

Nutritional Profile of Cancer Patients: An observational Study at a Tertiary Care Hospital

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Abstract

Cancer is a group of diseases involving abnormal cell growth with the potential to invade or spread to other parts of the body. So patient's condition affects their metabolism, muscle mass, body fat and the level of their energy. As a presumption cachexia, sarcopenia and fatigue affect the diagnosis and treatment process. In this study, cancer diagnosed patients, seen in out-patient (OP) department, admitted at day care for short treatment were invited to participate. The nutritional status was assessed using Karada Scanner, simple bioelectric impedance instrument. A standardized functional assessment of chronic illness therapy fatigue scale (FACT- G, version 4), 27-point scale questionnaire was administered to assess Cancer Related Fatigue (CRF). This pilot study provided a fresh positive correlation between the nutritional status of cancer patients and cancer related fatigue. BMI has significant positive correlation with total body fat % ($P < 0.05$). In malnourished cancer patients, up to 70.6% fall under stage IV cancer with definite loss of weight, appetite or decrease in intake and fatigue presence. With Karada scanner in OP clinic, FACT-G can be useful tool to objectively measure CRF.

Keywords: Cancer, nutrition, Cancer-Related Fatigue (CRF), Body Mass Index (BMI), cachexia, chronic illness, fatigue

Introduction

According to the International Association of Cancer Registries, every year, 23.7% of the world population has registered new cancer cases and 12.5% die from cancer all around the world¹. Malnutrition is present in nearly 85% of those affected in certain types of cancers (e.g. pancreas)². Undiagnosed, untreated cases and poor nutritional status in cancer can lead to cancer-related cachexia or loss in body mass. Cancer cachexia has a poor prognosis for survival and early detection of malnutrition can effectively prevent cachexia³. Previous studies do show the benefits of interventions that focus on weight, physical activity and diets to improve patient quality of life and decrease the side effects of cancer treatment⁴⁻⁶.

A cohort study with 3408 patients who were in I and III CRC showed a U-shaped relationship between Body Mass Index (BMI) and Colorectal Cancer (CRC) survivors⁷. Underweight patients at the time of diagnosis (BMI < 18.5 to 24.9 kg/m²) and patients who were Class II and III of obesity (BMI ≥ 35 kg /m²) faced “worse all-cause mortality compared with high normal weight (BMI 23 to <25 Kg/m²), low-overweight (BMI 25 to 28 kg/m²) and high-overweight (BMI 28 to <30 kg/m²)” as the study showed patients with high-normal weight, low-overweight, high overweight had lower mortality risk than underweight and obese patients⁸.

A retrospective study on all cancer admissions in palliative units covering 4 months, revealed the prevalence of inadequate nutritional status while the patients are in hospital. In conclusion, the author reports a lower incidence of cancer cachexia when nutritional symptoms were listed using screening tools and administering multidisciplinary nutrition care⁹. In 2016, an observational study with 41 participants found that there is a relationship between “ingestion of a prudent dietary pattern (a diet rich in fruit, vegetable, whole grains, low in red and processed meats) and a decrease in the risk of overall mortality (Relative Risk (RR) 0.76, 95% CI 0.71-0.89)”¹⁰. Nutritional status can be assessed by performing the body anthropometry. The most basic method is the Body Mass Index (BMI). Others like waist circumference, waist to hip ratio, skinfold thickness and bioelectric impedance¹¹ are better in making a diagnosis but need the presence of a trained assistant. Bioelectric impedance measurement¹² is a validated tool for measuring body anthropometry. The Bioelectric impedance analyzer (HBF-352, Omron Health care Co., Kyoto, Japan) Karada Scanner, is an instrument that is portable and easy to use. It does not require the presence of a trained fieldworker and has been used extensively in epidemiological field surveys (Figure 1 and 2).



Picture 1: Karada Scanner



Picture 2: Karada Scanner

Cancer - Related Fatigue (CRF) is defined as “a distressing persistent, subjective sense of physical, emotional and / or cognitive tiredness or exhaustion related to cancer or cancer treatment that is not proportional to recent activity and interferes with usual functioning”^{3,11}. It is multi-factorial and could be associated with the nutritional status of the patient. Various scales have been developed to measure CRF and there is no gold standard till date.

The functional assessment of chronic illness therapy fatigue scale¹³ (FACT – G, version 4) is an easy to administer 27-item questionnaire. Lower scores on the FACT-G indicate the greater levels of fatigue. Higher FACT-G scores indicate higher quality of life¹³. Poor nutritional status leads to poor scores in FACT-G- a measure of cancer related fatigue⁵. Cancer and Nutrition affects the physical,

mental, psychological and social scores. Information about the effects of nutritional status on cancer-related fatigue is limited. Hence, this observational cohort aimed at studying the correlation between the nutritional status using bio-impedance and CRF using the FACT-G scores, in patients with ECOG status 3 and below.

The association between nutritional risk and related fatigue in a cancer patient with “Colorectal Cancer Fast-Track Surgery” was measured in a single-arm observational study. Among 70 eligible postoperative patients who were diagnosed with the colorectal cancer were subjected to the fast-track surgery in the study. Twenty per cent of patients from this group had severe fatigue and 94.29% were malnourished by reference to PG-SGA score. With an average of 15.585, fatigue severity and a positive correlation with

their nutrition status was found. It was also found that White Blood Cells (WBC) and serum calcium were significantly related to both cancer fatigue scale and PG-SGA¹⁴. With these objectives the study was aimed to assess the nutritional status of cancer patients and measure the prevalence of Cancer Related Fatigue (CRF) in a tertiary care referral hospital and to assess factors that influence nutritional status and CRF in cancer patients.

Materials and Methods

Patients whose diagnosis of cancer was confirmed by a physician and who were also on chemotherapy and radiation therapy on an outpatient basis at the Medical Day Care Unit at Mazumdar Shaw Medical Center, Narayana Health City, Bommasandra, Bengaluru from November 25th, 2015 to December 16th, 2015 were recruited and screened for eligibility. All consenting patients with a physician diagnosis of cancer and patients' > 18 years of age were included in the study. Patients who were pregnant or had physical/cognitive impairments / performance status ECOG 4 (Eastern Cooperative Oncology Group 4) with Implantable Cardiac Device (ICD) and defibrillators preventing enrolment in the study were excluded. The study was registered under the Clinical Trial Registry, India (CTRI). Ethical Committee clearance was obtained from the Narayana Health Medical Ethics Committee on 20th October 2015. The CTRI Number is CTRI/2018/02/012237.

Health-related quality of life in cancer patients

The FACT G, version 4 is a generic measure of health status comprising 27 items related to four dimensions: (a) Physical wellbeing: for the limitation in performing all physical activities, for problems with work or other daily activities and body pain. The dimensions such as physical function, body pain and general health reflect the physical wellbeing component of health. (b) Functional wellbeing: for general health, sleep cycle, level of satisfaction at present state of life and vitality. (c) Emotional wellbeing and (d) Social / Family wellbeing: dealing with social functioning, emotional role, family support and mental health which reflects the mental components of health.

Body composition

Weight, total body fat percentage, trunk subcutaneous fat percentage, visceral fat percentage, Body Mass Index (BMI), skeletal muscle mass percentage, resting metabolism (kcal) and body age were measured using Bio-Impedance Analyzer (BIA), the Karada Scanner patented by Omron Health Care Co., Kyoto, Japan. This method was opted to access the overall nutritional status of cancer patients.

Sample size estimation

There are no previous studies available that have looked into the relationship between nutritional status and Cancer Related Fatigue (CRF). Poor

nutritional status leads to poor FACT-G scores. Nutritional status is determined by body mass index, total Body Fat percentage and skeletal muscle mass percentage. Total body fat percentage is a stable measure of nutritional status. Assuming a Standard Deviation (SD) of total body fat percentage of 10, at an absolute precision of 2.5% for a power of 80% at 95% confidence interval, for which the minimum required sample size was 61 was calculated using nMaster 2.0 software, where the final sample size was rounded to 100, anticipating a 15% rate of drop out for the subjects due to non-compliance to the study protocol. Statistical significance was reported at $P < 0.05$.

Statistical analysis

The statistical analysis was done using SPSS v.22 software IBM. Corp. Descriptive statistics were reported as Mean $\pm$ SD, medians and inter quartile ranges, frequencies, confidence intervals and percentages. Independent 't' tests were used to examine differences in Mean for normally distributed variables [age, weight, height, Body Mass Index (BMI) and the Mann-Whitney test was used to examine differences in skeletal muscle mass percentage, trunk subcutaneous fat percentage, visceral fat percentage and FACT-G scores between early and later stages of cancers respectively. Regression statistics were performed to test the hypothesis of a positive correlation between

nutritional status and CRF. Kruskal Wallis Test analysis was performed concerning non-parametric variables. One-way ANOVA test analysis was performed to determine whether there were any statistically significant differences between the means of three or more independent (unrelated) groups.

Results and Discussion

A total of 104 participants were enrolled in the study. The Karada Scanner was validated by taking the readings from 100 normal identified subjects from the clinics and bystanders of an eligible study subjects. Baseline demographic and clinical characteristics are presented in Table I where the patient anthropometry and total FACT-G score with their respective Standard Deviations (SD) are described. The mean age is 53.68 ± 12.97 years ($SD = 12.97$) and 58.7% ($n = 61$) were males (Table I).

Fifty nine per cent of participants ($n=62$) had metastatic (stage IV) disease. Overall, 31 (29.8%) participants were classified as over-nourished or obese, 56 (53.8%) participants were classified as well-nourished and 17 (16.3%) were classified as malnourished or under nourished. Malnourished patients were also significantly older ($P < 0.001$) and had lower BMI ($P < 0.01$) (Table I and Table IV)

The overall educational status of participants was assessed using

TABLE I
Baseline Demographic and Clinical Characteristics (N=104)

Characteristics	Values
Age - Mean (SD)	53.68 (12.97) 55.82 (14.45)
Sex - Frequency (%)	
Female	43 (41.3)
Male	61 (58.7)
BMI - (%)	Underweight 17 (16.3)
Normal	56 (53.8)
Over weight	24 (23.1)
Obese	7 (6.7)
Stages of Cancers - Frequency (%)	
1	3 (2.9)
2	10 (9.6)
3	29 (27.9)
4	62 (59.6)
Decrease Weight - Frequency (%)	
Present	56 (53.8)
Fatigue - Frequency (%)	
Present	81 (77.9)
Decrease Appetite - Frequency (%) Present	72 (69.2)
Height (cm) KS - Mean (SD)	160.399 (8.6309)
Weight (kg) KS - Mean (SD)	58.705 (13.1166)
Total Fat % KS - Mean (SD)	30.707 (8.8281)
Trunk subcutaneous fat % KS - Mean (SD)	20.272 (8.0141)
Visceral fat % KS - Mean (SD)	8.005 (5.9167)
BMIKS - Mean (SD)	22.756 (5.0238)
Resting metabolism (kcal) KS - Mean (SD)	1324.51(217.924)
Skeletal muscle mass % KS - Mean (SD)	26.251(4.7381)
Body age KS - Mean (SD)	49.83 (15.618)
PWB subscale Score - Mean (SD)	16.644 (5.6892)

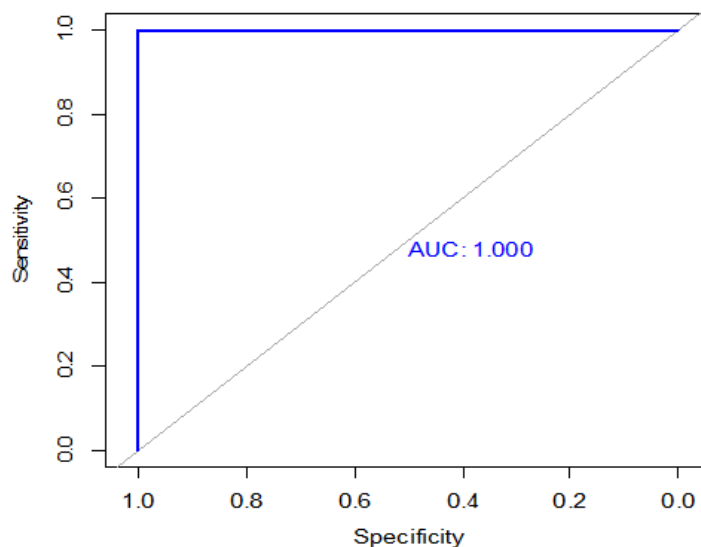


Figure 3
PWB subscale score versus FACT group ROC AUC plot

Kuppuswamy Socioeconomic Status Scale, 43.3% (n=45) participants were illiterate or primary school level and 38.5% (n=40) participants were in the category of High school / Intermedia / Diploma. (Table I).

A Receiver Operating Characteristic (ROC) curve, is a graphical plot that illustrates the discriminative ability of a binary classifier system as its discrimination threshold is varied. The ROC curve is created by plotting the True Positive Rate (TPR, sensitivity) against the False Positive Rate (FPR, 1 - specificity) at various threshold settings. The ROC plot, ROC AUC values, were determined using pROC R statistical package. The above

plot demonstrates the ability of PWB subscale Score scores at classifying FACT group patients to be 100%. The FACT group column consists of two groups those with FACT score greater than '70.5' were classified as '2' and FACT scores less than '70.5' were classified as '1'. The optimal PWB subscale Score threshold was estimated to be 10.09 using the 'coords' function in the pROC package. The optimal specificity and sensitivity measured using the same functions were '1.0' and '1.0' at the above threshold.

Age, mean skeletal muscle mass percentage and FACT-G both total and subscale scores were significantly higher

TABLE II
Results of Different Groups of BMI V/S Anthropometric Details and it's Correlation Analysis

Variables	BMI			F value	Sig p-value
	<18.5	18.5-25.0	>25.0		
Age	58.12 ± 15.43	51.11 ± 13.39	55.90 ± 9.17	2.631	0.077
Height (cm)	160.94 ± 1.03	161.11 ± 8.85	158.80 ± 9.05	0.751	0.475
Weight (kg)	41.20 (7.3)	54.55 (10.0)	71.20 (11.7)	2	
Trunk subcutaneous fat %	14.97 ± 7.07	18.56 ± 6.12	26.26 ± 8.16	18.193	0.000
Visceral fat%	0.50 (1.8)	6.00 (4.0)	13.00 (6.5)	2	
Total fat %	26.91 ± 10.33	29.17 ± 8.22	35.57 ± 7.063	8.092	0.001
Skeletal muscle mass %	27.62 ± 5.86	27.06 ± 4.34	24.03 ± 4.11	5.350	0.006
Body age	35.29 ± 13.02	46.21 ± 12.29	64.32 ± 10.45	38.291	0.000
Total FACIT-G	72.33 ± 11.50	70.69 ± 16.42	70.68 ± 11.11	0.094	0.910
Resting metabolism (kcal)	1113.35 ± 191.29	1298.98 ± 170.50	1486.42 ± 191.50	24.711	0.000

One- way ANOVA test performed indicates that age, mean skeletal muscle mass % and FACT - g both total and subscale scores were significantly higher ($p>0.05$) and resting metabolism, trunk subcutaneous fat %, body age, total body fat % and visceral fat % were significantly lower in all the three mean body mass index (BMI) categories ($P<0.05$)

($P>0.05$) and resting metabolism, trunk subcutaneous fat percentage, body age, total body fat percentage and visceral fat percentage were significantly lower in all the three mean Body Mass Index (BMI) categories ($P<0.05$) (Table II).

Table II summarizes the results of the group and correlation analysis. The items were sorted according to the number of variables to which they were responsive in these two analyses. Kruskal Wallis Test analysis was performed to determine whether there are any statistically

significant differences between the BMI categories and FACT-G subscale scores and overall total score. Analysis indicates that the BMI categories are not statistically significant with the FACT-G subscale and overall total scores. Statistically significant values were found when ROC curve plotted against physical well being subscale score and FACT-G overall score against BMI categories (Figure 1). Kruskal Wallis Test analysis was performed concerning non-parametric variables in comparison to grouping variable BMI on weight

TABLE III
Multiple Comparisons

Dependent Variable	(I) BMI	(J) BMI	P value	95% Confidence Interval	
				Lower Bound	Upper Bound
Age	Underweight	Normal	0.151	-1.60	15.62
		Obese	1.000	-7.17	11.60
	Normal	Underweight	0.151	-15.62	1.60
		Obese	0.290	-11.76	2.17
	Obese	Underweight	1.000	-11.60	7.17
		Normal	0.290	-2.17	11.76
Height (cm)	Underweight	Normal	1.000	-6.007	5.658
		Obese	1.000	-4.222	8.491
	Normal	Underweight	1.000	-5.658	6.007
		Obese	0.708	-2.406	7.025
	Obese	Underweight	1.000	-8.491	4.222
		Normal	0.708	-7.025	2.406
Trunk subcutaneous fat %	Underweight	Normal	0.194	-8.266	1.090
		Obese	0.000	-16.383	-6.186
	Normal	Underweight	0.194	-1.090	8.266
		Obese	0.000	-11.479	-3.915
	Obese	Underweight	0.000	6.186	16.383
		Normal	0.000	3.915	11.479
Total fat %	Underweight	Normal	0.981	-7.837	3.322
		Obese	0.002	-14.734	-2.572
	Normal	Underweight	0.981	-3.322	7.837
		Obese	0.002	-10.906	-1.884
	Obese	Underweight	0.002	2.572	14.734
		Normal	0.002	1.884	10.906
Skeletal muscle mass %	Underweight	Normal	1.000	-2.506	3.628
		Obese	0.031	.248	6.934
	Normal	Underweight	1.000	-3.628	2.506
		Obese	0.011	.551	5.510
	Obese	Underweight	0.031	-6.934	-.248
		Normal	0.011	-5.510	-.551

Contd.

Body age	Underweight	Normal	0.004	-18.94	-2.90
		Obese	0.000	-37.77	-20.29
	Normal	Underweight	0.004	2.90	18.94
		Obese	0.000	-24.59	-11.63
	Obese	Underweight	0.000	20.29	37.77
		Normal	0.000	11.63	24.59
Total FACIT-G	Underweight	Normal	1.000	-7.9967	11.2764
		Obese	1.000	-8.8466	12.1585
	Normal	Underweight	1.000	-11.2764	7.9967
		Obese	1.000	-7.7744	7.8065
	Obese	Underweight	1.000	-12.1585	8.8466
		Normal	1.000	-7.8065	7.7744
Resting metabolism (kcal)	Underweight	Normal	0.001	-307.20	-64.06
		Obese	0.000	-505.56	-240.57
	Normal	Underweight	0.001	64.06	307.20
		Obese	0.000	-285.72	-89.16
	Obese	Underweight	0.000	240.57	505.56
		Normal	0.000	89.16	285.72

and visceral fat percentage. Bonferroni correction is one of several methods used to counteract the problem of multiple comparisons (Table III).

One-way ANOVA test analysis was performed to determine whether there were any statistically significant differences between the means of three or more independent (unrelated) groups (Table II). And the same above test was performed to determine whether there were any statistically significant differences between the BMI categories and FACT- G total and sub-scales scores (Table VI).

This table suggests that if any nutritional intervention is being done during stage I, II and III of cancer, the general condition of the patients can be maintained, whereas in stage IV, because of loss in appetite, weight, and fatigue; the patient goes to the irretrievable stage.

The frequency of symptoms affecting dietary intake and levels of functional capacity was reported in Table IV. The most common symptoms affecting intake were decreased weight (53.8%), decrease or loss of appetite (69.2%) and fatigue (77.9%) (Table IV). When compared with BMI <18.5, the loss of appetite, decrease

TABLE IV
Nutritional Intervention

Parameters	BMI			P - value
	< 18.5	18.5 - 25	> 25	
Lack or decrease in appetite	100%	80.4%	32.3%	0.000
Presence of fatigue	100%	64.3%	9.7%	0.051
Decrease in weight	100%	75.0%	71.0%	0.000
Stages of cancer				
(a) Stage I	0.0%	1.8%	6.5%	0.657
(b) Stage II	5.9%	8.9%	12.9%	
(c) Stage III	23.5%	26.8%	32.3%	
(d) Stage IV	70.6%	62.5%	48.4%	

in weight and presence of fatigue along with total FACT G score was statistically significant ($P < 0.05$) (Table IV).

Although resting metabolism, trunk subcutaneous fat percentage, body age, total body fat percentage and visceral fat %, BMI had a significant positive correlation with all the three mean Body Mass Index (BMI) categories ($P < 0.05$), no significant correlation could be established between age, mean skeletal muscle mass percentage and FACT-G both total and subscale scores with all the three mean Body Mass Index (BMI) categories ($P > 0.05$) (Table V and VI).

Discussion

Nutritional status can be considered as one of the major factors of cancer related fatigue. Till date, measuring the nutritional

status in the clinical setup was neglected by clinicians due to various reasons such as difficulty in procuring a suitable instrument. Karada Scanner, which works on the principle of bio-impedance that is validated and is also portable, can be a privilege for the clinician to instantly assess the nutritional status of the cancer patients who suffer from decreasing appetite and weight.

In this study, the nutritional status evaluation was performed by considering BMI as a dependent variable. The most common symptoms affecting intake were decrease in weight (53.8%) decrease or loss of appetite (69.2%) and fatigue (77.9%). In a detailed version of it, the cancer patients with < 18.5 BMI score have fatigue (100%), weight loss (100%) and appetite or intake reduction (100%)

TABLE V
FACIT G Scores in BMI Categories

Descriptive		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
Sum individual Item scores PWB	Uw	17	15.235	7.1461	1.7332	11.561	18.909	4.0	26.0
	n	56	17.000	5.4839	0.7328	15.531	18.469	0.0	26.0
	Ow	31	16.774	5.2327	0.9398	14.855	18.694	7.0	25.0
	Total	104	16.644	5.6892	0.5579	15.538	17.751	.0	26.0
Sum individual Item scores SWB	Uw	17	20.294	4.1498	1.0065	18.161	22.428	9.0	25.0
	n	56	20.089	4.9074	0.6558	18.775	21.404	7.0	28.0
	Ow	31	20.000	4.5461	0.8165	18.332	21.668	12.0	28.0
	Total	104	20.096	4.6436	0.4553	19.193	20.999	7.0	28.0
Sum individual Item scores EWB	Uw	17	16.471	3.2039	0.7770	14.823	18.118	10.0	22.0
	n	56	16.000	5.7017	0.7619	14.473	17.527	2.0	24.0
	Ow	31	15.484	5.5128	0.9901	13.462	17.506	3.0	24.0
	Total	104	15.923	5.2836	0.5181	14.896	16.951	2.0	24.0
Sum individual Item scores FWB	Uw	17	14.765	5.3681	1.3019	12.005	17.525	6.0	27.0
	n	56	17.125	5.5204	0.7377	15.647	18.603	2.0	28.0
	Ow	31	16.290	4.7623	0.8553	14.543	18.037	8.0	26.0
	Total	104	16.490	5.2988	0.5196	15.460	17.521	2.0	28.0
Total score (FACT-G Total score)	Uw	17	69.1863	16.61376	4.02943	60.6443	77.7283	40.50	99.00
	n	56	71.6369	13.58877	1.81588	67.9978	75.2760	47.50	100.00
	Ow	31	70.6989	14.16865	2.54477	65.5018	75.8960	41.33	97.83
	Total	104	70.9567	14.16822	1.38931	68.2014	73.7121	40.50	100.00

Uw - Under weight; n - Normal; Ow - Over weight

indicating that the nutritional status in malnourished cancer patients is poor. Similarly, with an 18.5-25 BMI score, they were having fatigue (75%), weight loss (64.3%), and decrease in appetite or intake (80.4%). Lastly, with >25 BMI score patients were suffering from fatigue (71%),

weight loss (9.7%) and appetite or intake reduction (32.3%) indicating that in obese or over- nourished patients, the appetite is more compared to the other two groups whereas in malnutrition patients there was a drastic loss of appetite. As expected, physical activity and appetite scores

TABLE VI
One- way ANOVA Test performed between the different BMI categories and total and sub-scale scores of FACIT – G scores

ANOVA		Sum of Squares	df	Mean Square	F	P value
Sum individual item Scores PWB	Between groups	41.358	2	20.679	0.634	0.532
	Within groups	3292.478	101	32.599		
	Total	3333.837	103			
Sum individual item Scores SWB	Between groups	0.955	2	0.478	0.022	0.979
	Within groups	2220.083	101	21.981		
	Total	2221.038	103			
Sum individual item Scores EWB	Between groups	11.407	2	5.704	0.201	0.818
	Within groups	2863.977	101	28.356		
	Total	2875.385	103			
Sum individual item Scores FWB	Between groups	74.419	2	37.210	1.334	0.268
	Within groups	2817.571	101	27.897		
	Total	2891.990	103			
Total score (FACT-G Total score)	Between groups	81.255	2	40.627	0.199	0.820
	Within groups	20594.800	101	203.909		
	Total	20676.055	103			

were associated with fatigue, anorexia or cachexia, and the general quality of life. Similarly, there was a severe loss of weight in malnourished or under-nourished patients but negligible or no loss of weight was seen in obese patients. This indicates that in cancer patients, the nutritional status of the patient was directly proportional to cancer-related fatigue (CRF), which was seen in all the patients suffering from cancer irrespective of any BMI category they

belong to, since in all the three categories more than three-fourth of the population complained of fatigue. Further in the study, in malnourished cancer patients, most of the patients (up to 70.6%) fall under stage IV cancer (Metastasizing or End-stage) in which there was a definite loss of weight, loss of appetite or decrease in intake (which is definite in end-stage cancer) and presence of fatigue. In normal BMI cancer patients, the stages of cancer,

loss of weight, loss of appetite or reduction in intake and fatigue was a moderate variable. In high BMI cancer patients, stages of cancer were variable and there was a negligible loss of weight, no loss of appetite or decrease in intake and a lower presence of fatigue. If any nutritional intervention is done during stages I, II and III of cancer, the general condition of the patients can be maintained, whereas in stage IV, because of loss in appetite, weight and fatigue the patient goes to the irretrievable stage (Table III).

Obesity or overweight is a chronic, refractory condition, with relapse rates ranging from 50% to 90%¹⁵. The strong, negative impact of obesity on physiological health has been well established^{16,17}.

However, the impact of overweight on emotional, psychological and social functioning has been studied less extensively¹⁸. While it is generally believed that obesity has adverse effects on many areas of emotional and psychosocial functioning¹⁹, the impact of weight on the overall quality of life has not been studied directly^{16,17}. J de Raaf *et al*²⁰ postulated that there were two types of cancer-related fatigue: namely physical fatigue and mental fatigue, which are not two expressions of a single symptom but should be considered as two different symptoms (a multiple symptom concept). They insisted on more research on the pathogenesis of both

physical and mental fatigue which aid in confirming this hypothesis. They also affirm that a paradigm shift in the management of fatigue will be needed, if this multiple symptom concept is proven²¹.

In the present study, fifty-nine per cent of participants (n=62) had metastatic (stage IV) disease. Overall, 31 (29.8%) participants were classified as over-nourished or obese, 56 (53.8%) participants were classified as well-nourished and 17 (16.3%) were classified as malnourished or undernourished. Malnourished patients were also significantly older ($P < 0.001$) and had lower BMI ($P < 0.01$).

Cancer cachexia is a complex, multifactorial syndrome, which is thought to result from the actions of both host- and tumor-derived factors, including cytokines involved in a systemic inflammatory response to the tumor^{3,11}. It is also associated with poor response to therapy, increased susceptibility to treatment-related adverse events, as well as poor outcome and quality of life. The definition of cancer-related fatigue as proposed by the National Comprehensive Cancer Network is: "Cancer-related fatigue is a distressing persistent, subjective sense of physical, emotional and/or cognitive tiredness or exhaustion related to cancer or cancer treatment that is not proportional to recent activity and interferes with usual functioning"²².

Through bio-impedance analysis, the prevalence of cancer-related fatigue was the main reason for poor response to therapy that could be measured. FACT- G that could be provided by Karada scanner, measures cancer-related fatigue and an early detection can improve the therapy outcome. In the study performed by Donini *et al*²³, whole-body impedance vector components, resistance (R), reactance (Xc) and phase angle (pA), were measured with a single-frequency 50 kHz analyzer STA-BIA (AKERN Bioresearch SRL, Pontassieve, Florence, Italy) to perform Bio-Impedance Analysis (BIA). Other parameters like Body Cell Mass (BCM: the protein-rich compartment which is affected in catabolic states) and hydration status (Total Body (TBW), Extracellular (ECW) and Intracellular Water (ICW)) were derived from electrical data²³.

Poor nutritional status is associated with Cancer Related Fatigue (CRF). Seventy per cent of the malnourished cancer patient with low body fat and fatigue fall under metastasizing or loss of weight and appetite or decrease in intake (stage IV). Any intervention before this stage could improve patient health status.

This pilot study provided an insight into the treatment of cancer through a nutritional perspective which may reduce the burden of patients physically, mentally

and economically from undergoing or getting massively exposed to chemotherapy and radiotherapy. It provided an awareness of assessing the nutritional status of the cancer patients chair side or in a clinical setup itself, irrespective of the stage of cancer they belong to, by using an economical and portable device *i.e.* Karada Scanner which describes the overall nutritional status of the patient. The study also provided a fresh correlation between the nutritional status of cancer patients and its association with cancer related fatigue. It also recommended the development and work on the intervention of nutritional supplement to treat cancer leading to the prevention of patients unnecessarily getting exposed to enormous amount of chemotherapy and radiotherapy so that it might be a ray of hope for the patients to change their lifestyle and postpone their death by increasing their self-confidence and self-esteem. More studies on cancer patients to find a way to make the therapy period easier was one of the motivations for the study. More attention and concentration on nutritional status and finding a more related variable to their fatigue problem was the major goal that the current paper tried to reach. Chemotherapy is one of the worst periods of treatment in cancer patients and their family life and nutritional status is one of the variables that patients and their families could consider to pass this therapy more easily.

Conclusion

Malnourished cancer patients (up to 70.6%) fall under stage IV cancer (Metastasizing or End-stage) poor nutrition affects cancer related fatigue. In normal BMI cancer patients, the stages of cancer, loss of weight, loss of appetite or decrease in intake and fatigue was moderately varied and in high BMI cancer patients, stages of cancer are varied and there is a negligible loss of weight, no loss of appetite or decrease in intake and lower presence of fatigue. With Karada Scanner in an OP clinic, FACT G can be a useful tool to objectively measure CRF. If this intervention takes place during stage I, II and III cancer, the general condition of the patients can be maintained, whereas in stage IV, because of loss of appetite, loss of weight and fatigue, the patient goes to the irretrievable stage. If CRF is detected early and nutritional studies are corrected, the patient's treatment outcome will improve.

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