intake (by +329 kcal/day) and protein intake (by +12.2 g/day) than CG patients.

DISCUSSION

This study demonstrated that an early (commenced at the time of diagnosis) and INI (individualised dietary counselling, provision of ONS, telephone counselling, and home visit) improved the weight and dietary intake of GC patients preoperatively. In this study, at the two-week post-intervention, IG patients reported significant and positive (0.09 ± 1.37) weight changes, as compared to those in CG (-0.87 ± 1.2) (Figure 2). Again, this particular finding was found to conform to the argument that dietetic intervention can maintain or improve the nutritional status of patients preoperatively. For instance, Isenring et al. (13) found that intensive nutrition support with regular follow-up can help to attenuate weight loss, as compared to the usual care provided. Those subjects in the intervention group (consisted of GI or HNC patients) who received early nutritional counselling, telephone reviews, and ONS showed higher weight stability. In another study, Baldwin, Spiro, Ahern, and Emery (33) found that patients who received dietary intervention showed greater weight gain than those who did not receive any intervention. With that, the current study successfully demonstrated that the combination of dietary counselling and ONS can contribute to weight gain in GC patients preoperatively. This was found to support the reported finding by Baldwin et al. (33) that the weight gain in patients who received dietary counselling and ONS was higher than that in patients who received dietary counselling alone.

As shown in Table III, the mean energy and protein intake of IG patients and CG patients demonstrated improvements preoperatively from baseline. IG patients reported higher energy intake (by 328 kcal) and protein intake (by 12.2 g) than CG patients. The provision of ONS for IG patients led to significantly higher energy and protein intake, as compared to CG. Similar finding was reported by Macfie et al. (34), where patients in the treatment group who received ONS reported significantly higher energy and protein intake than those

Table III: Comparisons of nutrient intake of the patients in the intervention group (IG) and control group (CG) over 2 weeks

Nutrient intake	IG (n = 34)				CG (n = 35)				p-value[ø]		
	Baseline	Phone F/U	Home Visit	Pre-operative	Baseline	Phone F/U	Phone F/U	Pre-operative	Group	Time	Group*-Time
Energy, kcal	951 ± 218	1333± 322	1380± 333	1469 ± 330	989 ± 229	1035± 235	1099± 291	1140 ± 321	0.001	<0.001	0.001
Protein, g	38.2 ± 9.1	53.2 ±11.5	55.4 ±12.5	58.7 ± 11.7	41 ± 11.8	42.3± 11.5*	45.4± 12.6	46.5 ± 14.2	0.004	<0.001	0.001

[ø]Repeated measures analysis of variance
p>0.05 non-significantly different from baseline using Independent sample t-test

in the control group during the preoperative outpatient phase.

Burden et al. (35) revealed the compliance to the prescribed ONS as the main factor that would affect the nutritional outcomes. As for the current study, the recorded compliance rate was more than acceptable, where 31 (91%) patients managed more than 75% of the recommended dose. With the adherence rate of 88.2%, most of the IG patients in this study were able to tolerate the prescribed ONS. Meanwhile, Burden et al. (35) reported that two-thirds of the patients consumed greater than 75% of the recommended dose, with a total adherence rate of 71%. In order to assess the adherence rate of the patients in the those study, they were required to record their ONS intake in the provided diary book. The report fully depended on the sincerity of the patients, which may suggest potential bias. Therefore, the patients in this study were required to return the empty cartons at the end of intervention in order to assess their compliance.

Patients typically experience changes in their appetite prior to surgery, which is known as appetite swings. Appetite swings are predominantly described as a symptom before any treatment commences (36). Thus, this may explain why the current study was not able to manage all patients to consume more than 75% of the recommended dose. The patients in this study revealed poor appetite according to the outcomes of MST. Besides that, several patients experienced diarrhoea and reported intolerance to the prescribed ONS whereas some patients felt that they consumed limited amount of food after consuming the prescribed ONS. There were other patients who experienced symptoms like nausea and feeling full easily. Thus, the above findings potentially explained their non-compliance rate.

Although this study did not manage to obtain an adherence rate of 100%, the inclusion of telephone counselling and home visit as follow-up in this monitoring system to assess the patients' compliance demonstrated positive outcomes. During this follow-up session, each patient was educated on how to manage symptoms and motivated to maximise health and most importantly, to achieve high-calorie and high-protein diet. These approaches were believed to be the drivers of dietary manipulation.

This study presented several important strengths and limitations. In this study, all data were collected preoperatively—the data collection started from the day the specialist and patients met until the day before the patients were admitted. However, several patients expressed unwillingness to meet the research dietitian immediately before the surgery, which may be due to worry and stress about the coming surgery, as reported by Burden et al. (12). Therefore, some patients declined to participate in this study. However, due to the cooperation of the specialist and well description of this study from the specialist to the potential patients, this study was able to achieve the targeted number of subjects.

Overall, this study highlighted the importance of an early and INI in improving the nutritional outcomes of malnourished GC patients preoperatively. This suggests the importance of involving dietitian as early as possible, specifically during the patients' first visit to the specialist, in order to provide a suitable nutrition intervention and subsequently, improve the patients' nutritional outcomes preoperatively.

It is recommended for future research to incorporate technologies in the nutrition intervention strategies. For example, the use of an application in smartphone to record dietary intake at the comfort of home allows dietitian to easily and effectively track the patients' nutrient intake. However, such application should have a user-friendly database and offer more interesting options to attract usage.

CONCLUSION

INI that incorporated individualised dietary counselling, provision of ONS, telephone counselling, and home visit was proven beneficial in this study to improve the weight and dietary intake of GC patients preoperatively.

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