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NUTRITIONAL STATUS OF HOSPITALIZED COVID-19 PATIENTS AND FACTORS AFFECTING THEIR DISEASE SEVERITY

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ABSTRACT **Background:** Individuals who are immunosuppressed and harbor co-morbid disorders are at risk of severe disease and poor prognosis for Covid-19 infection. Dietary intake gets impacted by the severity of disease and hospital stay thus creating nutritional deficiencies and malnourishment among infected patients. **Objective:** To assess the importance of nutritional status on severity of COVID 19 disease **Materials and methods:** The study was a prospective cross sectional one conducted on adults with mild or moderate COVID-19 admitted to MGM Hospital, from 15th October to 15th November 2020. Written informed consent was taken. Ethical clearance was taken from the institute's ethical committee. A total of 42 mild and 58 moderate COVID-19 patients admitted in hospital were analyzed. The socio-demographic profile, anthropometric measurements, biochemical parameters and dietary intake which was noted by three-day 24-hour dietary recall were assessed in each patient. The progression of these patients was noted over the study period. The data was analyzed using descriptive statistics, frequencies, Independent T-test method and Pearson chi - square test. **Results:** 68% participants had co-morbidities namely Hypertension, Obesity and Diabetes Mellitus. 43% were overweight. Patients with moderate disease (patients with pneumonia and oxygen saturation between 90% to 95%), were overweight in comparison to patients with mild disease (36.2% moderate and 14.3% mild). There was a lower intake of nutrients and micro nutrients as compared to the expected daily allowance in these patients. Significant association was seen for severity of illness with history of irregular food consumption and obesity. All of the mild cases were discharged within a week of admission. 8% of the moderate cases worsened and had prolonged stay in the hospital. There was one death in the moderate group. **Conclusion:** Severity of COVID-19 disease increases with comorbidities like Hypertension, Diabetes mellitus and Obesity. Meal pattern and symptoms like chest pain, nausea, vomiting and dysphagia lower the oral food intake in patients. This may contribute to malnutrition and severity of disease.

INTRODUCTION

The pandemic of COVID-19 has drastically affected communities and healthcare systems all over the world. It has impacted patients from all age groups especially elderly and individuals with comorbidities. Due to alterations in the dietary and lifestyle patterns during hospital admissions the nutritional status of patients gets negatively impacted.[1] According to various studies, it is discerned that comorbidities increase the risk for COVID-19.[1,2] High adiposity and lower lean mass predispose a patient to severity of the disease. Hospitalized patients are prone to malnutrition due to inflammation that causes a catabolic state in them. Cytokines and other acute phase reactants like Tumour necrosis factor alpha (TNF-α), ferritin, C reactive protein result in hypoalbuminemia and skeletal muscle atrophy.[3] Other reasons for malnourishment could be due to occurrence of gastrointestinal and severe respiratory symptoms in Covid patients that would hamper adequate oral intake.

Our study highlights the importance of nutritional status assessment of covid-19 patients and association of different factors with disease severity. It would help healthcare providers understand the importance of following a dietary pattern and quantified nutrition in their admitted patients to curb the risk of malnourishment and indirectly helping to reduce the severity of COVID 19.

METHODOLOGY

This study was conducted on adults with mild or moderate COVID-19 admitted to MGM Hospital, from 15th October to 15th November 2020. Informed consent was taken from every patient and this study has received ethical approval from the Institute's ethical committee. The authors declare that they have no conflict of interest and no grants were taken for this study.

A total of 100 patients were enrolled during the time frame of the study. Patients with severe psychiatric illness and pregnant ladies were excluded from the sample. Height of the patients was measured by anthropometric rod and weight by a calibrated weighing balance. The socio-demographic profile of the patients was assessed by a pre-structured pre-valid questionnaire (Annexure 1). The patient's clinical history, vitals and investigations were recorded by the treating doctors. The three days diet history was collected through 24-hour dietary recall. Further nutrient intake was assessed with the help of DietCal software. The patients were followed up to ten days and their outcome noted.

All the data was analyzed by using Statistical Package For Social Sciences (SPSS)VERSION 4.0. The correlation between different variables has been found by Pearson chi square test, Pearson correlation and regression analysis. Independent T test was used to analyze the difference between mild and moderate categorized patients based on severity for various variables like biochemical parameters, vitals, anthropometric measurements, nutrient intake and food group consumption. Linear variables were presented using descriptive statistics and categorical variables were presented using frequencies and proportion.

RESULTS

As shown in Table 1, there were 73% male and 27% female patients included in the study. The data had been distributed as mild (42%) and moderate (58%) COVID- 19 category. All the patients were from the lower middle income group as per the modified Kuppuswamy index.[4] 95% of the patients were literate, in which 63% completed their secondary school certification. Majority of the patients belonged to 48-57 years age group (23%).

Table 1: Socio- Demographic Profile of Participants

Variable	Mild (n= 42)	Moderate (n=58)	Total (N=100)
Gender			
Male	28 (66.7%)	45(77.6%)	73(73%)
Female	14(33.3%)	13(22.40%)	27(27%)
Age in years			
18-27	4(9.5%)	5(8.6%)	9(9%)
28-37	5(11.9)	8(13.8)	13(13)
38-47	7(16.7)	13(22.4)	20(20)
48-57	9(21.4)	14(24.1)	23(23)
58-67	13(31)	6(10.4)	19(19)
68-77	4(9.5)	8(13.8)	12(12)
+77	0	4(6.9)	4(4)
Education			
Literate	41 (97.6%)	54 (93.1%)	95 (95%)
Illiterate	1(2.4%)	4 (6.9%)	5 (5%)
Educational qualification			
Primary	10 (23.8%)	13 (22.4%)	23 (23%)
Secondary	25 (59.5)	38 (65.5)	63(63)
UG	5 (11.9)	6 (10.4)	11(11)
PG	1(2.4)	0 (0)	1(1)
Vocational	1(2.4)	1 (1.7)	2 (2)
Occupation			
Private job	9 (21.4%)	20 (34.5%)	29 (29%)
Government job	1 (2.4)	4 (6.9)	5 (5)
Business	25 (59.5)	32 (55.2)	57 (57)
House wife retired	7 (16.7)	2 (3.4)	9 (9)
Income			
<50000	25 (59.5%)	31 (53.4%)	56 (56%)
50,000-100000	15 (35.7)	20 (34.5)	35 (35)
>100000	2 (4.8)	7 (12.1)	9 (9)

Table 2 shows details of the clinical features of the patients. Majority of the patients had fever (93%) in followed by cough (84%), headache (82%) and muscular pain (77%). 68% of the patients suffered from comorbidities. 35% of them had Diabetes mellitus and 38 % had Hypertension.

Table 2: Symptoms and Comorbidities among Patients

Variable	Mild n=42(%)	Moderate n=58(%)	Total n=100
Symptoms			
Fever days	39 (92.9)	54 (93.1)	93
Sore Throat	18 (42.9)	15 (25.9)	33
Sneezing	18 (42.9)	20 (34.5)	38
Breathlessness	17 (40.5)	33 (56.9)	50
Chest pain	8 (19.1)	27 (46.6)	35
Cough	38 (90.5)	46 (79.3)	84
Generalised weakness	29 (69.1)	39 (67.2)	68
Headache	36 (85.7)	46 (79.3)	82
Muscle Pain	32 (76.2)	45 (77.6)	77
Ocular Complaints	2 (4.8)	7 (12.1)	9
Comorbidities			
Present	22 (52.4)	46 (79.3)	68
Diabetes	14 (33.3)	35 (60.3)	49
Hypertension	18 (42.9)	38 (65.5)	56
Cardiovascular disease	4 (9.5)	11 (19)	15
Renal disease	4 (9.5)	9 (15.5)	13
Chronic lung disease	3 (7.1)	8 (13.8)	11
Cerebrovascular disease	0	4 (6.9%)	4
Tuberculosis –active	3 (7.1)	0	3

As shown in Table 3, it was seen that moderate cases of Covid 19 had higher incidence of tachycardia and hypoxemia as expected and these patients had higher body weight but there was no significant difference in the Body Mass Index (BMI) of mild and moderate cases.

Table 3: Anthropometric Measurements and Biochemical Parameters

Variable	Mild (n=42) Mean ±SD	Moderate (n=58) Mean ±SD	Total (n=100) Mean ±SD	P value
Height	159.4±5.7	163.7±6.7	161.9± 6.5	0.5
Weight	69.4±9.7	74.6±10.7	72.4± 10.6	0.01**
BMI	26.3±3.7	28.9±4.5	27.7± 4.2	0.46
Systolic blood pressure	126.7±11.2	129.5±11.9	128.3 ± 11.6	0.23
Diastolic blood pressure	86.1±10.6	90±10.1	88.4 ±10.4	0.06
Pulse rate	92.4±8.3	96.9±10.5	95.0 ±9.8	0.02*
Spo2	97.8±1.0	94.9±2.3	96.1 ± 2.3	0.001**
Temperature	98.6±0.7	98.6±1.4	98.5 ±1.2	0.68
RR	24.9±1.4	25.9±2.1	25.9 ±6.9	0.98
TLC	12920.4 ± 4267.4	13451.5 ± 5136.2	13228.4 ± 4774.9	0.58
Hemoglobin	13.9±1.8	12.1±1.6	13.6 ±1.7	0.015*
Serum albumin	3.5±0.7	3.7±0.7	3.6 ±0.7	0.12
Serum Protein	7.12±0.98	7.17±0.79	7.2 ± 0.9	0.79

* Significant difference at p value of ≤ 0.05
** significant difference at p value of ≤ 0.01

Patients with moderate illness had lower hemoglobin values as compared to the mild cases (p=0.015).

The dietary and substance addiction pattern of the participants is depicted in the Table 4. 83% of the patients were non vegetarian. 12% of the subjects were smokers, in which 9% were from moderately ill category. Maximum numbers of the subjects (46%) were taking four meals in a day. 74% of the subjects had complaints of reduced appetite and 79% of them were not taking meals on time as per their routine in the hospital.

Table 4: Lifestyle Pattern of Patients

Variable	Mild (n=42)	Moderate (n= 58)	Total (n= 100)
Food habits			
Vegetarian	10 (23.8)	7 (12.1)	17 (17)
Non-Vegetarian	32 (76.2)	51 (87.9)	83 (83)
Health Abuse			
Smoking	3	9 (15.5)	12(12)
Tobacco	1	4	5(5)
Alcohol	0	0	0
All	0	2	2(2)
Meal pattern			
Twice a day	7 (16.7)	8 (13.8)	15 (15)
Thrice a day	0 (0)	35(60.4)	35 (35)
Four times a day	32 (76.2)	14 (24.1)	46 (46)
More than four times	3 (7.1)	1 (1.7)	4 (4)
Perceived reduced appetite in patients	29 (69.1)	45 (77.6)	74 (74)

The three days dietary intake during the hospital stay was taken into account to know their nutrient intake. After taking dietary recall the nutrient intake was calculated by the DietCal Software. It was found that all the patient were taking a calorie deficit diet in the hospital. The percentage of protein, minerals (calcium, iron, sodium, potassium, zinc) and

vitamins (Vitamin A, vitamin C, vitamin D, thiamine, riboflavin, niacin, vitamin B_6, folate and vitamin B_{12}) in the daily meals were inadequate as per recommended daily allowances. The details are depicted in Table 5. There was no significant difference found for nutrient intake in between mild and moderate Covid patients.

Table 5: Nutrient Intake of Participants

Variable	Mild (n=100) Mean ±SD	%RDA Approx For Male & Female	Moderate (n=100) Mean ±SD	%RDA Approx For Male & Female	P-Value
Energy (kcal)	1,169.1 ±139.3	62	1,172.7 ±118.9	62.2	0.89
Carbohydrates (gm)	157 ±22.04	121	161.1 ± 22.4	123.9	0.39
Protein (gm)	35 ±3.40	69.9	34.40 ± 3.4	68.9	0.42
Fats (gm)	23.60 ±4.30	104.9	22.5 ±3.9	100	0.20
Vitamin A	282±61.70	30.6	289.7±54.50	31.5	0.5
Iron	7.4±1.0	30.8	7.0±1.0	29.2	0.11
Calcium	558±130	55.8	568.9±112.2	56.9	0.67
Thiamine	1.0±0.1	71.4	1±0.1	71.4	0.12
Riboflavin	1.9± 0.2	97.4	1.8±0.2	92.3	0.44
Niacin	10.9±0.90	87.2	10.6±0.8	84.8	0.17
Vitamin C	37.7±5.3	52	36.8±4.5	50.8	0.41
Folate	148±17.8	57	130±14.5	57.8	0.57
Vitamin B12	1.9±0.2	76	1.9± 0.1	76	0.17
Sodium(mg)	1244 ±184.8	62.2	1268 ±190.6	63.4	0.52
Potassium (mg)	1971.3 ±235.0	56.3	2040.4 ±243.40	58.3	0.16
Zinc(mg)	11.0 ±1.50	72.8	11.0 ±1.4	72.8	0.91
Vitamin D	192.3±58.50	32.1	201±63.5	33.5	0.48

* Significant difference at p value of ≤ 0.05

The mean intake of food groups namely cereals and millets, legumes, green leafy vegetables, other vegetables, roots and tubers, sugar, milk and milk products were lower in moderate patients in comparison to mild patients. This could be due to complaints of indigestion, increased breathlessness, cough and loss of appetite in the moderate category of patients. The Table 6 shows the details.

Table 6: Mean ± Sd of The Food Groups Consumption

Food Groups	Mild [Mean ± SD]	Moderate [Mean ± SD]	Total [Mean ± SM]	P Value
Cereals and Millets	190.44 ± 52.65	150.58 ± 43.87	166.84 ± 49.01	0.416
Legumes	43.65 ± 12.97	32.57 ± 13.41	39.11 ± 13.11	0.007**
Green Leafy Vegetables	40 ± 19.69	30.20± 20.17	35.87 ± 19.57	0.755
Other Vegetables	70.34 ±21.55	40.34 ± 20.48	110.44 ± 56.87	0.267
Fruits	100.13 ± 22.32	100.00 ± 24.86	96.95 ± 33.80	0.605
Roots and Tubers	81.68 ± 37.51	74.50 ± 34.63	77.95 ± 47.16	0.718
Sugars	25.31 ± 3.29	20.11 ± 3.52	9.69 ± 3.46	0.338
Milk and Milk Products	185.20 ± 95.05	170.46 ± 82.90	178.22 ± 89.80	0.624
Edible Oils and Fats	24.07 ± 5.82	24.92 ± 4.27	24.49 ± 5.20	0.617

* Significant difference at p value of ≤ 0.05
** significant difference at p value of ≤ 0.01

Association was assessed in between severity of illness and different clinical, demographic and nutrition variables. As revealed in Table 7, there were significant associations noticed with obesity, erratic meal timings at hospital, symptoms like dysphagia and vomiting and co-morbidities like hypertension and diabetes mellitus at p value less than 0.05.

Table 7: Association between Severity of Illness with Different Variables

Variable	P value
Sex	0.22
Age	0.16
Education	0.31
Occupation	0.06
Weight status	0.03*
Infrequent meal pattern and timings	0.02*
Reduced appetite	0.56
Loss of appetite	0.06
Dysphagia	0.04*
Nausea	0.01*
Vomiting	0.04*
Disease symptoms	
Fever	0.96
Sore throat	0.07
Sneezing	0.39
Breathlessness	0.11
Chest pain	0.01*
Cough	0.13
Generalized weakness	0.85
Headache	0.41
Muscle pain	0.87
Ocular pain	0.21
Comorbidities	0.01*
Diabetes	0.01*
Hypertension	0.02*
Cardiovascular Disease	0.19
GI Disease	0.69
Tuberculosis	0.93
Malignancies	0.31
Cerebrovascular Disease	0.08
Renal Disease	0.38
Chronic Lung disease	0.29
Liver Disease	0.89

* Significant association at p value of ≤ 0.05

DISCUSSION

This small hospital-based study looked into the different socio economic and clinical variables that may influence the severity of Covid 19 infection. It is well known that comorbid conditions such as Hypertension, Diabetes mellitus and Obesity are risk factors for a poorer prognosis and severe infection as per many Indian and international studies. Our study reiterated the same with patients with moderate COVID 19 having increased incidence of obesity and comorbidities. Similar results were found from the study conducted by de Almedia-Pititto et al.[5] which concluded that Diabetes mellitus, hypertension and cardiovascular diseases increased the risk of COVID-19 severity and mortality among the infected individuals. Similar review was obtained from the study which states that obesity and diabetes are major risk factors for COVID-19 patients as these comorbidities reduce the metabolic functions and aggravate cytokine storm making it difficult to entrap and render the replication of the virus.[6]

From our study it was observed that obesity was more prevalent among moderate patients than in mild COVID-19 patients (36.2% moderate and 14.3% mild). Also, association was observed in between weight status and severity of disease. Similar findings were revealed by Chu et al.[7] In this study it was found that 69% of the patients were overweight/

obese. The study conducted by T.J.M.Goncalves et al in 2020 also had a high prevalence of obesity among COVID-19 patients.[8] Similarly; Cao P. et al did a study on Chinese persons with COVID-19 that show that obesity is one of the major risk factors for severe illness.[9]

Another major reason for severity of disease is tobacco addiction. In our study, smokers fared worse as compared to non-smokers as far as disease severity was concerned. Similar findings were observed in a study by Dubey et al which summarized that substance abuse led to poor outcomes in COVD 19 patients.[10] Studies done by Gulsen et al. and Zhang et al. also state that smoking worsens the prognosis for COVID 19.[11,12]

Malnutrition has direct impact on the severity of illness. Factors like lower calorie intake, erratic frequency of meals, symptoms of gastritis like nausea and loss of appetite reduce adequate nutrient intake of a patient. In the present study it was seen that all patients were taking a micronutrient deficit diet. As far as the macronutrients were concerned, the fats and carbohydrates were adequate but protein intake was not in most patients. Similar findings were observed in a study by Cereda et al. that suggests that a calorie deficit diet increases that severity of COVID19 infection among patients and optimal nutritional support should be provided for these patients to recover fast.[13]

Evidence suggests that protein deficiency causes lower immunity due to decreased formation of immunoglobulins. Adequate protein intake is required to exhibit anti-inflammatory effect by reducing deliverance of cytokines (Ferrara et al.)[14] Fernandez- Quintela et al. also emphasized on importance of adequate protein intake in COVID 19.[15] Kim et al. stated that a diet low in saturated fat and rich in fibre should be emphasized to reduce the severity of illness.[16] Micronutrients are also important to support immune function and decrease severity of the illness. Lower intake of micronutrients results in its deficiency this increasing the risk of COVID 19 as shown by McAuliffe et al.[17]

Reasons for lower nutrient intake and malnourishment in admitted patients can be due to many causes like reduced appetite, symptoms like fever, nausea, vomiting, dysphagia, erratic meal frequencies and inadequate food variety available in hospitals. In the present study it was seen that maximum participants had reduced appetite (74%). It was also observed that mild patients ate frequent meals in comparison to moderately severe patients, indicating that severity of disease might affect the meal pattern. Symptoms like breathlessness, cough, smell or loss of taste, fever and generalized weakness predispose a patient to reduced appetite and lesser food consumption as stated in a study by Mentella MC et al.[18]

CONCLUSION

The study reiterates the fact that obesity and malnutrition is one of the factors which is associated with severity of covid disease along with comorbidities like diabetes and hypertension. Diet plan for patients who are hospitalized for mild and moderate cases of COVID 19 is seldom tailored for individual patients. An intervention which recognizes and corrects micro and macronutrient deficiencies is very important. Patients also have to be counselled and motivated on tobacco cessation, alcohol avoidance, importance of regular exercise and adequate sleep. However, this study had limitations. The sample size was small and certain tests for micronutrient assessment were not available. We intend to do a follow up study in the future with more parameters to assess a detailed nutritional assessment of patients with COVID 19.

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