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A Study to Analyze Pulmonary Function Among Post Covid Patients Having Different Comorbid Conditions

Dr. Vidhi Gandhi[1], Dr. Kevin Harry[2]

[1]Department of Physiotherapy, Sharda College of Physiotherapy, Gujarat University, Pethapur, District Gandhinagar, Gujarat, India
[2]Department of Physiotherapy, Ahmedabad Institute of Medical Science, Gujarat University, Ahmedabad, Gujarat, India

Corresponding Author: Dr. Vidhi Gandhi

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ABSTRACT

INTRODUCTION: COVID-19 caused by severe SARS-CoV-2 is a global pandemic. People of any age who have underlying medical conditions, such as hypertension and diabetes and obesity, have shown worse prognosis and increased morbidity and mortality rates, also have been linked to more hospitalization and ICU admissions.
NEED OF STUDY: Need arise for this due to limited PFT data and its uses, for rehabilitation program, to corelate upcoming variants and its effect, for new covid guidelines and management.
METHEDOLOGY: The technique of procedure was in accordance with the standardized reference from "American thoracic society of standardization of spirometry". Test maneuvers included parameters like, FVC, FEV1, FEV1/FVC ratio, PEFR.
RESULT: The study suggestive that there is significant difference between age, Weight, FVC, PEFR and FEV1. whereas the height and FEV1/FVC values doesn't show any significant difference among the group.
CONCLUSION: The study concluded that all the post covid patients show variations in different lung functions. The study is suggestive that there is significant difference between age, Weight, FVC, PEFR and FEV1. whereas the height and FEV1/FVC values doesn't show any significant difference among the group.

Keywords: PFT, Post Covid Patients, Comorbid Conditions, Pandemic.

INTRODUCTION

A pandemic is a disease outbreak that spreads across countries or continents. It affects more people and takes more lives than an epidemic. The World Health Organization (WHO) declared COVID-19 to be a pandemic when it became clear that the illness was severe and that it was spreading quickly over a wide area.

Coronavirus disease (COVID-19) caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is a global pandemic that initially started in Wuhan, China, and spread extremely quickly, making its way to over 180 countries.

Older adults and people of any age who have underlying medical conditions, such as hypertension and diabetes and obesity, have shown worse prognosis. Diabetic, Hypertensive and obese patients have increased morbidity and mortality rates and have been linked to more hospitalization and intensive care unit (ICU) admissions.

The current outbreak of COVID-19 in India, which started in early March 2021, has created a new world record even beyond the

outbreaks in the UK, the United States and Brazil. This current second wave took only 2 months to infect an Indian population over 0.4 million new cases per day (as of 23 April 2021). As the coronavirus disease 2019 (COVID-19) outbreak, identification of clinical predictors of severe or fatal disease are necessary to enable risk stratification and optimize allocation of limited resources.

Individuals with diabetes mellitus (DM), hypertension, and severe obesity (BMI ≥ 40 kg/m^2) are more likely to be infected and are at a higher risk for complications which may contribute to the need for mechanical ventilation in intensive care units and in the high incidence of mortality with premature death. Studies shows, Pulmonary complication of diabetes mellitus have been poorly characterized. Although some authors have reported normal pulmonary function, others found abnormalities in lung volumes, pulmonary mechanics, and diffuse capacity. The effect of hypertension on the lung are limited and contradicted. Some investigators show a decrease in pulmonary function parameters in hypertensive patients. Obese persons who had normal arterial oxygen saturation had reduced expiratory reserve volumes, reduced maximal breathing capacities, and reduced maximal flow rates.

Due to limited data which shows alter in pulmonary function among post covid patients and to know that, there can be changes in pulmonary functions in post COVID-19 patients with comorbid conditions and post covid patient without any comorbid condition with the help of Spirometer. If there are abnormal pulmonary function changes, which pattern can be seen, that is restrictive, obstructive or mix. So, the purpose of this research is to review the effect and characteristics of Covid19 exposure on Pulmonary function among post covid patients having different comorbid condition.

PFT in post covid patients helps for rehabilitation program who are suffering from post-COVID-19 syndrome or "long COVID-19. So, this data can be helpful in future study and rehabilitation program. New researches in covid are extremely needful for upcoming variants and its effect, it also helpful for new covid guidelines and also for aggressive management of covid. So, need arise for this study to analyse pulmonary function among post covid patients having different comorbid conditions.

Aim of study to Analyze Pulmonary Function Among Post Covid Patients Having Different Comorbid Conditions and without any comorbid condition in Ahmedabad and Gandhinagar city of Gujarat with The Help of Pulmonary Function Test (PFT).

Objectives are to assess the influence of covid 19 on pulmonary function to compare FVC, FEV^1, FEV^1/FVC Ratio and PEFR values in post covid19 patients either with Diabetes Mellitus, with Hypertension, with Obesity, or with above any two comorbid conditions and without any comorbid conditions.

MATERIALS & METHODS

- ETHICAL APPROVAL- The study was started after taking approval from institutional ethical committee
- STUDY DESIGN- An observational study was conducted to study Pulmonary Function Among Post Covid Patients Having Different Comorbid Conditions and without any comorbid condition.
- STUDY SETTING- The study was carried out at different Hospitals, Clinics and Societies of Ahmedabad and Gandhinagar Cities of Gujarat.
- SAMPLE SELECTION- Patients were selected as per inclusion and exclusion criteria.
- STUDY DURATION- Data was collected over a period of 1 year
- SAMPLE DESIGN- Conventional Sampling use for data collection.
- SAMPLE SIZE- Total (n) = 150 (Group A: Hypertensive Patients (n = 30), Group B: Diabetic Patients (n = 30), Group C: Obese Patients (n = 30), Group D: with above any 2 comorbid condition Patients (n = 30), Group E: with not having any comorbid conditions (n = 30))

- SELECTION CRITERIA:

Inclusion Criteria:

- Post covid subjects with comorbid condition and Post covid subjects without comorbid condition between 30 to 55 years, both males and females
- Post covid 19 subjects with or without any comorbid conditions within 3months.
- SpO2 95% or below that at least 2 to 5 days during covid infection
- Common comorbid Conditions: HTN, DM, Obesity, patient having any 2 comorbid conditions and not having any comorbid conditions in post covid subjects.

Exclusion Criteria:

- Subjects have any other comorbid conditions except HTN, DM and Obesity.
- Subjects who needed ventilator support.
- Subjects who had any past cardio pulmonary history or condition.
- Subjects who have any abnormal chest shape.
- Subject who had history of Mucomycosis.
- Subjects who have any orthopedic, neurological, or psychological condition.

MATERIALS:

PFT machine, Computer, Camera, Assessment form, Consent form, Pen, paper, measuring tape, Sanitizer, Plinth. Cotton, Data sheet

METHODOLOGY

Total 150 subjects (post covid without any comorbidity (n=30), post covid with hypertension (n=30), post covid with diabetes mellitus (n=30), post covid with obesity (n=30) and post covid with any two mix comorbidities (hypertension, diabetes mellitus, obesity) (n=30)) were included in the study, written informed consent taken, Demographic details taken from participants were name, age, gender, weight, height, post covid day, comorbid condition (HTN, DM, Obesity).

Pulmonary Function Test (PFT) checked and values noted (FVC, FEV1, PEFR, FEV1/ FVC %) in each participant.

STATISTICAL ANALYSIS

Data analysis was done and result calculated using SPSS Software

RESULT

- Statistical data distribution and Data analysis was performed using statistical package of social sciences (SPSS) version 20.0 and Microsoft office Excel 2007. Here there is significant difference between age, Weight, FVC, PEFR and FEV1.
- On applying Bonferroni post hoc test to compare between groups for the significant difference, P value is >0.05. As data is normally distributed parametric test is used for analysis. In this study level of significance was kept at 95%.

TABLE 1: For age: Shows Age distribution of all the groups namely Without Any Comorbid Condition (WACC) (n=30), Hypertensive (n=30), Obese (n=30), DM (n=30) and With Any Two Comorbid Conditions (WATCC) (n=30). Bonferroni post hoc test was applied to find difference between them which indicated p<0.001, there is significant difference between WACC and Hypertensive, with DM and WATCC.

AGE	MEAN	SD	F	P
NORMAL	34.83	5.41	22.96	<0.001
HYPERTENSIVE	41.80	8.14		
OBESE	38.50	7.46		
DM	48.40	5.29		
MIX	47.03	5.74		

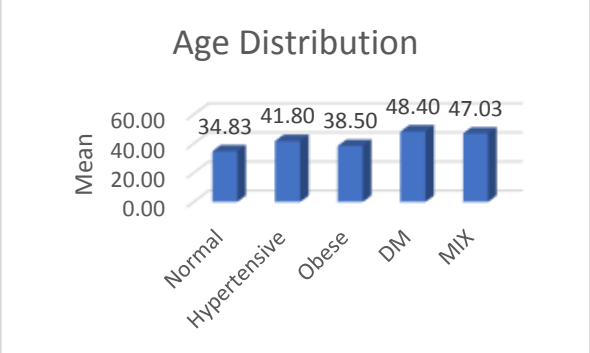


TABLE 2: For Height: Shows Height distribution of all the groups namely Without Any Comorbid Condition (WACC) (n=30), Hypertensive (n=30), Obese (n=30), DM (n=30) and With Any Two Comorbid Conditions (WATCC) (n=30). Bonferroni post hoc test was applied to find difference between them which indicated p>0.038, there is no significance difference between WACC and any comorbid condition.

Height	MEAN	SD	F	P
NORMAL	5.41	0.41	1.06	0.38
HYPERTENSIVE	5.47	0.34		
OBESE	5.40	0.29		
DM	5.55	0.34		
MIX	5.46	0.31		

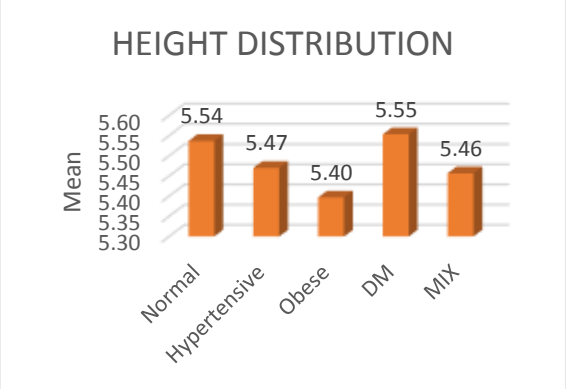


TABLE 3: For weight: Shows Weight distribution of all the groups namely Without Any Comorbid Condition (WACC) (n=30), Hypertensive (n=30), Obese (n=30), DM (n=30) and With Any Two Comorbid Conditions (WATCC) (n=30). Bonferroni post hoc test was applied to find difference between them which indicated p<0.001, there is significant difference between WACC and Obese, and WATCC.

WHEIGHT	MEAN	SD	F	P
NORMAL	66.93	12.48	19.87	<0.001
HYPERTENSIVE	67.50	12.42		
OBESE	88.30	10.05		
DM	70.33	9.39		
MIX	82.63	14.66		

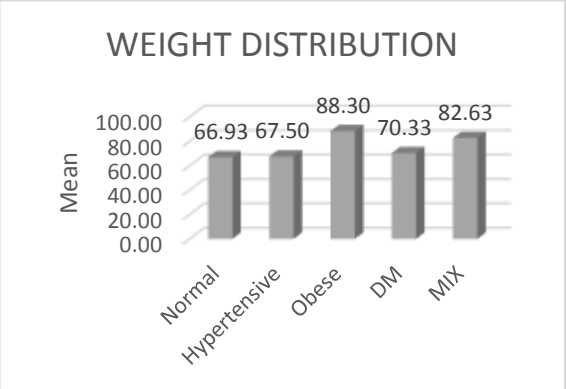


TABLE 4: For BMI: Shows BMI distribution of all the groups namely Without Any Comorbid Condition (WACC) (n=30), Hypertensive (n=30), Obese (n=30), DM (n=30) and With Any Two Comorbid Conditions (WATCC) (n=30). Bonferroni post hoc test was applied to find difference between them which indicated p>0.37, there is significant difference between Normal and Hypertensive, with DM and Mix.

BMI	MEAN	SD	F	P
NORMAL	23.20	2.23	1.08	0.37
HYPERTENSIVE	23.95	2.83		
OBESE	32.74	2.10		
DM	24.39	2.93		
MIX	32.04	2.96		

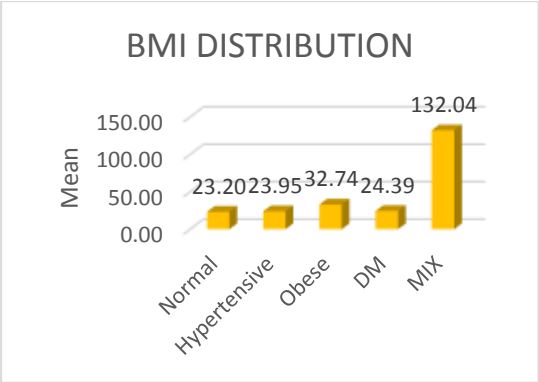


TABLE 5: For FVC: Shows FVC distribution of all the groups namely Without Any Comorbid Condition (WACC) (n=30), Hypertensive (n=30), Obese (n=30), DM (n=30) and With Any Two Comorbid Conditions (WATCC) (n=30). Bonferroni post hoc test was applied to find difference between them which indicated p>0.03, there is significant difference between Normal and Mix.

FVC	MEAN	SD	F	P
NORMAL	89.27	25.77	2.70	0.03
HYPERTENSIVE	78.20	20.06		
OBESE	79.80	17.92		
DM	85.53	22.25		
MIX	73.33	17.04		

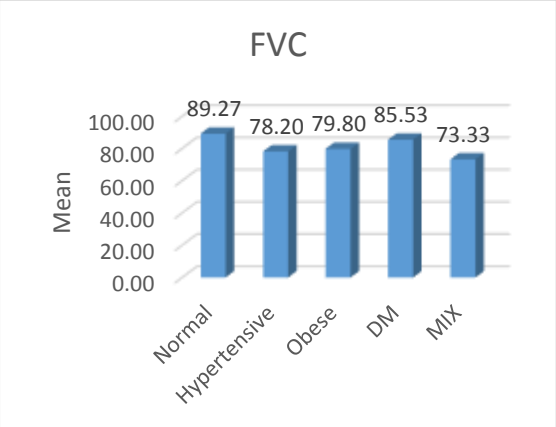


TABLE 6: For FEV1/FVC: Shows FEV1/FVC distribution of all the groups namely Without Any Comorbid Condition (WACC) (n=30), Hypertensive (n=30), Obese (n=30), DM (n=30) and With Any Two Comorbid Conditions (WATCC) (n=30). Bonferroni post hoc test was applied to find difference between them which indicated p>0.66For FEV1/FVC there is no significance difference between Normal and any comorbid condition.

FEV1/FVC	MEAN	SD	F	P
NORMAL	105.77	15.24	0.61	0.66
HYPERTENSIVE	105.50	14.22		
OBESE	100.50	18.58		
DM	103.30	12.86		
MIX	103.63	12.86		

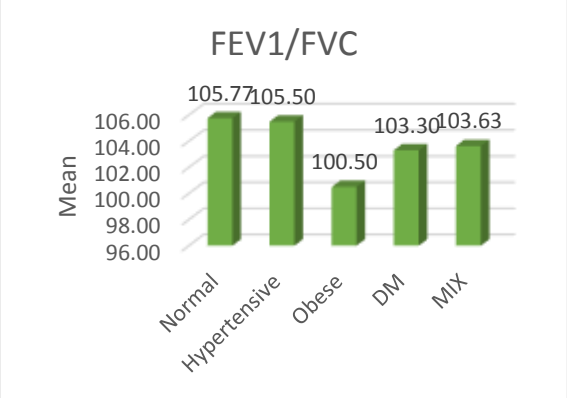


TABLE 7: For PEFR: Shows PEFR distribution of all the groups namely Without Any Comorbid Condition (WACC) (n=30), Hypertensive (n=30), Obese (n=30), DM (n=30) and With Any Two Comorbid Conditions (WATCC) (n=30). Bonferroni post hoc test was applied to find difference between them which indicated p>0.06 there is significant difference between Normal and Mix.

PEFR	MEAN	SD	F	P
NORMAL	61.83	22.85	2.30	0.06
HYPERTENSIVE	58.93	21.66		
OBESE	51.90	18.95		
DM	54.33	15.17		
MIX	48.07	19.51		

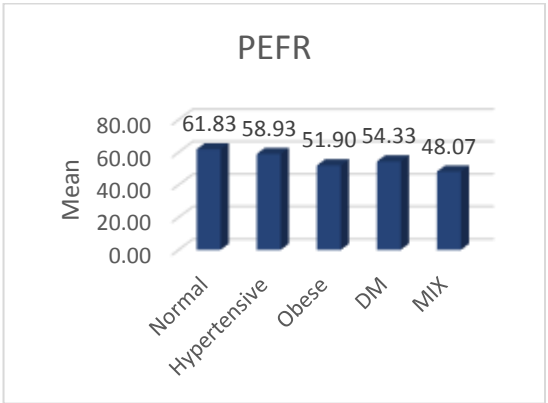
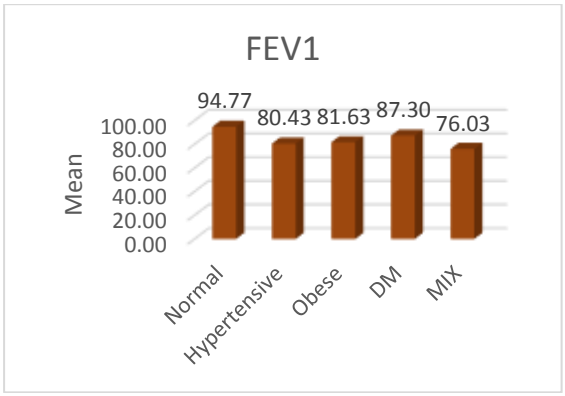


TABLE 8: For FEV1: Shows FEV1 distribution of all the groups namely Without Any Comorbid Condition (WACC) (n=30), Hypertensive (n=30), Obese (n=30), DM (n=30) and With Any Two Comorbid Conditions (WATCC) (n=30). Bonferroni post hoc test was applied to find difference between them which indicated p>0.01 there is significant difference between Normal and Mix.

FEV1	MEAN	SD	F	P
NORMAL	94.77	30.26	3.32	0.01
HYPERTENSIVE	80.43	17.01		
OBESE	81.63	17.27		
DM	87.30	21.33		
MIX	76.03	19.91		



DISCUSSION

The present study was conducted to observe the Pulmonary function among post covid patient having different comorbid conditions (Hypertension, Diabetes Mellites, Obesity, and any two comorbid conditions) and without any comorbid condition, 150 participants of different groups. Their MEAN±SD for age in post covid without any comorbid condition 34.83±5.41, HTN 41.80±8.14, OBESE 38.50 ± 7.46, DM 48.40 ± 5.29 and any two mix comorbidities 47.03 ± 5.74. Bonferroni post hoc test was applied to find difference between them which indicated p<0.001, there is significant difference between WACC and Hypertensive, with DM and WATCC.

An important aspect to consider is that the British Thoracic Society (BTS) guide recommends the evaluation of PFTs at three months post discharge. So, in this study PFTs within three months of post covid was conducted and found the restrictive patterns in 24% of patients, which is known to be associated with increased risk of comorbidities. The current guidelines

suggest a restrictive pattern if the FEV_1/FVC ratio ≥ lower limit normal (LLN) and the FVC is < LLN, which should be confirmed by evaluating the TLC. So, it suggests that there is abnormal pulmonary function among post covid patients either with or without any comorbid condition. The common cause of this pattern is extrapulmonary restriction, Muscle weakness causing extrapulmonary restriction would show a reduction in muscle pressures. Logically, this would be more prevalent in covid 19 survivors treated in ICU but may also be a contributing factor for patients treated on ward or at home who remained bed-bound for long durations. Although we didn't measure respiratory muscle function.

Another explanation for the restrictive pattern could be the development of necrotising pulmonary capillarity occurring in isolation. This arises from diffuse interstitial neutrophilic infiltration with cell fragmentation and, because of apoptosis, cellular accumulation within lung tissue, filling the interstitial space. This can lead to expansion and fibrinoid necrosis. As a result of this processes, the integrity of interstitial capillaries is damaged, allowing red blood cells to pass through the alveolar capillary basement membranes, freely enter the interstitial compartment and flood alveolar spaces.[23] The study has insufficient data to prove or disapprove this hypothesis currently so, even though it is unlikely, it cannot be excluded.

In addition, we have been able to identify common pattern of restrictive pulmonary impairment in covid 19 recovery but not the specific cause. There are many potential contributing factors both directly related to infection but, also, comorbidities, treatment regimens, length and stay, physical fitness, etc. Lastly, radiological data and symptom score were not available. Due to multifaceted nature of the clinical outcome in covid 19, it would be most likely to require a much larger population with additional information to elicit the specific pathologies that induce these physiological effects.

There are limitations in our study. Firstly, the lack of the baseline PFT results prior to the illness make it difficult to make a comparison with the results after the illness. The interpretation regarding to the impact of the COVID-19 on lung function remain valid. Secondly, the association between CT image and the lung function parameter wasn't analyzed in our study. DLCO not measured in this study only spirometry (FVC, FVE1, FEV1/FVC Ratio, and PEFR) done. Also blind was not done in the study. Study was only confirmed to Ahmedabad and Gandhinagar City, Larger sample can be taken in the future study. This analysis only provides a short follow-up, the long-term dynamic variation of the lung function after covid exposure within 3 months still require further investigation, a greater number of different comorbid conditions can be compared, New covid variants can be compared, Area of study can be expanded, Sample size can be increased. Lastly, Other contextual factors can also be considered.

CONCLUSION

- The study results concluded that all the post covid patients show variations in different lung functions. The study is suggestive that there is significant difference between age, Weight, FVC, PEFR and FEV1. whereas the height and FEV1/FVC values doesn't show any significant difference among the group.
- Pulmonary function test (not only spirometry, but also diffusion capacity) should be considered to performed in routine clinical follow-up for certain recovered survivors, especially in severe cases.
- Subsequent pulmonary rehabilitation might be considered as an optional strategy.
- Long-term studies are needed to address whether these deficits are persistent.

Declaration by Authors

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Conflict of Interest: The authors declare no conflict of interest.

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