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Efficacy of Diet Consultation through Online and Offline Platforms to COVID Inpatients and Non-COVID Outpatients

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Abstract

Current pandemic has brought technological advancements in nutrition intervention methods and diet consultations, which was taken into consideration for analyzing the efficacy of different approaches. This study aimed to assess the efficacy of diet consultation through online and offline platforms to COVID inpatients and non-COVID outpatients and to understand the impact of consultation methods on the dietary intake of patients. Retrospective data from a tertiary care multispecialty hospital in Central Kerala were collected after obtaining ethical clearance. Online diet recall of COVID inpatients (n=302, follow-up n=277) and non-COVID outpatients (n=14, follow-up n=5) through telephonic, e-mail, and WhatsApp and offline or direct consultation for outpatients (n=298, follow-up n=28) were conducted and data collected. ANOVA with a Greenhouse-Geisser correction or sphericity assumption, *post hoc* tests using the Bonferroni correction, standard deviation, significance test using p-value, and percentage analyses were the statistical parameters used for the study. The results revealed that proper diet consultation and follow-up may bring about changes in nutritional status of all categories of patients. Online method was more consistent in follow-up when compared to offline method. During COVID period, patients opting for online diet consultation increased. Both COVID inpatients and non-COVID outpatients who were consistent with online follow-up were showing significant nutritional changes and those who had offline consultation lacked regular follow-up. Digital health intervention measures have more scope than conventional methods in the current pandemic.

Keywords: COVID inpatients, Digital health intervention, Non-COVID outpatients, Offline consultation, Online diet recall

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Introduction

Clinical nutrition and dietetics services contribute to evidence-based suggestions on dietary guidelines. Diet consultation is an integral part at the hub of many services delivered in health-care settings across the whole world. Nutrition intervention and follow-up too are equally important to ensure the quality of life of patients of all categories. Even though hospitals aimed to serve patients with the best medical care services, the nutrition provided to patients may face less concern as it is often underestimated. Food intake stands one of the important aspects that facilitate recovery. At times, there will be major nutritional deficit observed among inpatients (IP) and also with vulnerable outpatients.[1] Hospital diet contributes to an important role in enhanced recovery. Still, malnutrition is a common problem among hospitalized patients[2] and outpatients (OPs) that are at risk with compromised immunity and post-surgical status.

Populations having good dietary practices may not have severe infection.[3] The best strategy to fight with infectious diseases is to take preventive measures and to carry out holistic health promotion activities along with adequate physical activity. Dietary interventions can be adopted to provide the best prevention, as preventive nutrition too is gaining vast importance in current pandemic scenario. Such knowledge, when transferred through generations by collective approach, would benefit humanity as a whole.[4] When people are infected, perhaps due to in-built immunity, the severity of the infectious condition may not be that worse. However, vulnerable populations such as geriatric persons, pregnant mothers, children, post-operative patients, and persons having other disabilities or comorbidities are more prone to contract such infections. Extra precautions including modified and balanced diets are so crucial for such category of people. Small frequent meals with a varied diet and proper nutritional follow-up at regular intervals are advisable to them.

The current study was planned with objectives to evaluate the efficacy of diet consultation through online and offline platforms to COVID inpatients and non-COVID outpatients and to understand the impact of consultation methods on their dietary intake. It was observed that the dietary intake of COVID IPs was much below than the target goals for nutrition expected but was showing an improvement with continuous online monitoring and follow-up. There was another category of patients (non-COVID outpatients) with comorbidities who were being consulted online and offline. Nutrient intake varied vastly with the frequency with which the consultations are done. Those who lacked follow-up were found to be much undernourished along with the underlining disease condition. An increasing trend toward newer methods of choosing diet consultation too was found during the COVID pandemic. With this observation, it was planned to get the secondary data on

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the dietary intake of patients who opt for different consultation methods and thus to study the efficacy of type of consultation which could make a qualitative impact of patients' lives.

Methods

A tertiary care multispecialty hospital in Central Kerala was selected for the study for a period of 6 months, from July 1, 2020, to December 31, 2020. The Institutional Ethical Clearance was obtained to collect and analyze the retrospective data of impact of diet consultation on the diet recall of patients (LHRC/EC-2020-1/02). Online diet recall of COVID in patients (n = 302, follow-up n = 277) and non-COVID outpatients (n = 14, follow-up n = 5) through telephonic conversation, e-mail, and WhatsApp; and offline or direct consultation for OPs (n = 298, follow-up n = 28) with comorbidities were conducted and data analyzed. Subjective Global Assessment was the validated nutrition screening and assessment tool used in both the groups, which was being followed in the hospital. COVID IPs were categorized on the basis of severity of infection, namely, category A, B, and C as per their medical record. All patients were classified into different age groups from <21 years to >60 years, with an interval of 10 years, so as to get maximum possible analyses within closer age groups. Length of stay, occupational background, and details of other comorbidities were collected from the background data. Diet recall analysis of COVID IPs (n = 277) was done for 4 days during the length of stay (SD 8.8 ± 4.9) for 6 months, and statistically relevant number (n = 159) was selected for analysis of data to maintain consistency. Nutrition intervention was done by modifying the hospital diet with oral nutrition supplements and blenderized, nutrient dense dietary modifications to bridge the gap between actual nutrition intake and prescribed goal. Diet recall analysis was conducted for non-COVID outpatients (n = 298 of which revisits n = 28) to find out significance of efficacy for diet consultation and follow-up and statistically relevant number was selected for further analysis (n = 19).

Statistical Analysis

Categorical variables were presented as number and percentage. Normally distributed continuous variables were presented as mean with SD. Significance test using *P*-value, repeated measures ANOVA (to determine the mean macronutrients for diet recall) with *post hoc* Bonferroni correction (to analyze the increase in macronutrients during hospital stay) was used to compare the diet consumption in different days. Statistical analyses were conducted using SPSS Version 20.0 for Windows (IBM Corporation ARMONK, NY, USA).

Results

The results revealed that proper diet consultation and follow-up could bring about changes in nutritional status of all categories of patients. Online method was more consistent in follow-up when compared to offline method. Different statistical analyses were applied to the given data.

In the given population, the available sample size in COVID and non-COVID follow-up groups showed much variation. It is because the former group consisted of admitted patients (IP, n = 302) whose online follow-up was done on a regular basis and secondary data were collected for analysis. In the latter (non-COVID, n = 298), it was OPs who opted for the conventional pattern of diet consultation, in which, very few (n = 28) had reported for revisits for their nutrition follow-up and dietary assessment (either as walk in or as referral from another department). The analyses were done as secondary data based on the number of patients with whom the dietary recall analyses were possible during the duration of the study. Sample size in either of the groups was not pre-fixed, but the study duration was defined as 6 months.

Initial classifications based on the general details along with length of hospital stay are depicted in Table 1.

The patients were from different occupational background and specifically when categorized to health-care providers, 36 and 8 were present among the COVID and non-COVID OP groups, respectively. Another observation on the mortality rate revealed that, due to severity of infection and post-COVID sequelae in the COVID group (n = 302), 22 deaths over 6 months had reported, and no health-care providers were included in that category.

Classification based on severity of infection among COVID IPs is listed in Table 2.

COVID IPs were nutritionally screened on admission and the assessment was done using the validated screening and assessment tool being used in the hospital. The assessment details are given in Table 3.

Major comorbidities existed among COVID patients (n = 302) were cancer, renal impairment, diabetes, diabetes with cancer, diabetic kidney disease, post-operative status/post-transplant surgeries, liver diseases, metabolic syndrome, and other medical conditions (n = 118, n = 39.07%). Male patients (n = 64, n = 54.24%) constituted more when compared to female patients (n = 54, n = 45.76%). It was observed that 50% (n = 59) of the affected cases were having diabetes and diabetes induced secondary diagnoses, as discussed in Figure 1. Males above 40 years of age were more affected (n = 55, n = 46.61%) than females of the same age group (n = 41, n = 34.75%).

In the pandemic scenario, an assessment was done to understand the number of patients opting for online and offline diet consultations and how many are actually doing follow-up consultation to be consistent with the diet pattern. The findings are presented in Table 4.

The comparison of diet recalls for COVID IPs during hospital stay was analyzed regularly and the results are discussed in Table 5.

Even though 277 COVID IPs were followed up for nutritional status and diet recall, consistency in statistical analysis with

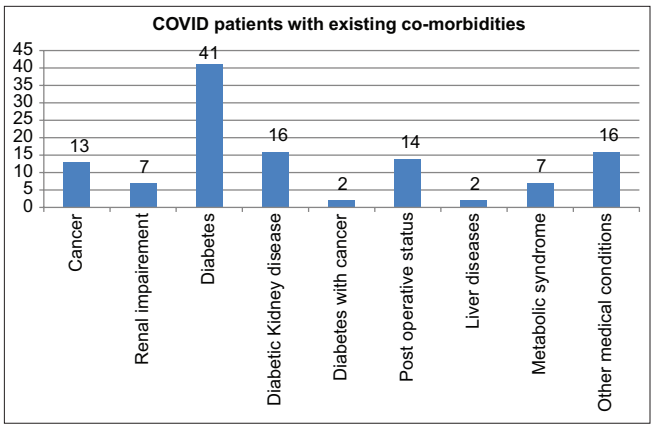

Figure 1: Major comorbidities existed among COVID-19 inpatients (n=118)

Table 1: Classification of COVID and non-COVID patients based on general data

Parameters assessed	*COVID-19 (n=302) Mean±SD or n (%)*	*Non-COVID (n=28) Mean±SD or n (%)*	*P-value*
Age (years)	51.4±17.6	49.1±13.8	0.516
Gender			
Male	151 (50.0)	18 (64.3)	0.148
Female	151 (50.0)	10 (35.7)	
Nutrition assessment (SGA)			
Mildly malnourished	224 (74.2)	11 (39.3)	0.001
Moderately malnourished	54 (17.9)	14 (50.0)	
Severely malnourished	24 (7.9)	3 (10.7)	
COVID category			
Mild	159 (52.6)	-	NA
Moderate	87 (28.8)	-	
Severe	56 (18.5)	-	
Hospital stay (days)	8.8±4.9	-	NA

SGA: Subjective Global Assessment

Table 2: Classification based on COVID category (*n*=302)

Age group	*Male*			*Female*		
	COVID category			*COVID category*		
	A	*B*	*C*	*A*	*B*	*C*
	n (%)	*n (%)*	*n (%)*	*n (%)*	*n (%)*	*n (%)*
<21	8 (100.0)	-	-	3 (100.0)	-	-
21–30	4 (80.0)	1 (20.0)	-	27 (93.1)	2 (6.9)	-
31–40	7 (53.8)	5 (38.5)	1 (7.7)	21 (84.0)	4 (16.0)	-
41–50	14 (53.8)	8 (30.)	4 (15.4)	14 (50.0)	9 (32.1)	5 (17.9)
51–60	14 (40.0)	12 (34.3)	9 (25.7)	22 (73.3)	5 (16.7)	3 (10.0)
>60	12 (18.8)	31 (48.4)	21 (32.8)	13 (36.1)	10 (27.8)	13 (36.1)
Total	59 (39.1)	57 (37.7)	35 (23.2)	100 (66.2)	30 (19.9)	21 (13.9)

*A: Mild, B: Moderate, C: Severe[14]

Table 3: Classification based on nutritional assessment of COVID IPs (*n*=302)

Age group	*Male*			*Female*		
	Nutritional assessment (SGA)			*Nutritional assessment (SGA)*		
	A	*B*	*C*	*A*	*B*	*C*
	n (%)	*n (%)*	*n (%)*	*n (%)*	*n (%)*	*n (%)*
<21	8 (100.0)	-	-	2 (66.7)	1 (33.3)	-
21–30	4 (80.0)	1 (20.0)	-	29 (100.0)	-	-
31–40	10 (76.9)	3 (23.1)	-	25 (100.0)	-	-
41–50	19 (73.1)	7 (26.9)	-	21 (75.0)	2 (7.1)	5 (17.9)
51–60	23 (65.7)	10 (28.6)	2 (5.7)	22 (73.3)	7 (23.3)	1 (3.3)
>60	43 (67.2)	13 (20.3)	8 (12.5)	18 (50.0)	10 (27.8)	8 (22.2)
Total	107 (70.9)	34 (22.5)	10 (6.6)	117 (77.5)	20 (13.2)	14 (9.3)

*A: Normal or mildly malnourished, B: Moderately malnourished, C: Severely malnourished. SGA: Subjective Global Assessment, IP: Inpatient[15]

Table 4: Number of patients who opted for online and offline diet consultation methods

Category	*Online diet consultation*		*Offline diet consultation (OP)*
	COVID (IP)	*Non-COVID (OP)*	
	n (%)	*n (%)*	*n (%)*
Total	302 (100.0)	14 (100.0)	298 (100.0)
Walk-in	0 (0)	14 (100.0)	72 (24.2)
Follow-up/ revisit	*277 (91.7)	5 (35.7)	28 (9.4)
Male	151 (50.0)	6 (42.86)	142 (47.65)
Female	151 (50.0)	8 (57.14)	156 (52.35)

*Length of stay – >3 days

respect to length of stay was attained for 159 patients and analyzed to obtain results. A repeated measures ANOVA with a Greenhouse-Geisser correction determined that mean energy (F [1.696, 179.556] = 870.626, P < 0.001), carbohydrate (*F* [2.132, 96.751] = 154.468, *P* < 0.001), protein (*F* [2.467, 46.853] = 736.963, *P* < 0.001), and fat (*F* [2.503, 50.732] = 131.280, *P* < 0.001) consumption differed statistically significantly between days.

Post hoc tests using the Bonferroni correction revealed that diet consultation elicited an increase in energy (day 2, 791.0 ± 227.4 Kcal vs. day 4, 957.0 ± 211.5 Kcal vs. day 6, 1125.3 ± 180.2 Kcal vs. day 8, 1354.9 ± 161.1 Kcal), carbohydrate (day 2, 103.7 ± 57.0 vs. day 4, 119.1 ± 55.3 vs. day 6, 140.0 ± 40.0 vs. day 8, 169.0 ± 40.7), protein (day 2, 19.0 ± 7.2 vs. day 4, 29.9 ± 6.8 vs. day 6, 37.4 ± 7.2 vs. day 8, 44.7 ± 8.1), and fat (day 2, 33.0 ± 12.0 vs. day 4, 39.7 ± 12.4 vs. day 6, 44.4 ± 11.1 vs. day 8, 54.4 ± 9.2) consumption from the 2nd day to 8th day of admission which was statistically significant (*P* < 0.001).

The estimated marginal means of macronutrients (energy, carbohydrate, protein, and fat) are depicted in Figures 2 and 3, respectively.

The diet recall analyses for non-COVID offline group who were presented for follow-up (*n* = 28, *n* = 9.4) were conducted during the study period. The results are discussed in Table 6.

In non-COVID-19 group, statistical significance was attained with follow-up of 19 patients (*n* = 6.38%) and repeated measures ANOVA with a Greenhouse-Geisser correction or

Table 5: Diet recall analysis of COVID IPs, *n*=159 (online)

Nutrient	*Day 2*	*Day 4*	*Day 6*	*Day 8*	*P-value*
Energy (Kcal) (*n*=159)	791.0±227.4	957.0±211.5	1125.3±180.2	1354.9±161.1	<0.001
Carbohydrate (g) (*n*=159)	103.7±57.0	119.1±55.2	140.0±40.0	169.0±40.7	<0.001
Protein (g) (*n*=159)	19.0±7.2	29.9±6.8	37.4±7.2	44.7±8.1	<0.001
Fat (g) (*n*=159)	33.0±12.0	39.7±12.4	44.4±11.1	54.4±9.2	<0.001

IP: Inpatient

Table 6: Diet recall analysis of non-COVID OPs, *n*=19 (offline)

Nutrient	*Day 2*	*Day 4*	*Day 6*	*P-value*
Energy (Kcal) (*n*=19)	1160.3±277.5	1215.8±223.0	1246.3±173.2	0.088
Carbohydrate (g) (*n*=19)	163.1±55.5	170.9±49.2	162.2±36.1	0.463
Protein (g) (*n*=19)	26.8±9.2	31.8±8.4	33.2±6.3	0.001
Fat (g) (*n*=19)	44.3±10.0	44.8±11.2	51.4±10.3	0.007

*Significant values given for 3 day recall. Recall for day 8 has not included in the analysis as the number of cases were less. OP: Outpatient

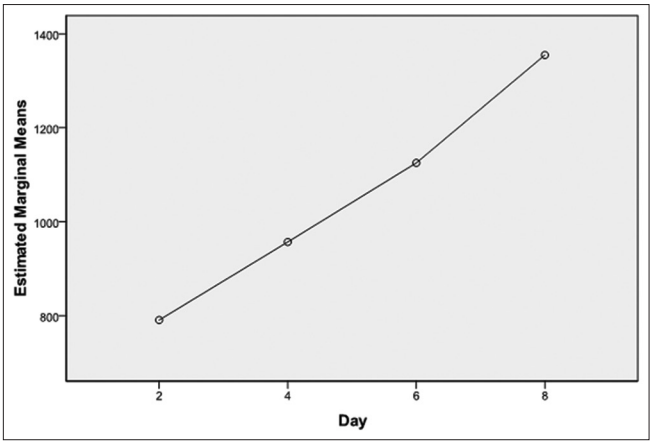

Figure 2: Estimated marginal means of energy

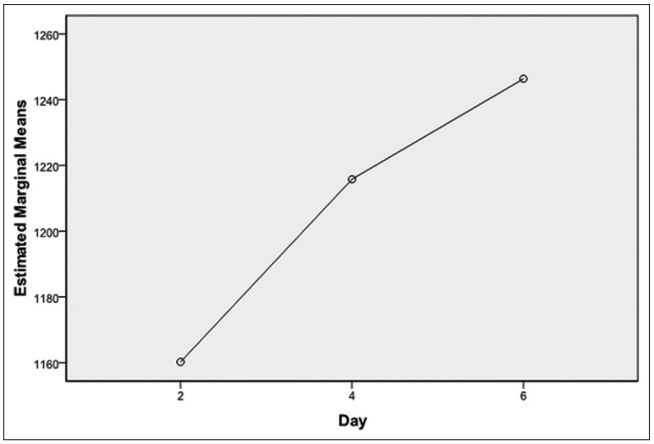

Figure 4: Estimated marginal means of energy

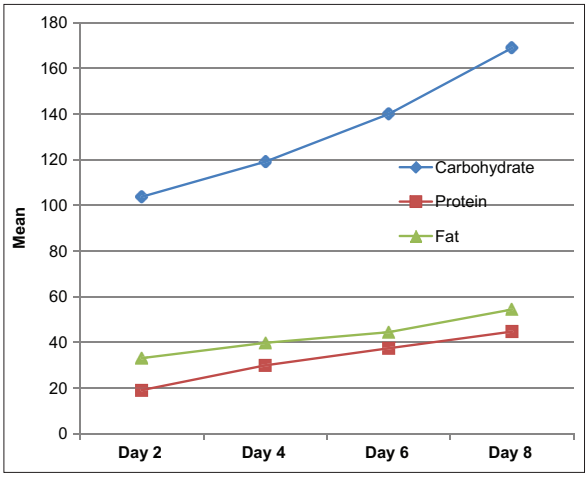

Figure 3: Estimated marginal means of carbohydrate, protein, and fat

sphericity assumption determined that mean energy (F [1.285, 13.833] = 2.999, *P* = 0.088) and carbohydrate (*F* [2, 0.451] = 0.787, *P* = 0.463) consumption were not statistically significantly differed between days. However, protein (*F* [1.437, 8.462] = 11.986, *P* = 0.001) and fat (*F* [2, 1.107] = 5.793, *P* = 0.007) consumption differed statistically significantly between days.

Post hoc tests using the Bonferroni correction revealed that diet consultation elicited a statistically significant increase in energy consumption from day 2 to day 4 (1160.3 ± 277.5 Kcal vs.1215.8 ± 223.0 Kcal) (P=0.001) and to day 6 (1246.3 ± 173.2 Kcal) (P=0.006). However the increase in the energy consumption from day 4 to day 6 (1215.8 ± 223.0 Kcal vs. 1246.3 ± 173.2, respectively) which was not statistically significant (P=0.740).

The fat consumption increased from day 2 to day 4 (44.3 ± 10.0 vs. 44.8 ± 11.2, respectively) which was not statistically significant (*P* = 1.000). However, day 6 consumption increased to 51.4 ± 10.3 which was statistically significantly different to day 2 (*P* = 0.012) and day 4 (*P* = 0.024) consumptions.

The estimated marginal means of macronutrients (energy, carbohydrate, protein, and fat) are depicted by Figures 4 and 5, respectively.

Strengths and Limitations

Diet consultation and follow-up for the defined groups were conducted in a systematic manner, results obtained as per the type of follow-up and analyzed. The modifications on dietary intake and quality of life of respondents too add to the strength of study. Online follow-up was promising but weight was not recorded on discharge of the patients, so the difference in weight during hospital stay for the COVID group was not documented. Furthermore, the number of samples was less in the online and offline non-COVID group, data were analyzed with the sample available, which was considered as the limitation of the study.

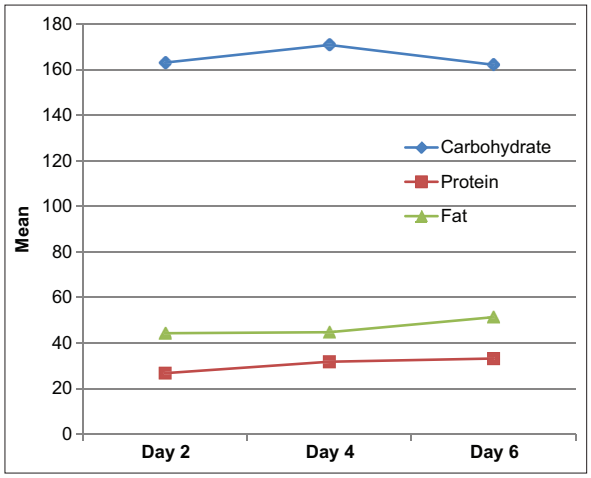

Figure 5: Estimated marginal means of carbohydrate, protein, and fat

Conclusion

COVID-19 has brought advanced options for utilizing the digital solutions to the fore while practicing social distancing and new guidance[5] to reduce contact-related risks. The possibilities and potential of new digital health technologies are emerging.[6] Digital devices and software support people to monitor their bodily functions and activities, and also to share and create health information.[7] Digital transformation has drastically gained attention with dietary intervention methods too. People are suggested to avoid face-to-face or direct consultations for their own safety, if those are not necessary.[8] Technology emerges as a perfect solution to maintain services and minimize risk, and there is a huge variety of digital options at our finger tips. Food intake monitoring systems are mainly of two types where the traditional systems rely heavily on self-reporting and manual recording of eating activities.[9,10] The second category with automated systems consists of digital techniques with minimum or no interaction of individuals. Wearable sensors are mostly being used for such advancements and therefore have the ability to cover pitfall of the traditional systems.[11,12] Researches in this area are happening, and more and more advancements are expected within a short period of time.

Even with the lifting of some restrictions in selected states, scientists believe that some degree of social distancing may be needed until 2022.[13] During COVID period, patients opting for online diet consultation increased. Both COVID IPs and non-COVID outpatients who were consistent with online follow-up were showing significant nutritional changes and those who had offline consultation lacked regular follow-up. Digital health intervention measures have more scope than conventional methods in the current pandemic.

The given study had limitations in such a way that nutrient goal was not attained even though improvement in intake was observed. Lack or long gap of regular follow-up in consultation resulted in the lacuna for attaining proposed nutrition intervention goals.

Diet consultation measures using novel approached have a vast future and scope as they provide more convenience and solutions at "fingertip." More research in this area would help to explore the possibilities of advanced digital interventions and personalized disease specific diet consultations. This would help dietitians and patients to make use of qualitative time, cloud-based record keeping and, thus, would open up a new era with revolutionary changes in the field of clinical nutrition and dietetics practice.

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