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Original Research Article

Using modified DECAF Score in mortality prediction in acute exacerbation of COPD patients presenting to emergency department in a tertiary care hospital

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ABSTRACT

Background: Chronic obstructive pulmonary disease (COPD) is a prominent cause of illness and mortality on a global scale. In 2019, it was predicted to rank as the sixth largest cause of mortality. COPD is one of the most prevalent non-communicable illnesses in the field of pulmonology. The DECAF score (Dyspnea, Eosinopenia, Consolidation, Acidemia, and Atrial Fibrillation) is a risk stratification tool for patients with AECOPD that can be used at the bedside to guide treatment, such as hospital at home for low-risk patients. The purpose of this study is to predict the in-hospital mortality in acute exacerbation of COPD patients with modified DECAF scores. Modified DECAF score includes Dyspnea, Eosinopenia, Consolidation, Acidemia and Frequency of Hospitalization.

Material and Methods: A total of 50 patients attending Emergency Medicine Department with Acute Exacerbation of COPD were recruited to this hospital based observational study. This study was conducted at the Department of Emergency medicine & Pulmonary medicine, at APOLLO GLENEAGLES HOSPITALS, Kolkata.

Results: COPD was more prevalent in the age groups of 41-50 years (28%) and 61-70 years (28%) followed by those having age between 51-60 years (22%). Majority of the COPD patients were males (88%) compared to (12%) females. Majority of the COPD patients were males (88%) compared to (12%) females. Most common co-morbid condition associated with COPD washypertension (16%) followed by IHD (8%), pulmonary hypertension (6%) and diabetes mellitus (4%). Out of 50 patients with COPD, 11 (22%) had previous history of AECOPD, 38 (76%) were regular user of inhaler, 33 (66%) had history of influenza vaccination, 16 (32%) had Pneumococcal Vaccination and 2 (4%) patients had COVID-19 pneumonia. Out of 50 patients, 24 (48%) had Dyspnea (eMRCD) score of 5a whereas 26 (52%) had Dyspnea (eMRCD) score of 5b as well as 7 (14%) had Eosinopenia (<50 cells/mm3) and 20 (40%) had Consolidation.

Conclusion: We conclude that the Modified DECAF score is both sensitive and specific in predicting in-hospital mortality in AECOPD patients. Modified DECAF is a simple tool that predicts mortality that incorporates routinely available indices. It effectively stratifies COPD patients admitted with acute exacerbations into mortality risk categories.

Keywords: Modified DECAF Score, COPD patients, Emergency department, Tertiary care hospital

Introduction:

Chronic obstructive pulmonary disease (COPD) is a prominent cause of illness and mortality on a global scale. In 2019, it was predicted to rank as the sixth largest cause of mortality.[1] COPD is one of the most prevalent non-communicable illnesses in the field of pulmonology. It is defined by restricted airflow and has a detrimental effect on both quality of life and life expectancy.[2] COPD is a long-term, steady pattern that is exacerbated by rapid, acute episodes of dyspnea and coughing. Acute exacerbations of COPD (AECOPD) can be fatal and are caused by tobacco smoking or air pollution.[3] AECOPD becomes more common as COPD advances and has a significant chance of recurrence within eight weeks. The in-hospital mortality rate for AECOPD may range from 2.5 percent to 25 percent; readmission rates for those who survived may range from 25 percent to 55 percent, and 25 percent to 50 percent of these patients may die within one year.[4 Most patients with AECOPD who attend an emergency room have a significant exacerbation and require hospitalisation. If respiratory failure is apparent, Intensive care and mechanical ventilation may be required. In such cases, determining the severity of the Exacerbation is critical in guiding decisions about the level of care (at home, in a hospital ward, or in an intensive care unit), as well as the intensity of treatment, the beginning of mechanical ventilation, and follow-up.[5] The forced expiratory volume (FEV1) in one second is the single most important metric in determining the risk of mortality in patients with AECOPD. Other concerns include hypoxemia or hypercapnia on arterial blood gas (ABG) tests, walking a short distance in a short amount of time, the severity of functional dyspnea, and a low body mass index.[6] A variety of AECOPD scores have been established, including DECAF, modified DECAF, and CAPS. Scores such as CURB-655, which was created for pneumonia, have also been utilised in AECOPD, and standard ICU scoring systems such as APACHE II have been used to predict mortality. The DECAF score has a higher prediction accuracy than other scoring systems of a similar nature.[7] The DECAF score (Dyspnea, Eosinopenia, Consolidation, Acidemia, and Atrial Fibrillation) is a risk stratification tool for patients with AECOPD that can be used at the bedside to guide treatment, such as hospital at home for low-risk patients.[8] The DECAF score uses indices routinely available at admission. The score includes five predictors, the strongest of which is stable state dyspnoea, measured by the extended Medical Research Council Dyspnea score.[9] The purpose of this study is to predict the in-hospital mortality in acute exacerbation of COPD patients with modified DECAF scores. Modified DECAF score includes Dyspnea, Eosinopenia, Consolidation, Acidemia and Frequency of Hospitalization.

Aim and Objectives: To validate the use of modified DECAF score for prediction of mortality in patients of acute exacerbation of COPD.

Material and Methods:

Study design: Hospital based observational study.

Study area: The study was performed in the Department of Emergency medicine & Pulmonarymedicine, at APOLLO GLENEAGLES HOSPITALS, Kolkata.

Study population: Patients attending Department of Emergency Medicine with Acute Exacerbationof COPD.

Inclusion criteria:

1. Patients who were previously diagnosed COPD (as per GOLD Guidelines) and had AcuteExacerbation at the time of admission.
2. Those giving informed consent.

Exclusion criteria:

1. Primary reason for admission other than Acute Exacerbation of COPD
2. Patients presenting with Myocardial Infarction
3. Unstable cardiovascular status, unstable angina
4. Past or present history of tuberculosis
5. Pneumothorax
6. Malignancy

Calculation of Sample Size: The formula used to calculate the sample size was as follows:

$$n = \frac{z^2pq}{d^2}$$

where n = sample size, z = the standard normal deviate, which is 1.96 at 95% confidence interval, p = prevalence in the population of the factor under study = 7% = 0.07 (From previous study*), q = 1-p = 93% = 0.93,

d = Absolute precision

$$\frac{z^2pq}{d^2} = \frac{(1.96)^2 * 0.07 * 0.93}{d^2(= 0.0064)}$$

Thus using the formula , we get n > 39.

Thus we have to take at least 40 patients in our study. Our sample size included 50 patients.

(*Verma A, Gudi N, Yadav UN, Roj MP, Mahmood A, Nagraja R, Nayak P. Prevalence of COPD
among population above 30 years in India: A systematic review and meta-analysis. J Glob Health 2021;11:04038.)

Modified dyspnea scores, eosinopenia, consolidation, acidemia, and frequency of hospitalization score

Variables	**Score**
Dyspnea limiting the patient to home (eMRCD 5) and independent in bathing and dressing (eMRCD5a)	1
Requires assistance in bathing and dressing (eMRCD 5b)	2
Eosinopenia (<50 cells/mm3)	1
Consolidation	1

Acidemia (pH <7.30)	1
Frequency of hospitalization in last one year (2 or more)	1
Total score	6

eMRCD: Extended medical research council dyspnea score

Correlation was analyzed between modified DECAF score given to AECOPD patients and their In- hospital mortality. Based on the total score patients were grouped in to Low Risk (0-1), Intermediate risk (2) and High Risk (3-6).

DATA COLLECTION TECHNIQUE AND TOOLS:

All the data were collected in pre-approved data collection from and data was transferred to an Microsoft excel sheet by the same person filling the data collection from.Detailed history, including age, sex, comorbidities, clinical examination including assessment of mental state conscious level and signs of severity of exacerbation were recorded for all patients in the study. Other parameters such as invasive or non-invasive ventilation support was also recorded. Modified DECAF score has five variables (Baseline dyspnoea eMRCD 5a or 5b, Eosinopenia (<50 cells mm3), Consolidation, Acidemia (pH < 7.3), frequency of hospitalisation in the last 1 year, with a maximum score of 6. Patients were categorized in to Low Risk (0-1), Intermediate risk (2) and High Risk (3-6) based on Modified DECAF score. Hospital outcomes were evaluated in terms of in hospital mortality in relation to Modified DECAF score.

STATISTICAL ANALYSIS: All the data analysis was performed using IBM SPSS ver. 20 software.

Frequency distribution and cross tabulation was performed to prepare the tables. Categorical data is expressed as number and percentages. Chi Square test was performed to compare the variables with Modified DECAF score. P value of <0.05 was considered as significant.

Observation and Results: A total 50 COPD patients were enrolled for the study and among them 44(88%) were males and 6(12%) were females.

COPD was more prevalent in the age groups of 41-50 years (28%) and 61-70 years (28%) followed by those having age between 51-60 years (22%). There were 9 (18%) patients with age more than 70 years and only 2 (4%) patients had age less than 40 years. [Table:1]

Table 1: Distribution of patients according to age (years)

Age groups (years)	Frequency	Percent

≤40	2	4.0
41-50	14	28.0
51-60	11	22.0
61-70	14	28.0
>70	9	18.0
Total	50	100.0

Table 2: Modified DECAF Score

Modified DECAF Score	Frequency	Percent
Low Risk (0-1)	23	46.0
Intermediate risk (2)	9	18.0
High Risk (3-6)	18	36.0
Total	50	100.0

Patents were grouped based on Modified DECAF score in to low risk, intermediate risk and high risk.

Out of 50 COPD patients, 23 (46%) were low risk patients, 18 (36%) were high risk and 9 (18%) were intermediate risk patients.

Table 3: Association between Modified DECAF score and outcome

		Modified DECAF score new			Total
		High Risk	Intermediate risk	Low Risk	
Outcome	Improved	8	9	23	40
	Mortality	10	0	0	10
Total		18	9	23	50

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)

Pearson Chi-Square	22.222[a]	2	.000
Likelihood Ratio	25.310	2	.000
N of Valid Cases	50		
a. 3 cells (50.0%) have expected count less than 5. The minimum expected count is 1.80.			

Mortality was more in those patients with high Modified DECAF score (n=10 out of 18) whereas no
mortality was reported in patients with low or intermediate risk (p<0.001).

Figure 1: Association between Modified DECAF score and ventilation status

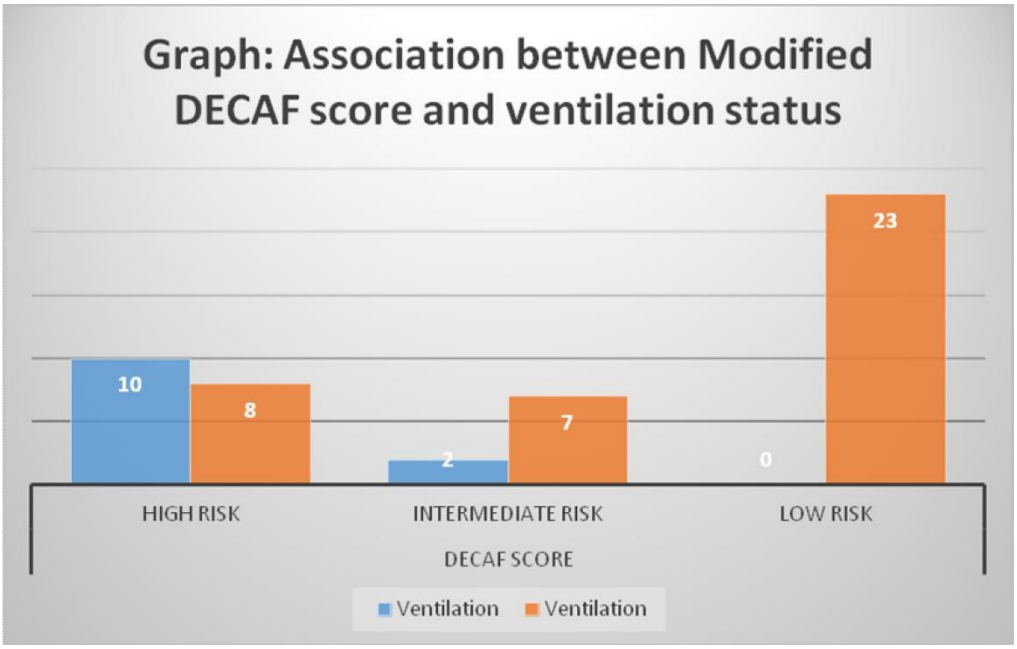
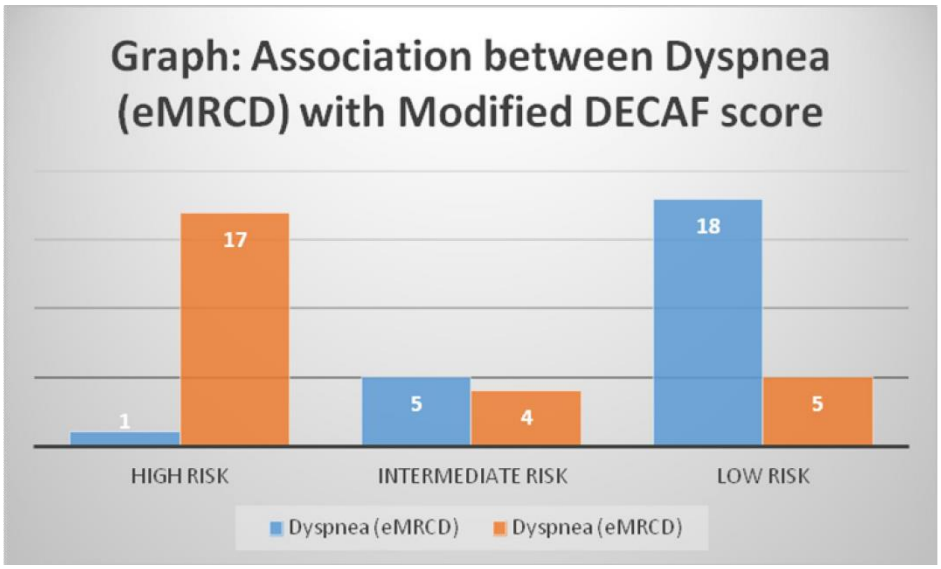


Figure 2: Association between Dyspnea (eMRCD) with Modified DECAF score



Majority of the patients with high risk had Dyspnea (eMRCD) score of 5b (n=17 out of 18) compared to those with low or intermediate risk (p<0.001).

Table 4: Association between consolidations with Modified DECAF score

		Modified DECAF score			Total
		High Risk	Intermediate risk	Low Risk	
Consolidation	No	2	5	23	30
	Yes	16	4	0	20
Total		18	9	12	50

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	33.333[a]	2	.000
Likelihood Ratio	42.378	2	.000
N of Valid Cases	50		
a. 1 cells (16.7%) have expected count less than 5. The minimum expected count is 3.60.			

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Figure 3. Association between Frequency of Hospilisation with Modified DECAF score

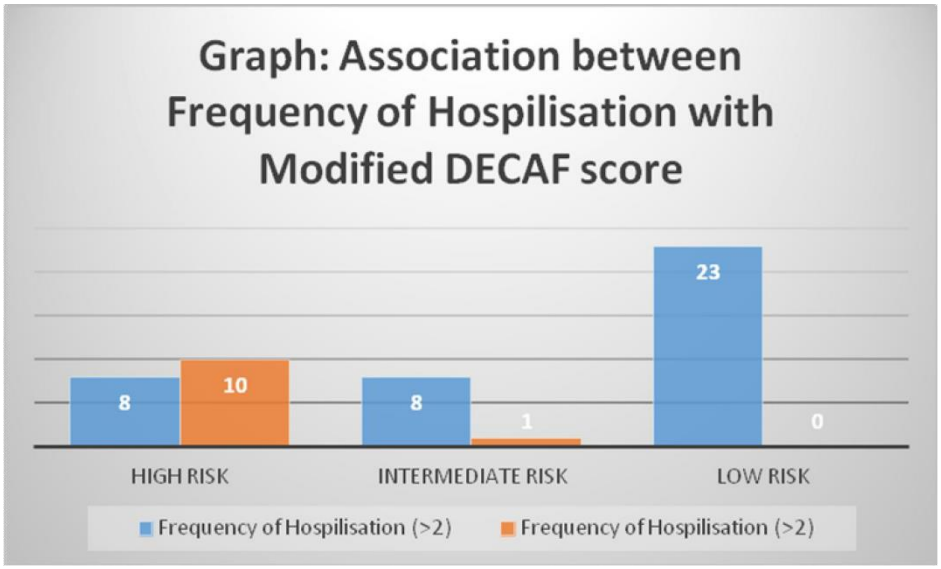
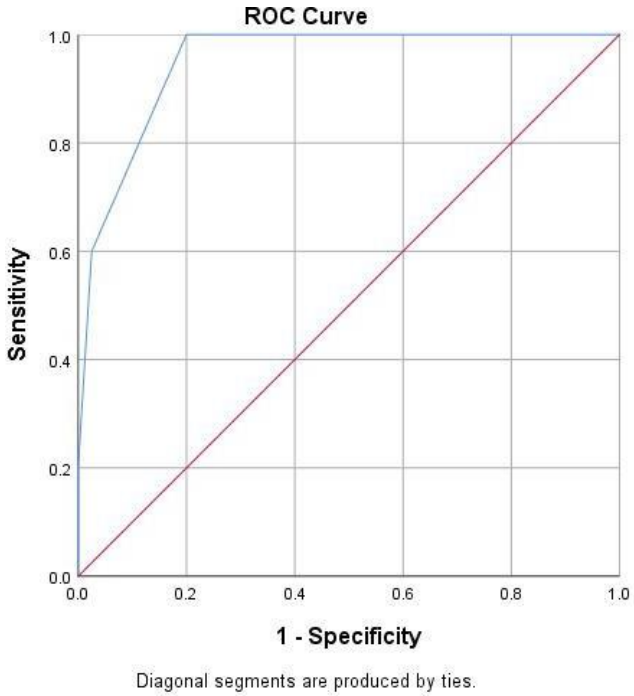


Figure 4: ROC curve of Modified DECAF score in predicting mortality

ROC curve of Modified DECAF score in predicting mortality revealed by probability as revealed by the area under the curve of 0.950 with p value of <0.001 which is highly significant. This indicate that Modified DECAF score is a good tool in



predicting mortality risk in patients with COPD.

Discussion:

We observed in the present study that COPD was more prevalent in the age groups of 41-50 years (28%)

and 61-70 years (28%) followed by those having age between 51-60 years (22%). There were 9 (18%)
patients with age more than 70 years and only 2 (4%) patients had age less than 40 years. We observed
maximum prevalence of COPD in the patient's age group of 41 – 70 years. Sharma S et. al (2020) reported in their study that out of 160 patients, 94 (58.75%) patients were in the age group above 60 years, followed by 63 (39.37%) patients in 41–60 years' age group. There were only three cases in the age group 21–40 years.
Overall, the mean age of patients was 64.27 ± 9.768 years.[10] This finding was in close correlation with the present study. Bansal HK et al (2018) reported that maximum patients 54 (48.21%) were from 61-75 yrs age group, 23 (20.53%) patients were from more than 75 yrs, 33 (29.46%) patients were from 46-60 yrs age group and 2 (1.79%) patients were from 30-45 yrs age group.[11] We also observed that majority of the COPD patients
were males (88%) compared to (12%) females and there was a clear male preponderance for the prevalence
of COPD. This finding of the present study was in agreement with the previous study by Sharma S et. al (2020) who note that there was a predominance of males as compared to females, 137 patients were male and 23 were female.[10] Nafae R et. al (2014) also reported similar results.[7] Thus, it was established that prevalence of COPD is higher in males as compared to females. We also studied the associated co-morbidities in the patients
of COPD. We observed that most common co-morbid condition associated with COPD was hypertension (16%)
followed by IHD (8%), pulmonary hypertension (6%) and diabetes mellitus (4%). Nafae R et al (2014)
observed in their study that the most common associated co-morbidity in the patients of COPD was
hypertension, which was in agreement with the present study.[7]

Out of all the recruited patients in the current study, 11 (22%) had previous history of AECOPD, 38 (76%) were regular user of inhaler, 33 (66%) had history of influenza vaccination, 16 (32%) had Pneumococcal Vaccination and 2 (4%) patients had COVID-19 pneumonia. Bansal AG et. al (2020) noted in their study that 10.53% had no previous history of COPD, 102 (44.74%) had a disease duration of 1–5 years, and 102 (44.74%) had a disease duration of ≥6 years with the disease duration of 0, 1–5, and ≥6 years taken randomly. Of the 228 patients, 84 (36.84%) patients had no history of exacerbations in the previous 1 year, 112 (49.12%) had one exacerbation in the past 1 year, and 32 (14.04%) patients had two or more exacerbations in the past 1 year.[11]
24 (48%) patients in the current study had Dyspnea (eMRCD) score of 5a whereas 26 (52%) had Dyspnea (eMRCD) score of 5b. Sharma S et al (2020) reported in their study that there were 92 cases presenting with eMRCD Grades 0–4 with score 0, 42 cases presented with eMRCD Grade 5a with score 1 and 26 cases
presented with eMRCD Grade 5b with score 2.[10] Out of 50 patients with COPD, 20 (40%) had Consolidation
in the current study population. Sharma S et al (2020) reported in their study that 26% patients presented with consolidation.[10] Bansal HK et. al (2018) reported the

contradictory results in their study. They reported almost 50% of the patients with the presence of consolidation.[12] Nafae R et al (2014) found in their study that 35% of the patient revealed the presence of consolidation radiologically.[7] In the present study, patents were grouped based on Modified DECAF score into low risk (Modified DECAF Score 0 - 1), intermediate risk (Modified DECAF Score 2) and high risk (Modified DECAF Score 3 - 6). Out of 50 COPD patients, 23 (46%) were low risk patients, 18 (36%) were high risk and 9 (18%) were intermediate risk patients. Sharma S et. al (2020) reported in their study that 74% patients in their study belong to low risk patients. This was high number than the findings of the present study. They reported the number of the intermediate and high risk patients in their study to be 9% and 16% respectively.[10] Bansal AG et al (2020) reported in their study that, 112 patients were identified as low risk with a DECAF score of 0–1, 60 patients were identified as intermediate risk with a DECAF score of 2, and 56 patients were identified as having high risk based on the DECAF score of 3 or more.[11] We observed in the present study that mortality was more in those patients with high Modified DECAF score (n=10 out of 18) whereas no mortality was reported in patients with low or intermediate risk (p<0.001). Sharma S et al (2020) reported that mortality was the highest (83.33%) in cases with modified DECAF score 5, it was also significantly high (65%) in patients with score 4, hence these two scores were classified as High risk category. A mortality of 6.66% was observed among patients with Modified DECAF score 3, hence classified as intermediate risk category Modified DECAF scores 02 did not show any mortality.
They were classified as low risk group [Table 4]. It suggests that mortality was increasing progressively with increase in Modified DECAF score. The Modified DECAF score showed a statistically significant relation with the in-hospital mortality of AECOPD (P < 0.0001).[10] We also observed that majority of the patients with high Modified DECAF score had invasive ventilation (8 out of 18) compared to low or intermediate risk patients (p=0.001). Sharma S et al (2020) reported their results as per this, Ventilator was not used in patients who had Modified DECAF score 0–2. Average length of ventilator use was 3, 2 and 3 days in Modified DECAF scores 3, 4 and 5, respectively.[10] We didn't find any significant correlation between Modified DECAF score and duration of hospital stay was obtained as revealed by the insignificant p value of 0.782. The result of the present study was contradictory to the findings of Sharma S et al (2020) who observed that the length of hospital stay was 4, 6, 9, 11, 9 and 6 days on an average for modified DECAF scores 0, 1, 2, 3, 4 and 5, respectively.This relation between modified DECAF score and the length of hospital stay is statistically significant (P < 0.0001).[10] Memon MA et. al (2019) reported that the mean duration of hospital stay was 4 ± 3 days. In total, 141 patients (87.0%) survived the AECOPD, were successfully managed, and discharged to home. Twenty-one patients (13.0%) died in the hospital.[13] In the present study, we also didn't find any significant association between age and sex with Modified

DECAF score was obtained as revealed by the insignificant p value of 0.145. ROC curve of Modified DECAF score in predicting mortality revealed by probability as revealed by the area under the curve of 0.950 with p value of <0.001 which is highly significant. This indicate that Modified DECAF score is a good tool in predicting mortality risk in patients with COPD. Bansal HK et. al (2018) reported that there was a statistically significant association between all predictors of the Modified DECAF score (statistically significant $p < 0.05$) and severity of Acute Exacerbation of COPD present. There is statistically significant p value between eMRCD score (0.0001), Eosinopenia (0.0001), Consolidation (0.014), Acidemia (0.0001) and Frequency of admission (0.0001) found.[12] Similarly Bansal AG et al (2020) reported similar results. They noted that the receiver operating characteristic (ROC) curve analysis was done for all variables independently and the DECAF score as a whole in predicting inhospital mortality, and it was observed that exacerbations/year, dyspnea, consolidation, acidemia, and the DECAF score were significantly associated with increased mortality, thus proving that the DECAF is an important and significant predictor of mortality in AECOPD.[11] Lastly, we report in the present study that the sensitivity, specificity, Positive Predictive Value (PPV) and Negative Predictive Value (NPV) of Modified DECAF score in predicting in- Hospital mortality was 100%, 57.50%, 100% and 37.4% respectively. Memon MA et. al (2019) reported that the sensitivity and specificity of the DECAF score for predicting mortality was 100% and 34.1% respectively.[13]

CONCLUSION:

Present study conclude that COPD is most prevalent in the age groups of 41 - 70 years of age and it has more male predominance in terms of occurrence. We observed a total morality of 20% in our patient population.

The use of Modified DECAF score was found to be useful for the management of the COPD patients as well as their prognosis. The categorical classification of patients in to high, intermediate and low risk group has definitive associations in terms of mortality and other COPD related outcomes. Mortality was more in those patients with high Modified DECAF scores. Also, majority of the patients with high Modified DECAF score has invasive ventilation compared to low or intermediate risk patients. Similarly, patients with high risk had categories of dyspnoea (eMRCD), eosinopenia, presence of consolidation, acidemia as well as frequency of hospitalization. Sensitivity, Specificty, PPV and NPV of Modified DECAF score in predicting in-Hospital mortality was 100%, 57.50%, 100% and 37.4% respectively. Thus, we conclude that the Modified DECAF score is both sensitive and specific in predicting in-hospital mortality in AECOPD patients.

Modified DECAF is a simple tool that predicts mortality that incorporates routinely available indices. It effectively stratifies COPD patients admitted with acute exacerbations into mortality risk categories.

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