



Patterns Of Structural And Functional Lung Abnormalities And Associated Factors
Among Post Covid-19 Survivors On Follow up At Yeka Kotebe General Hospital,
Addis Ababa, Ethiopia

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A Research Paper Submitted To Departments Of Internal Medicine And Public
Health, St. Paul's Hospital Millennium Medical College In Partial Fulfillment Of
The Requirement For Specialty Certificate In Internal Medicine

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Summary

Background: Post COVID-19 syndrome is a wide range of new, returning or ongoing health problems in people who had covid 19 disease. This, post covid 19 syndromes seen to affect every system of the body among which respiratory, neurologic and cardiovascular condition is the commonest and it is becoming the emerging public health priority. However, the magnitude & distribution of this condition is not well known in African population and particularly in Ethiopia.

Objective: To describe patterns of structural and functional lung abnormalities and associated factors among post covid-19 survivors on follow at Yeka Kotobe General Hospital, Addis Ababa, Ethiopia

Methods: A descriptive and analytical cross-sectional study was conducted from March 1/2022 – May 30/2022. Convenience sampling technique was used and all patients who fulfilled the inclusion criteria were included. Data was collected using pre-prepared checklist by interviewing participants and from their medical record. Collected data was entered, cleaned and analyzed using statistical package for social sciences (SPSS) version 25. Multivariable logistic regression between dependent and independent variables were performed to identify factors associated with functional and structural lung abnormalities.

Results: A total of 120 post covid 19 patients were assessed. Overall cumulative functional and structural lung abnormality were seen in 77(64.25%) of post COVID 19 patients. Thirty-one patients (25.8%) had more than one post covid 19 sign and symptoms. Dyspnea was the most common symptom reported by 58(48.3%) participants followed by severe fatigue, 45(37.5%) and chronic cough, 24(20.0%). Forty-four (36.6%, n=120) participants had resting oxygen saturation < 93% and 10(8.3%) were tachypneic during the interview. Only 30 participants had repeat chest Ct scan/ x-ray during post COVID 19 period and 24(80%) had some form of residual parenchymal lung abnormality mainly, bilateral parenchymal fibrotic changes. Older age, longer hospital stays and raised creatinine during admission found to increase risk of functional & structural lung abnormality among post covid 19 patients.

Conclusion and recommendations: Respiratory system dysfunction manifested by pulmonary symptoms and structural lung abnormality are common in patients who recovered from acute covid-19 illness. As a result, COVID-19's long-term consequences should not be neglected, as they may lead to increased morbidity, consumption of financial resources, and increased health system burden. Therefore, discrete screening especially those with high risk profile, assessment, appropriate investigation and providing evidence-based treatment for post COVID 19 patients is mandatory to reduce long term respiratory impact.

Abbreviations and Acronyms

ARDS: Acute Respiratory Distress Syndrome

CBC: Complete Blood Count

Ct scan: computed tomography scan

ENT: Ear, Nose, Throat

FEV1: Forced Expiratory Volume at 1 second

FVC: Forced Vital Capacity

GGO: Ground Glass Opacity

ICU: Intensive Care Unit

MERS: Middle East Respiratory Syndrome

MMRC: Modified Medical Research Council

NICE: National Institute For Health And Care Excellence

OPD: Out-Patient Department

PCS: Post- COVID Syndrome

PICS: Post Intensive Care Syndrome

PFT: Pulmonary Function Test

SARS: Severe Acute Respiratory Syndrome

SARS-COVID 19: Severe Acute Respiratory Syndrome Corona Virus Disease 19

SFQ: Shortened Fatigue Questionnaires'

TLC: Total Lung Capacity

UK: United Kingdom

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1 Introduction

1.1 Background

Since the first report of severe acute respiratory syndrome corona-virus 2 (SARS- CoV-2), which causes corona-virus disease (COVID 19) on December 31, 2019, the virus has dominated the life of every person worldwide(1). As of October 1/2022, more than 623 million of peoples were infected and more than 6 million were dead(2).

The clinical presentation of COVID 19 ranges from asymptomatic, mild symptomatic to fulminant and fatal cases. Severe cases of infection can lead to serious complications including, pneumonia, acute respiratory distress syndrome, sepsis, multiple organ failure, blood clotting, myocarditis, acute myocardial infarction, acute kidney injury, and other viral and bacterial infections that are not unique to corona-virus(3,4). COVID 19 associated death is possibly a result of pneumonia and hyper inflammation associated with cytokines storm syndrome(5).

Currently, many patients are surviving the acute phase due to improved quality of early supportive care and the number of COVID 19 survivors suffering from long term complication even after they have been laboratory tested negative for the disease are also increasing tremendously. This long-term COVID 19 sequelae may range from mild form of fatigue to serious forms requiring long-term oxygen therapy or even lung transplantation owing to pulmonary fibrosis(6).

Although there is not yet enough data to definitively establish and characterize a post COVID 19 syndrome, potential long-term consequences can be inferred from emerging data as well as prior experiences with other serious respiratory illnesses and the broader post-intensive care syndrome (PICS), a constellation of physical, cognitive, and psychological disabilities that can develop in those surviving critical illness(7).

Therefore, many researchers and health professionals are raising questions of potential long-term systemic organ dysfunction in COVID 19 survivors. In the previous corona-virus outbreaks of severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS), such long-term complication occurred in every domain of health including physical, psychological, and social aspects(8).

This growing evidence of long term COVID 19 complication had drawn attention of international health community. For instance, the United kingdom's (UK)s National Institute for Health and

Care Excellence (NICE) had implemented guidance on this ongoing covid-19 sequelae early on December 2020. This guidance distinguishes between acute COVID 19 (signs and symptoms of COVID 19 last up to four weeks), ongoing symptomatic COVID 19 (signs and symptoms of COVID 19 last from four to 12 weeks) and post COVID 19 syndromes. The NICE guidance described post COVID 19 syndromes as the set of signs and symptoms that develop during or after an infection compatible with COVID 19 and continue for more than 12 weeks and cannot be explained by an alternative diagnosis. This can affect any body system, including the cardiovascular, respiratory, gastrointestinal, neurological, musculoskeletal, metabolic, renal, dermatological, ear, nose & throat (ENT) and hematologic systems, as well as psychiatric problems, generalized pain, fatigue and persistent fever(9).

Recent evidence suggests that the lungs are the organ most affected by COVID 19 with different psychophysiological events that include diffuse alveolar epithelium destruction, hyaline membrane formation, capillary damage and bleeding, alveolar septal fibrous proliferation, and pulmonary consolidation. A characteristic of COVID 19 is the extensive injury to alveolar epithelial cells and endothelial cells with secondary fibroproliferation, indicating a potential for chronic vascular and alveolar remodeling leading to lung fibrosis and/or pulmonary hypertension. These findings generate concerns regarding the assessment of lung injury for discharged patients(10).

1.2 Statement of the problem

There were two coronavirus related epidemic before the current covid 19 pandemics. The severe acute respiratory syndrome coronavirus (SARS-COV) in China in 2003 and middle east respiratory syndrome corona virus (MERS-COV) in Saudi Arabia in 2012(8,11). Data from those epidemics showed significant long term health effect which extended to months to years after acute infection. To see some of them, study done by Tansay et, al which followed 117 patients who had contracted SARS-COV at 3, 6 and 12 months of infection found that 18% of individuals had reduced 6MWT, due to shortness of breath and fatigue, reduced quality of life at 3 months and most patients returned to work after 1-2 months of reduced work hours(12). Additionally, a follow up of 80 health care workers showed residual radiological lung lesion and impaired diffusion lung capacity of carbon monoxide at 1 year of acute infection(13). Similarly, Batawi et, al, followed 78

MERS-COV survivors in Saudi Arabia and found 48% of them described chronic fatigue symptom, 28% shortness of breath on moderate to severe exertion and few of them complained dry intermittent dry cough(14).

Knowledge from long term health consequence of MERS-COV & SARS- COV raised questions whether current COVID 19 pandemics had prolonged health effects among survivors of acute infection. From those insight some researches done on COVID 19 patients described significant long term health effects among COVID 19 survivors. For instance, study from Ireland showed significant morbidity persisted at median of 10 weeks after acute infection. 62%(n=153) of patients have not returned to full health and the median 6 MWT was reduced from normal subject(6). Similarly, data of one hospital from Italy which assessed 143 post covid patients at outpatient clinic service showed 44.1% of them had worsened quality of life and 88% reported at least one persisted symptom at median of 2month after acute infection(15). Another large cohort study done by Chaolin Huang et,al, China which enrolled 1733 post covid 19 patients found that, most patients endorsed at least one symptom, particularly fatigue or muscle weakness, sleep difficulties, and anxiety or depression at 6 month of covid 19 symptom onset(16).

Those studies demonstrated health impact of COVID 19 might last longer beyond acute phase similar to previous coronavirus epidemics. However, those studies are small in number and assessed small number of patients mainly from a few hospitals. Because of this, the representativeness of those studies and the explicitness of information provided were insufficient to represent general post COVID 19 patients. Additionally, those data are mainly from western patients and there were a few published studies done in Africa and to my knowledge, there was no single published study on post covid 19 health consequence in Ethiopia till this time.

Therefore, long-term health consequences of discharged patients after acute covid 19 treatment and the associated risk factors needs further scientific knowledge. Hence, this study, “patterns of structural and functional lung abnormality and associated factor among post covid 19 patients at Yeka Kotobe General Hospital, Addis Ababa, Ethiopia” is designed to put foundational scientific data.

1.3 Significance of the study

The finding of this study will help different sectors as follows:

Physician and health workers: It give knowledge and awareness of post COVID-19 sequalae in local population and hence prepare physician and health workers to prepare themselves in providing health service for COVID-19 survivors

Saint Paul's Hospital Millennium Medical College and Yeka Kotobe General Hospital: The hospitals might use this study result as a baseline knowledge for future research and academic purpose.

The ministry of health and health sector policy makers: This study result provide baseline information which helps in planning, organizing and strengthening health services and also to efficiently allocate public health resources for post COVID 19 patients.

Local Non-Governmental and Governmental Organization and Researchers: The study result provide baseline information for organization interested in similar area of research.

2 Literature review

2.1 post COVID 19 sequelae

Currently different studies are showing multi organ dysfunction which is merely related to long term effect of COVID 19 among patients survived acute phase of illness. Qitang Xiong et.al./2021, China, found among 538 survivors who were followed for median of 97 days after hospital discharge, 49.6% had general clinical symptom while persisted respiratory symptom found in 39%, cardiovascular related symptom in 13% and psychosocial symptoms in 22.7%(17). Similarly Townsend et.al/2020, described among 487 patients followed for average date of 75 days post- COVID-19, 62% of patients had not returned to full health(18).

Those post COVID 19 sequelae are not limited to patients who had severe COVID-19 or who were admitted. But also, those with mild COVID 19 experienced long-term effect of the illness. For instance Claudia Carvalho-Schneider et.al. found persisted symptom up to 2 months after symptom onset in two thirds of adults with noncritical COVID 19(19). Similarly one of the study recruited patient who had mild-moderate COVID 19 in Italy by Boscolo-Rizzo et.al showed, persistence of at least one symptom at 12 months which was reported by 161 patients (53.0%) with the most frequent being "felt tired" ($n = 83$, 27.3%), followed by "smell or taste impairment" ($n = 67$, 22.0%), "shortness of breath" ($n = 39$, 12.8%), and "muscle pain" ($n = 28$, 9.2%)(20) .

Respiratory system is one of the commonest body systems which is affected by long term effect of COVID 19. This respiratory sequelae is more commonly seen among patients who recovered from severe/critical COVID 19. It is associated with significant functional and radiological abnormalities, potentially due to small airway and lung parenchymal disease(21).

2.2 Post COVID-19 structural lung abnormality

Persistent pulmonary parenchymal radiologic abnormalities are noticed in post covid-19 patients. Y.M. Zhao et al. / (2020), described different pattern of pulmonary radiologic abnormalities after 3 months of discharge, the degrees of radiological abnormalities were detected in 39 patients (70.91%), and their HRCT scan images showed GGO (7 of 55, 7.27%), interstitial thickening (15 of 55, 27.27%), and crazy paving (3 of 55, 5.45%) were the most common CT features found(22).

Another study done in Netherland by Bram van den Borst, et.al/2021 found residual pulmonary parenchymal abnormalities in more than 90% of discharged patients even though 99% of patients

had lower GGO density which is consistent with decrease in the extent of affected pulmonary parenchyma(23). Similarly You J,et,el described 83.3%(n=15) of patients still had residual CT abnormalities, including peripheral GGO plus pulmonary fibrosis in 11 cases and pulmonary fibrosis in four cases after hospital discharge(24).

2.3 post-COVID-19 functional lung abnormality

Respiratory sign/symptom

Study done at university of paris, Beaujon hospital, by Eve Garrigus et,el found that after a mean ($\pm$ SD) of 110.9 ($\pm$ 11.1) days following admission, out 120 patients surveyed, fatigue (55%) was most common persistent symptom reported followed by dyspnea (42%). Those symptoms occurred without statistical difference between ward and ICU admitted patients(25). Similarly, the study done by Mandal S, et al./2021, at university of London, enrolled 308 patients and after a median of 56 days post discharge 53% reported persistent breathlessness, 34% persistent cough and 69% persistent fatigue(26).

Another study from Wuhan, China, the place where pandemic originated showed significant number of patients complained persistent symptom. Xiong et al./2021 described characteristic of the persisted symptom among 587 patients at median of 96 days after discharge and found that dyspnea is the commonest symptom reported by 21.4% of patients followed by, chest distress 14.1%, chest pain 12.3%, cough 7.1%, excessive sputum 3% and throat pain 3.2%. This study also evaluated the apparently healthy comparison group and found that the prevalence of all respiratory symptoms was significantly higher in the survival group than in the comparison group (all $p < 0.05$)(17).

In addition to common respiratory symptom like dyspnea and cough, post-viral fatigue in those recovered from the acute phase of COVID 19 impair quality of life and respiratory function. An Irish study of 128 post COVID 19 patients, who had recovered from the acute phase of COVID 19 infection (half required hospital admission) also supports this finding. They found 52% of patient reported persistent “post-viral fatigue” at a median of 10 weeks after initial COVID-19 symptoms and of those, 31% were unable to return to work. Over half of individuals (50% of 128) in the study demonstrated symptoms consistent with severe fatigue a median of 10 weeks after their initial illness, while almost one-third of those previously employed had not returned to work (27). Most interestingly, fatigue was not associated with initial disease severity, and there were no

detectable differences in pro-inflammatory cytokines or immune cell populations. Preexisting diagnosis of depression is associated with severe post COVID 19 fatigues. One of found that among 143 post COVID 19 acute-care patients surveyed, 87% of them reported ongoing fatigue after 2 months of discharge(6). This study highlighted the burden of fatigue, the impact on return to work and the importance of following all patients diagnosed with COVID 19, not merely those who required hospitalization.

Pulmonary function test

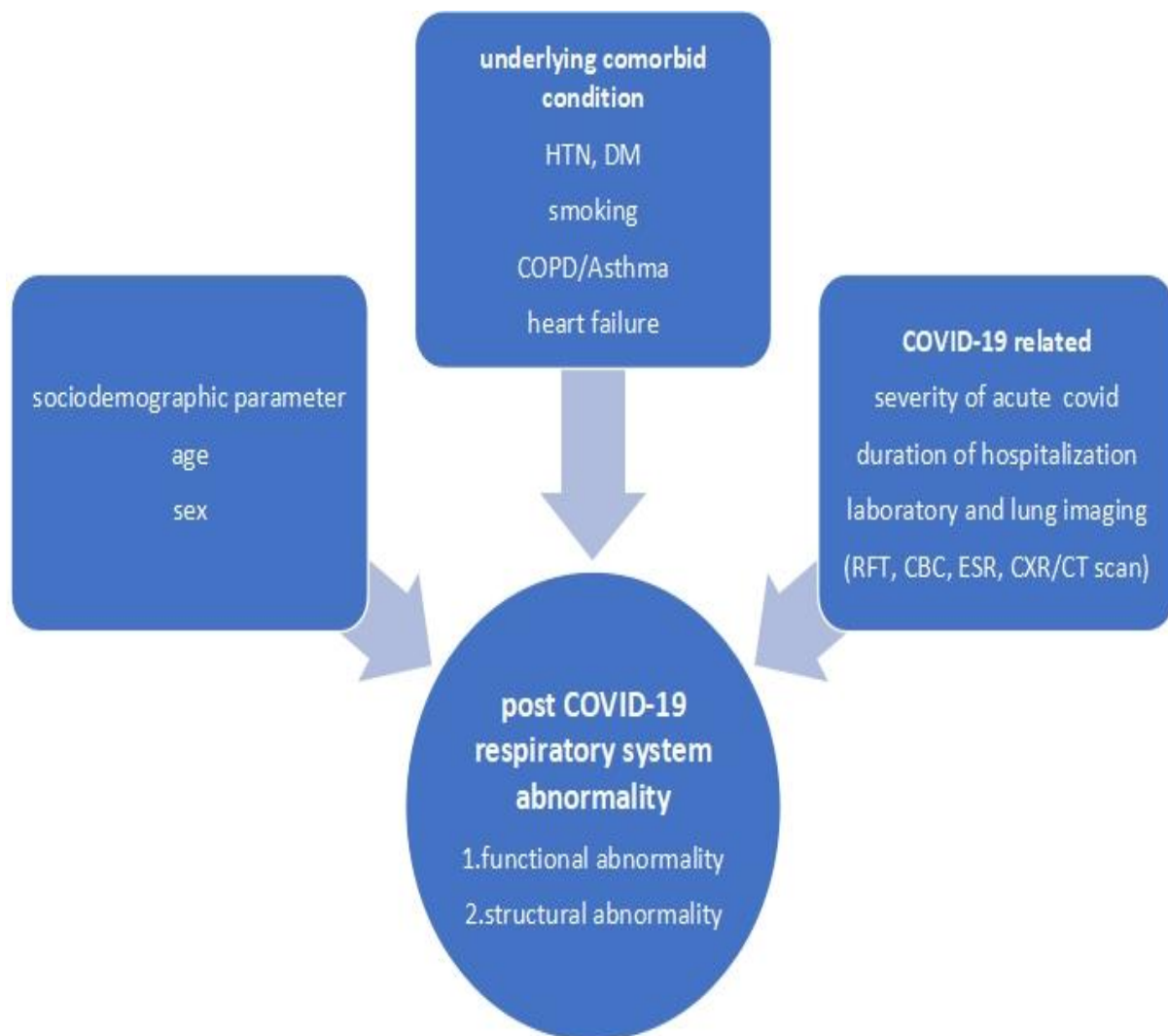
In addition to persisted respiratory symptom and pulmonary imaging abnormality in post COVID 19 patients, COVID 19 posed persistent PFT abnormality. For instance, study done by Y.-m. Zhao et al. / (2020), at shangue university, China, identified lung function abnormalities which were detected in 14 patients (25.45%) after 3 months of discharge. Anomalies were noted in TLC of 4 patients (7.27%), FEV1 of 6 patients (10.91%), FVC of 6 patients (10.91%), DLCO of 9 patients (16.36%), and small airway function in 7 patients (12.73%)(22). Another follow-up study of 76 survivors of COVID-19 in Wuhan Union Hospital for three months after discharge showed persistent impairment in FEV1, FEV1/FVC ratio, and DLCO in about 32.42% of cases(28). Furthermore, a study on 13 COVID 19 patients at the time of discharge and 6 weeks later showed abnormalities in the lung function with a decrease in FVC and FEV1 along with an increase in FEV1/FVC which demonstrates a restrictive pattern(29).

2.4 Risk factors associated with post COVID-19 structural and functional lung abnormality

There are multiple factors associated with post covid 19 sequele in different studies. Study done in Egypt by Ali et,el identified advanced age, sex, cigarette smoking, prolonged ICU admission, and CT severity score are positively correlated with post- COVID-19 lung fibrosis and pulmonary dysfunction(30). Similarly study done by Adomela S.Ojo et.el/2020 have found advanced age, illness severity, length of ICU stay and mechanical ventilation, smoking, and chronic alcoholism are associated with post covid 19 lung fibrosis(31). Another study found length of hospital stay, obesity and smoking are associated with persistent abnormal CXR after 12 weeks(32). Mahmud et,el also identified among 46% of patients who developed post COVID 19 syndrome, female sex, respiratory distress, lethargy, and long disease duration are significantly associated with the development of post COVID 19 syndrome(33). In contrast to those finding perez et,el assessed 277 patients (50% of them developed PCS) 10 week after COVID 19 and do not found any

significant association between base line characteristics(age, sex, comorbidity, severity of acute COVID 19 infection, inflammatory markers, ICU-admission, hospital/ICU length of stay, or treatment) and development of post COVID 19 syndrome(34).

2.5 Conceptual framework



3. OBJECTIVE OF THE STUDY

3.1 General Objective

To assess patterns of structural and functional lung abnormalities and associated factors among post COVID 19 survivors on follow up at Yeka Kotebe General Hospital.

3.2 Specific Objective

1.To describe post COVID 19 structural lung abnormalities among survivors on follow up at Yeka Kotebe General Hospital.

2.To assess post COVID 19 functional lung abnormalities among COVID 19 survivors on follow up at Yeka Kotebe General Hospital.

3.To identify factors associated with post COVID 19 structural and functional lung abnormalities among COVID 19 survivors on follow up at Yeka Kotebe General Hospital.

4. Methodology

4.1 Study design

Cross-sectional analytical study design was undertaken.

4.2 Study Area

The study was conducted at Yeka Kotobe General Hospital, one of the largest centers designated to treat COVID 19 in Addis Ababa, Ethiopia. The hospital is well known in giving service related to mental health, rehabilitation and psychotherapy beside emergency, surgical and maternity service. The hospital opened COVID 19 treatment and isolation center early in the pandemic, and had about 100 beds at ward & 30 functional ICU bed reserved for COVID 19 +v patients during the pandemic. It has regular post COVID 19 follow up OPD clinic equipped with all necessary staffs and facilities which serves the patients five days/week. In average 15-20 patients who were discharged from COVID 19 treatment center visits the clinic to be evaluated for complete recovery of acute illness, status of comorbid illness and overall quality of life(35).

4.3 Study period

Study was conducted from March 1/2022 - May 30/2022

4.4 Study population

The study population were all adult patients who had been hospitalized for moderate-severe covid 19 treatment and attended follow up at yeka kotobe general hospital outpatient service after discharge.

4.5 sample size and sampling technique

Convenience sampling technique was used and all patients who fulfilled inclusion criteria during study period were enrolled. This technique was used in order to enroll maximum number of participants during study period and since, trajectory of pandemic & service of it was also not known at time convenience sampling allows flexible data collection.

4.6 Inclusion and exclusion criteria

4.6.1 Inclusion criteria

The study included all post COVID 19 patients who had follow up at COVID 19 outpatient clinic at Yeka Kotobe General Hospital, Addis Ababa, Ethiopia during March 1/2022 – May 30/2022 and:

- ❖ Age >18 years old
- ❖ Had moderate to severe COVID 19
- ❖ Consented for the study.

4.6.2 Exclusion criteria

All of the patients with the following condition were excluded from the study

- ❖ Patients who had unstable cardiopulmonary disease which is not related to COVID 19 (as judged by treating physician).
- ❖ Patients whose symptom might be explained by chronic underlying cardiorespiratory disease.
- ❖ Patients who cannot describe their symptom due to underlying medical illness like stroke, dementia and psychiatric illness
- ❖ Patients whom time since onset of COVID 19 symptom were less than 3 months
- ❖ Patients who were on chronic home oxygen therapy due to non-COVID 19 associated pulmonary disease

4.7 Variables

Independent variables

Age & Sex

Comorbid conditions (hypertension, diabetes, heart failure, chronic obstructive pulmonary disease, asthma, smoking)

Duration of hospital stay

Unit of admission (ICU, HDU, ward)

Severity of the covid 19 at admission

Baseline laboratory finding during acute illness (complete blood count, renal function rate, erythrocyte sediment rate).

Baseline lung imaging finding (chest CT scan/ Xray)

Dependent variables

Chest CT or X ray finding during post COVID 19 period.

Chronic cough,

Chronic fatigue,

Dyspnea,

Resting oxygen saturation &

respiratory rate during interview

4.8 Operational definition

Chronic cough: Persisted cough for more than 2 months after symptom onset of covid 19(36).

Dyspnea: is sensation of breathlessness measured by mMRC dyspnea scale which is approved by GOLD-COPD (37).

Fatigue: decrease in physical or mental performance that results from changes in central, psychological, and/or peripheral factors and measured by shortened fatigue questionnaires (SFQ) (38).

Post- COVID 19 syndromes: persisted sign and symptom of organ dysfunction which is merely related to covid-19 after 3 months of onset of covid 19 symptom(39).

Moderate COVID 19 Pneumonia: Respiratory symptoms such as cough and shortness of breath (or tachypnea in children) are present without signs of severe pneumonia(40).

Severe COVID 19 Pneumonia: severe dyspnea, respiratory distress, tachypnea (> 21 breaths/min), and hypoxia ($SpO_2 < 93\%$ on room air)(40).

Post COVID 19 Functional lung abnormality: is derangement in lung function measured by assessing respiratory symptom/sign which includes **either** of cough, dyspnea, fatigue, oxygen saturation **or** PFT (FEV1, FVC, TLC & FEV1/TLC) after 3 months of COVID 19 symptom onset.

Post COVID 19 Structural lung abnormality: is lung parenchymal abnormality seen on either chest x-ray or chest CT scan result after 3 months of covid 19 symptom onset.

4.9 Data Collection tool and data quality management

4.9.1 Data collection tool and procedure

Data was collected from March 1/2022 - May 30/2022 G.C using well-structured pre-prepared checklist prepared in English and Amharic language. The data collection checklist was prepared based on review of similar records and literature in a way it answers the objective of study. It consists sociodemographic data which include age & sex of the patient, comorbid illness, duration of hospital stays, severity of the disease, duration after hospital discharge, chest x-ray/CT scan finding, cough, dyspnea, fatigue, respiratory rate and oxygen saturation questionnaires' in well formulated ways. Data collectors were given detail explanations of data collection checklist and tutorials on data collection procedure, relevance of the study and confidentiality of information two week ahead of data collection period. Data was collected from patients' chart and by face-to-face interviewing of patients or using the checklist by three data collectors. Data on lung imaging was acquired from radiology department report list by searching by card number of the patient. Degree of fatigue and dyspnea were assessed by validated SFQ & MMRC scale respectively. Pulse oximetry & stop watch were used to assess oxygen saturation and respiratory rate.

4.9.2 Data quality management

Data quality assurance was in place during checklist designing, interviewing & record reviewing and data entering. Pretest was done two weeks ahead of study period for five days on total of 15 samples at Yeka Kotobe General Hospital, Addis Ababa, Ethiopia to check for variability of data and questionnaires were assessed for its clarity, simplicity and completeness after which checklist was reformulated. Pretest sample was not included in data analysis. Collected data were manually assessed for completeness and consistency by one trained supervisor daily. Absent data for some variable within the medical record of the patients were rechecked by second data collector and labelled as missing data. The final data were inserted into SPSS version 25 by supervisor and cleaned by sorting & running frequencies.

4.10 Data Analysis

Data was analyzed using the Statistical Package of Social Sciences (SPSS) version 25.0. Means, standard deviations, frequency and percentages were calculated. Crosstabulation was done to describe some of independent variables. Bivariable logistic regression was done to sort variables for multivariable logistic regression and variables with p value <0.25 were selected for multivariable logistic regression. Hosmer and Lemeshow significance level of >0.05 was used for model fitness and P value <0.05 was used to declare significant association. The results were presented by the use of charts, tables, graphs and texts.

4.11 Ethical Consideration

Ethical clearance was obtained from the Institutional Review Board of St. Paul's Hospital Millennium Medical College, and then permission was sought from Yeka Kotobe General Hospital administration through chief clinical director to carry out the study. Each patient's information was collected after obtaining written consent. The collected information was kept confidential.

5. Results

5.1 Demographic characteristics of the sample

Total sample size of 120 who fulfilled inclusion criteria were assessed and data from all of them were included in the analysis. During the data collection the mean duration of time passed after onset of COVID-19 symptoms is 189 ± 88.6 days with the earliest and last being 80 & 370 days respectively. Majority of the study participants were male 67(55.8%). The mean age of the study participants was 58.83 ± 14.82 . (**Table 1**)

Table 1: Socio-demographic characteristics (age & sex cross tabulation) of covid-19 patients at Yeka Kotobe General Hospital, Addis Ababa, Ethiopia from March 1 /2022- May 30/2022

sex of the patients	frequency	age of patients		
		Mean age	Maximum age	Minimum age
female	53(44.16%)	55.42 ± 14.958	90	24
Male	67(55.8%)	61.52 ± 14.249	85	22
Total	120	58.83 ± 14.821	90	22

5.2 baseline characteristics of the participants

5.2.1 clinical factors at admission

Majority of the participants 106(88.3%) had severe COVID pneumonia and among them, 6(5.0%) were admitted to ICU. One hundred fifteen (87.5%) of the participants were given supplemental oxygen and 6(5.0%) of them required either noninvasive continuous positive airway ventilation (CPAP) or invasive ventilation. Hypertension was the most frequent comorbid condition found in 46(38.3%) of patients, followed by diabetes 34(28.3%). 6(5.0%) of the participants were active smokers. (**Table 2**)

Table 2. Clinical status of covid 19 study participants at a time of admission for acute COVID 19 treatments at Yeka Kotobe General Hospital, Addis Ababa, Ethiopia.

Clinical factors	Status	frequency	percent
Covid severity	Mild	6	5.0
	Moderate	8	6.7
	severe	106	88.3
Max. o2 support	No supplemental O2	15	12.5
	Intranasal O2	77	64.2
	Facemask O2	22	18.3
	CPAP/mechanical ventilation	6	5.0
Unit of admission	Ward	120	100
	HDU	19	15.8
	ICU	6	5.0
Comorbidity	Hypertension	46	38.3
	Diabetes	34	28.3
	Heart failure	5	4.2
	COPD/asthma	6	5.0
	Smoking	6	5.0

5.2.2 Laboratory and imaging status at admission

Most of the participants had hematologic derangement, among which lymphopenia is the common. Seventy-eight (65%, n=120) of participants had Lymphopenia and 10% had anemia. Twenty

(16.7%, n=120) had impaired renal function. Initial lung imaging either Xray or CT scan was documented for 116 participants and majority of them 108(90%) had abnormal finding, among which GGO/consolidation is the frequent abnormal finding. (**Table 3**)

Table 3: Laboratory and lung imaging finding of post covid 19 study participants at a time of admission for acute covid 19 treatments at Yeka Kotobe General Hospital, Addis Ababa, Ethiopia.

Laboratory/imaging		Frequency	percent
Anemia		12	10.0
Lymphopenia		78	65.0
Impaired RFT		20	16.7
Lung parenchymal imaging abnormality	Yes	108	90.0
	No	12	10.0
	Septal/interlobular infiltrate	38	31.7
	GGO/consolidation	108	90.0
	Fibrosis	19	15.8
	Interstitial infiltrate	26	21.7

5.3. Outcome variables

Overall post COVID 19 functional and structural lung abnormality was seen in 77(64.2%, n=120) of patients. Thirty-one patients (25.8%, n=120) had more than one abnormality.

5.3.1 Dyspnea

Fifty-eight participants (48.3%, n=120) complained different degrees of breathlessness during the interview. (**Figure 1**)

5.3.2 fatigue

Fatigue was assessed by validated SFQ which is composed of 4 easily understandable questions. Score greater or equal to 18 was used to denote severe fatigue. Accordingly, 45(37.5%) of participants experienced severe fatigue which lasted more than 3 months. **(Figure2)**

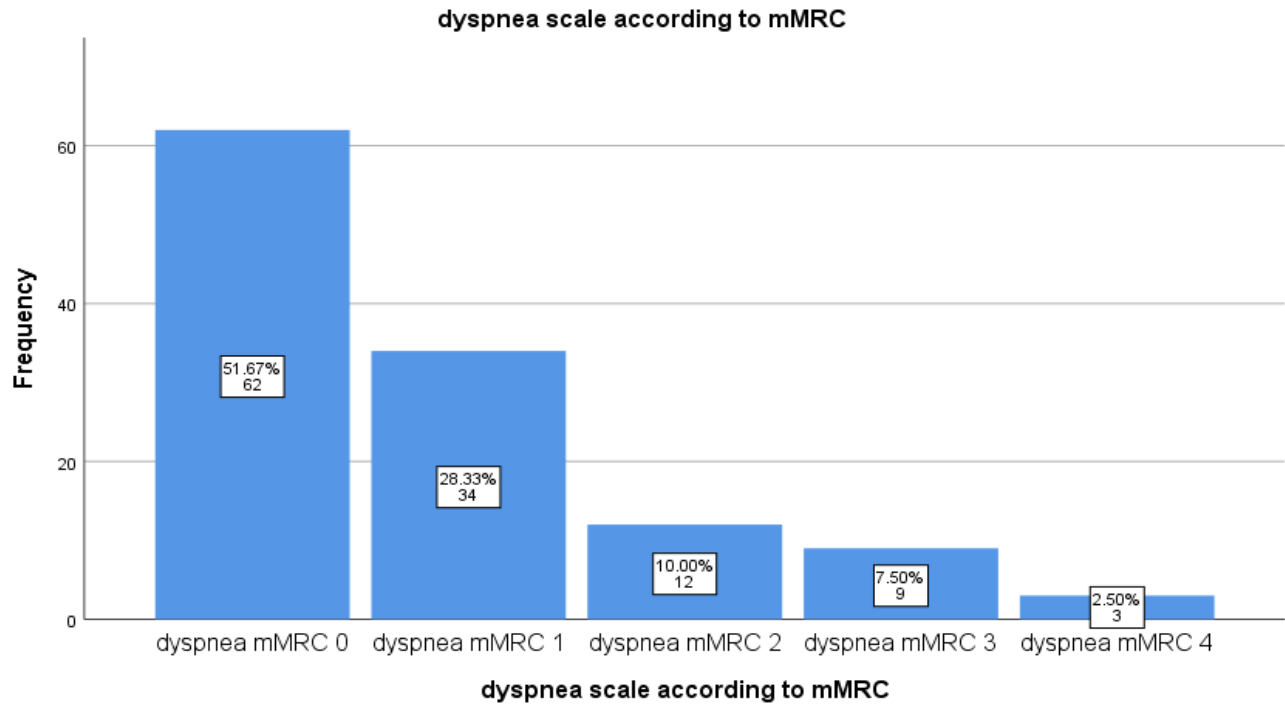


Figure 1: Level of breathlessness reported by post COVID 19 study participants at Yeka Kotobe General Hospital, Addis Ababa, Ethiopia from March 1/2022- May 30/2022

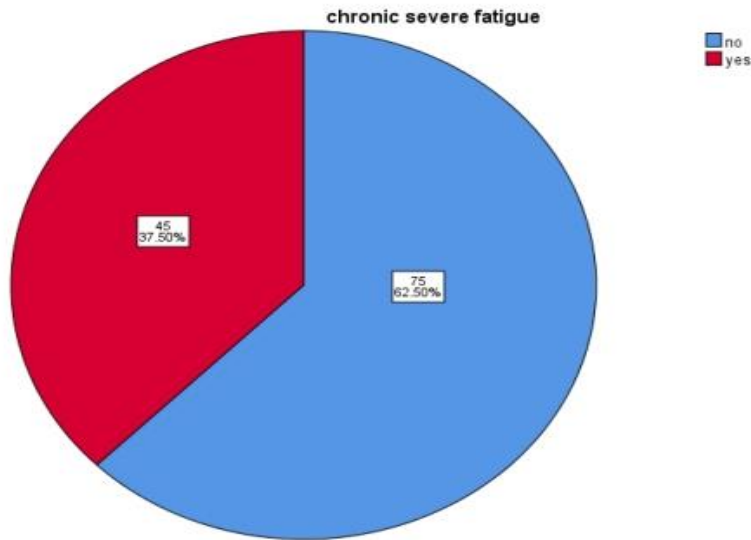


Figure 2: Frequency of chronic severe fatigue reported by post covid 19 study participants at Yeka Kotobe General Hospital, Addis Ababa, Ethiopia from March 1/2022- May 30/2022.

5.3.3 chronic cough

Twenty-four (20%, n=120) of participants reported cough which lasted more than 2 months after onset of COVID 19 symptoms. The mean cough duration was 33.5 ± 10 days. The minimum duration of cough reported was 5 days and the maximum was 360 days.

5.3.4 respiratory rate

During interview 10 (8.3%) of participants were tachypneic and maximum observed respiratory rate were 26 breaths/minute.

5.3.5 oxygen saturation

During interview 27 (22.5%, n=120) of participants had resting oxygen saturation less than 90%.

(Figure 3)

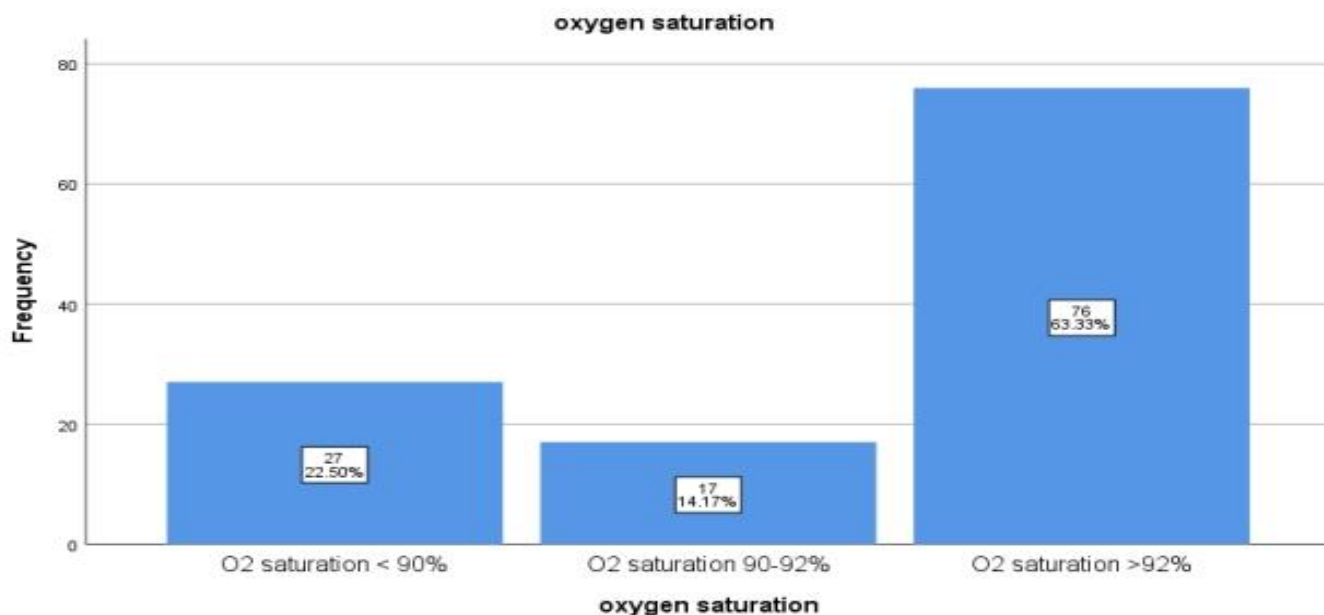


Figure 3: Resting oxygen saturation of post COVID 19 study participants during interview at Yeka Kotobe General Hospital, Addis Ababa, Ethiopia from March 1/2022- May 30/2022.

5.3.6 post COVID lung imaging

Thirty participants had repeated chest CT scan/x-ray and 24(80%, n=30) of them had parenchymal lung abnormality mainly bilateral fibrotic changes while 6(20%,n=30) of them had complete structural resolution of initial abnormality. (**Table 4**)

Table 4. Repeat lung imaging finding of 30 post COVID 19 study participants at Yeka Kotobe General Hospital, Addis Ababa, Ethiopia.

		frequency	Percent
Post COVID-19 repeated lung imaging abnormality	Yes	24	80
	No	6	20
Interstitial infiltrate		22	46.7
Fibrosis		24	80
Septal thickening		14	26

5.3.7 Associated factors

Multivariable binary logistic regression was done to identify whether independent variables like age & sex of the participants, duration of hospital stay, severity of acute COVID 19, unit of admission, presence of comorbidity and laboratory derangement (anemia, impaired RFT, lymphopenia) during admission affects the post covid 19 respiratory outcomes. Before multivariable logistic regression, simple binary logistic regression was performed for all independent variables and those variables which showed significance level of <0.25 were selected for multivariable logistic regression. Hosmer & Lemeshow showed significance level of 0.961 for model fitness and P value of < 0.05 was used to determine the significant association. Age >60 , duration of hospital stays, and raised creatinine during admission showed significant association with respiratory functional and structural abnormality among post COVID 19 patients. Older age > 61 yr increased the likelihood of the events by 15.66 times ($p=0.001$, 95%CI 3.36-72.86) and as length of hospital stay prolonged by one day, the likelihood of developing the events were increased by 10% ($p=0.03$ 95%CI 1.006- 1.210). Raised creatinine during hospital admission also increased the occurrences of post covid 19 respiratory functional abnormality by factor of 6.85($p=0.038$, 95%CI 1.12-42.10). Sex of the participant, presence of comorbidity, severity of acute covid 19 and baseline HGB & lymphocyte count didn't show significant associations with post covid 19 respiratory functional and residual structural abnormality. **(Table 5)**

Table 5: Multivariable analysis of factors associated with structural and functional lung abnormality among post COVID 19 participants, Yeka Kotobe General Hospital, Addis Ababa from March 1/2022- May 30/2022

	Category	Post COVID 19 respiratory functional & residual structural abnormality		COR (95% CI)	AOR (95% CI)	P- value
		No	Yes			
Sex	Female	20 (37.73%)	33 (62.26%)	0.86 (0.40-1.87)	1.85 (0.59 - 4.22)	0.36
	Male	23 (34.32%)	44 (65.67%)	Ref(1)	1	1
Age	20-40	12 (70.58%)	5 (29.41%)	1	1	1
	41-60	22 (48.88%)	23 (51.11%)	2.50 (0.75-8.29)	2.33(0.54-10.10)	0.251
	>61	9 (15.51%)	49 (84.48%)	13.06 (3.69 - 46.17)	15.66 (3.36- 72.86)	0.001
Smoking	Yes	3 (50.00%)	3 (50.00%)	0.54 (0.10-2.80)	0.09 (0.01 –0.77)	0.028
	No	40 (35.08%)	74 (64.91%)	1	1	1
Raised creatinine	No	40 (40%)	60 (60%)	1	1	1
	Yes	3 (15%)	17 (85%)	3.77 (1.03-13.73)	6.85(1.12-42.10)	0.038
Comorbidity	No	22 (40%)	33 (60%)	1	1	1
	Yes	21 (32%)	44 (68%)	1.39 (0.66-2.95)	0.59 (0.22- 1.66)	0.310
Acute COVID 19 severities	mild	4 (66.66%)	2 (34.44%)	1	1	1
	moderate	6 (75%)	2 (25%)	0.66 (0.06-6.87)	0.61 (0.06 –6. 39)	0.627
	severe	33 (31.33%)	73 (68.86%)	4.42(0.77-25.37)	0.21 (0.03 – 1.52)	0.125
Duration of hospital stay in days during admission				1.11 (1.03-1.19)	1.10 (1.006-1.21)	0.037
Baseline hemoglobin				1.03 (0.84-1.26)	1.08 (0.83 - 1.41)	0.549
Baseline lymphocyte count				1.00 (0.99-1.00)	1.00 (0.99 - 1.00)	0.294

6. Discussion

From this study, 64.25% of patients developed post COVID 19 functional and structural abnormality. Twenty five percent had two and more post COVID 19 respiratory sign & symptom. This finding is greater than prospective study done at Bangladesh which showed prevalence of 40%(n=355) post COVID 19 syndromes(41) and study at Moscow which showed 50%(n=2509) post COVID 19 syndromes at 6 months(42). However, this finding is comparable to study done in Fars province, Iran which showed 62.5%(n=2915) post COVID 19 syndromes(43) and study at Saudi Arabia which showed 59%(n=222) post COVID syndrome(44).

Dyspnea is the most common symptom reported by 48.3% of patients followed by chronic severe fatigue (37.5%) and chronic cough (20%). This finding is slight in contrary to metanalysis of 15 trial done by Sandro-lopez et,al, which showed the most common reported symptom was fatigue(58%) followed by neurologic symptom(headache, attention disorder) and dyspnea(24%)(45). Study done at Paris by garrigues also showed fatigue was the most common symptom reported by 55% of 120 patients followed by dyspnea 45%(25) and also study done by Mandal et,al at university of London showed fatigue reported by 69% of 308 patients followed by dyspnea 53% and chronic cough 34%(26). However, this small heterogeneity in frequency of finding might be explained by difference in study population, sample size and symptom assessment method. In fact, in this study, fatigue is assessed by SFQ at cut point of 18 & above which categorize patient to severe form of fatigue. Therefore, mild form of fatigue is not included which under report the frequency of fatigue compared to other studies. Similarly, dyspnea is assessed by modified MRC scale which include lesser degree of breathlessness. For instance, Xiong et, al mentioned dyspnea as the most frequent symptom reported by 21.7% of 528 post COVID patients(17).

In addition to symptom reported by patients, this study also assessed objective respiratory sign like respiratory rate and resting oxygen saturation. It is found that 8.3% of patients were tachypneic and 22.5% had resting oxygen saturation < 90%. This goes in comparison with large percent of patients complaining dyspnea.

In this study repeat pulmonary imaging was done for 30 symptomatic patient and majority of them 80%(n=30) had residual lung parenchymal abnormality, mainly bilateral fibrotic changes (80%) followed by interstitial infiltrate (46.7%) & septal thickening (26%). This goes in comparison to

study done by Zhao et al, China, which showed 70% of 55 post COVID patients had residual lung structural abnormality, mainly showed GGO (7.27%), interstitial thickening (27.27%), and crazy paving (5.45%) (22). Similarly study done by You et al showed 83.3% (n=15) post COVID patients have residual lung parenchymal abnormality (24).

In this study, age > 60 years, longer duration of hospital stay and raised creatinine were significantly associated with increased risk of post COVID 19 structural & functional abnormality. Sex, comorbidity, severity of disease, ICU admission, lymphopenia & anemia didn't show significant association. Different other studies showed diverse factors associated with post COVID syndrome. For example, study done at Egypt showed advanced age, sex, cigarette smoking, prolonged ICU admission, and CT severity score are associated with post COVID 19 lung fibrosis and pulmonary dysfunction (18). Similarly, Ademola et al found advanced age, illness severity, length of ICU stays and mechanical ventilation, smoking, and chronic alcoholism are associated with post COVID 19 lung fibrosis (31). However other studies, for example, prospective cohort study done by Oscar-Perez showed no significant associations between post COVID syndrome and severity of disease, unit of admission, sex, hospital stay and comorbidity similar to this study (46). This variation might be due to small size of samples, single center of study and difference in study population type which might affect the regression analysis. However, this finding gives ground for further large scale multi centric studies to be undertaken in future.

7. Conclusions and recommendations

Respiratory system dysfunction manifested by pulmonary symptoms and structural lung abnormality are common in patients who recovered from acute COVID 19 illness. As a result, COVID 19's long-term consequences should not be neglected, as they may lead to increased morbidity among patients, consumption of financial resources, and increased health system burden. Therefore, appropriate follow up & screening of post COVID 19 patients, evaluating patients' clinical condition, selecting right diagnostic tests and providing appropriate treatment for those who had post COVID 19 sequelae are recommended.

8 Strength and limitation of the study

8.1 Strength of the study

The main strength of this study is data was collected from both patients and medical record chart of the patients at the same time, which increase the accuracy of gathered information. Data collectors were also physicians who are well experienced in COVID 19 patient treatment and follow up.

The other strength of this study is, most of baseline clinical factors were included to assess risk factor associated with post COVID 19 respiratory abnormalities, beside description of patterns of respiratory abnormality.

8.2 Limitation of study

The main limitation of this study is that it was carried out in single center, convenience sampling technique used and small sample size which might affect generalization of study to target population. However, it was undertaken at one of the largest country's COVID 19 treatment center which can boost the sample similarity to overall population. Additionally, the study topic is one of the new unresearched area and hence small sample size of the study might be acceptable as initial step for further researches.

The other limitation of the study was missing of data on some of important variable like post COVID 19 lung imaging, PFT & ESR for majority of participants. There was also probability of recall bias of reporting symptoms duration. However, the data collectors used both documented medical record of patients during previous OPD visit and patient's symptom report to reduce recall bias.

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ANNEXES

ANNEX I: Information Sheet

Research Title: To Assess Patterns Of Structural And Functional Lung Abnormalities And Associated Factors Among Post Covid-19 Survivors At Yeka Kotobe Hospital, Addis Ababa, Ethiopia:

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ANNEX II Data collection check list

Part1. Socio Demographics

- A) Card no
- B) Age
- C) Sex

Part 2. Patient data and clinical characteristic

- A) Time elapsed after hospital discharge-----**
- B) Time elapsed after symptom onset-----**
- C) Where was the Unit of admission and how long did stay in each unit-----**
 - a. Ward
 - b. ICU
 - c. HDU
- D) Severity of covid-19**
 - a. Mild
 - b. Moderate
 - c. Severe/critical
- E) The maximum oxygen support patient ever required**
 - a. Supplemental INO2
 - b. Supplemental facemask o2
 - c. CPAP/mechanical ventilation
- F) baseline laboratory during admission**

WBC:-----

Hgb:-----

Lymphocyte count:-----

ESR:-----

Creatinine.....

G) Presence of known comorbidity

- a. Diabetes
- b. Hypertension
- c. COPD/ asthma
- d. Congestive heart failure history
- e. Smoking
- f. If yes to smoking number of pack/yr smoked

Part 3. Outcome variables

A) Symptom and sign

I. Dyspnea scale MMRC (label degree of breathlessness of the participants at a time of interview)

MMRC 0: Not troubled by breathlessness, except with strenuous exercise

MMRC 1: Shortness of breath walking on level ground or with walking up a slight hill

MMRC 2: Walks slower than people of similar age on level ground due to breathlessness, or has to stop to rest when walking at own pace on level ground

MMRC 3: Stops to rest after walking 100 m or after walking a few minutes on level ground

MMRC 4: Too breathless to leave the house, or breathless with activities of daily living (e.g., dressing/undressing)

II. Fatigue assessment: shortened fatigue questionnaires

1. I feel tired

Yes, that
is true

7	6	5	4	3	2	1
---	---	---	---	---	---	---

no, that is
not true

2. I tire easily

yes, that
is true

7	6	5	4	3	2	1
---	---	---	---	---	---	---

no, that is
not true

3. I feel fit

yes, that
is true

1	2	3	4	5	6	7
---	---	---	---	---	---	---

no, that is
not true

4. Physically, I feel exhausted

yes, that
is true

7	6	5	4	3	2	1
---	---	---	---	---	---	---

no, that is
not true

Total score SFQ:

III. Chronic cough assessment

1. Did you have cough persisted for more than 2 month since you tested positive for COVID-19/noticed COVID-19 symptom? A) Yes B) no

2. how long did your cough persisted: -----

IV. Resting Oxygen saturation during interview: -----

V. Respiratory rate during interview-----

V. Pulmonary function test ever done post COVID-19

Spirometry	Result	% Of predicted	Conclusion
FEV1			
FVC			
FEV1/FVC			

VI. Pulmonary Imaging ever done post COVID-19

Abnormality	x-ray		CT scan		number of lung segments	
	At admission	Follow up	At admission	Follow up	At admission	Follow up
Septal thickening						
GGO						
consolidation						
Interlobular thickening						
fibrosis						
interstitial infiltration						

Amharic translation of interview questionnaires

ክፍል 3፡

ሀ) ምልክቶች

I). የትንፈሽ ማጠር ልኬት

MMRC 0: ከከባድ የአካል ብቃት እንቅስቃሴ በስተቀር በትንፈሽ እጥረት አሊጨነቅም

MMRC 1: በተስተካከለ መሬት ላይ ሲራመድ ወይም በትንሽ ኮሮብታ ላይ ሲራመድ ትንፈሽ ያጥረኛል

MMRC 2: በአተነፋፈለ ችግር ምክንያት በተመሳሳይ እድሜ ካላቸው ሰዎች ቀርፋፋ መሬት ላይ ሲራመድ ወይም በእርጋታ መሬት ላይ ሲራመድ ለማረፍ መቆም አለብኝ

MMRC 3: 100 ሜትር ከተራመድኩ በኋላ ወይም ጥቂት ደቂቃዎችን በእርጋታ መሬት ላይ ከተራመድኩ በኋላ በትንፈሽ እጥረት ችግር አርፈለው

MMRC 4: ከቤት ለመውጣት ትንፋሽ ያጥረኛል፤ ወይም በእለት ተእለት ኑሮ እንቅስቃሴዎች (ለምሳሌ፣ አለባበስ/መለበስ) ጊዜ ትንፋሽ ያጥረኛል

II). የድካም ግምገማ፡ አጭር የድካም መጠይቆች

ድካም ይሰማኛል አዎ እዉነት ነዉ. 7 6 5 4 3 2 1 አይ አይደለም

በቀላሉ ይደክማኛል አዎ እዉነት ነዉ. 7 6 5 4 3 2 1 አይ አይደለም

ብቁ ነኝ አዎ እዉነት ነዉ. 7 6 5 4 3 2 1 አይ አይደለም

ሰዉነቴን በጣም ያደክመኛል አዎ እዉነት ነዉ. 7 6 5 4 3 2 1 አይ አይደለም

III). ሥር የሰደደ ሳል ግምገማ

1.ኮቪድ-19 ከታወቀ ወይም የኮቪድ-19 ምልክት መያዙን ካረጋገጡ በኋላ ሳል ከ 3 ወር በላይ ቆይቶቦታል? ሀ) አዎ ለ) አይደለም

2 ሳልዎ በጠቃላይ ለምን ያህል ጊዜ ቆይቷል-----

ANNEX III Consent Form

Participants Information Sheet and Informed Voluntary Consent Form for Participants Selected for the Study

My name is_____ I am working as data collector for the study being conducted in Yeka Kotebe General Hospital; I kindly request you to lend me your attention to explain you about the study.

Study Title: Patterns Of Structural And Functional Lung Abnormalities And Associated Factors Among Post Covid-19 Survivors On Follow up At Yeka Kotebe General Hospital, Addis Ababa, Ethiopia

Purpose: -The study will be helpful to assess patterns of post COVID-19 respiratory sequelae and it will generate information for future action.

Procedure and duration: There are a list questions to be answered where I fill the questioner by interviewing you. The interview will take around 30 minutes.

Risks and benefits: - The risk of being participating in this study is very minimal, except taking some minutes, for the interview, there is no other risk that you will experienced. By participating in this study, you will not get direct benefit but the outcome of this study will be useful tool for decision makers

Confidentiality: - The information, which you provide us, will be confidential. There will be no information that will identify you. The finding of study will be general for the study population and will not reflect any thing particular of individual person. The questionnaire will be coded to exclude showing names; no references will be made in oral or written reports that could link participants to the research.

Right: - Participation in this study is voluntary. You have the right to declare not to participate in this study. If you decide to participate first, you have the right to with draw from the study at any time and this will not result in you for any loss of benefit, which you otherwise are entitled. You do not have to answer any question that you do not want to answer.

Contact address: -If you have any questions or enquiries at any time about the study or the procedures, please contact and communicate with Principal investigator: - Dr.Dereje Kebede :- +251917250251, dkebede1984@gmail.com

Declaration of informed voluntary Consent:

I have clearly understood the purpose of the research, the procedure, risks and benefits, issues of confidentiality rights of participating and contact address for any queries. I have given the opportunity to ask questions for things that may have been unclear. I was informed that I have the right to with draw from the study at any time; therefore, I declare my voluntary consent to participate in this study with my signature.

Name and Signature of Participants: _____date_____/_____/_____

Name and Signature of data collector: _____date_____/_____/_____

ለጥናቱ ለተመረጡ ተሳታፊዎች የተሳታፊዎች መረጃ ወረቀት እና በመረጃ የተደገፈ የፍቃደኝነት ስምምነት ቅጽ

ስሜ _____ በ የካ ኮተቤ አጠቃላይ ሆስፒታል ውስጥ ለሚካሄደው ጥናት መረጃ ሰብሳቢ ሆኜ እየሰራሁ ነው። ስለ ጥናቱ ማብራሪያ እንድሰጥህ ትኩረት እንድትሰጠኝ በትህትና እጠይቃለሁ።

የጥናት ርዕስ: የመዋቅር እና የተግባር የሳምባ እክሎች እና ተያያዥ ምክንያቶች ከኮቪድ-19 የተረፉ ሰዎች በክትትል ላይ በየካ ኮተቤ አጠቃላይ ሆስፒታል፣ አዲስ አበባ፣ ኢትዮጵያ

ዓላማው:- ጥናቱ ከኮቪድ-19 በኋላ ያሉትን የመተንፈሻ አካላት ሁኔታ ለመገምገም የሚረዳ ሲሆን ለወደፊት እርምጃ መረጃን ይፈጥራል።

ሂደት እና የቆይታ ጊዜ:- እርስዎን በመጠየቅ ጠያቂውን የምሞላበት ዝርዝር ጥያቄዎች አሉ። ቃለ መጠይቁ 30 ደቂቃ አካባቢ ይወስዳል።

ስጋቶች እና ጥቅማ ጥቅሞች፡- በዚህ ጥናት ውስጥ የመሳተፍ እድሉ በጣም አናሳ ነው፤ ጥቂት ደቂቃዎችን ከመውሰድ በስተቀር፤ ለቃለ መጠይቁ፤ ሌላ የሚያጋጥሙዎት አደጋ የለም። በዚህ ጥናት ውስጥ በመሳተፍ ቀጥተኛ ጥቅም አያገኙም ነገር ግን የዚህ ጥናት ውጤት ለውሳኔ ሰጪዎች ጠቃሚ መሳሪያ ይሆናል።

ምስጢራዊነት፡- እርስዎ ያቀረቡልን መረጃ ሚስጥራዊ ይሆናል። እርስዎን የሚለይ መረጃ አይኖርም። የጥናቱ ግኝት ለጥናቱ ህዝብ አጠቃላይ ይሆናል እናም የግለሰብን የተለየ ነገር አያንፀባርቅም። መጠይቁያው ስሞችን ከማሳየት እንዲገለሉ ኮድ ይደረጋል፤ ተሳታፊዎችን ከጥናቱ ጋር ሊያገናኙ የሚችሉ የቃል ወይም የጽሁፍ ዘገባዎች ማጣቀሻዎች አይደረጉም።

መብት፡- በዚህ ጥናት ውስጥ መሳተፍ በፈቃደኝነት ነው። በዚህ ጥናት ውስጥ ላለመሳተፍ የማወጅ መብት አልዎት። በመጀመሪያ ለመሳተፍ ከወሰኑ በማንኛውም ጊዜ ጥናቱን የመተው መብት አለዎት እና ይህ ምንም አይነት ጉዳት አያመጣም። መመለስ የማትፈልገውን ማንኛውንም ጥያቄ መመለስ የለብህም።

ስለ ጥናቱ ወይም አሠራሩ በማንኛውም ጊዜ ጥያቄ ወይም ጥያቄ ካለዎት ከዋናው መርማሪ ጋር ይገናኙ፡- ዶ/ር ደረጀ ከበደ፡-
+251917250251, dkebede1984@gmail.com

በመረጃ ላይ የተመሰረተ የፈቃደኝነት ስምምነት መግለጫ፡-

የጥናቱን አላማ፤ አሰራሩን፤ ስጋቱን እና ጥቅሞቹን፤ የመሳተፍ ሚስጥራዊ መብቶች ጉዳዮች እና ለማንኛውም መጠይቆች አድራሻ በግልፅ ተረድቻለሁ። ግልጽ ባልሆኑ ጉዳዮች ላይ ጥያቄዎችን ለመጠየቅ እድሉን ሰጥቻለሁ። በማንኛውም ጊዜ ጥናቱን የመተው መብት እንዳለኝ ተነግሮኛል፤ ስለዚህ በዚህ ጥናት ለመሳተፍ በፍቃዴ ፈቃዴን በፊርማ አውጃለሁ።

የተሳታፊዎች ስም እና ፊርማ፡- _____/____/_____

የመረጃ ሰብሳቢው ስም እና ፊርማ፡- _____/____/_____

ANNEX IV: Declaration

I the undersigned resident declare that this thesis is my original work, in partial fulfillment of the requirement for the certificate of specialty in Internal Medicine. I also declare that it has never been presented in this or any other higher institution and all the resources and materials used in the research work have been duly acknowledged.

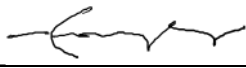
Name of the resident: _____

Signature: _____

Date: _____

Approval of Advisors

Name of Public Health Advisor: Yoseph Worku

Signature:  _____

Date: 16 October 2022

Name of Clinical Advisor: _____

Signature: _____

Date: _____

