HEALTH AND WELLBEING OF LONG COVID PATIENTS IN KANNUR DISTRICT OF KERALA.

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FOOD SCIENCE AND NUTRITION

By

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CERTIFICATE

I hereby certify that the dissertation entitled **"Health and Wellbeing of Long COVID patients in Kannur district of Kerala"** prepared and submitted by Ms. Jesnet Sebastian is an original research work carried out under my guidance and supervision.

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DECLARATION

I hereby declare that this research work entitled **"Health and Wellbeing of Long COVID patients in Kannur district of Kerala"** is an original research work carried out by me under the supervision and guidance of Dr. Reshmi H Poojara, Assistant Professor, Department of Home Science, St. Teresa's College Ernakulam.

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INTRODUCTION

CHAPTER 1

INTRODUCTION

In late December 2019, an outbreak of a mysterious pneumonia characterized by fever, dry cough, and fatigue, and occasional gastrointestinal symptoms happened in a seafood wholesale wet market, the Huanan Seafood Wholesale Market, in Wuhan, China. The initial outbreak was reported in the market in December 2019 and involved about 66% of the staff there. The market was shut down on January 1, 2020, after the announcement of an epidemiologic alert by the local health authority on December 31, 2019(Wu *et al.*, 2020). The COVID-19 is a highly contagious infectious disease and one infected person can infect an average of three other people (Alimohamadi *et al.*, 2020).

The first COVID-19 case in India was reported on January 30, 2020 in Trissur, Kerala. COVID-19 has been fought mostly by a containment strategy, which is typically utilised when a virus has a poor transmission capacity or is imported from outside sources. This allows for measures like quarantining people who have travelled from a high-transmission location, isolating infected people, tracking contacts, and restricting people's mobility in high-case-load areas to be implemented. Kerala's containment strategies had helped to limit the spread of sickness in the community by the end of March. Regulations include school closures and a ban on public mass gatherings (Varghese and John, 2020). This is because the disease is spread by huge droplets produced by sick people coughing and sneezing. In some cases, infection can occur in asymptomatic persons prior to the onset of symptoms (Ishrath *et al*., 2021).

SARS-CoV-2 was first isolated in the bronchoalveolar lavage fluid (BALF) of three COVID-19 patients. After sequence and evolutionary analysis, SARS-CoV-2 was considered as a member of β-CoVs. The CoVs family is a class of enveloped, positive-sense single-stranded RNA viruses having an extensive range of natural roots. These viruses can cause respiratory, enteric, hepatic, and neurologic diseases(Jin *et al.*, 2020). Primary mechanism of transmission of SARS-CoV-2 is via infected respiratory droplets, with viral infection occurring by direct or indirect contact with nasal, conjunctival, or oral mucosa, when respiratory particles are inhaled or deposited on these mucous membranes.

Hypertension, diabetes, cardiovascular illness, chronic obstructive pulmonary disease, and coronary heart disease were the most prevalent comorbidities. Other comorbidities observed in COVID-19 patients include cancer, chronic renal disease, chronic liver illness, digestive system disease, and nervous system disease (Pinto *et al.,* 2020).Each comorbidity has its own pathophysiology and mechanism for SARS-CoV-2 infection and death, some of which have been postulated or established, while others have yet to be discovered.

The duration of incubation and latency of the virus is about 1 to 14 days. This means that the person may be infected with the virus without symptoms. In a study of symptoms of COVID-19, chest pain, dizziness, and nausea were observed. In a study of 41hospitalized patients, pneumonia, shortness of breath, fever, symptoms of dry cough and fatigue were reported. Fewer cases of headache, haemoptysis, nausea and vomiting and diarrhoea were also observed. Comorbidities such as blood sugar, hypertension and cardiovascular disease were found in half of these patients. In addition, patients with abnormal dyspnea may indicate that these complications are likely to be important contributors to the death of COVID-19 patients (Abolfazl *et al.*, 2020).

Target host receptors are found mainly in the human respiratory tract epithelium, including the oropharynx and upper airway. The conjunctiva and gastrointestinal tracts are also susceptible to infection and may serve as transmission portals. Transmission risk depends on factors such as contact pattern, environment, infectiousness of the host, and socioeconomic factors, as described elsewhere(Cevik *et al.*, 2020). Diagnosis of COVID-19 is done through polymer chain reaction (PCR), computed tomography (CT) scan, and blood test. Supportive treatment, such as antibiotics, vitamins, trace elements, and antipyretics, is the only alternative for mild cases, however, for those with respiratory distress, oxygen therapy with or without mechanical ventilation is initiated and individualized to each patient (Kamal *et al.*, 2021).

Long COVID is defined as a series of symptoms that appear weeks or months after obtaining SARS-CoV-2 infection, independent of viral status. “Post COVID,” “Chronic COVID Syndrome,” “Long-Haul COVID,” “Post-Acute Sequelae of SARS-CoV-2 infection,” and “Post-Acute COVID-19 Syndrome (PACS) are other names for Long COVID(Dixit et al., 2021). It might be persistent or relapsing and remitting. One or more acute COVID symptoms may linger, as well as the appearance of new symptoms (Raveendran *et al.*, 2020).

The National Institute for Health Research has suggested that post-acute COVID-19 may consist of several distinct clinical syndromes including: a post intensive care syndrome, chronic fatigue syndrome, long-term COVID-19 syndrome and disease from SARS-CoV-2 inflicted organ damage(Michelen et al., 2021).Patients suffering from long COVID report a wide range of new or persistent symptoms.

Most other body systems, both physically and physiologically, are affected by the post-COVID-19 syndrome, which goes beyond the cardio-respiratory system. Although the reasons of the post-COVID-19 illness are unknown, immunological activation that persists may be a factor. Although the pathogenesis, treatment, and prognosis of distinct syndromes of post-acute SARS-CoV-2 sequela have not been characterised, it has been hypothesised that numerous post-COVID-19 condition morphologies may exist (Munblit *et al*., 2022).

COVID-19 has the greatest impact on the lungs. Abnormal lung functions and structural changes were reported up to 6 months after hospitalization in mild-to critical COVID-19 patients also with diffuse alveolar damage, desquamation of alveolar epithelial type II cells, and macrophages (Salamanna *et al.,* 2021).The severe damage to alveolar epithelial and endothelial cells, as well as subsequent fibro proliferation, is a hallmark of COVID-19, indicating the possibility of persistent vascular and alveolar remodelling resulting in lung fibrosis and/or pulmonary hypertension (Torres *et al.,* 2021).

Signs of cardiovascular autonomic dysfunction appear to be common in long COVID (Bisaccia et al., 2021). The most common cardiovascular (CV) symptoms present are chest pain or tightness, palpitations, dizziness, and an increase in resting heart rate. These symptoms appear in both hospitalized and non-hospitalized groups. There is no clear relationship with CV symptoms and pre-existing CV disease (Dixit *et al.,* 2021).

Persistent musculoskeletal aches and pains, reactive arthritis (symmetric arthritis of large joints) rheumatoid arthritis-like presentation (arthritis of the small joints) and femoral head necrosis are some of the presentations of post COVID-19 syndrome. Post viral chronic fatigue syndrome, similar to fibromyalgia, with poor sleep, fatigue, myalgia and depression with some unable to return to work, as a result, are also seen (Kabi *et al*., 2020).

In patients with Long COVID, gastrointestinal-related symptomatology includes loss of appetite, nausea, weight loss, abdominal pain, heartburn, dysphagia, altered bowel motility and irritable bowel syndrome. In a different study of 73,435 users of the Veterans Health Administration, motility disorders (including constipation and diarrhoea), oesophageal disorders, dysphagia and abdominal pain were reported (Meringer and Mehandru, 2022).

Fatigue is one of the most reported symptoms both during and after COVID-19 infection. Fatigue can thus be envisioned as a disorder of energy balance and availability, a sort of alert that mimics the exhaustion of the metabolic reserves of an individual (ie, frailty. The long-term negative effects of the pandemic might negatively affect the accumulation of the biological reserves of an individual. In other words, in the near future, we could see a high prevalence of frailty in people who survive the pandemic(Azzolino and Cesari, 2022)

COVID-19 is expected to have a significant influence on physical, cognitive, mental, and social health status, even in individuals with the moderate illness. Previous coronavirus outbreaks have been linked to a variety of symptoms including prolonged pulmonary function impairment, muscular weakness, discomfort, tiredness, depression, anxiety, career issues, and a poor quality of life (Klok *et al*., 2020). Individuals affected in the pandemic may have a high epidemiological burden of depression, anxiety disorders, stress, panic attack, somatization disorder, sleep disorders, emotional disturbance, PTSD symptoms, suicidal behaviour, and many more mental health problems(Hossain *et al.*, 2020).

Food variety had a significant impact on people's immunity and susceptibility to infection during the COVID-19 pandemic. Dietary discrepancy has been linked to physical and mental illnesses such as anxiety and depression. Mental illnesses may have an impact on dietary diversity due to decreased hunger, lack of appetite, and depression. Maintaining immunological function requires adequate intake of various types of dietary nutrients. Work-related issues, as well as the psychological distress that comes with them (depression, anxiety, and insomnia), can substantially impair dietary diversity and nutritional habits.

AIM

The aim of the present study is to evaluate the Health and Wellbeing of Long COVID patients in Kannur district of Kerala.

BROAD OBJECTIVES

- To assess the general health profile of COVID patients.
- To obtain an insight into health-related problems during and post-recovery.

SPECIFIC OBJECTIVES

- To obtain information regarding the socio-demographic profile of the selected Long-COVID patients
- To assess the nutritional status of Long-COVID patients using Anthropometric assessment and Dietary Diversity Score.
- To evaluate the health and well-being of study subjects by assessing comorbidities, symptoms during COVID and the Long COVID period, as well as fatigue, stress, and insomnia.
- To examine the impact of exercise on Sleep Pattern, Dietary Diversity Score, Stress Level, and Fatigue Level among Long-COVID patients using Analysis of Variance.
- To evaluate the correlation of COVID-19-related stress, fatigue, insomnia and its association with dietary diversity score among Long-COVID patients.

SIGNIFICANCE OF THE STUDY

A significant number of patients with COVID-19 experience prolonged symptoms, known as Long COVID. Few systematic studies have investigated this population, particularly in outpatient settings. Hence, relatively little is known about symptom makeup and severity, expected clinical course, impact on daily functioning, and return to baseline health. Many patients have not yet recovered have not returned to previous levels of work, and continue to experience significant symptom burden. Most Long COVID patients were not hospitalized. It’s essential these patients’ persisting symptoms are acknowledged, and that they get support from their family, employer and a multidisciplinary medical team.

REVIEW OF LITERATURE

CHAPTER 2
REVIEW OF LITERATURE

The review of literature of the study entitled "HEALTH AND WELLBEING OF LONG COVID PATIENTS IN KANNUR DISTRICT OF KERALA" is discussed under the following headings:

2.1 COVID: An overview

2.2 Clinical characteristics of Long COVID

2.3 Nutritional Assessment of COVID patients

2.3.1 Anthropometric Assessment

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2.1 COVID: An overview

The pandemic of new coronavirus disease (COVID-19), caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), continues to pose a global threat (Tfi *et al.,* 2020). Coronaviruses are enveloped viruses with nonsegmented, single-stranded RNA genomes that are positive-sense. COVID-19 is an illness caused by the SARS-CoV-2 coronavirus (Ishrath *et al*., 2021). In late December 2019, an outbreak of pneumonia with symptoms such as fever, dry cough, tiredness, and sometimes gastrointestinal symptoms broke out at the Seafood Wholesale Market in Wuhan, China. After the local health department issued an epidemiologic alert, the market was shut down on January 1, 2020 (Shi *et al.*, 2020).

The first COVID-19 case in India was reported on January 30, 2020 in Trissur, Kerala. COVID-19 has been fought mostly by a containment strategy, which is typically utilised when a virus has a poor transmission capacity or is imported from outside sources. This allows for measures like quarantining people who have travelled from a high-transmission location, isolating infected people, tracking contacts, and restricting people's mobility in high-case-load areas to be implemented. Kerala's containment strategies had helped to limit the spread of sickness in the community by the end of March. Regulations include school closures and a ban on public mass gatherings (Varghese and John, 2020).

SARS-CoV-2 enters host cells by a series of stages before releasing its genome into target cells. The protein spike is used by the virus and is critical for determining tropism and virus transmissibility (Mohamadian *et al.*, 2021). The Coronavirus enters the host cell, by attaching to specific cell surface receptors (Kumar *et al.*, 2021). Host cell-surface proteases act on a crucial cleavage point and membrane fusion and viral infection occurs. Virus particles are finally budded and discharged into the extracellular environment. As a result, both the viral replication cycle and the development of the virus begin (Mohamadian *et al.*, 2021).

COVID-19 symptoms range from asymptomatic infection to severe respiratory failure. The majority of infected patients will experience mild to moderate sickness and will recover without the need for hospitalisation. Fever, cough, fatigue, and loss of taste or smell were observed in the vast majority of people. Sore throat, headache, aches and pains, diarrhoea, skin rash, discoloration of fingers or toes, and red or irritated eyes are some of the less common symptoms. Symptoms such as trouble breathing or shortness of breath, loss of speech or mobility, or confusion, as well as chest pain, are all considered significant. The clinical signs of COVID-19 infection can appear after 5–6 days of incubation, depending on the person's age and immune system (Kumar *et al.*, 2021) .

The distribution patterns of virus are influenced by a number of factors, including the virus's basic reproductive number, the virus's type, the environment, trade/travel with the affected area, population density, and social culture. According to WHO data, colder and humid regions are more affected than warmer and drier parts. On March 12, 2020, the first death was reported. A 76-year-old guy who had recently returned from Saudi Arabia was the first victim (Kaushik *et al.*, 2020).

A nasal swab, tracheal aspirate, or bronchoalveolar lavage (BAL) specimen is used in the RT-PCR diagnostic test. Upper respiratory samples collected using nasopharyngeal and oropharyngeal swabs are the primary and preferred approach for diagnosis. Bronchoscopy should only be considered for intubated patients who have negative upper respiratory samples and would benefit from other diagnostic methods. Bronchoscopy, on the other hand, may be recommended if clinical and safety requirements are met, as well as if the diagnosis is unclear. Intubated patients can also be collected respiratory specimens via tracheal aspiration and nonbronchoscopic BAL (Pascarella *et a*l., 2020.).

Supportive therapy, as well as treating symptoms and preventing respiratory failure, are the mainstays of treatment. Infected people, both symptomatic and asymptomatic, must be isolated, as must everyone who has come into contact with them. Self-isolation at home is the best option in mild instances, as long as hydration and nourishment are maintained and symptoms like fever, sore throat, or cough are treated. As a result, hospital beds might be made accessible for serious cases (Pascarella *et al.,* 2020). Early symptoms can be treated with modest pain medicines, cough syrup, rest, and a large amount of fluid intake. In addition, although ventilators cannot treat infection, they aid in breathing and sustain lung function in infected patients. Extracorporeal membrane oxygen-ation ECMO is a lifesaving therapy for refractory respiratory failure (Baloch *et al.,* 2020).

Vaccines to prevent SARS-CoV-2 transmission have been the subject of intense research in the year 2020. A COVID-19 vaccination confers immunity against the virus that causes coronavirus illness. Non-replicating mRNA (NRM) vaccines and self-amplifying mRNA (SAM) vaccines are the two types of messenger ribonucleic acid (mRNA) vaccines now available (Huang *et al*., 2022). The COVID19 vaccine, also known as Comirnaty, was developed by BioNTech in Germany and Pfizer in the United States. The Sputnik V COVID19 vaccine, a viral vector vaccine, was created by the Russian Research Institute of Epidemiology and Microbiology in Gamaleya. Covaxin, an inactivated viral vaccine, was developed in collaboration between Bharat Biotech and the Indian Council for Medical Research. EpiVacCorona, a peptide vaccine, was created by the Russian State Research Center for Virology and Biotechnology (Kumar *et al.,* 2021).

2.2 Clinical characteristics of Long Covid

Long COVID refers to the presence of numerous symptoms weeks or months after contracting SARS-CoV-2 infection, regardless of viral state. "Long COVID-19," "post-acute COVID-19," "persistent COVID-19 symptoms," "chronic COVID-19," "post-COVID-19 manifestations," "long-term COVID-19 effects," "post COVID-19 syndrome," "ongoing COVID-19," "long-term sequelae," or "long-haulers" have all been used as synonyms to describe prolonged symptoms following COVID-19 illness by different writers. The terms "post-acute sequelae of SARS-CoV-2 infection," "long-COVID-19," and "post-acute COVID-19" have all lately been used (Leon *et al.,* 2021). It might be either continuous or relapsing and remitting.

There may be a persistence of one or more acute COVID symptoms, as well as the emergence of new symptoms (Raveendran *et al.,* 2020). Although acute COVID-19 can affect numerous organ systems, the most prevalent symptoms are systemic, respiratory, gastrointestinal, cardiovascular, and neurological. Systemic (fatigue and poor concentration), neuropsychiatric (sleep abnormalities, chronic headache, 'brain fog,' defects in memory, mood impairment, and pain syndromes), cardiac (palpitations, syncope, dysrhythmias, and postural symptoms), and respiratory symptoms(dyspnea and cough) are the most common manifestations of post-COVID-19 syndrome (Mehandru and Merad, 2022).

Following up on individuals who had recovered from COVID, researchers discovered a few factors that are typically linked to the development of long COVID. Increased age is also a risk factor (Nabavi, 2020). More than five symptoms seen during the acute stage of disease are linked to a higher chance of developing long COVID. Fatigue, headache, dyspnea, hoarse voice, and myalgia are the most common symptoms associated with extended COVID. The presence of co-morbidities raises the chances of acquiring post-COVID syndrome. Even individuals with minor symptoms at first were found to have had long COVID (Sudre *et al.*, 2021).

It's crucial to figure out what's causing the symptoms to remain. Chronic infection can occur as a result of re-infection, relapse, or persistent viremia in persons with compromised immunity. Symptoms are exacerbated by deconditioning and psychological problems such as post-traumatic stress. COVID-19's social and economical consequences add to long-term

COVID concerns, such as psychological problems (Dean *et al*., 2021). Differentiating residual symptoms from re-infection is important in the public health perspective. Inflammatory markers that remain consistently elevated suggest that inflammation is persistent. (Raveendran *et al.,* 2020).

In people with long COVID, researchers discovered two main patterns of symptoms: 1) fatigue, headache, and upper respiratory complaints (shortness of breath, sore throat, persistent cough, and loss of smell) and 2) multi-system complaints, which include ongoing fever and gastroenterological symptoms. Some of the symptoms in patients with long COVID are first observed 3e to 4 weeks after the onset of acute symptoms (Sudre *et al.,* 2020). Overall symptom severity for each time interval (weeks 1-4, month 2-7) was measured using a Likert scale (no symptom, very mild, mild, moderate, severe, very severe) (Davis *et al.*, 2021).

SARS-CoV-2 infection can cause chronic cough, fibrotic lung disease (post-COVID or post-ARDS fibrosis), bronchiectasis, and pulmonary vascular disease. Chronic shortness of breath could be caused by persistent pulmonary involvement, which is known to clear over time (Fraser, 2020). Common cardiac issues in patients from COVID 19 include labile heart rate and blood pressure responses to activity, myocarditis and pericarditis, impaired myocardial flow reserve from micro vascular injury, myocardial infarction, cardiac failure, life-threatening arrhythmias and sudden cardiac death.(Becker, 2020).

Profound tiredness is a common symptom, and one study reported that more than half of those infected with SARS-CoV-2 remained fatigued after ten weeks. There was no link between the onset of fatigue, the severity of COVID-19, and the level of inflammatory markers. Female sex and diagnosis of depression/ anxiety is more common in those with fatigue (Townsend *et al.*, 2020). Furthermore, the infection may cause peripheral and central inflammatory reactions, which can result in long-term musculoskeletal issues, cognitive impairment, and psychological distress, as well as increased depression, anxiety, post-traumatic stress disorder (PTSD), and sleep issues (Shanbehzadeh *et al.,* 2020)

Evaluation, symptomatic treatment, treatment of underlying disorders, physiotherapy, occupational therapy, and psychological support are all part of the treatment of patients with long COVID (Greenhalgh *et al.*, 2020). Cough, discomfort, and myalgia are minor symptoms that can be treated symptomatically with paracetamol, cough suppressants, and oral antibiotics. In patients with pulmonary and neuromuscular consequences, physiotherapy and neurorehabilitation are critical. Because it is a new condition, information about long-term impacts and treatment possibilities is currently developing. After SARS-CoV-2 infection, people's preexisting co-morbidities such as diabetes, hypertension, and cardiovascular disease may worsen, necessitating treatment optimization (Raveendran *et al.,* 2020).

2.3 Nutritional Assessment of COVID patients

Infections take a toll on the body, especially when they result in a fever, which requires additional energy and nutrition. As a result, eating a nutritious diet is crucial during the COVID-19 epidemic. Foods contain vital phytochemicals and critical nutrients that not only support basic biological functions in living creatures, but also have protective and complementary effects in the prevention and treatment of diseases, such as infections (Carr and Maggini, 2017). Although no specific nutrients have been scientifically proved to aid in the prevention or treatment of COVID-19, a well-balanced and varied diet is unquestionably important in maintaining a healthy immune system and supplying adequate nutrients for recovery (Zhao *et al.,* 2020). A well-balanced diet can help to boost the immune system's response.

Although social isolation is an effective method for preventing infections, a lack of access to family, friends, and social support can exacerbate issues like anxiety and depression. Daily stress, sleep deprivation, and a nutritionally unbalanced diet generate a condition of chronic inflammation in this setting, negatively damaging the immune system (Haspel *et al.*, 2020; Mackay, 2019) The cytokine storm causes immunological dysregulation in COVID-19, an inflammatory illness that can lead to multiple organ failure and death. As a result, it's critical to comprehend the role of diet in inflammation, including deficiencies and excesses, as well as its pro- or anti-inflammatory effects (Francesca *et al.,* 2020; Msyamboza *et al.,* 2013)

2.3.1 Anthropometric Assessment

Anthropometry is the science that determines a person's size, shape, and functional abilities using physical measures. Body measures are used to determine an adult's health and dietary status, illness risk, and body composition (CDC, 2021). Height, weight, and BMI are the most important aspects of anthropometry (BMI).

Standing upright against a wall with a height mark, the participant's height was measured. The person was measured while standing barefoot against the wall, his back against the wall, and his head in the Frankfort position with his heels together. The individual was told to stretch as much as he or she could. After the subject had been appropriately positioned, he or she was requested to exhale and a height mark with white chalk was made. The height was measured from the mark to the floor in centimetres using a tape measure. The measurements were taken to within 0.1 centimetres of one another (Msyamboza *et al.,* 2013).

Weighing is usually the first step in anthropometric evaluation, and it is necessary to determine the weight-for-height z-score (WHZ) for children and the body mass index (BMI) for adults. The relationship between weight and general health is well established. Weight loss that occurs unintentionally leads to ill health and a compromised immune system. The usage of a working weighing scale that measures weight in kilogrammes is required for weighing. Inaccuracies in measurement might lead to erroneous nutritional status classification and incorrect care and therapy (NACS, 2016).

BMI is an anthropometric indicator based on the weight-to-height ratio. It is used to categorise malnutrition in non-pregnant and postpartum women (NACS, 2016). Based on BMI, the WHO classified people as being underweight, normal weight, overweight, or obese. Individuals with a BMI of less than 18.5 were deemed malnourished, those with a BMI of 18.5 to 24.9 were regarded normal, and those with a BMI of more than 25 were labelled overweight. (Majumder, 2014; Vallois, 1965).

$$BMI = kg/m^2$$

Overweight and obesity have been increasingly common in India over the last few decades. In India, the prevalence of overweight and obesity is rising faster than the global average. For example, between 1998 and 2015, the prevalence of overweight went from 8.4 percent to 15.5 percent among women, while the prevalence of obesity climbed from 2.2 percent to 5.1 percent (Luhar *et al.*, 2020). Obesity has now reached epidemic proportions around the world. The WHO had estimated that in 2016, more than 1.9 billion adults worldwide (39%) were overweight, and over 650 million (13%) were obese (Venkatrao *et al.,* 2020).

According to the data from the India survey, which included 2,33,805 participants, a considerable proportion of the Indian population was physically inactive (20%) or slightly active (37%), and so 57 percent of the population failed to follow the WHO physical activity guidelines. According to latest estimates, a bigger portion of India's population is at risk of developing NCDs, including diabetes. Furthermore, the current condition of physical inactivity, which has been exacerbated by current COVID-19 confinement rules, increases the chance of serious illness from the disease. This can be improved by promoting workouts that can be done at home, such as yoga (Podder *et al.*, 2020).

2.3.2 Dietary Diversity Score Assessment

Dietary assessment is a technique for evaluating an individual's, household's, or population group's food and nutrient intake and dietary pattern over time (FAO, 2010). Individuals or populations groups' nutritional status is determined using dietary assessment tools. In order to determine dietary consumption in this study, a 24-hour dietary recall was done for two days. The 24HR is a completely open-ended survey intended to gather a range of detailed information regarding food ingested over a set period of time. For a single-day recall, the 24HR is an in-depth interview that takes about 20 to 30 minutes to complete. Detailed information about food preparation processes, ingredients used in mixed dishes, and the brand name of commercial items, depending on the study topic.The patients' dietary patterns, such as food habits and meal frequency, were reviewed (Shim et al., 2014).

DDS was used to assess the households' diet diversity. The Dietary Variety Score (DDS) is a proxy tool based on the concept that "dietary diversity is a crucial aspect of diet quality, and a diverse diet helps deliver adequate intakes of vital nutrients that promote health" (FAO, 2018). Dietary diversity refers to the number of different meals or food types consumed in a given day (DD). Dietary Diversity Score (DDS) is a reflection of the diet's quality and diversity. DDS keeps a record of everything they ate or drank in the previous two days (meals and snacks), both during the day and at night. It all started with the first meal or drink of the day, which included meals and beverages.

Dietary diversity scores are calculated by adding up the totals of each respondent's 16 food groups ingested during a 24-hour period. The steps in the IDDS (Individual Dietary Diversity Score) are as follows: To make a total of nine food groups, new food group variables were constructed for those food groups that needed to be aggregated. The dietary groups "Starchy fundamentals" and "White roots and tubers" in the IDDS, for example, are made up of "Cereals" and "White roots and tubers." By merging the answers to "Cereals" and "White roots and tubers," a new variable called "Starchy staples" was formed.

Starchy staples = 1 if (Cereals) =1 or (White roots and tubers) = 1

Starchy staples = 0 if (Cereals) = 0 and (White roots and tubers) =0

DDS correlates with the severity of symptoms. A person with a high dietary variety score has fewer DDS < 4 was considered as poor dietary diversity. A score between 6 and 9 represents good diversity. Each food group was only counted once when calculating DDS. The nine groups used were: 1) cereals/roots/tubers; 2) meat/poultry/fish; 3) dairy; 4) eggs; 5) vitamin A rich fruit and vegetables; 6) legumes; 7) other fruit; 8) other vegetables; 9) fats and oils (FAO 2010).

To reduce day-to-day changes, the subjects' food consumption data were gathered via a 24-hour food recall by a trained person on a random day. A 24-hour recall technique was used in this study. The interviews included a full description of the foods consumed, the cooking methods used, and the brand names of the products used. The respondent used cups, tablespoons, coconut spoons, the size of a pack of matches, and other common household measurements to estimate how much the subject ate (Rathnayake *et al*., 2012).

Interviewers, on the other hand, should be given standardised neutral probing questions to avoid guiding respondents to certain replies when they don't know or recall them. The Automated Multiple-Pass Method of the United States Department of Agriculture (USDA) is the current state-of-the-art 24-hour dietary recall device (AMPM). The National Health and Nutrition Examination Survey in the United States uses this method(NHANES) (Steinfeldt *et al.*, 2013).

It was noticed that the samples were giving importance to cereals and majority (58%) were having medium dietary diversity score (Score 4 or 5) due to the consumption of 4–5 food groups whereas 33% were having high dietary diversity (Score >6) who consume more than

6 food groups and only 9% were found to have low dietary diversity score (Score $\leq$3) because of consuming three or less than 3 food groups. When considering the dietary diversity in detail it was noticed that majority of samples were only giving importance to cereals (rice, wheat), pulses and legumes and other vegetables such as onion, tomato, and ladies finger. They weren't conscious or bothered about dietary diversity and nutritional status. The consumption of vitamin A rich vegetable, tubers and fruits (pumpkin, carrot and mango), dark green leafy vegetables, organ meat was once or twice in a month (Aiswarya and Bhagya, 2021).

2.4 Assessment of Health and Wellbeing

Wellbeing is not just the absence of disease or illness. It's a complicated mix of physical, mental, emotional, and social aspects that affect a person's health. Mental health refers to a condition of well-being in which a person recognises his or her own abilities, is able to cope with everyday stressors, works productively, and contributes to his or her community. Because it indicates that people believe their lives are going well, well-being is a positive result that is relevant for individuals and many sectors of society. Health is more than the absence of disease; it is a resource that enables people to achieve their goals, meet their requirements, and cope with their surroundings in order to live a happy and healthy life (Martin, 2016).

2.4.1 Assessment of comorbidity

Comorbidity refers to the presence of two or more ailments or illnesses in the same person. They can happen simultaneously or one after the other (Guan *et al.,* 2020). The elderly, particularly those in long-term care facilities, and those of any age with major underlying medical issues are at a higher risk of contracting COVID-19, according to current data and clinical experience (CDC, 2020). The aged, a vulnerable population with chronic health disorders such as diabetes and cardiovascular or lung disease, are at a higher risk of not just getting severe sickness but also of dying if they become ill. People with uncontrolled medical disorders such diabetes, hypertension, lung, liver, and renal disease, cancer patients receiving chemotherapy, and smokers (Sanyaolu *et al.,* 2020).

Patients with chronic comorbid diseases face significant obstacles in terms of diagnosis, ill health, and disease management, all of which have a negative impact on treatment options and outcomes. Finally, the intensity of comorbidity results in poor health conditions and outcomes, a higher chance of hospitalisation, and a higher financial load on the healthcare system (Mahumud *et al.,* 2020). Early clinical experience revealed that individuals with COVID-19 who were older and had a number of comorbidities, such as hypertension, cardiovascular disease, diabetes mellitus, and chronic pulmonary disease, had a higher chance of death (Kario *et al.*, 2020).

In COVID-19 patients, hypertension has been routinely identified as the most common pre-existing comorbidity. During SARS-CoV-2 infection, hypertension patients appear to have a higher mortality risk than normotensive patients (Fernández *et al*., 2022). The renin-angiotensin-aldosterone (RAS) system has been implicated in aiding the entry of coronaviruses, such as SARS-CoV-2, into target cells, particularly in the lungs. As a result, it's been proposed that angiotensin receptor blockers and angiotensin-converting enzyme inhibitors, which affect ACE2 expression, may affect the susceptibility to and severity of SARS-CoV-2 infection (Hoffmann *et al*., 2020).

SARS-CoV-2 causes increased stress levels in diabetic people, causing hyperglycemic hormones to be released and blood sugar levels to rise. The receptor responsible for SARS-CoV-2 entrance and binding, has a higher level of expression in DM. Because adaptive immunity is delayed in DM, an inflammatory storm develops following SARS-CoV-2 infection, resulting in respiratory failure and rapid organ deterioration (Koneru *et al.*, 2021). People with long COVID-19 should be managed with interventions that target various risk factors, as well as the use of innovative glucose-lowering medicines that enhance metabolic function and the main processes that are disrupted in COVID-19 (Jin and Hu, 2021).

Acute cardiac damage is a common extrapulmonary symptom of COVID-19, and it can have long-term implications. In people infected with SARS, cardiovascular disease is a prevalent comorbidity (Nishiga *et al*., 2020). A wide range of issues can occur in the cardiovascular system, putting patients at a higher risk of morbidity and mortality (Hamadi *et al*., 2020). Patients with Long COVID frequently report of palpitations and chest pain, which can be caused by simple sinus tachycardias or supraventricular or ventricular arrhythmias (Di Toro *et al*., 2021). SARS-CoV-2 may infect and destroy cardiac cells directly in the short term, resulting in severe cellular and organ-wide disease and dysfunction (Chung *et al.*, 2021).

Obesity generally worsens the severity of respiratory disorders, however it's unclear whether obese persons are also more prone to develop COVID-19 symptoms that are more severe. According to early research, people who were overweight or obese were admitted to ICUs and required mechanical breathing far more frequently than people who were not overweight or obese (Mohammad *et al.,* 2021). Obese patients have poorer chest-wall elastance and overall respiratory system compliance, as well as a smaller expiratory reserve volume. Patients with obesity frequently experience difficult airway management, as well as this altered lung and chest-wall physiology, in combination with positional gas trapping (Jose and Manuel, 2020).

Patients with chronic obstructive pulmonary disease (COPD) who are older are more likely to develop acute respiratory distress syndrome (ARDS), which is linked to a higher rate of morbidity and mortality (Polverino and Kheradmand, 2021). When individuals contract COVID-19, they are at a higher risk of developing severe pneumonia and having a poor prognosis (Leung *et al.*, 2020). Hemolytic-uremic syndrome, obstructive lung disease, pleural effusion, and chronic bronchitis are all disorders linked to COVID-19. Because of their tight relationship, COVID-19 patients who have both of these disorders may have a greater mortality rate (Das, 2021). The primary cause of COVID-19 mortality is aberrant alveolar fluid metabolism in the lungs, which results in fluid buildup in the alveolar airspace. Pulmonary edoema is the common name for this illness, which is caused by a lack of oxygen in the lungs (Cui *et al.*, 2021) .

One of the most important criteria for COVID-19 vulnerability is the existence of CKD. Recent research suggests that hematuria and proteinuria may occur following COVID-19 infection, whereas some patients may show indications of AKI (Askari *et al.*, 2021). Three putative pathogenic pathways for COVID-19-induced kidney injury have been identified. First, the development of intrarenal inflammation has been linked to cytokine release syndrome. Second, cardiorenal and alveolar-tubular crosstalk have been implicated. Finally, the renin-angiotensin-aldosterone pathway causes hemodynamic damage to the vascular endothelium and glomerulus by increasing both glomerular capillary and systemic hypertension. Angiotensin II and aldosterone, which have direct profibrotic and proinflammatory effects, may also contribute to kidney injury (Spuntarelli *et al*., 2020)

Because liver injury and CLD are linked to COVID-19 severity and mortality, indications of liver disease such as liver enzymes, liver fibrosis, and liver steatosis should be prioritised as COVID-19 severity prognostic markers. Individuals with liver illness have an immune inflammatory state that is especially important in other infectious disorders (Martinez and Franco, 2021). COVID19 is largely a respiratory condition, although it also affects the liver. Because viral entry receptors, such as angiotensin-converting enzyme 2, are widely distributed, the liver may be involved . COVID19-related liver injury is defined as any liver damage that occurs during the progression of COVID19 disease and treatment in patients with or without preexisting liver disease (Garrido *et al.*, 2020; Nawghare *et al*., 2022)

Due to various comorbidities and immunosuppression, cancer patients with haematological diseases or haematopoietic stem cell transplant are at a significant risk of COVID-19 infections. (Sharma *et al.*, 2020). Cancer patients' higher vulnerability to severe COVID-19 problems can be related to their immunosuppressed state as a result of their cancer and anticancer treatments like chemotherapy or surgery (Quteimat and Amer, 2020). When compared to other cancers, patients with lung cancer have regularly been shown to have a higher chance of death (Passaro *et al.*, 2021).

There are two reasons for determining the comorbidities linked with this condition. First, it allows clinicians to adapt treatment for their patients on an individual basis, which is especially significant for patients who are more susceptible to severe disease. Second, it enables governments to adjust their public health recommendations in accordance with a risk stratification strategy. Furthermore, determining which comorbidities are most closely linked to COVID-19 will lead to more in-depth research into the pathophysiology of SARS-CoV-2 infection on these underlying disorders, as well as vice versa (Gold *et al*., 2020).

Hypertension has been reported as the highest pre-existing comorbidity (43.1 percent). In COVID-19 patients, hypertension has been routinely identified as the most common pre-existing comorbidity. During SARS-CoV-2 infection, hypertensive individuals appear to have a higher mortality risk than normotensive patients (Fernández *et al.*, 2022). Diabetes mellitus was prevalent among 32.8% of the subjects, in diabetic patients, SARS-CoV-2 triggers higher stress conditions and elevating blood sugar levels. SARS-CoV-2 causes increased stress in diabetes patients, causing hyperglycemic hormones to be released and blood sugar levels to rise (Koneru *et al.*, 2021).

The occurrence of obesity or overweight among the study subject has been reported as 26.8%. Patients with obesity frequently experience difficult airway management, as well as altered lung and chest-wall physiology, in combination with positional gas trapping (Jose and Manuel, 2020). One of the most important criteria for COVID-19 vulnerability is the existence of CKD and 22% of the subjects suffering from renal diseases. Carcinoma found among 21% of the subjects. Due to many comorbidities and immunosuppression, cancer patients with haematological illnesses are at high risk of COVID-19 infections, which can expose cancer patients to catastrophic problems as a result of an infection (Sharma *et al.,* 2020).

15.2% of the subjects had cardiovascular diseases. Acute cardiac damage is a common extra pulmonary symptom of COVID-19. Chronic lung disease reported as 10% among the subjects, 9.2% of the subjects had liver disease. Because liver injury and CLD are linked to COVID-19 severity and mortality, indications of liver disease should be prioritised as COVID-19 severity prognostic markers (Martinez and Franco., 2021).

Hypertension was the most common comorbidity (22%), followed by diabetes (14%), cardiovascular disease (13%), respiratory disease (5%), and other chronic diseases (8%). According to Guan et al. (2020), hypertension (16.9%) was the most common comorbidity, followed by diabetes (16.9%). (8.2 percent). 130 individuals (8.2%) said they had two or more comorbidities (Mahumud *et al.*, 2021)

A systematic review to evaluate comorbidities associated with severe and fatal cases of COVID-19 was conducted by Gold *et al.*, the most prevalent comorbidities were hypertension (31.39%), cardiovascular disease (25.24%), diabetes (23.95%), and respiratory diseases (9.39%). In a study conducted by Richardson *et al*.,among 5700 patients, the most common comorbidities were hypertension (56.6%), obesity (41.7%), and diabetes (33.8%). Comorbidity causes poor health conditions and results, as well as a higher chance of hospitalisation and a costly strain on the healthcare system.

2.4.2 Symptom Assessment During COVID and Long COVID

The majority of those infected with the virus will experience mild to moderate respiratory symptoms and will recover without medical help. On the other side, some people will become dangerously ill and require medical treatment. The elderly and those with underlying medical conditions including cardiovascular disease, diabetes, chronic lung disease, or cancer are more likely to develop serious illnesses. COVID-19 is a virus that can make anyone sick, make them very sick, or cause death at any age. The majority of infected patients will have mild to moderate symptoms and will be able to recover without hospitalization. The most common symptoms include fever, cough, exhaustion, and loss of taste or smell.

COVID-19 causes viral pneumonia, according to three large-scale studies conducted on 278 individuals in Wuhan, China. All of the patients were adults over the age of 18, with 172 (61.9 percent) men and 106 (38.1 percent) females. Two of the 13 patients with COVID-19 pneumonia in a recent research in Beijing were youngsters aged 2–15 years. Co-morbidities such as cardiovascular disease, hypertension, diabetes, and patient age all play a role in illness outcome. An adult with no substantial co-morbidities recovered quickly, whereas an elderly person with severe co-morbidities required intensive care and a ventilator. Fever, cough, sore throat, nasal congestion, lethargy, and headache are the most common symptoms. Atypical infections are more common and severe among the elderly and other immunocompromised persons (Kaushik *et a*l., 2020).

COVID 19 is described as a condition in which symptoms of COVID 19 last longer than three weeks after onset of symptoms, and chronic COVID 19 lasts longer than 12 weeks (Siba et al., 2021). Patients with lengthy COVID experience a variety of new or persistent symptoms. The post-COVID-19 condition affects most other body systems, both physically and biologically, and extends beyond the cardio-respiratory system. Although the cause of the post-COVID-19 disease is uncertain, persistent immune activation could be a component. Although the pathophysiology, management, and prognosis of different post-acute SARS-CoV-2 sequela syndromes have yet to be determined, it is thought that a variety of post-COVID-19 disease morphologies exist. (Munblit *et al*., 2022).

Patients with mild-to-critical COVID-19 had abnormal lung functions and structural changes up to 6 months after hospitalisation, as well as diffuse alveolar damage, desquamation of alveolar epithelial type II cells, fibrine exudation, hyaline membranes, scattered interstitial inflammation, monocytes, and macrophages. In a prospective analysis of 114 severe COVID-19 patients, Han et al. discovered lung fibrotic-like alterations in 35% of patients 6 months after infection. The diffusing capacity of the lung for carbon monoxide (DLCO) was also altered in a small group of critically ill COVID-19 patients for up to 3 months. Non-critical COVID-19 patients who also presented with persistent DLCO impairment were also shown to have persistent DLCO impairment (Salamanna *et al.,* 2021).

Long-term COVID appears to be associated with signs of cardiovascular autonomic dysfunction (Bisaccia et al., 2021). Chest pain or tightness, palpitations, dizziness, and an increase in resting heart rate are the most frequent cardiovascular (CV) symptoms. These signs and symptoms can be found in both hospitalised and non-hospitalized patients (Dixit *et al.,* 2021). Long-term damage from direct viral invasion of cardio myocytes and subsequent cell death, endothelial cell infection and endotheliitis, transcriptional alteration of multiple cell types in heart tissue, dysregulation of the renin–angiotensin–aldosterone system, autonomic dysfunction to induce subsequent fibrosis and scarring of cardiac arteries are all possible mechanisms (Xie *et al.,* 2022).

Post COVID-19 syndrome can manifest as persistent musculoskeletal aches and pains, reactive arthritis (symmetric arthritis of major joints), rheumatoid arthritis-like presentation (arthritis of the tiny joints), and femoral head necrosis. Post-viral chronic fatigue syndrome, comparable to fibromyalgia, is also found, with poor sleep, fatigue, myalgia, and depression, and some people being unable to return to work as a result (Kabi *et a*l., 2020). At 6 months, approximately 3 out of every 5 patients had at least one symptom, with 2 out of every 5 patients having at least one rheumatic and musculoskeletal symptom and just over half of the patients having at least one additional COVID-19 symptom. The most common rheumatic and musculoskeletal complaints were fatigue, joint pain, and myalgia. The most common complaints were joint discomfort and myalgia (Karaarslan *et al.*, 2022).

Loss of appetite, nausea, weight loss, abdominal discomfort, heartburn, dysphagia, decreased bowel motility, and irritable bowel syndrome are common gastrointestinal symptoms in people with Long COVID. Acute COVID-19 infection is caused by the strong constitutive expression of angiotensin-converting enzyme 2 on the brush edge of the small intestine mucosa. Motility issues (including constipation and diarrhoea), oesophageal difficulties, dysphagia, and abdominal pain were all observed in a separate study of 73,435 Veterans Health Administration patients. The exact frequency of PACS gastro-intestinal problems is currently unknown. Furthermore, Su et al. showed a significant enrichment of the cytotoxic T cell pool in patients with gastrointestinal PACS, which was mostly linked with bystander activation of cytomegalovirus-specific T cells (Meringer and Mehandru, 2022).

Current research on the relationship between COVID-19 severity and allergy disorders and asthma is conflicting. Only a few studies have published sufficient clinical information on asthma in COVID-19 patients, such as lung function, control status, asthma phenotypes, or treatment regimen, making comparison difficult. Reduced ACE2 expression and overexpression of transmembrane protease serine 2 (TMPRSS2), two critical molecules for SARS-CoV-2 entrance, are found in the nasal and airway epithelial cells of patients with respiratory allergies. This may result in a lower infection risk but a higher severity risk. A recent large cohort study aimed at investigating the relationship between atopy and COVID-19 severity discovered that AR was linked to a decreased rate of COVID-19 severity (Gao *et al.*, 2021).

One of the most common symptoms reported during and after COVID-19 infection is fatigue. Fatigue can thus be seen of as a disturbance in energy balance and availability, a kind of warning that simulates the exhaustion of an individual's metabolic reserves (i.e. frailty). The pandemic's long-term negative impacts may have an adverse influence on an individual's ability to accumulate biological reserves. In other words, we may witness a high prevalence of frailty in persons who survive the pandemic in the near future (Azzolino and Cesari, 2022). Fatigue is one of the most commonly reported symptoms of Long COVID with the ONS predicting a five-week incidence of 11.9 percent among those who have received covid-19.53. Fatigue is a typical symptom that persists regardless of severity (Crook *et al.*, 2021).

Covid-19 has been linked to septic encephalopathy, nonimmunological consequences such hypotension, hypoxia, and vascular thrombosis, and immunological effects like adaptive autoimmunity, microglial activation, and a maladaptive cytokine profile, according to studies (Needham *et al.*, 2020). Encephalopathy, cognitive impairment, cerebrovascular events/disease, seizures, hypoxic brain injuries, corticospinal tract symptoms, dysexecutive syndrome, a changed mental status, and psychiatric problems have all been reported in patients admitted to hospitals with covid-19. Although patient experiences and published summaries of lengthy covid have characterised "brain fog" as a prevalent and debilitating symptom, it is uncertain who is most impacted by cognitive problems caused by covid-19 and how long they last (Crook *et al.*, 2021).

Even in people with modest illness, COVID-19 is projected to have a significant impact on physical, cognitive, mental, and social health. Prolonged pulmonary function impairment, muscular weakness, discomfort, fatigue, depression, anxiety, employment challenges, and a poor quality of life have all been associated to previous coronavirus outbreaks (Klok *et al.*, 2020). Individuals who are affected by the pandemic may experience a high prevalence of depression, anxiety disorders, stress, panic attacks, somatization disorder, sleep difficulties, emotional disturbance, PTSD symptoms, suicidal behaviour, and other mental health issues (Hossain *et al.*, 2020).

In medical education and research, Likert-type scales are commonly utilised (Sullivan and Artino, 2013). For each symptom that was reported as absent, mild, moderate, or severe, a 4-point Likert scale was utilised (Galal *et al.*, 2021). Physical symptoms were reported as moderate or severe during and after Long COVID infection. Participants could reply to it to the best of their knowledge, and symptoms of Long COVID were studied for a period of 0 to 30 weeks.

2.4.3 Fatigue Assessment

One of the most common complaints among community-dwelling older individuals is fatigue. It has a number of side effects, including a decreased ability to continue everyday activities and a decrease in involvement in leisure activities that safeguard cognitive, physical, and psychosocial wellbeing. Fatigue is a multidimensional concept that can manifest as general tiredness (i.e., trait, chronic subjective fatigue) or as the expectation and experience of becoming tired in response to activities, leading to difficulty in maintaining these activities at a desired level of performance (Lin *et al.*, 2014). People who were infected with COVID generally felt weary, lacked energy, or were weak throughout the pandemic time, necessitating the assessment of fatigue in the selected participants. COVID-19-related fatigue can affect multiple patients at the same time.

One of the most common symptoms reported during and after COVID-19 infection is fatigue. Fatigue is complex and cannot be fully explained by a single disease or pathogenetic mechanism. Inflammation, mitochondrial dysfunction, sleep disturbances, autonomic nervous system abnormalities, and poor nutritional status are among the most promising pathways causing the disease. All of these mechanisms are linked to COVID-19 infection, and many recovered patients, dubbed "long haulers," suffer from long-term physical, cognitive, and psychological symptoms, including weariness, which is one of the most devastating post-COVID-19 symptoms (Azzolino and Cesari, 2022).

The virus infiltrating the CNS may be one of the major causes driving post-COVID-19 tiredness. Neurotransmitter levels (e.g., dopamine and serotonin), intrinsic neuronal excitability, inflammation, demyelination (leading in changes in axonal conduction velocity), and many other factors may all have a role in COVID-19 fatigue. Many techniques used to battle the pandemic, such as quarantining, social distancing, and isolation, have proven to be helpful in limiting the transmission of the virus, but they may have unexpected consequences that worsen fatigue in COVID-19 patients recuperating. One or more peripheral factors may contribute to post-COVID-19 tiredness. COVID-19 symptoms include discomfort, skeletal muscle weakness, and injury, all of which lead to tiredness (Rudroff *et al.*, 2020).

The Chalder Fatigue Scale (CFQ-11) was used to determine fatigue. Participants are asked to respond to these questions on a Likert scale (0–3), with responses assessed in contrast to their pre-COVID-19 baseline. From this, a global score of 33 can be calculated, as well as scores for the physical (0–21) and psychological (0–12) fatigue subscales. Furthermore, the CFQ distinguishes between "cases" and "non-cases" by assigning a zero to scores 0 and 1 ("Better than usual"/"No worse than usual") and a one to scores 2 and 3 ("Worse than usual"/"Much worse than usual") (bimodal scoring). The sum of all 11 binary scores is computed, and those having a total score of of four or greater considered to meet the criteria for fatigue. This latter method for “caseness” is validated and closely resembles other fatigue questionnaires (Townsend *et al.*, 2020) .

In a study of 17 percent of the Norwegian population, 52 percent reported persistent fatigue after a median of 10 weeks after the onset of COVID-19 symptoms. Another study, using a different multi-item scale, found a prevalence of 53% about 4 weeks after a COVID-19 hospitalisation, and a third study found that 69 percent of respondents experienced exhaustion on the Nijmegen clinical screening instrument 3 months following a COVID-19 hospitalisation. Few other studies have utilised single items to quantify fatigue after

COVID-19, with generally higher fatigue prevalence than ours. On average, 60–70 percent of hospitalised patients experienced fatigue 48 days after discharge, while 53 percent reported fatigue 36 days after discharge. In a large web-recruited population with hospitalised and non-hospitalized subjects after COVID-19 , 87% reported current fatigue on average 79 days after COVID-19, in a population mainly consisting of women (Stavem *et al.*, 2021).

2.4.4 Stress Assessment

Stress is a universal occurrence that affects everyone at some point in their lives. Stress is a situation or feeling that occurs when a person believes that demands are greater than the individual's personal and social resources. Emotional anguish, despair, stress, mood swings, irritability, insomnia, attention deficit hyperactivity disorder, post-traumatic stress disorder, and hostility are all signs of mental trauma in the affected persons. COVID-19 may affect the mental health of individuals at several layers of society, ranging from infected patients and health care workers to families, children, students, patients with mental illness, and even workers in other sectors, due to the virus's pathogenicity, rapid spread, and high mortality rate (Salari *et al.*, 2020).

COVID-19 survivors will have a high prevalence of emergent psychiatric illnesses such as mood disorders, anxiety disorders, PTSD, and insomnia, based on the limited preliminary investigations on COVID-19 and earlier findings from the SARS pandemic. Confusion and delirium are prominent symptoms in the acute stage, according to available data, but little evidence on psychopathology in the post-illness phase exists (Gennaro *et al*., 2020). Individuals who have been through a stressful event may develop posttraumatic stress disorder (PTSD). In post-illness stages, coronavirus epidemics were linked to PTSD diagnoses, with meta-analytic studies revealing a prevalence of 32.2 percent (Janiri *et a*l., 2021).

One of the most extensively used stress perception evaluation instruments in the world is the Perceived Stress Scale (PSS). Cohen *et al*. created the scale in 1983 to measure how stressed people felt in unpredictable, out-of-control, and overloaded circumstances. The PPS had 14 items in the original edition (PSS-14), with seven negative items. Based on factor analysis, the researchers reduced the PSS-14 to a 10-item version (PPS-10) by removing the four questions with the lowest factor loadings (She et al., 2021). It is a metric for determining how stressful one's life is. Several direct questions concerning present stress levels are also included on the scale

The PSS asks about feelings and thoughts experienced throughout the quarantine period. In each example, respondents were asked how many times they had experienced a specific ailment. The PSS-10-C has ten items with five response alternatives each: never, seldom, occasionally, almost always, and always. Items 1, 2, 3, 6, 9, and 10 are scored straight from 0 to 4, while items 4, 5, 7, and 8, on the other hand, are scored directly from 4 to 0. (Each item on the PSS-10 is graded on a 5-point Likert scale, with 0 (never) to 4 (always)) (very often). The severity of stress is related to the TPSS score. Low stress was defined as a score between 0 and 13. A score of 14-26 indicates high stress, whereas a score of 14-26 suggests severe stress(Arias *et al*., 2020).

Anxiety symptoms were more common than depressive symptoms, which is consistent with most studies to date, and 16.5 percent of the recovered participants had moderate to severe anxiety symptoms, which is consistent with most studies to date. However, 6 months after discharge, as indicated by Huang et al in a fast research in China, with 23 percent of the 1733 patients reporting sadness and anxiety symptoms. The majority of COVID-19 patients who were discharged had signs of traumatic stress and PTSD, with 37.4% expressing at least mild stress symptoms and the plurality (24.4%) reporting moderate to severe symptoms (Pappa *et* al., 2022).

2.5.5 Sleep Assessment

Sleep is a crucial biological function for regulating internal balance and enhancing quality of life. Increased sleep quality has positive effects on physical and mental health; yet, sleep difficulties have a negative impact on immunological responses because of their effects on the body's circadian rhythm (Sayed *et al.,* 2021). A sleep disorder is an irregular sleep pattern that interferes with a person's normal physical, mental, and/or emotional functioning. The true prevalence of sleep problems is unknown due to the fact that they are still underdiagnosed in the majority of cases. According to certain surveys, the prevalence in the general population is between 10% and 15% (Shukla *et al.,* 2013).

Because a significant shift in lifestyle is a large stressor, the general population is likely to acquire mental health and sleep difficulties as a result of COVID-19's effects (Alimoradi *et* *al.*, 2021). Sleeplessness is one of the most commonly reported symptoms of COVID-19 infection, both during and after infection. According to Tony et al., one patient infected with the acute respiratory syndrome coronavirus-2 (SARS-CoV-2) had sleeplessness and restless leg syndrome. Meanwhile, she was having sleep problems, including insomnia, poor sleep quality, and unusual events such as a strong impulse to move while sleeping (Tony *et al*., 2020).

Insomnia Severity Index (ISI) which is a brief scale evaluating the patient's insomnia. The ISI evaluates the subjective complaints and results of insomnia as well as the level of dysfunctions from these sleep disturbances. The ISI is composed of seven domains which include the following: (a) the degree of severity of sleep-onset (initial), (b) The maintenance of sleep (middle), (c) early morning awakening (terminal) problems, (d) to what extent the patient was satisfied with current sleep pat- tern, (e) impact on daily activities, (f) observed by others/ interfering with the quality of life and (g) distress level caused by the sleep problem. Each item is scaled on a 5-point Likert scale from 0 to 4, so the total score ranging from 0 to 28. Interpretation of the results is as follows: absence of insomnia (0–7); subthreshold insomnia (8–14); moderate insomnia (15–21); and severe insomnia (22–28) (Sayed *et al.*,2021).

Sleep issues, high anxiety levels, and depressive symptoms have been linked to PTSD after recovery from COVID-19 in Chinese and Italian persons, and the quality of life of front-line staff and patients has been severely impacted during the post-recovery period. Several studies have shown that adequate sleep not only reduces the harmful effects of noncommunicable diseases (NCDs), but also leads to enhanced immunity to guard against various viral infections. As a result, with normal sleep structure, the boosted immune system lowered the risk of COVID-19 infection. Sleep issues were prevalent among patients in the post-recovery phase after COVID-19, and these sleep problems affected various domains of quality of life (Sayed *et al.*, 2021).

METHODOLOGY

CHAPTER 3

METHODOLOGY

Since the world is amid a pandemic, COVID-19 causes long-term symptoms in a substantial proportion of people. Many researchers have examined COVID-19 patients, but only a few systematic studies have looked into the severity of Long COVID. Long-COVID patients experience multi-system dysfunction and substantial impairment.

The methodology pertaining to the study entitled "HEALTH AND WELLBEING OF LONG COVID PATIENTS IN KANNUR DISTRICT OF KERALA" is discussed under the following headings:

3.1 Study locale

3.2 Selection of subjects

3.3 Selection of tools

3.3.1 Socio- demographic characteristics

3.3.2 Anthropometric assessment

3.3.2.1 Height

3.3.2.2 Weight

3.3.2.3 BMI

3.3.3Assessment of comorbidity and medical history

3.3.3.1 Hypertension / High blood pressure

3.3.3.2 Diabetes mellitus

3.3.3.3 Cardiovascular diseases

3.3.3.4 Obesity / overweight

3.3.3.5 Chronic lung disease

3.3.3.6 Kidney disease

3.3.3.7 Liver disease

3.3.3.8 Cancer

3.3.4 Assessment of COVID and Post COVID symptoms

3.3.5 Assessment of fatigue

3.3.6 Assessment of stress

3.3.7 Assessment of sleep

3.3.8 Dietary Assessment

3.3.8.1Dietary diversity score of the selected subjects

3.4 Data analysis and interpretation

3.1 Study Locale

The coronavirus disease pandemic which originated in the city of Wuhan, China in early December 2019 has rapidly widespread with confirmed cases in almost every country across the world and has become a new global public health crisis. India recorded 2,710 new coronavirus infections, taking the country's total tally of COVID-19 cases to 43,147,530, according to WHO data. As of 23 May 2022, a total of 1,941,328,608 vaccine doses have been administered.

The study locale was confined to Ayyankunnu Grama Panchayat geographically falls in the Kannur district. Between July 2021 and January 2022, the study locale had 4 COVID-19 4396 patients. Subjects were chosen from this location according to the subject's availability and data accessibility at the PHC.

3.2 Selection of the Subjects

The survey was open to individuals 18 years of age and older who experienced symptoms consistent with COVID-19, including those with and without positive SARS-CoV-2 diagnostic or antibody test results. In order to be able to characterize the Long COVID symptom properties over an extended duration, analysis was limited to respondents with illnesses lasting longer than 28 days and whose onset of symptoms occurred between July 2021 and January of 2022.

The only other exclusion criteria for all groups were age less than 18 and current pregnancy and lactation (or pregnancy during COVID-19). Data were collected using an interview schedule. Specific information, such as contact numbers and addresses was gathered from ASHA workers and the district's DMO. By using these collected data's, the 250 subjects were interviewed with the purpose to extract the desired information from a respondent, the subjects are interviewed by two types i.e., telephonic and direct interview.

3.3 Selection of tools

The selected tool for this study is an interview schedule (Appendix 1).

An interview is an important qualitative research method in which the researcher collects data directly from the participants with a specific set of questions. Most of the qualitative research interviews are either semi-structured, lightly structured or in-depth. Structured interviews are fully controlled by the interviewer (who possesses much power) and as such, gives the interviewee less room to be flexible and casual. However, semi-structured interviews also an outline of topics and questions prepared by the researcher but have no rigid adherence. Their implementation is dependent on how the interviewee responds to the question or topics laid across by the researcher. Unstructured interviews need to be conceptualized as the narrative interview (Stuckey, 2013).

Traditionally, qualitative interviews have involved a face-to-face interviewee dyad (or pairing). However, in recent years, data has been collected in increasingly various ways, including focus groups, telephone interviews, e-mail, and the internet (Bolderston, 2012).

3.3.1 Socio- demographic characteristics

The respondents' socio-demographic variables were included in the first section of the interview schedule in order to obtain general background and personal information. The sociological and demographic characteristics obtained by an individual(s) in a population influence his or her socio-demographic positions, socio-demographic roles, and the corresponding socio-demographic benefits he or she achieves and succeeds in. It provides information about a person's socio-demographic profile (Abdullahi, 2019).

Personal information such as name, designation, age, gender, education and religion was collected.

3.3.2. Anthropometric assessment

Anthropometry is the science that defines the physical measurements of a person's size, shape, and functional abilities. Adults' health and dietary status, disease risk, and body composition are all estimated using body measurements (CDC, 2021). The main components of anthropometry are height, weight, body mass index (BMI).

3.3.2.1 Height

The participant's height was measured by standing upright against a wall marked with a height mark. The individual was measured while standing barefoot against the wall with his back against the wall and his head in the Frankfort posture with his heels together. The subject was instructed to stretch as far as possible. After the subject was properly positioned, he or she was asked to exhale and a height mark was created with white chalk. Using the tape-measure, the height was measured in centimetres from the mark to the floor. The measurements were taken to within 0.1 cm of each other (Msyamboza *et al.*, 2013).

3.3.2.2 Weight

Weighing is usually the initial step in anthropometric assessment and is required to calculate the weight-for-height z-score (WHZ) for children and the body mass index (BMI) for adults. Weight has a strong link to one's overall health. Unintentional weight reduction means poor health and a weakened immune system. Weighing requisites, the use of a working weighing scale that measures weight in kilogrammes. Correct measurement is critical since inaccuracies can lead to erroneous nutritional status classification and improper care and treatment (NACS, 2016).

3.3.2.3 BMI

BMI is a weight-to-height ratio-based anthropometric indicator. It is used to classify malnutrition in people who are not pregnant or postpartum (NACS, 2016). WHO defined underweight, normal weight, overweight, and obesity based on BMI. Individuals with BMI less than 18.5 were considered malnourished, BMI from 18.5 to 24.9 was normal and overweight if ≥ 25 (Lancet, 2004).

$$BMI = kg/m^2$$

Table 3.1: WHO CLASSIFICATION OF WEIGHT STATUS

WEIGHT STATUS	BODY MASS INDEX (BMI)
Under weight	< 18.5
Normal	18.5 – 24.9
Over weight	25.0 – 29.9
Obese	≥ 30.0

*****WHO-2004

3.3.3 Assessment of Comorbidity and medical history

Comorbidity refers to the existence of a long-term health condition in the presence of a primary disease of interest (Porta, 2014). Patients with chronic comorbid diseases face significant obstacles in terms of diagnosis, ill health, and disease management, all of which have a negative impact on treatment options and outcomes (Mahumud *et al*., 2020). Early clinical experience revealed that individuals with COVID-19 who were older and had a number of comorbidities, such as hypertension, cardiovascular disease, diabetes mellitus, and chronic pulmonary disease, had a higher chance of death (Kario *et al*., 2020).

The following lifestyle diseases were assessed:

3.3.3.1 Hypertension / High blood pressure

In COVID-19 patients, hypertension has been routinely identified as the most common pre-existing comorbidity. During SARS-CoV-2 infection, hypertension patients appear to have a higher mortality risk than normotensive patients (Fernándezes *et al*., 2022). Hypertension results in several pathophysiological changes in the cardiovascular system such as left ventricular hypertrophy and fibrosis (Kulkarni *et al*., 2020).

3.3.3.2 Diabetes mellitus

Diabetes mellitus (DM) also known as simply diabetes, is a group of metabolic diseases in which there are high blood sugar levels over a prolonged period. In diabetic patients, SARS-CoV-2 triggers higher stress conditions, inducing hyperglycemic hormones (glucocorticoids and catecholamine) and elevating blood sugar levels (Koneru *et al*., 2021)

3.3.3.3 Cardiovascular diseases

In people infected with SARS, cardiovascular disease is a prevalent comorbidity (Nishiga et al., 2020). A wide range of issues can occur in the cardiovascular system, putting patients at a higher risk of morbidity and mortality (Hamadi et al., 2020). SARS-CoV-2 may infect and destroy cardiac cells directly in the short term, resulting in severe cellular and organ-wide disease and dysfunction (Chung *et al.*, 2021).

3.3.3.4 Obesity / overweight

Obesity generally worsens the severity of respiratory disorders, however it's unclear whether obese persons are also more prone to develop COVID-19 symptoms that are more severe (Mohammad *et al.*, 2021). Obese patients have poorer chest-wall elastance and overall respiratory system compliance, as well as a smaller expiratory reserve volume. Patients with obesity frequently experience difficult airway management, as well as this altered lung and chest-wall physiology, in combination with positional gas trapping (Jose and Manuel, 2020).

3.3.3.5 Chronic lung disease

Chronic lung disease is a largely preventable and treatable disease characterized by persistent airflow limitation and respiratory symptoms due to chronic inflammation, which causes structural changes, such as fibrosis of the small airways and alveolar wall destruction (Barnes *et al.,* 2021). The patients have an increased risk of severe pneumonia and poor outcomes when they develop COVID-19 (Leung *et al.,* 2020).

3.3.3.6 Kidney disease

Kidney disease means your kidneys are damaged and can't filter blood the way they should. Kidney problems include acute kidney injury, kidney cysts, kidney stones, and kidney infections. The kidneys are like filters that screen out toxins, extra water and waste products from the body. COVID-19 can cause tiny clots to form in the bloodstream, which can clog the smallest blood vessels in the kidney and impair its function.

3.3.3.7 Liver disease

Individuals with liver illness have an immune inflammatory state that is especially important in other infectious disorders (Martinez and Franco, 2021). COVID19 is largely a respiratory condition, although it also affects the liver. Because viral entry receptors, such as angiotensin-converting enzyme 2, are widely distributed, the liver may be involved (ACE2). COVID19-related liver injury is defined as any liver damage that occurs during the progression of COVID19 disease and treatment in patients with or without preexisting liver disease (Garrido *et al.,* 2020; Nawghare *et a*l., 2022)

3.3.3.8 Cancer

Cancers are a group of diseases characterized by uncontrolled growth and the spread of abnormal cells (Mathur et al., 2015). Cancer patients increased susceptibility to severe complications of COVID-19 can be attributed to the immunosuppressed status caused by the malignancy and anticancer treatments, such as chemotherapy or surgery (Quteimat and Amer, 2020).

The medical history of patients was evaluated. The questions included whether the patient is taking regular medicines and also the medications followed during covid period such as Allopathy, Homeopathy, and Ayurveda etc. If it was allopathy treatment, the patient was asked which all drugs were consumed like paracetamol, antibiotics, cough syrup, nutritional supplements etc.

Physical activity refers to any physical movement that produces skeletal muscle that requires energy expenditure. It includes all movements, including leisure. Moderate and vigorous physical activity improves health. Regular physical activity is good for body and mind. It can lower high blood pressure, control body weight, and reduce the risk of heart disease, stroke, type 2 diabetes, and various cancers - all conditions that increase sensitivity to COVID-19 (WHO, 2020). Most people nowadays participate in yoga, dancing, and gym classes to keep themselves fit and healthy.

3.3.4 Assessment of COVID and Long COVID Symptoms

The SARS-CoV-2 virus causes Coronavirus Disease (COVID-19), an infectious disease. The majority of those infected with the virus will have mild to moderate respiratory symptoms and will recover without the need for medical attention. Some, on the other hand, will become critically unwell and require medical assistance. Serious sickness is more likely to strike the elderly and those with underlying medical disorders such as cardiovascular disease, diabetes, chronic respiratory disease, or cancer. COVID-19 can make anyone sick and cause them to get very ill or die at any age. The majority of infected patients will experience mild to moderate sickness and will be able to recover without the need for hospitalization. Fever, cough, fatigue, and loss of taste or smell are the most prevalent symptoms (WHO, 2020).

Although most people with COVID-19 get better within weeks of illness, some people experience Long COVID conditions. Long COVID conditions are a wide range of new, returning, or ongoing health problems people can experience four or more weeks after first being infected with the virus that causes COVID-19. Even people who did not have COVID- 19 symptoms in the days or weeks after they were infected can have Long COVID conditions. These conditions can present as different types and combinations of health problems for different lengths of time. (CDC, 2021).

A 4-point Likert scale was used for each symptom reported as absent, mild, moderate, or severe so participants could respond to it to the best of their knowledge, and Long COVID symptoms were analyzed in the time duration of 0 to 30 weeks.

Table 3.2: A 4-POINT LIKERT SCALE TO ASSESS SEVERITY OF SYMPTOMS OF THE STUDY SUBJECT

SCORE	INTERPRETATION

1	Absent
2	Mild
3	Moderate
4	Severe

3.3.5 Assessment of Fatigue

Fatigue is a multidimensional concept that can manifest as general tiredness (i.e., trait, chronic subjective fatigue) or as the expectation and experience of becoming tired in response to activities, leading to difficulty in maintaining these activities at a desired level of performance (Lin *et al.*, 2014). People who were infected with COVID generally felt weary, lacked energy, or were weak throughout the pandemic time, necessitating the assessment of fatigue in the selected participants. COVID-19-related fatigue can affect multiple patients at the same time.

Fatigue was assessed by using the Chalder Fatigue Scale (CFQ-11).The Chalder Fatigue Scale (CFQ-11) was used to measure fatigue or tiredness. It has 11 items with bimodal scoring technique, in which each item answer is dichotomized as 0 (0 to 1) or 1. (2–3), resulting in a 0–11 scale(Stavem *et al*., 2021)

The CFQ 11 allows the user to distinguish between 'cases' and 'non-cases' of fatigue. The physical and mental fatigue subscales are not employed in this study; instead, the responder is given a global binary fatigue score ranging from 0 to 11. Those who are not exhausted have a global binary fatigue score of 3 or less, while those who have a score of 4 or more have severe fatigue(Jackson, 2015)

Table 3.3: CFQ-11 SCALE TO ASSESS FATIGUE OF THE STUDY SUBJECT

SCALE	INTERPRETATION

0-3	Not severe /Not a case
4-11	Severe fatigue/caseness

3.3.6 Assessment of Stress

Stress is a universal occurrence that affects everyone at some point in their lives. Stress is a situation or feeling that occurs when a person believes that demands are greater than the individual's personal and social resources (Salari *et al*., 2020). COVID-19 survivors will have a high prevalence of emergent psychiatric illnesses such as mood disorders, anxiety disorders, PTSD, and insomnia, based on the limited preliminary investigations on COVID-19 and earlier findings from the SARS pandemic. Confusion and delirium are prominent symptoms in the acute stage, according to available data, but little evidence on psychopathology in the post-illness phase exists (Gennaro *et al*., 2020). Individuals who have been through a stressful event may develop posttraumatic stress disorder (PTSD). In post-illness stages, coronavirus epidemics were linked to PTSD diagnoses, with meta-analytic studies revealing a prevalence of 32.2 percent (Janiri *et al.,* 2021).

Personal stress was assessed using the Perceived Stress Scale (PSS-10-C). It is a measure of how stressful a situation one's life is. The scale also includes several direct questions about the current levels of stress experienced. The questions and the alternatives of response are easy to understand. The questions in the PSS ask about feelings and thoughts during the quarantine days. In each case, the respondents were asked how many times they felt a particular condition.

The PSS-10-C comprises 10 items, each of which offers five response options: never, rarely, occasionally, almost always, and always. Items 1, 2, 3, 6, 9, and 10 are scored directly from 0 to 4, and items 4, 5, 7, and 8, conversely, from 4 to 0 (Campo-Arias et al., 2020). PSS score correlates with the severity of stress. A person with a score of 0 – 13 was considered low stress. A score of 14-26 indicates moderate stress, while a score of 27-40 indicates high–perceived stress.

Table 3.4: PSS-10-C SCALE TO ASSESS STRESS OF THE STUDY SUBJECT

SCORE	INTERPRETATION
0 - 13	Low stress
14-26	Moderate
27-40	High–perceived stress

3.3.7 Assessment of Sleep

Sleep is a crucial biological function for regulating internal balance and enhancing quality of life. Increased sleep quality has positive effects on physical and mental health; yet, sleep difficulties have a negative impact on immunological responses because of their effects on the body's circadian rhythm (Sayed *et al*., 2021). A sleep disorder is an irregular sleep pattern that interferes with a person's normal physical, mental, and/or emotional functioning.

The true prevalence of sleep problems is unknown due to the fact that they are still underdiagnosed in the majority of cases. According to certain surveys, the prevalence in the general population is between 10% and 15% (Shukla *et al.*, 2013). Because a significant shift in lifestyle is a large stressor, the general population is likely to acquire mental health and sleep difficulties as a result of COVID-19's effects (Alimoradi *et al.*, 2021).

The Insomnia Severity Index (ISI) is a brief instrument that was designed to assess the severity of insomnia The ISI is a 7-item self-report questionnaire assessing the nature, severity, and impact of insomnia. The usual recall period is the “last month” and the dimensions evaluated are: severity of sleep onset, sleep maintenance, and early morning awakening problems, sleep dissatisfaction, interference of sleep difficulties with daytime functioning, noticeability of sleep problems by others, and distress caused by the sleep difficulties (Morin *et al.*,2011).

The ISI is a credible and accurate worldwide scale for evaluating subjective sleep quality. Interpretation of the results is as follows: (0–7); subthreshold insomnia (8–14); moderate insomnia (15–21); and severe insomnia (22–28) (Sayed *et al*., 2021) **.**

Table 3.5: ISI SCALE TO ASSESS SLEEP QUALITY OF THE STUDY SUBJECT

SCALE	INTERPRETATION
0-7	Absence of insomnia
8-14	Subthreshold insomnia
15-21	Moderate insomnia
22–28	Severe insomnia

3.3.8 Dietary Assessment

Dietary assessment is a method of assessing an individual's or a household's or population group's food and nutrient intake and dietary pattern over time (FAO, 2018). Dietary assessment methods are used to determine the nutritional status of individuals or populations groups.

A 24-hour dietary recall was performed for two days in order to assess dietary intake in this study. The 24 HR is completely open-ended survey that is used to collect a variety of detailed information about food consumed over a specific period. The 24 HR is an in-depth interview that takes approximately 20 to 30 minutes to complete for a single day recall. According on the study topic, detailed information on food preparation techniques, materials used in mixed dishes, and the brand name of commercial items may be necessary. The patients' dietary patterns, such as food habits and meal frequency, were reviewed (Shim *et al.*, 2014).

3.3.9.1Dietary diversity score of the selected subjects

The Diet diversity of the households was assessed using DDS. The Dietary Diversity Score (DDS) is a proxy tool that is based on the idea that "dietary diversity is a fundamental part of diet quality, and a diverse diet helps provide appropriate intakes of vital nutrients that promote health" (FAO, 2018). The amount of various meals or food groups consumed in the previous day is referred to as dietary diversity (DD). DDS is a reflection of the diet quality and the diversity of the diet. DDS makes a list of everything they ate or drank in the past two days (meals and snacks), both during the day and at night. It starts with the first meal or drinkof the day, which comprised all of the stated meals and beverages.

Dietary diversity scores are obtained by adding the totals of 16 food groups consumed by each respondent over a 24-hour period. The IDDS (Individual Dietary Diversity Score) is made up of the following steps: new food group variables for those food groups that need to be aggregated were created to form a total of nine food groups. In the IDDS, for example, the food group "Starchy basics" is made up of "Cereals" and "White roots and tubers." By merging the answers to "Cereals" and "White roots and tubers," a new variable called "Starchy staples" was formed.

Starchy staples = 1 if (Cereals) =1 or (White roots and tubers) = 1

Starchy staples = 0 if (Cereals) = 0 and (White roots and tubers) =0

DDS correlates with the severity of symptoms. A person with a high dietary variety score has fewer DDS < 4 was considered as poor dietary diversity. A score between 6 and 9 represents good diversity. Each food group was only counted once when calculating DDS. The nine groups used were: 1) cereals/roots/tubers; 2) meat/poultry/fish; 3) dairy; 4) eggs; 5) vitamin A rich fruit and vegetables; 6) legumes; 7) other fruit; 8) other vegetables; 9) fats and oils (FAO 2010).

The food intake data of the subjects were collected by the 24-hour food recall by a trained person on a random day to minimize day-to-day differences. A standard protocol used to take 24-hour recall. The interviews included a detailed description such as the foods eaten, the cooking methods followed, and brand names. The respondent assessed how much the subject ate, using cups, tablespoons, coconut spoons, the size of a box of matches, and other typical home measurements (Rathnayake et al., 2012).

However, interviewers should be provided with standardized neutral probing questions so as to avoid leading the respondent to specific answers when the respondent really does not know or remember. The current state-of-the-art 24-hour dietary recall instrument is the U.S. Department of Agriculture’s (USDA) Automated Multiple-Pass Method (AMPM). This is used in the U.S. National Health and Nutrition Examination Survey (NHANES) (Steinfeldt et al., 2013) .

Table 3.6: SCALE TO ASSESS DIETARY DIVERSITY OF THE STUDY SUBJECT

SCORE	INTERPRETATION
1-3	Low
4-6	Medium
6-9	High

3.4 Data analysis and interpretation

The data that was collected from the study subjects using the developed tool was consolidated and appropriately interpreted. Statistical analysis that could determine the correlates of the different variables was used wherever relevant.

Data were recorded, validated and stored using the Statistical Package for the Social Sciences (SPSS) Windows software, version 22.0. The obtained results are discussed in the near section of the study.

The method used in the study is exploratory as it utilizes scoring of the variables. The collected data contains both the qualitative and quantitative data. Accordingly, the study uses both qualitative and quantitative techniques for the analysis of data. The statistical analysis comprised of two stages. The first stage examined the descriptive statistics of the measurement items and assessed the reliability and validity of the measure applied in this study. The second stage tested the proposed research model and this involves assessing the contributions and significance of the manifest variables path coefficients. Descriptive statistics were used to describe and summarize the properties of the mass of data collected from the respondents. Parametric statistics like independent ANOVA and correlation the one-way analysis of variance were used for comparison of the factors considered between different levels of the demographic variables. A level of 0.05 was established a priori for determining statistical significance.

Pearson Correlation was seen as appropriate to analyse the relationship between the two variables which were interval-scaled and ratio-scaled. Furthermore, correlation coefficients reveal magnitude and direction of relationships which are suitable for hypothesis testing. The researcher used Pearson Correlation to identify the relationship between the variables.

RESULTS AND DISCUSSION

CHAPTER 4

RESULTS AND DISCUSSION

The results and discussion of the study entitled "HEALTH AND WELLBEING OF LONG COVID PATIENTS IN KANNUR DISTRICT OF KERALA" is presented and discussed under the following heads.

4.1. Socio demographic status of the subjects

4.2. Nutritional status of study subjects

4.2.1 Anthropometric Assessment of the subjects using BMI classification

4.2.2 Dietary Diversity Score among study subjects

4.3. System of medicine adopted to treat COVID – 19 infection

4.4. Assessment of Health and Wellbeing among study subjects

4.4.1 Assessment of Comorbidity among study subjects

4.4.2 Assessment of symptoms during COVID among study subjects

4.4.3. Assessment of symptoms during LONG COVID among study subjects

4.4.4. Assessment of Fatigue among study subjects

4.4.5. Assessment of Stress among study subjects

4.4.6. Assessment of Sleep among study subjects

4.5. Analysis of variance (ANOVA)

4.5.1. ANOVA Analysis of different parameters among the subjects during COVID

4.5.2. ANOVA Analysis of different parameters among the subjects after Long COVID

4.6. Karl Pearson Correlation Coefficient of different parameters among the subjects

4.1. Socio demographic status of the subjects

The sociological and demographic characteristics obtained by an individual in a population influence his or her socio-demographic positions, socio-demographic roles, and the corresponding socio-demographic benefits he or she achieves and succeeds in. It provides information about a person's socio-demographic profile (Abdullahi, 2019).

The socio demographic information of the subjects with respect to gender, age and educational attainment are presented in Figure 4.1.

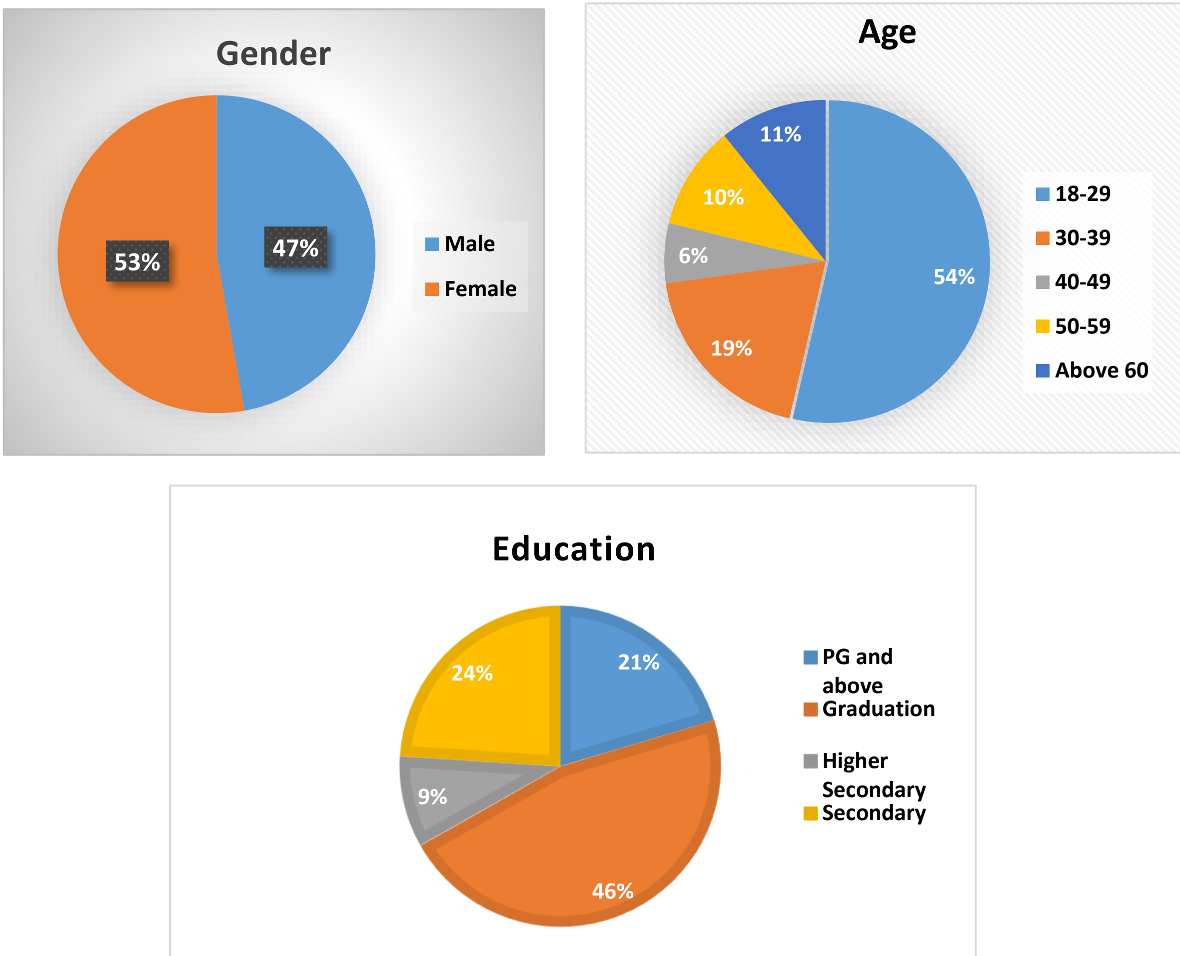


Figure 4.1 Socio demographic status of the subjects

In the present study, more than half of the subjects (53.6%) belonged to the age group of 18- 29 years. A few (6%) belonged to the age group of 40–49 years. About 52.8% of the subjects were female, and the remaining 47.2 percent of the subjects were male. Regarding educational attainment, it was observed that 46.4 percent had attained graduation, and 9.2 percent of the subjects had a higher secondary education respectively.

4.2. Nutritional Assessment among study subjects

Infections take a toll on the body, especially when they cause a fever, which necessitates more energy and nourishment. Anthropometric assessment of the patients using BMI categorization and Dietary Diversity Score was used to assess nutritional status among the study participants.

4.2.1 Anthropometric Assessment of the subjects using BMI classification

Anthropometry is the science that defines the physical measurements of a person's size, shape, and functional abilities. Adults' health and dietary status, disease risk, and body composition are all estimated using body measurements (CDC, 2021). The main components of anthropometry are height, weight, body mass index (BMI).

The details pertaining to the Anthropometric assessment of the subjects using BMI classification are presented in Table 4.1.

Table 4.1 Anthropometric assessment of the subjects using BMI classification by WHO

n=250

Variables	Frequency (N)	Percent (%)
BMI Classification		
Underweight (< 18.5)	6	2.4
Normal (18.5 - 24.9)	151	60.4
Overweight (25.0 -29.9)	82	32.8
Obese (≥ 30.0)	11	4.4

***WHO 2004**

Majority (60.4 %) of the subjects had a BMI in the normal range and 32.8 % of the subjects were overweight. 4.4% of the subjects were obese. A few (2.4%) of the subjects were underweight. Obesity in Asian Indians is characterised by excess body fat, abdominal adiposity, increased subcutaneous and intra-abdominal fat, and fat deposition in ectopic places (liver, muscle, etc.). In Asian Indians, obesity is a leading cause of metabolic syndrome and type 2 diabetes (Mahajan and Batra, 2018; Misra *et al.*, 2009).

Prevalence of obesity was found to be 44.7% among women and 33 % among men in a study by Bindhu *et al*. in Trivandrum district. In a study by Varghese *et al*., 41.7 % in 40 – 49 years and 41.9 % in 50 -59 years were obese or overweight in Kerala. According to Binu and Harnagle, it was observed that 47% of males and 58% of females were overweight and obese. Prevalence of obesity in India reported as 40.3% by Venkatrao *et al*.

According to ICMR-INDIAB study 2015 among the residents of the Tamil Nadu, Maharashtra, Jharkhand and Chandigarh population, prevalence rate of generalized obesity was 24.6, 16.6, 11.8 and 31.3 per cent, while the prevalence of abdominal obesity was 26.6, 18.7, 16.9 and 36.1 per cent, respectively. Combined obesity was present in 19.3, 13.0, 9.8 and 26.6 per cent.

As per NFHS 5 reports, the proportion of women and men, who are overweight or obese have increased across nearly all states (except Gujarat and Maharashtra). In Andhra Pradesh, Goa, Karnataka, Telangana, Kerala and Himachal Pradesh, nearly one-third of men and women (between 15-49 years of age) are overweight or obese. In Kerala, the percentage of women whose BMI below normal is 8% and women who were overweight or obese is 39.6%. In Kannur district the percentage of, women whose BMI below normal is 8.7% and women who are overweight or obese is 32.4 %.

The details regarding the physical activity pattern among study subjects are presented in Figure 4.2.

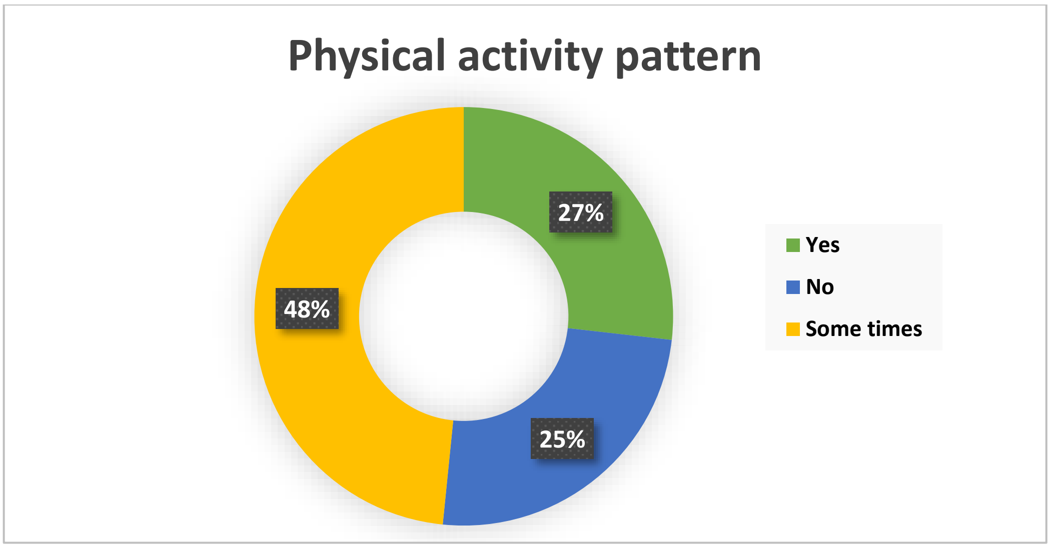


Figure 4.2 Physical activity pattern among study subjects

Among the study subjects, 48 % of the subjects exercise sometimes, 27 % of the subjects exercise regularly and 25 % of the subjects were physically inactive. Physically active subjects mainly involved in yoga, dance and gym class. Limited physical activity has harmful effects on mental and physical health due to social distancing and quarantine.

According to the data from the India survey, which included 2,33,805 participants, a considerable proportion of the Indian population was physically inactive (20%) or slightly active (37%), and so 57 percent of the population failed to follow the WHO physical activity guidelines. According to latest estimates, a bigger portion of India's population is at risk of developing NCDs, including diabetes. Furthermore, the current condition of physical inactivity, which has been exacerbated by current COVID-19 confinement rules, increases the chance of serious illness from the disease. This can be improved by promoting workouts that can be done at home, such as yoga (Podder *et al.*, 2020).

According to ICMR-INDIAB study 2015 among the residents of the Tamil Nadu, Maharashtra, Jharkhand and Chandigarh population, Of the 14227 individuals studied, 54.4% were physically inactive, while 31.9% were active and 13.7% were highly active. In a study by Joy and Vincent, to find out the physical activity among MBBS students in a medical college in Trissur ,of the total 180 students,71.1% were found as physically active, and 28.9% as physically inactive.

Physical activity exerts a major influence on human metabolism. Physical activity acutely increases glucose uptake, thus lowering circulating blood glucose level. This uptake by contracting skeletal muscles takes place through insulin independent mechanisms(Füzéki *et al.*, 2020).

4.2.2 Dietary Diversity Score among study subjects

The Dietary Diversity Score (DDS) is a proxy tool that is based on the idea that "dietary diversity is a fundamental part of diet quality, and a diverse diet helps provide appropriate intakes of vital nutrients that promote health" (FAO, 2018). DDS correlates with the severity of symptoms.

The details regarding the assessment of Dietary Diversity Score among the subjects during COVID and presented in Figure 4.3.

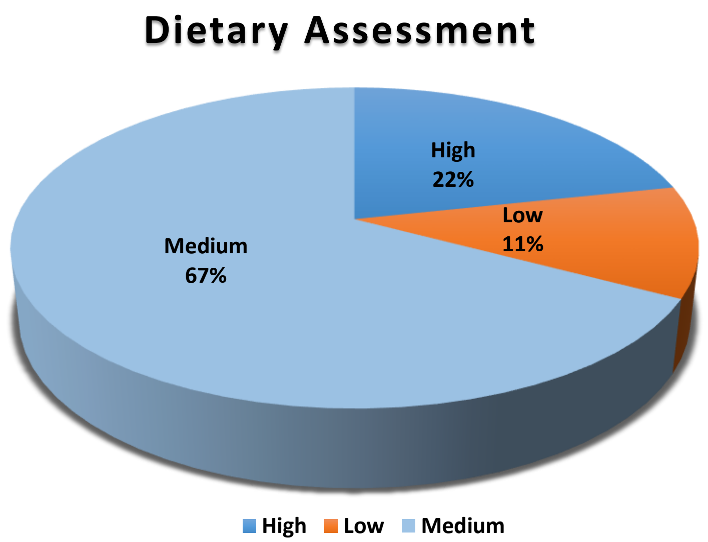


Figure 4.3. Distribution of subjects by Dietary Diversity Score (DDS)

It was observed that the subjects were giving importance to cereals and majority 67 per were having medium dietary diversity score (Score 4 or 5) whereas 22% were having high dietary diversity (Score >6) and only 11 percent were found to have low dietary diversity score (Score ≤3) because of consuming three or less than 3 food groups. When considering the dietary diversity in detail it was noticed that majority of samples were only giving importance to rice, wheat, pulses and legumes and other vegetables.

In a study conducted by Aiswarya and Bhagya, among women handloom workers between the sages of 30–60 years in Kannur district , It was noticed majority (58%) were having medium dietary diversity score (Score 4 or 5) due to the consumption of 4–5 food groups whereas 33% were having high dietary diversity (Score >6) who consume more than 6 food groups and only 9% were found to have low dietary diversity score (Score ≤3) because of consuming three or less than 3 food groups. When considering the dietary diversity in detail it was noticed that majority of samples were only giving importance to cereals (rice, wheat), pulses and legumes and other vegetables such as onion, tomato, and ladies finger. They weren't conscious or bothered about dietary diversity and nutritional status. The consumption of vitamin A rich vegetable, tubers and fruits (pumpkin, carrot and mango), dark green leafy vegetables, organ meat was once or twice in a month.

An adequate intake of different kinds of food nutrients is predominantly vital for the maintenance of immune function during a pandemic. However, work-related challenges during the COVID-19 pandemic and associated psychological distress (depression, anxiety, and insomnia) can significantly impair dietary diversity or nutritional patterns among health care workers. Health professionals with low dietary diversity scores and depression were more likely to develop COVID-19-related anxiety (Alenko *et al*., 2021).

4.3. System of medicine adopted to treat COVID – 19 infection

Types of the system of medicine adopted to treat COVID – 19 by the subjects were analysed. The details pertaining to the system of medicine adopted treat COVID – 19 of the subjects are presented in Figure 4.4.

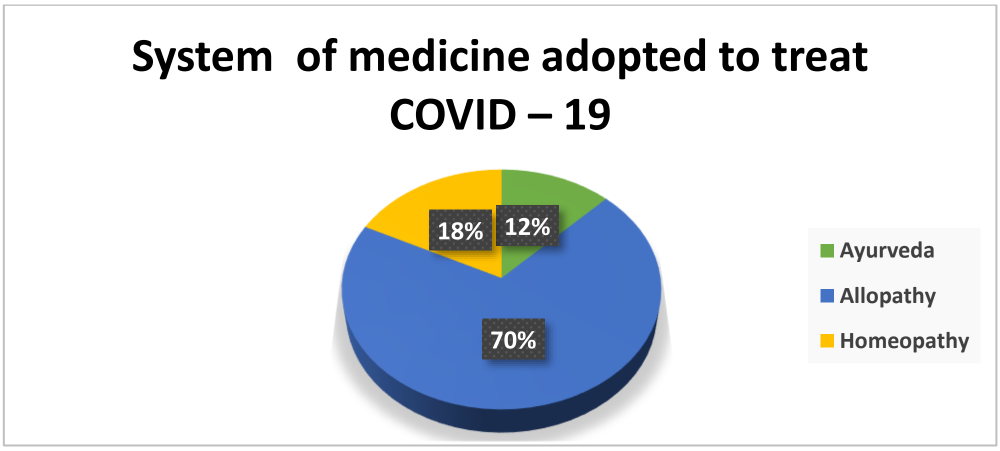


Figure 4.4. System of medicine adopted to treat COVID – 19

Among the study subject's majority (70%) choose allopathy for treating the complications of COVID 19. The commonly uses drugs included, Paracetamol, Vitamins and Mineral Supplements Nutraceuticals and Cough syrups. Homeopathy was adopted by 17.6 % of the subjects and the remaining 12.4% opted for Ayurveda as a treatment option.

Oxygen therapy, intravenous fluid infusion, and life support are all examples of allopathic treatment and management. The combination of remdesivir and chloroquine, may be useful in treating COVID-19 according to Wang *et al.* Flu and common cold virus infections were shown to be treated effectively using an aqueous extract of certain herbs, lemon juice, and honey. Allium sativum, Piper nigrum, Cinnamomum verum, Curcuma longa, and other significant plants Antiviral qualities are found in the ingredients in this recipe. Arsenic is used in homoeopathy to treat a variety of illnesses, including viral infections, at very low concentrations (Ali and Alharbi, 2020).

4.4. Assessment of Health and Wellbeing among study subjects

Wellbeing is not just the absence of disease or illness. It's a complicated mix of physical, mental, emotional, and social aspects that affect a person's health.

Comorbidity, symptoms during covid and Long COVID period, Timeline graph for evaluation of Long COVID symptoms, Fatigue, Stress and Sleep quality were assessed among the study subjects.

4.4.1. Assessment of Comorbidity among study subjects

Comorbidity refers to the existence of a long-term health condition in the presence of a primary disease of interest (Porta, 2014).

The details pertaining to the assessment of comorbidity among the subjects are presented in Figure 4.5.

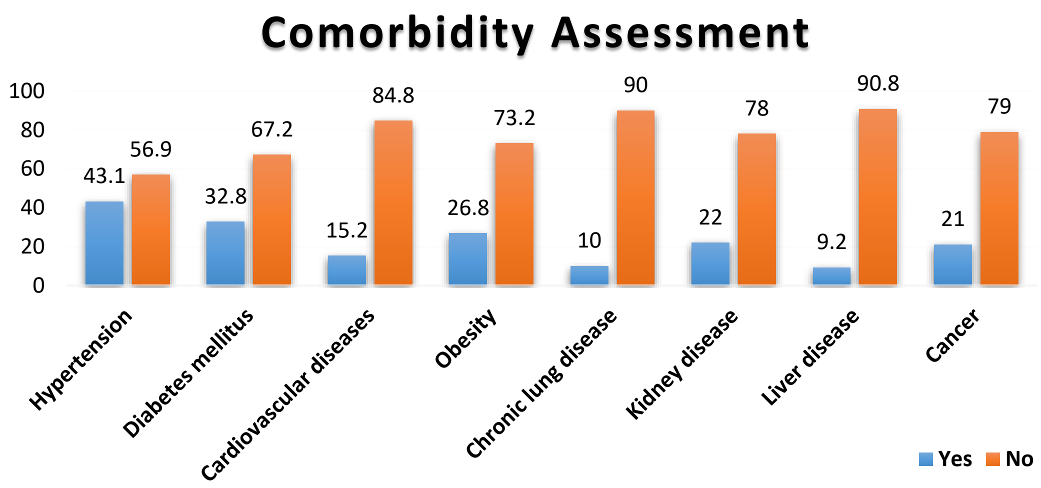


Figure 4.5. Assessment of Comorbidity among the study subjects

According to the data, hypertension has been reported as the highest pre-existing comorbidity (43.1 percent). In COVID-19 patients, hypertension has been routinely identified as the most common pre-existing comorbidity. During SARS-CoV-2 infection, hypertensive individuals appear to have a higher mortality risk than normotensive patients (Fernández *et al.*, 2022).

Diabetes mellitus was prevalent among 32.8% of the subjects, in diabetic patients, SARS-CoV-2 triggers higher stress conditions and elevating blood sugar levels. SARS-CoV-2 causes increased stress in diabetes patients, causing hyperglycemic hormones to be released and blood sugar levels to rise (Koneru *et al.*, 2021).

The occurrence of obesity or overweight among the study subject has been reported as 26.8%. Anthropometric assessment of the subjects using BMI classification by WHO reported 33.1% of the subjects were overweight and 4.4% of the subjects were obese. Patients with obesity frequently experience difficult airway management, as well as altered lung and chest-wall physiology, in combination with positional gas trapping (Jose and Manuel, 2020).

One of the most important criteria for COVID-19 vulnerability is the existence of CKD and 22% of the subjects suffering from renal diseases. Carcinoma found among 21% of the subjects. Due to many comorbidities and immunosuppression, cancer patients with haematological illnesses are at high risk of COVID-19 infections, which can expose cancer patients to catastrophic problems as a result of an infection (Sharma *et al.,* 2020).

15.2% of the subjects had cardiovascular diseases. Acute cardiac damage is a common extra pulmonary symptom of COVID-19. Chronic lung disease reported as 10% among the subjects, 9.2% of the subjects had liver disease. Because liver injury and CLD are linked to COVID-19 severity and mortality, indications of liver disease should be prioritised as COVID-19 severity prognostic markers (Martinez and Franco, 2021).

In a study conducted by Mahumud *et al*, among covid patients, hypertension was the most common comorbidity (22%), followed by diabetes (14%), cardiovascular disease (13%), respiratory disease (5%), and other chronic diseases (8%). According to Guan *et al.* (2020), hypertension (16.9%) was the most common comorbidity, followed by diabetes (16.9%). (8.2 percent). 130 individuals (8.2%) said they had two or more comorbidities.

A systematic review to evaluate comorbidities associated with severe and fatal cases of COVID-19 was conducted by Gold *et al.*, the most prevalent comorbidities were hypertension (31.39%), cardiovascular disease (25.24%) , diabetes (23.95%), and respiratory diseases (9.39%). In a study conducted by Richardson *et al.*,among 5700 patients, the most common comorbidities were hypertension (56.6%), obesity (41.7%), and diabetes (33.8%). Comorbidity causes poor health conditions and results, as well as a higher chance of hospitalisation and a costly strain on the healthcare system.

4.4.2 Assessment of symptoms during COVID among study subjects

COVID-19 symptoms range from asymptomatic infection to severe respiratory failure. The majority of infected patients will experience mild to moderate sickness and will recover without the need for hospitalisation. Fever, cough, fatigue, shortness of breath, and loss of taste or smell were observed in the vast majority of people. Sore throat, headache, aches and pains, diarrhoea, skin rash, discoloration of fingers or toes, and red or irritated eyes are some of the less common symptoms (Kumar *et al.*, 2021). For each symptom that was reported as absent, mild, moderate, or severe, a 4-point Likert scale was utilised (Galal *et al.*, 2021).

The details regarding the Assessment of symptoms during COVID -19 infection period among the subjects are presented in Table 4.2.

Table 4.2 Assessment of symptoms during COVID -19 infection period

n=250

Symptoms	Frequency(N)	Percent(%)
Fever		
Absent	108	43.2
Mild	28	11.2
Moderate	28	11.2
Severe	86	34.4
Dry Cough		
Absent	19	7.6
Mild	94	37.6
Moderate	43	17.2
Severe	94	37.6
Tiredness		
Absent		
Mild	20	8.0
Moderate	95	38.0
Severe	44	17.6
	91	36.4
Headache		
Absent	20	8.0
Mild	104	41.6
Moderate	48	19.2
Severe	78	31.2
Diarrhoea		
Absent	72	28.8
Mild	146	58.4
Moderate	26	10.4
Severe	6	2.4
Loss of taste / smell		
Absent	94	37.6
Mild	17	6.8
Moderate	54	21.6
Severe	85	34.0

Skin rash		
Absent	138	55.2
Mild	84	33.6
Moderate	23	9.2
Severe	5	2.0
Breathlessness		
Absent	25	10.0
Mild	102	40.8
Moderate	52	20.8
Severe	71	28.4
Chest pain		
Absent	105	42.0
Mild	113	45.2
Moderate	26	10.4
Severe	6	2.4

Among the study subjects the most prevalent symptoms were dry cough (92.4%), headache (92%), tiredness (92 %) and breathlessness (90 %) followed by diarrhoea (71.2%), loss of taste (62.4%), and fever (56.8%). Chest pain found (58%) and skin rashes (44.8%) found to be the least prevalent symptoms among the study subjects. The severity of each symptom varies according to each study subject. The majority of those infected with the virus will have mild to moderate symptoms and will recover without the need for medical attention. Although most people with COVID-19 get better within weeks of illness, some people experience post-COVID conditions.

In a study conducted by Amin *et al.*, conducted among 439 people in Bangladesh who recovered from COVID-19 the most common symptoms reported by the study subjects were fever (93.60 percent), tiredness (88.80 percent), and cough (70.80 percent). Taste loss, sore throats, body aches, and hair loss were all reported by more than half of the participants. The infection caused nearly half of the respondents (49.70 percent) to lose their sense of smell. According to Grant *et al*, fever is the most common symptom (78 percent), followed by cough (57 percent) and tiredness (31 percent).In another study conducted by Alimohamadi *et al.*, The most common symptoms in COVID-19 patients include Fever 81.2%, Cough: 58.5%, Fatigue 38.5%. According to Varghese et al., the most common symptoms reported were fever (45 %), cough (27 %), sore throat (22 %) and diarrhoea (14.5%) .

In a large study from China, although fever was present in 44% of patients at admission, but after admission, 88% developed fever. A dry cough is reported in approximately 65 to 70% of patients. Among patients 88. In a meta-analysis of 60 studies including 4243 patients, the prevalence of gastrointestinal symptoms was 17.6%. Gastrointestinal symptoms included diarrhoea, abdominal pain, and vomiting/nausea in 13%, 9%, and 10% respectively (Chowdhury and Oommen, 2020).

4.4.3. Assessment of symptoms during LONG COVID among study subjects

Long COVID" refers to the presence of a variety of symptoms which occurs in individuals with a history of probable or confirmed SARS CoV-2 infection usually 3 months from the onset of COVID-19 with symptoms and that last for at least 2 months and cannot be explained by an alternative diagnosis. It might be either continuous or relapsing and remitting (WHO,2021).

The details regarding the assessment of cardiovascular symptoms of Long COVID among the study subjects are presented in Table 4.4.3.1.

Table 4.4.3.1. Cardiovascular Long COVID Symptoms among study subjects

n=250

Symptoms	Frequency(N)	Percent(%)
Fainting		
Absent	218	87.2
Mild	25	10.0
Moderate	5	2.0
Severe	2	0.8
Tachycardia		
Absent	99	39.6
Mild	108	43.2
Moderate	42	16.8
Severe	1	0.4
Pain or burning in chest		
Absent		
Mild	114	45.6
Moderate	70	28.0
Severe	20	8.0
	46	18.4

Swelling		
Absent	151	60.4
Mild	68	27.2
Moderate	30	12.0
Severe	1	0.4
Palpitations		
Absent	66	26.4
Mild	93	37.2
Moderate	77	30.8
Severe	14	5.6

On studying the cardiovascular symptoms among the subjects, the most prevalent symptoms were palpitation (73.6 %) and tachycardia (60.4 %). Other major symptoms are pain or burning in chest (54.4%) and swelling (39.6%). Fainting (12.8 %) found to be the least prevalent symptoms among the study subjects. SARC-CoV2 affects the respiratory system, direct and indirect involvement of the cardiovascular system has been identified in various studies, and the associated complications are closely related to worse prognosis and mortality.

In an international online survey research conducted among 3762 among long COVID patients by Davis *et al*, it was reported that the study subjects frequently experience chest pain, dyspnea, weariness, palpitations, and cough as a result of cardiopulmonary problems. Heart palpitations (67.4 percent), tachycardia (61.4 percent), and pain/burning in the chest were the most commonly reported symptoms (53.1 percent). 12.9 percent of respondents reported fainting. By 7 months after infection, cardiac symptoms such as chest discomfort (53 percent), palpitations (68 percent), and fainting (13 percent) were recorded in up to 86 percent of patients in a study by Raman *et al*., reported as. In 31% of patients, tachycardia was identified.

People with COVID-19 had increased rates of cerebrovascular disorders, dysrhythmias, inflammatory heart disease, ischemic heart disease, heart failure, thromboembolic disease, and other cardiac disorders, as well as greater 12-month burdens. The risks were present regardless of age, race, sex, or other cardiovascular risk factors like obesity, hypertension, diabetes, chronic kidney disease, implying that these risks can manifest even in people who are not at high risk of cardiovascular disease (Xie *et al*., 2021).

The details pertaining to the assessment of systemic symptoms Long COVID symptoms among the study subjects are presented in Table 4.4.3.2.

Table 4.4.3.2. Systemic Long COVID Symptoms among study subjects

n=250

Symptoms	Frequency(N)	Percent(%)
Malaise		
Absent	86	34.4
Mild	133	53.2
Moderate	26	10.4
Severe	5	2
Elevated temperature		
Absent	89	35.6
Mild	88	35.2
Moderate	67	26.8
Severe	6	2.4
Chill / flushing/sweats		
Absent	96	38.4
Mild	82	32.8
Moderate	69	27.6
Severe	3	1.2
Weakness		
Absent	27	10.8
Mild	99	39.6
Moderate	55	22.0
Severe	69	27.6
Extreme thirst		
Absent	75	30.0
Mild	76	30.4
Moderate	80	32.0
Severe	19	7.6
Menstrual issues		
Absent	203	81.2
Mild	32	12.8
Moderate	15	6.0
Severe	0.0	0.0

It was observed that the systemic symptoms among the subjects, the most prevalent symptoms were weakness (89.2 %) and extreme thirst (70 %). other major symptoms malaise (65.3%), elevated temperature (64.4%) and chill / flushing/sweats (61.6%). Menstrual issues reported (18.8%) as the least prevalent systemic symptom among the study subjects.

Davis *et al.* conducted an online survey of people with suspected and confirmed COVID-19 reported that Fatigue (98.3%,) and post-exertional malaise (89.0%) were the most common symptoms reported by respondents. Weakness was experienced by 44.5% of respondents. Elevated temperature below 100.4F was almost twice as common as fever above 100.4 F. Skin sensations of burning, itching, or tingling without a rash were reported by 47.8% of respondents.

In a study conducted by Raveendran *et al*., Fever and chills present in the acute stage of infection resolved in 97% and 96% of individuals respectively. But cough, fatigue and shortness of breath did not resolve in 43%, 35% and 29% of patients during interview. Loss of taste and loss of smell took longer duration for resolution (8 days).

The details regarding the assessment of musculoskeletal symptoms of Long COVID among the subjects are presented in Table 4.4.3.3.

Table 4.4.3.3. Musculoskeletal Long COVID Symptoms among study subjects

n=250

Symptoms	Frequency(N)	Percent(%)
Tightness of chest		
Absent	45	18.0
Mild	102	40.8
Moderate	93	37.2
Severe	10	4.0
Muscle aches		
Absent	42	16.8
Mild	142	56.8
Moderate	60	24.0
Severe	6	2.4
Joint pain		
Absent	19	7.6
Mild	103	41.2
Moderate	108	43.2
Severe	20	8.0

Stiff neck		
Absent	112	44.8
Mild	83	33.2
Moderate	49	19.6
Severe	6	2.4
Muscle spasms		
Absent	122	48.8
Mild	71	28.4
Moderate	54	21.6
Severe	3	1.2
Bone ache or burning		
Absent	78	31.2
Mild	122	48.8
Moderate	43	17.2
Severe	7	2.8

The most prevalent musculoskeletal symptoms among the subjects was observed that were joint pain (92.4%), muscle aches (83.2%) and tightness of chest (82 %). Other major symptoms include bone ache or burning (68.8%), stiff neck (55.2%) and muscle spasms (52.2%). Studies showed that regarding the musculoskeletal system sequelae, COVID-19 survivors, including those who also had the mild to moderate forms of the infection, can experience muscle and joint pain (Elhiny *et al.*, 2021), and intense myalgia (muscle pain) (Aiyegbusi *et al*., 2021; Carvalho *et al.*, 2021; Santos *et al.*, 2022).

Davis *et al.* found that the musculoskeletal symptoms were common in 93.9% among the study subjects. Chest tightness was most common (74.8%,) followed by muscle aches (69.1%,) and joint pain (52.2%). In month 7, chest tightness affected 32.9% of month 7 respondents and muscle aches affected 43.7% of month 7 respondents. Fernández *et al*. reported musculoskeletal post-COVID pain is present in 45.1% of COVID-19 survivors at 8 months after hospital discharge. In a study conducted by Raveendran *et al.*, joint pain was reported as 27.3% and 21.7% of the study subjects had chest pain.

COVID-19 survivors, including those who had had the mild to severe forms of the illness, have been shown to have aggravated muscle and joint pain, as well as intense myalgia (muscle pain) according to studies. Finally, the mechanism of long-term COVID musculoskeletal issues is unknown, but researchers suspect that post-COVID symptoms are linked to a chronic pro-inflammatory condition that contributes to long-term difficulties(Santos *et al.*, 2022).

The details regarding the assessment of immunologic symptoms of Long COVID among the subjects are presented in Table 4.4.3.4.

Table 4.4.3.4. Immunologic Long COVID Symptoms among study subjects

n=250

Symptoms	Frequency(N)	Percent(%)
Reactions to old allergies		
Absent	168	67.2
Mild	54	21.6
Moderate	25	10.0
Severe	3	1.2
New allergies		
Absent	159	63.6
Mild	61	24.4
Moderate	26	10.4
Severe	4	1.6

The immunologic symptoms among the subjects were reactions to old allergies (32.8 %) and new allergies (36.4%). The symptoms are most prevalent for the time period of 0-5 weeks.

Immunologic and autoimmune symptoms were reported by Davis *et al* as 21.0% of respondents. Heightened reaction to old allergies was most common, at 12.1%, followed by new allergies at 9.3%.

COVID-19-induced hyper inflammation could be mediated by mast cell activation (MCA), which has also been linked to Long-COVID symptoms. Unregulated chemical mediator release causes a wide range of symptoms in MCAS, many of which are experienced by Long-COVID patients(Weinstock *et al.*, 2021). Many people with Long COVID are finding that they have new food allergies and sensitivities that bring on a lot of obvious allergy symptoms through MCAS leading to histamine over production and inflammation of nerves causing organ dysfunction (Mack *et al.*, 2020).

The details pertaining to the assessment of dermatologic symptoms of Long COVID among the subjects are presented in Table 4.4.3.5.

Table 4.4.3.5. Dermatologic Long COVID Symptoms among study subjects

n=250

Symptoms	Frequency(N)	Percent(%)
Itchy skin		
Absent	101	40.4
Mild	112	44.8
Moderate	33	13.2
Severe	4	1.6
Skin rashes		
Absent	142	56.8
Mild	79	31.6
Moderate	25	10.0
Severe	4	1.6
Peeling skin		
Absent	174	69.6
Mild	54	21.6
Moderate	22	8.8
Severe	0.0	0.0

It was observed that the dermatologic symptoms among the subjects, the most prevalent symptoms were itchy skin (59.6 %) and skin rashes (43.2%). Other symptoms were peeling skin (30.4%). COVID-19 is linked to a variety of extrapulmonary symptoms, including dermatological indications(Genovese *et al.*, 2021).

HEENT stands for Head, Eyes, Ears, Nose, and Throat. The details regarding the assessment of HEENT symptoms of Long COVID among the subjects are presented in Table 4.4.3.6.

Table 4.4.3.6. HEENT Long COVID Symptoms among study subjects

n=250

Symptoms	Frequency(N)	Percent(%)
Sore throat		
Absent	35	14.0

Mild	113	45.2
Moderate	84	33.6
Severe	18	7.2
Blurred vision		
Absent	96	38.4
Mild	105	42.0
Moderate	44	17.6
Severe	5	2.0
Difficulty in swallowing		
Absent	‘	
Mild	59	23.6
Moderate	144	57.6
Severe	39	15.6
	8	3.2
Sensitivity to light		
Absent	74	29.6
Mild	132	52.8
Moderate	41	16.4
Severe	3	1.2
Running nose		
Absent		
Mild	147	58.8
Moderate	78	31.2
Severe	23	9.2
	2	0.8
Dry eyes		
Absent	94	37.6
Mild	125	50.0
Moderate	29	11.6
Severe	2	0.8
Changes in voice		
Absent		
Mild	129	51.6
Moderate	88	35.2
Severe	30	12.0
	3	1.2
Eye pain		
Absent	85	34.0
Mild	129	51.6
Moderate	31	12.4
Severe	5	2.0
Ear pain		
Absent	86	34.4
Mild Moderate	142	56.8
Severe	20	8.0
	2	0.8

All respondents experienced at least one HEENT symptom. Among the study subjects sore throat (86%), difficulty in swallowing (76.4%), sensitivity to light (70.4%) were the most prevalent symptoms followed by ear pain (66.8%), eye pain (66%), dry eyes (62.4%) and blurred vision (61.6%). Running nose was reported by 48.4 % of the study subjects.

In a study conducted by Davis *et al.* , sore throat was the most prevalent symptom (59.5% %) which was reported almost twice as often as the next most prevalent symptom, blurred vision (35.7%). Within this category, symptoms involving vision were as common as other organs. Notably, 1.0% of subjects reported total loss of vision (no data on the extension and duration of vision loss were collected). Ear and hearing issues (including hearing loss), other eye issues, were also common.

Coronaviruses can cause severe ocular illness. Human ocular signs, on the other hand, are usually mild and rare. Dry eye or foreign body sensation, eye redness, weeping, and itching were among the most common symptoms.(Hu *et al*., 2020).

The details regarding the assessment of pulmonary symptoms of Long COVID among the subjects are presented in table 4.4.3.7.

Table 4.4.3.7. Pulmonary Long COVID Symptoms among study subjects

n=250

Symptoms	Frequency(N)	Percent(%)
Shortness of breath		
Absent	29	11.6
Mild	82	32.8
Moderate	55	22.0
Severe	84	33.6
Dry cough		
Absent	35	14.0
Mild	71	28.4
Moderate	118	47.2
Severe	26	10.4
Breathing difficulty		
Absent	29	11.6
Mild	78	31.2
Moderate	112	44.8
Severe	31	12.4

Sneezing		
Absent	112	44.8
Mild	103	41.2
Moderate	24	9.6
Severe	11	4.4
Coughing of blood		
Absent	243	97.2
Mild	6	2.4
Moderate	1	0.4
Severe	0	0.0

After analyzing the prevalence of pulmonary symptoms, it was found that most of the subjects breathing difficulty (94.4%) and shortness of breath (88.4%) followed by dry cough (86%) and sneezing (55.2%). Coughing of blood (2.8%) reported as the least prevalent among the study subjects.

In a study conducted by Davis *et al.* it was observed that, 93.0% of respondents reported pulmonary and respiratory symptoms. Shortness of breath at 77.4% was more common than dry cough at 66.2% or breathing difficulty with normal oxygen levels at 60.4%.

Boutou *et al.*, conducted a study among Long COVID patients and observed that 61% of patients with a disease duration of greater than 3 weeks developed persistent post-COVID-19 lung parenchymal abnormalities. In another study by Naeije and Caravita, Lung function and chest imaging in a subgroup of 390 of these patients showed a 6-min walk distance below the lower limit of normal in 24–29%, a lung diffusing capacity for carbon monoxide below 80% predicted in 29–56% and abnormal chest computed tomography (CT) imaging in 41–45%.

Patients with lung problems, advanced age, and obesity are thought to have a higher chance of developing post-acute COVID-19 syndrome. COVID-19 lung autopsy revealed all phases of diffuse alveolar destruction, as well as focused and organised fibro proliferative diffuse alveolar damage. Microcystic honeycombing, myofibroblastic proliferation, and mural fibrosis were only seen on rare occasions. The most commonly reported physiologic abnormality in post-acute COVID-19 is a decrease in diffusion capacity, which is directly related to the severity of acute infection (Nalbandian *et al.*, 2021).

The details regarding the assessment of gastrointestinal symptoms of Long COVID are presented in Table 4.4.3.8.

Table 4.4.3.8 Gastrointestinal Long COVID Symptoms among study subjects

n=250

Symptoms	Frequency(N)	Percent(%)
Diarrhoea		
Absent	113	45.2
Mild	57	22.8
Moderate	79	31.6
Severe	1	0.4
Vomiting		
Absent	158	63.2
Mild	60	24.0
Moderate	30	12.0
Severe	2	0.8
Constipation		
Absent	121	48.4
Mild	98	39.2
Moderate	30	12.0
Severe	1	0.4
Loss of appetite		
Absent	61	24.4
Mild	81	32.4
Moderate	83	33.2
Severe	25	10.0
Nausea		
Absent	160	64.0
Mild	56	22.4
Moderate	34	13.6
Severe	0.0	0.0
Abdominal pain		
Absent		
Mild	32	12.8
Moderate	79	31.6
Severe	125	50.0
	14	5.6

Bowel sensations		
Absent	36	14.4
Mild	89	35.6
Moderate	114	45.6
Severe	11	4.4

From the above data, the commonly reported gastrointestinal symptoms were abdominal pain (87.2%), bowel sensations (85.6%) and loss of appetite (75.6%). Other symptoms were followed by diarrhoea (54.8%), constipation (51.6 %). Vomiting (36.8%) and nausea (36 %) were the least common symptoms.

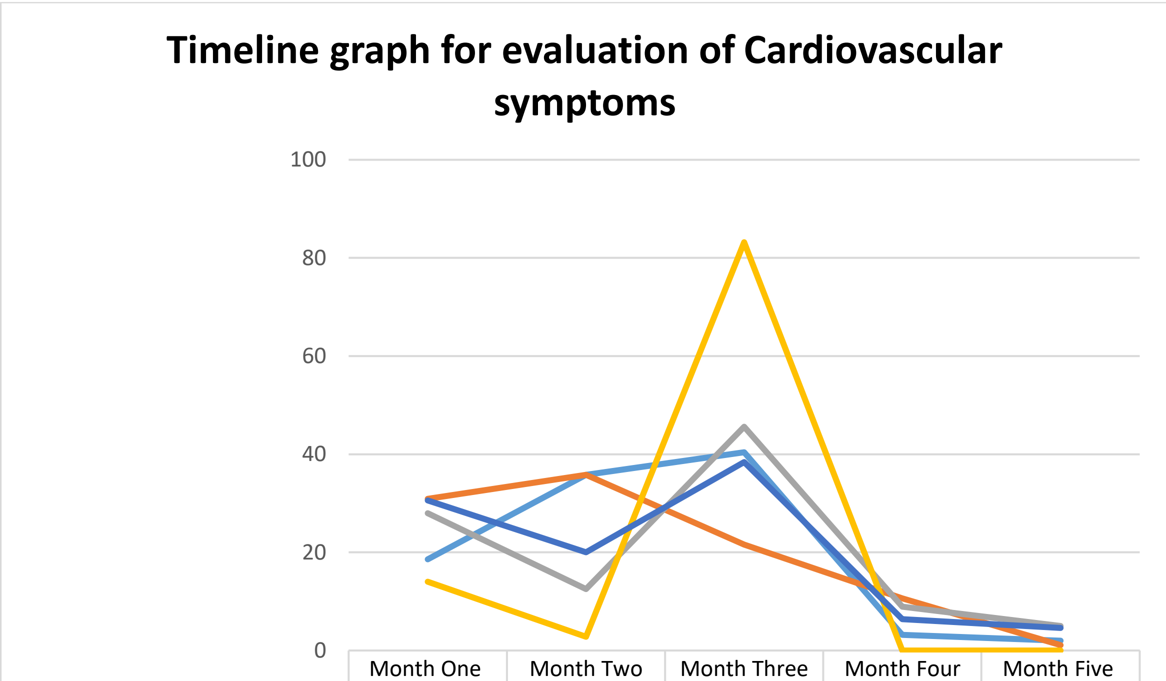
In a prospective cohort by Meringer and Mehandru conducted among 1,783 COVID-19 survivors ,220 patients (29%) self-reported gastrointestinal symptoms at 6 months that included diarrhoea (10%), constipation (11%), abdominal pain (9%), nausea and/or vomiting (7%) and heartburn (16%). In another study by Davis *et al.*, gastrointestinal symptoms were reported at 85.5% overall among the study subjects. Diarrhoea was the most commonly reported gastrointestinal symptom, experienced by 59.7% of respondents, followed by loss of appetite and nausea.
In another study conducted by Yusuf, the estimated prevalence of COVID-19 in a total of 527 patients. Consistent vomiting was reported, with a total prevalence of 46.19% percent. Prolonged diarrhoea and nausea were found to affect 40.28% of the population. COVID-19 was linked to a loss of or decrease in appetite, with 95.1% of those reporting the symptom. In individuals with COVID-19, an average of 75.3% experienced abdominal discomfort.

Joseph *et al.*, reported that GI symptoms were very common, affecting 87 (71.3%) of responders; abdominal pain affected 28 (23%), diarrhoea 37 (30.3%), constipation 15 (12.3%), nausea 32 (26.2%) and dyspepsia 27 (22. 1%).The patients completed the 6-month follow-up survey. 64% were healthcare workers. All had been admitted to hospital and eight (16.7%) admitted to ICU. 6 months after the acute illness, 21 of the 48 (43.8%) had been left with new GI symptoms, with abdominal pain affecting 14 (29.2%), diarrhoea nine (18.8%), constipation five (10.4%), nausea five (10.4%), and dyspepsia 14 (29.2%) since their COVID-19 illness. The majority of patients with new GI symptoms were troubled by them regularly: nine (39.1%) every day, seven (30.4%) a few times per week, two (8.7%) once a week, and five (21.7%) infrequently.

Laszkowska *et al*., reported the most common GI symptoms in her study were nausea (4.14%), anorexia (3.81%), and diarrhoea (2.78%), respectively. In another study by Alireza *et al*., the most common GI symptoms included diarrhoea (23.4%), nausea and vomiting (23.2%), and abdominal pain (11.9%).

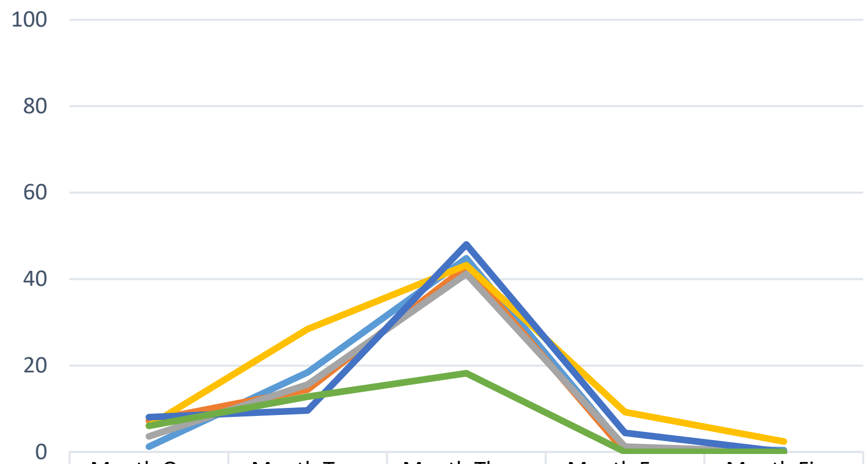
The survey asked respondents to detail their experience of a subset of 43 symptoms over time. Respondents indicated whether each of these symptoms was present throughout their illness during a series of time intervals following the onset and end of their symptoms from month one to month five. For each time period, a Likert scale was employed to assess overall symptom intensity (1-5 months).

The details regarding the Timeline graph for evaluation of COVID symptoms on various systems among study subjects are presented in Figure 4.6.



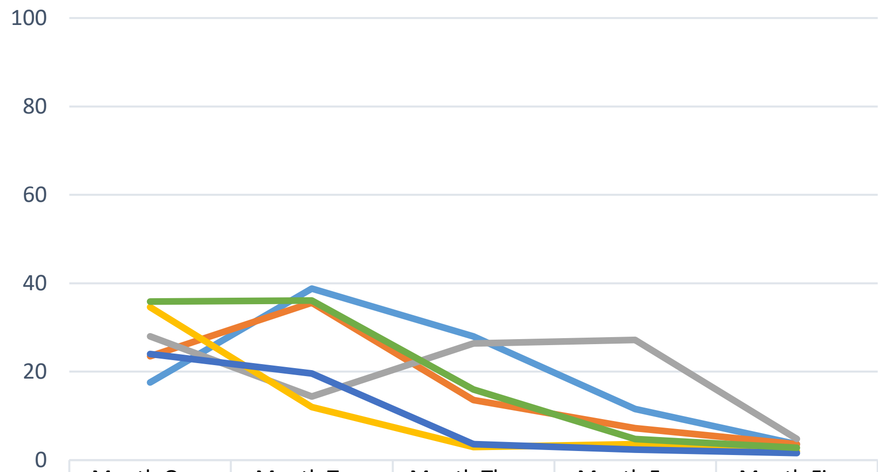
	Month One	Month Two	Month Three	Month Four	Month Five
Palpitation	18.6	35.8	40.4	3.2	2
Tachycardia	30.9	35.8	21.6	10.6	1.1
Pain or burning in chest	28	12.5	45.6	8.9	5
Swelling	14	2.8	83.2	0	0
Fainting	30.6	20	38.4	6.4	4.6

Timeline graph for evaluation of Systemic symptoms



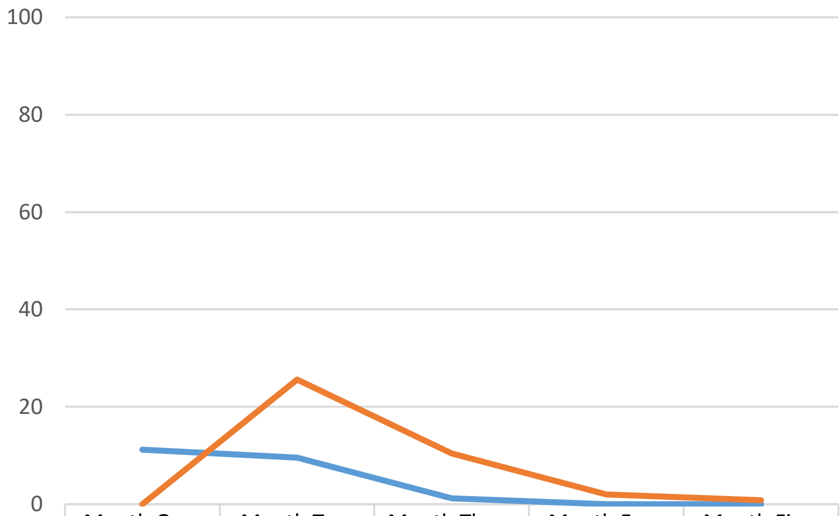
	Month One	Month Two	Month Three	Month Four	Month Five
Malaise	1.2	18.4	44.8	0.8	0.4
Elevated temperature	7.2	14.4	42.8	0	0
Chill/flushing/sweats	3.6	15.6	41.2	1.2	0
Weakness	6	28.4	43.2	9.2	2.4
Extreme thirst	8	9.6	48	4.4	0
Menstrual issues	6	12.8	18.2	0	0

Timeline graph for evaluation of Musculoskeletal symptoms



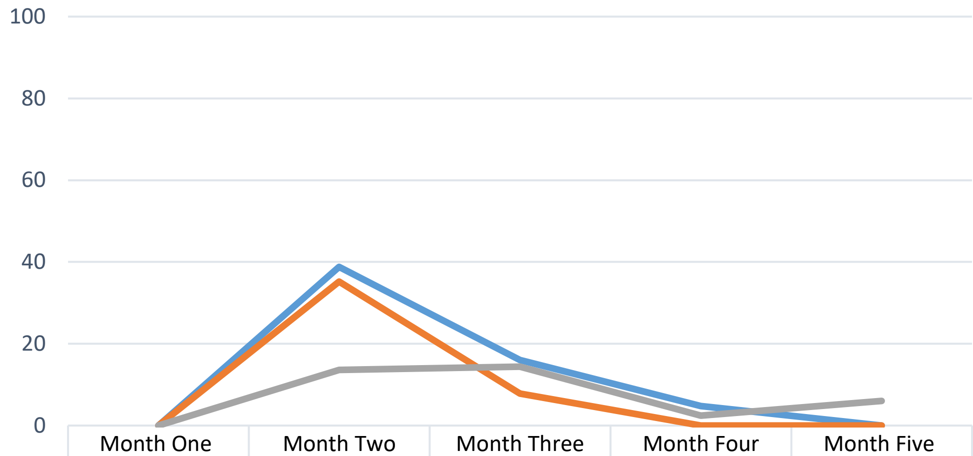
	Month One	Month Two	Month Three	Month Four	Month Five
Tightness of chest	17.6	38.8	28	11.6	3.6
Muscle aches	23.5	35.6	13.6	7.2	3.6
Joint pain	28	14.4	26.4	27.2	4.8
Stiff neck	34.6	12	3	3.6	2
Muscle spasms	24	19.6	3.6	2.4	1.6
Bone aches or burning	35.9	36.1	16	4.8	2.8

Timeline graph for evaluation of Immunologic symptoms



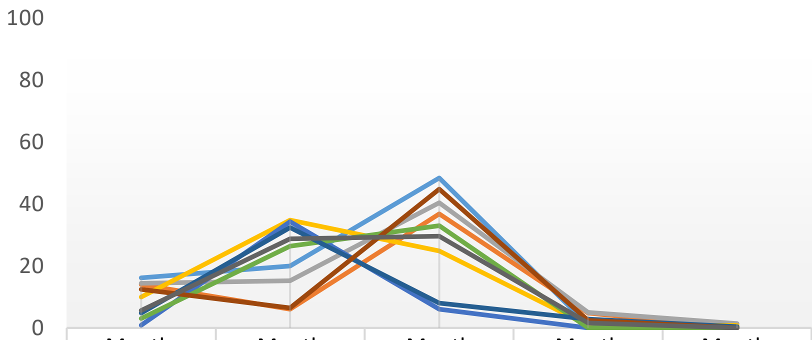
	Month One	Month Two	Month Three	Month Four	Month Five
Reactions to old allergies	11.2	9.6	1.2	0	0
New allergies	0	25.6	10.4	2	0.8

Timeline graph for evaluation of Dermatologic symptoms



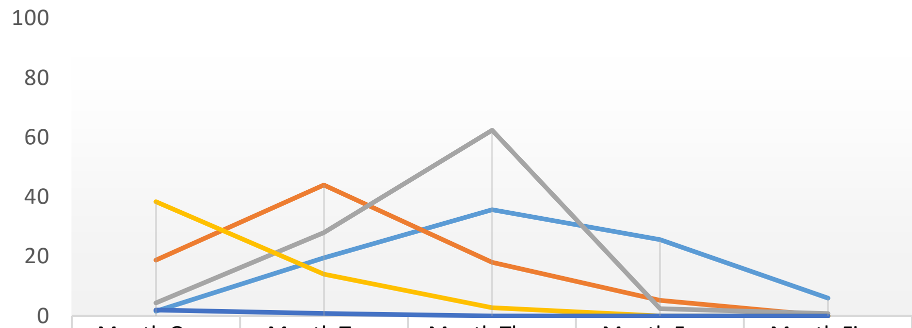
	Month One	Month Two	Month Three	Month Four	Month Five
Itchy skin	0	38.8	16	4.8	0
Skin rashes	0	35.2	7.8	0	0
Peeling skin	0	13.6	14.4	2.4	6

Timeline graph for evaluation of HEENT symptoms



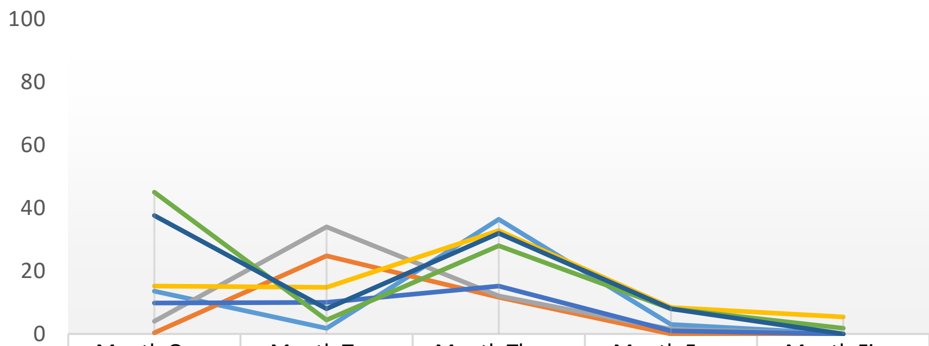
	Month One	Month Two	Month Three	Month Four	Month Five
Sore throat	16.2	20	48.4	1	0.4
Blurred vision	14	6	36.8	4.8	0
Difficulty in swallowing	14.4	15.2	40.4	5	1.4
Sensitivity to light	10	34.8	24.8	0.8	0.8
Running nose	0.9	34.3	6	0	0
Dry eyes	3	26.4	33	0	0
Changes in voice	4.8	32.4	8	2.8	0.4
Eye pain	12.4	6.4	44.8	2.4	0
Ear pain	5.6	28.8	29.6	1.6	0

Timeline graph for evaluation of Pulmonary symptoms



	Month One	Month Two	Month Three	Month Four	Month Five
Shortness of breath	1.6	19.5	35.7	25.6	6
Dry cough	18.8	44	18	5.2	0
Breathing difficulty	4.4	28	62.4	2.4	0.8
Sneezing	38.4	14	2.8	0	0
Coughing of blood	2	0.8	0	0	0

Timeline graph for evaluation of Gastrointestinal symptoms



	Month One	Month Two	Month Three	Month Four	Month Five
Diarrhoea	13.6	1.8	36.4	3	0
Vomiting	0.4	24.8	11.6	0	0
Constipation	4	34	12.1	1.5	0
Loss of appetite	15.2	14.8	32.8	8.4	5.4
Nausea	9.8	10	15.2	1	0
Abdominal pain	45	4.4	28	8	1.8
Bowel sensations	37.6	8	32	8	0

Figure 4.6. Time line serves graph for evaluation of COVID Systems among study subjects

Long COVID symptoms on various systems were assessed using timeline graph. All 43 symptoms were assessed over time using the above data in the following cases: very mild, mild, moderate, severe, and very severe.

According to the timeline graph for the evaluation of cardiovascular symptoms, swelling is 82.2 percent in month three and it steadily reduces until month 5 and fainting (0.8 percent) is prevalent on month five. Malaise (44.8 percent) and weakness (2.4 percent) were the most common systemic symptoms reported by the study subjects. These symptoms were more likely to occur in the month two to month four. The fifth month is when weakness is at its lowest, and it gradually fades among the study subjects.

The most prevalent musculoskeletal symptoms reported by the study subjects were chest tightness (38.8%) and joint pain (6.8%). These symptoms were more likely to appear from month one to month three. Weakness is the most prevalent symptom in month five. The assessment on immunological symptom shows that the high prevalence of new allergies 25.6% and gradually decline to 0.8%.

On analysing the dermatologic symptoms, it was observed that the occurrence of Itchy skin is 38 percent in month 2 and progressively decreases until peeling skin are 6 percent in month 5. According to the timeline graph for the evaluation of HEENT symptoms, sore throat (48 .8 percent) were the high prevalence symptom during the month three and gradually decreases to the least prevalent symptom difficulty in swallowing (1.4 percent) during the month five among the study subjects.

During the third month of the Long COVID research, the evaluation of pulmonary symptoms indicated that breathing difficulty (62.4 %) is the most common symptom, followed by a progressive drop in symptoms, with breathing trouble being the least prevalent (0.8 percent). The highest prevalent symptom observed in the examination of gastrointestinal symptoms was loss of appetite (32.8 percent) in month two, with a progressive drop in month five, with 5.4 percent among the study subjects.

4.4.4. Assessment of Fatigue among study subjects

Fatigue was assessed by using the Chalder fatigue scale (CFQ-11). The Chalder fatigue scale (CFQ-11) was used to measure fatigue or tiredness. The CFQ 11 allows the user to distinguish between 'cases' and 'non-cases' of fatigue. The responder is given a global bin0ary fatigue score ranging from 0 to 11. Those who are not exhausted have a global binary fatigue score of 3 or less, while those who have a score of 4 or more have severe fatigue (Jackson, 2015).

The details regarding the assessment of Fatigue among the subjects during COVID and after Long COVID presented in Table 4.4.4.

Table 4.4.4. Assessment of Fatigue using CFQ 11 scale among study subjects

n=250

Score	Interpretation	During COVID		After Long COVID	
		Frequency(N)	Percent(%)	Frequency(N)	Percent(%)
0-3	**Not Severe**	196	78.4	108	43.2
4-11	**Severe**	54	21.6	142	56.8
	Total	250	100.0	250	100.0

It has been established that only 21.6 % of the study subjects has fatigue syndrome during the period of infection. But on anayzing the results among long COVID cases, 56.8 % had severe fatigue.

Sandler *et al.*, conducted a study among covid patients and stated that 60% of patients reported ongoing fatigue at 12 months following recovery from the acute illness. In the acute phase, the peak fatigue rates in these studies ranged from 8% to 29%. At 4 weeks' post-symptom onset, rates of fatigue ranged from9% to 49%. A trend of resolution was evident within the individual cohorts with falling rates of fatigue reported at 8 weeks (4% to 35%) after symptom onset.

Shendy *et al.*, reported the prevalence fatigue post-covid-19 in post mild and moderate cases by adult people with age between 25 and 40 years and their results proved that the fatigue is prevalent among adult people post mild and moderate covid-19 cases after 3-5 months following recovery from acute covid-19 by 64.2%.

In a Chinese ambidirectional cohort study, conducted by Huang *et al.*, Fatigue or muscle weakness (63%, 1038 of 1655) was identified as the major symptom . In another study conducted by Stavem *et al*.,among Long Covid patients, reported 46% of respondents had fatigue about 4 months after symptom onset of COVID-19, which represents a substantially higher prevalence than in the norm population. Fatigue was lower among subjects and higher with high symptom load and confusion during acute COVID-19.

Townsend *et al.*,conducted a study in the post-COVID-19 review clinic at St James's Hospital (SJH), Dublin, Ireland and reported 50% of the participants do not feel back to full health, despite being medically deemed recovered from their primary illness. Secondly, the impact of this fatigue on daily function is already evident, with almost one third (31%) having not returned to employment. This is of particular concern; given that it is recommended that post-viral infection return to work should take place after four weeks to prevent deconditioning.

In another study conducted by Siba *et al* among asymptomatic or mildly symptomatic patients, admitted to CFLTCs of the coastal belt of Thiruvananthapuram, Kerala Fatigue (5.8 percent) was the most common symptom of both acute and long-term COVID in astudy conducted in post COVID syndrome.

4.4.5. Assessment of Stress among study subjects

Personal stress was assessed using the Perceived Stress Scale (PSS-10-C). It is a measure of how stressful a situation one's life is. The scale also includes several direct questions about the current levels of stress experienced. The PSS-10-C comprises 10 items, each of which offers five response options: never, rarely, occasionally, almost always, and always (Arias, 2020). PSS score correlates with the severity of stress.

The details regarding the assessment of Stress among the subjects during COVID and after Long COVID presented in Figure 4.7.

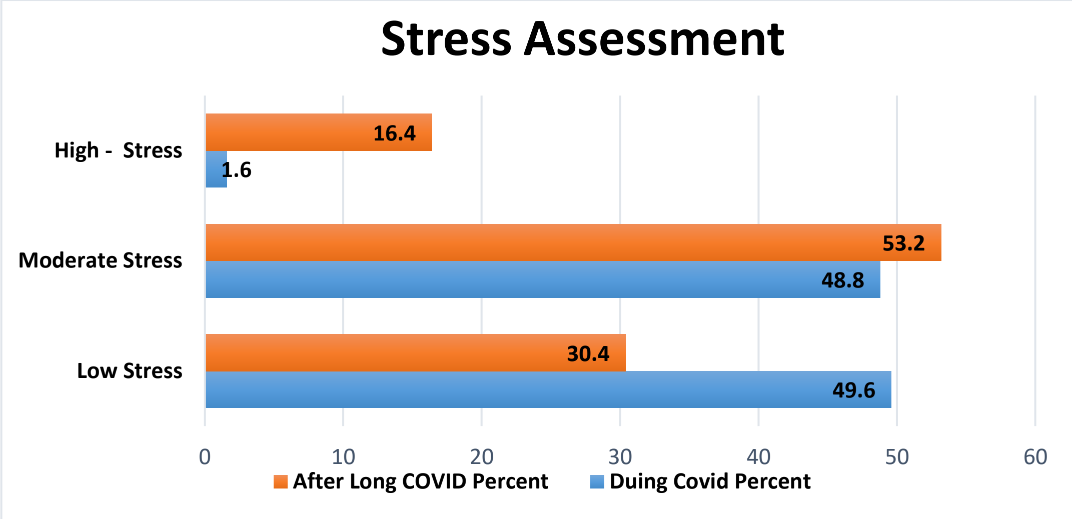


Figure 4.7. Assessment of Stress using PSS-10-C scale among study subjects

From the above Figure, we can interpret that during the period of infection 49.6% had low stress and 48.8% had moderate stress. Only 1.6 % of the study subjects suffers high stress during the period of infection. On anayzing the results among long COVID cases, 53.2% of the study subjects experienced moderate stress, 16.4% had high stress. Only 30.4% of the study subjects comes under low stress.

In a study conducted by Malihe *et al* among covid patients, the results indicated that the mean scores of depression and anxiety were at "extremely severe" levels, while stress levels were "severe." The prevalence of "extremely severe" symptoms of depression and anxiety was 54.29% and 97.29%, respectively. The prevalence of severe stress was 46.61%.

In another study by John *et al*,15% of the participants scored for high perceived stress associated with COVID-19, which was significantly related to participants' perception on the inconsistency between scientifically verified recommendations and adopted public health measures by the government authorities.

In Australia, Taylor *et al* conducted a study and revealed that there was an extremely high prevalence of high psychological distress in horse owners and those involved in the horse industry during a serious horse disease epidemic; with just over one third (34%) reporting levels of psychological distress that might require some form of external intervention, and 40% of these (14% of the sample) reaching levels that may be considered indicative of 'caseness' for a DSM-IV disorder (a clinically significant behavioural or psychological syndrome or pattern that occurs in an individual).

Laxmi *et al*.conducted a cross-sectional web-based survey was among dental faculties of all the five Government Dental Colleges across Kerala and a total of 162 faculties reported, some level of perceived stress exhibited by all the members of the present study group. 67.3% of the total respondents were having moderate levels and 6.8% of them were having high levels of perceived stress. These indicate that the unique demands of the disease (COVID-19) have contributed towards perceived stress among study subjects.

4.4.6. Assessment of Sleep among study subjects

Sleep is a crucial biological function for regulating internal balance and enhancing quality of life. Increased sleep quality has positive effects on physical and mental health (Sayed *et al.,* 2021).

The *Insomnia Severity Index* (ISI) is a brief instrument that was designed to assess the severity of insomnia The ISI is a 7-item self-report questionnaire assessing the nature, severity, and impact of insomnia. The usual recall period is the "last month" and the dimensions evaluated are: severity of sleep onset, sleep maintenance, and early morning awakening problems, sleep dissatisfaction, interference of sleep difficulties with daytime functioning, noticeability of sleep problems by others, and distress caused by the sleep difficulties (Morin *et al*., 2011).

The details pertaining to the assessment of Sleep among the subjects during COVID and after Long COVID presented in table 4.4.6.

Table 4.4.6. ISI Scale to Assess Sleep among Study Subjects

n=250

Score	Interpretation	During COVID		After Long COVID	
		Frequency(N)	Percent(%)	Frequency(N)	Percent(%)
0-7	**Absence of Insomnia**	190	76.0	80	32
8-14	**Moderate**	1	0.4	126	50.4

	Insomnia				
15-21	**Subthreshold Insomnia**	59	23.6	35	14
22-28	**Severe Insomnia**	0	0	9	3.6
	Total	250	100.0	250	100.0

From the data, we can interpret that during the period of infection 76% of the study subjects did not have any sleep disorders. 23.6 % of the subjects suffering from threshold insomnia and only 0.4% had moderate insomnia. On analyzing the results among long COVID subjects, 50.4 % had moderate insomnia, 14% had subthreshold insomnia. Only 3.6 % of the study subjects comes under severe insomnia.

Sayed *et al*., conducted a case series and reported that, three out of four patients had worsening in subjective sleep quality and sleep problems, including changes in subjective sleep quality, sleep latency and daytime function, were observed in (85%) of patients who recovered from COVID-19 infection and were evaluated again 8 weeks after discharge gain 8 weeks after discharge. This study concluded that the post-COVID-19 patients showed impairment of different subdomains of quality of life including physical and mental aspects.

In a study conducted by Davis *et al*. (2021) 78.6% (95% confidence interval 84.0% to 79.9%) of respondents experienced difficulty with sleep.

In another study by Branda *et al*., showed a high prevalence of sleep disturbances in Hong Kong residents during the COVID-19 pandemic. Around 30- 40% of the respondents felt that their sleep quality worsened, sleep initiation became more difficult, and sleep duration shortened after the first confirmed local case of COVID-19. After adjusting for other confounding factors, only insufficient stores of masks were associated with a worsening in sleep quality, sleep initiation, and shortened sleep duration since the local outbreak, and with current insomnia.

Cyrille *et al* conducted multivariate logistic regression analyses, it was found that while compared with individuals with postgraduate levels, those with undergraduate levels in which 95% and those attending college were more than twofold at greater risk for developing clinical insomnia. Higher levels of worries about the COVID-19 being infected by the virus, pre-existing mental health illness and loneliness increased the likelihood of being diagnosed with clinical insomnia (Cyrille *et al*., 2020).

Sanjenbam *et al* reported the higher prevalence of insomnia among females highlights gender variation to insomnia, as women have a higher risk of being owed to different reasons, including biological and genetic factors. The present findings reveal a potential alarming issue of insomnia. The overall prevalence of 12.13% clinical insomnia and 31.97% subthreshold in the present study is alarming. This finding is much higher than the reported prevalence of insomnia (9%) and that of subthreshold insomnia (30%). Subthreshold insomnia is identified as having a score of 8–14 in the Insomnia Severity Index, developed by Morin *et al*., who report frequency, persistence, or consequences of insomnia symptoms lower than those indicated by diagnostic criteria.

4.5. Analysis of variance (ANOVA)

Analysis of variance (ANOVA) is the most efficient parametric method available for the analysis of data from experiment.

Null hypothesis proposed as there is no significant effect of exercise, on Sleep, Diet, Stress and Fatigue.

Alternative hypothesis proposed as there is significant effect of exercise on Sleep, Diet, Stress and Fatigue.

4.5.1. ANOVA Analysis of different parameters among the subjects during COVID

The details pertaining to the ANOVA analysis of different parameters among the subjects During COVID are presented in Table 4.5.1

Table 4.5.1 The ANOVA analysis of different parameters among the subjects During COVID

Pandemic Score		df	SS	MS	F-value	p-value
Sleep	Between Groups	97.633	2	48.817	4.174	.016
	Within Groups	2888.543	247	11.695		
	Total	2986.543	249			

Diet	Between Groups Within Groups Total	417.183 8718.801 9135.984	2 247 249	208.592 35.299	5.909	.003
Fatigue	Between Groups Within Groups Total	22.854 6978.528 6848.144	2 247 249	11.427 28.253	.465	.861
Stress	Between Groups Within Groups Total	4.695 995.247 999.942	2 247 249	2.347 4.029	1.682	.435

df, degrees of freedom; SS, sum of square; MS, mean square

The analysis was conducted based on the question ‘Do you exercise regularly?’. The groups considered under this factor (exercise pattern) are ‘No exercise’, ‘Regular exercise’ and ‘Sometimes exercise’.

The null hypothesis was rejected at 5% level of significance for the variables Fatigue (0.861>0.05),) and Stress (0.435>0.05) indicating that the groups are not equal. Hence at 95% level of confidence, there is a significant effect of exercise on Stress and Fatigue.

For the variable Sleep (0.016>0.01), reject the null hypothesis at 1% level of significance. Thenull hypothesis under consideration is means are not equal. Hence with 99% level of confidence, there is significant effect of exercise on Sleep.

For the variable Diet (0.003 < 0.05), accept the null hypothesis at 5% level of significance. The null hypothesis under consideration is means are equal. Hence with 95 % level of confidence, there is no significant effect of exercise on Diet.

4.5.2. ANOVA Analysis of different parameters among the subjects after Long COVID

The details regarding the ANOVA analysis of different parameters among the subjects after Long COVID are presented in Table 4.6.2.

Table 4.5.2. The ANOVA analysis of different parameters among the subjects after Long COVID

Pandemic Score		df	SS	MS	F-value	p- value
Sleep	Between Groups Within Groups Total	97.633 2888.543 2986.176	2 247 249	48.817 11.695	4.174	0.016
Fatigue	Between Groups Within Groups Total	56. 865 4845.624 4376.249	2 247 249	28.432 19.617	5.909	0.396
Stress	Between Groups Within Groups Total	19.854 6828.290 6848.144	2 247 249	9.927 27.645	.359	0.699
Diet	Between Groups Within Groups Total	.282 561.962 562.244	2 247 249	.141 2.275	.062	0.940

df ,degrees of freedom; SS, sum of square; MS, mean square

The null hypothesis was rejected at 5% level of significance for the variables Fatigue (0.396>0.05), Stress (0.699>0.05) and Diet (0.940>0.05) this indicating that the groups are not equal. Hence at 95% level of confidence, there is a significant effect of exercise on Stress and Fatigue.

It is possible to reject the null hypothesis at 1% level of significance for the variable Sleep (0.016>0.01).That means exercise will affect the Fatigue, Stress Level, Diet Pattern and Sleep Pattern. Thenull hypothesis under consideration is means are equal. With 99% of confidence, there is significant effect of exercise on Sleep.

4.6. Karl Pearson Correlation Coefficient of different parameters among the subjects

Karl Pearson Correlation was seen as appropriate to analyze the relationship between the two variables which were interval-scaled and ratio-scaled. Furthermore, correlation coefficients reveal magnitude and direction of relationships which are suitable for hypothesis testing. The results are presented in Table 4.6.

Table 4.6. Karl Pearson Correlation Coefficient of different parameters among the subjects

Variables	Karl Pearson Correlation Coefficient (p)	
	During COVID	After Long COVID
Sleep and Diet	-0.003	-0.001
Fatigue and Diet	-0.196	-0.118
Sleep and Fatigue	0.614*	0.796*
Sleep and Stress	0.581*	0.761*
Stress and Fatigue	0.662*	0.738*
Stress and Diet	0.014	0.036

* Coefficient of correlation >0.5 considered significant

According to the data, during COVID the negatively correlated variables were Sleep and Diet (-0.003<0.5), Fatigue and Diet (- 0.196<0.5) and after Long COVID the negatively correlated variables were, Sleep and Diet (-0.001<0.5), Fatigue and Diet (- 0.118<0.5). The Correlation Coefficient is <0.5 indicating that the groups are not significant i.e. If the coefficient of correlation is less than its probable error, it is not at all significant.

From the above data, during COVID the positively correlated variables were Stress and Diet (0.014<0.5) and after Long COVID the variables were Stress and Diet (0.036<0.5). The Correlation Coefficient is <0.5 indicating that the groups are not significant i.e. if the coefficient of correlation is less than its probable error, it is not at all significant.

During COVID, the positively correlated variables were Sleep and Fatigue (0.614>0.5), Sleep and Stress (0.581>0.5), Stress and Fatigue (0.662>0.5) and After Long COVID, Sleep and Fatigue (0.796>0.5) Sleep and Stress (0.761>0.5) and Stress and Fatigue (0.738>0.5) The correlation coefficient is >0.5 indicating that the groups are significant i.e. if the probable error is not much and if the coefficient of correlation is 0.5 or more it is generally considered to be significant.

With many people having been infected and continuing to be infected with COVID-19, the long term implications are of increasing concern. Hypertension has been reported as the highest pre-existing comorbidity followed by of diabetes mellitus and obesity or overweight. The most prevalent symptoms among the study subjects during COVID were dry cough, headache, breathlessness, diarrhoea, loss of smell/taste, and fever. On studying the symptoms among the subjects during Long COVID, the most prevalent symptoms were breathing difficulty, joint pain, weakness, shortness of breath, abdominal pain, dry cough, sore throat, bowel sensations, muscle aches, tightness of chest, difficulty in swallowing, loss of appetite, palpitation, sensitivity to light, extreme thirst and tachycardia. The presence of post-COVID-19 manifestations is related to comorbidities and disease severity COVID-19 survivors presented a high prevalence of emergent fatigue level, perceived stress and sleeplessness. According to the ANOVA analysis of different parameters among the subjects During COVID, we reject the null hypothesis for the variables fatigue, stress and sleep. It was concluded as there is a significant effect of exercise on stress and fatigue. For the variable diet accept the null hypothesis at 5% level of significance. Hence with 95 % of confidence, there is no significant effect of exercise on diet. On alalyzing Long COVID cases we reject the null hypothesis for the variables fatigue, stress, sleep and diet and this means exercise will affect the stress level, fatigue level diet pattern and sleeplessness and. the null hypothesis under consideration is means are equal. Pearson correlation analysis between sleep and fatigue, sleep and stress, fatigue and stress, stress and diet shows positive correlation during COVID and after Long COVID while sleep and diet, fatigue and diet shows negative correlation.

SUMMARY AND CONCLUSION

CHAPTER 5

SUMMARY AND CONCLUSION

COVID-19 is an illness caused by the SARS-CoV-2 coronavirus. Since the world is amid a pandemic, COVID-19 causes long-term symptoms in a substantial proportion of people. Many researchers have examined COVID-19 patients, but only a few systematic studies have looked into the severity of Long COVID and the patients experience multi-system dysfunction and substantial impairment.

The present study was a survey which was open to individuals 18 years of age and older who experienced symptoms consistent with COVID-19, including those with and without positive SARS-CoV-2 diagnostic or antibody test results. An interview schedule was used among 250 subjects to gather details such as sociodemographic characteristics, assessment of comorbidity and medical history, assessment of COVID and Long COVID symptoms, assessment of stress, assessment of fatigue, assessment of sleep and dietary assessment.

The aim of the study is to evaluate the Health and Wellbeing of Long COVID patients in Kannur district of Kerala.

The broad objectives were-

- To assess the general health profile of COVID patients.
- To obtain an insight into health-related problems during and post-recovery.

The specific objectives were-

- To obtain information regarding the socio-demographic profile of the selected Long-COVID patients
- To assess the nutritional status of Long-COVID patients using Anthropometric assessment and Dietary Diversity Score.
- To evaluate the health and well-being of study subjects by assessing comorbidities, symptoms during COVID and the Long COVID period, as well as fatigue, stress, and insomnia.
- To examine the impact of exercise on Sleep Pattern, Dietary Diversity Score, Stress Level, and Fatigue Level among Long-COVID patients using Analysis of Variance.

To evaluate the correlation of COVID-19-related stress, fatigue, insomnia and its association with dietary diversity score among Long-COVID patients

The findings of the study are summarised as follows:

- Approximately half of the subjects (53.6%) belonged to the age group of 18–29 years. 19.2 percent of the subjects belonged to the age group of 30-39 years. A few (6%) belonged to the age group of 40–49 years. About 10.4 percent of the subjects belonged to the age group of 50–59, and the remaining 10.8 percent of the subjects belonged to the age group over 60.
- According to the data about 52.8% of the subjects were female, and the remaining 47.2 percent of the subjects were male.
- With regard to educational attainment, it was observed that 46.4 percent had attained graduation, and 20.4 percent of the subjects were post-graduates.9.2percent of the subjects had a higher secondary education and 24% had secondary level respectively.
- Majority (60.4 %) of the subjects had a BMI in the normal range and 32.8 % of the subjects were overweight. 4.4% of the subjects were obese. A few (2.4%) of the subjects were underweight.
- Among the study subjects, 48.4% of the subjects exercise sometimes, 26.8 % of the subjects exercise regularly. 24.8% of the subjects were physically inactive. Physically active subjects mainly involved in yoga, dance and gym class.
- According to the data hypertension has been reported as the highest pre-existing comorbidity (43.1 percent) followed by of diabetes mellitus (32.8%). The occurrence of obesity is 26.8 % , 22% of the subjects suffering from kidney diseases. Carcinoma found among 21% of the study subjects and 15.2% of the subjects reported with the occurrence of cardiovascular diseases. Lung disease was reported among 10% of the subjects, 9.2% of the subjects had liver disease.
- Among the study subject majority (70%) choose allopathy for treating the complications of COVID -19. Homeopathy was adopted by 17.6 % of the subjects and the remaining 12.4% opted Ayurveda.
- According to the data, the most prevalent symptoms among the study subjects during COVID were dry cough (92.4%), headache (92 %), tiredness (92 %) and

breathlessness (90 %) followed by diarrhoea (71.2%), loss of taste (62.4%), and fever (56.8%). Chest pain found (58%) and skin rashes (44.8%) found to be the least prevalent symptoms among the study subjects.

- On studying the cardiovascular symptoms among the subjects during Long COVID, the most prevalent symptoms were palpitation (73.6 %) and tachycardia (60.4 %). Other major symptoms are pain or burning in chest (54.4%) and bulging (39.6%). Fainting (12.8 %) found to be the least prevalent symptoms among the study subjects.
- It was observed that the systemic symptoms among the subjects during Long COVID, the most prevalent symptoms were weakness (89.2 %) and extreme thirst (70 %). other major symptoms malaise (65.3%), elevated temperature (64.4%) and chill / flushing/sweats (61.6%). Skin sensation (38.4%) and menstrual issues (18.8%) were found to be the least prevalent symptoms among the study subjects.
- Musculoskeletal symptoms among the subjects during Long COVID were joint pain (92.4%), muscle aches (83.2%) and tightness of chest (82 %). Other major symptoms include bone ache or burning (68.8%), stiff neck (55.2%) and muscle spasms (52.2%).
- According the data, the immunologic symptoms among the subjects were reactions to old allergies (32.8 %) and new allergies (36.4%). The symptoms are most prevalent for the time period of 0-5 weeks.
- It was observed that the dermatologic symptoms among the subjects, the most prevalent symptoms were itchy skin (59.6 %) and skin rashes (43.2%). Other symptoms were peeling skin (30.4%).
- All respondents experienced at least one HEENT symptom during Long COVID. Among the study subjects sore throat (86%), difficulty in swallowing (76.4%), sensitivity to light (70.4%) were the most prevalent symptoms followed by ear pain (66.8%), eye pain (66%), dry eyes (62.4%) and blurred vision (61.6%). Running nose was reported by 48.4 % of the study subjects.
- After analyzing the prevalence of pulmonary symptoms during Long COVID, most of the subjects had breathing difficulty (94.4%) and shortness of breath (88.4%) were the most prevalent symptoms followed by dry cough (86%) and sneezing (55.2%). Coughing of blood (2.8%) was reported as the least prevalent.

- From the above data among the study subjects during Long COVID, the most prevalent gastrointestinal symptoms were abdominal pain (87.2%), bowel sensations (85.6%) and loss of appetite (75.6%). Other symptoms were followed by diarrhoea (54.8%), constipation (51.6 %). Vomiting (36.8%) and nausea (36 %) were the least common symptoms.
- Most of the Long COVID symptoms were more common over the first 3 months than in later months.
- It has been established that only 21.6 % of the study subjects has fatigue syndrome during the period of infection. But on anayzing the results after long COVID, 56.8 % had severe fatigue. Fatigue is a dominant complaint in long COVID.
- From the data we can interpret that during the period of infection 49.6% had low stress and 48.8% had moderate stress. Only 1.6 % of the study subjects had high stress during the period of infection. On anayzing the results among long COVID, 53.2% had moderate stress, 16.4% had high stress. Only 30.4% of the study subjects comes under low stress.
- According to the data, during the period of infection 76% of the study subjects hasn't any sleep disorders. 23.6 % had subthreshold insomnia and only 0.4% had moderate insomnia. On analysing the results among long COVID subjects, 50.4 % had moderate insomnia, 14% had subthreshold insomnia. Only 3.6 % of the study subjects comes under severe insomnia.
- The DDS computation after Long COVID from the diets consumed by study subjects indicated that 67.2 per cent had a medium dietary diversity followed by 21.6 per cent having a high dietary diversity and only 11.2 percent having low dietary diversity.
- According to The ANOVA analysis of different parameters among the subjects During COVID, The null hypothesis was rejected at 5% level of significance for the variables Fatigue (0.861>0.05),) and Stress (0.435>0.05) indicating that the groups are not equal. Hence at 95% level of confidence, there is a significant effect of exercise on Stress and Fatigue.
- For the variable Sleep (0.016>0.01), reject the null hypothesis at 1% level of significance. Thenull hypothesis under consideration is means are not equal. Hence with 99% level of confidence, there is significant effect of exercise on Sleep.

- For the variable Diet (0.003 < 0.05), accept the null hypothesis at 5% level of significance. The null hypothesis under consideration is means are equal. Hence with 95 % level of confidence, there is no significant effect of exercise on Diet.
- During Long COVID cases, the null hypothesis was rejected at 5% level of significance for the variables Fatigue (0.396>0.05), Stress (0.699>0.05) and Diet (0.940>0.05) this indicating that the groups are not equal. Hence at 95% level of confidence, there is a significant effect of exercise on Stress and Fatigue.
- It is possible to reject the null hypothesis at 1% level of significance for the variable Sleep (0.016>0.01).That means exercise will affect the Fatigue, Stress Level, Diet Pattern and Sleep Pattern. Thenull hypothesis under consideration is means are equal. With 99% of confidence, there is significant effect of exercise on Sleep.
- According to the Karl Pearson Correlation Coefficient of different parameters among the subjects, According to the data, during COVID the negatively correlated variables were Sleep and Diet (-0.003<0.5), Fatigue and Diet (- 0.196<0.5) and after Long COVID the negatively correlated variables were, Sleep and Diet (-0.001<0.5), Fatigue and Diet (- 0.118<0.5). The Correlation Coefficient is <0.5 indicating that the groups are not significant i.e. If the coefficient of correlation is less than its probable error, it is not at all significant.
- From the data, during COVID the positively correlated variables were Stress and Diet (0.014<0.5) and after Long COVID the variables were Stress and Diet (0.036<0.5). The Correlation Coefficient is <0.5 indicating that the groups are not significant i.e. if the coefficient of correlation is less than its probable error, it is not at all significant.
- During COVID, the positively correlated variables were Sleep and Fatigue (0.614>0.5), Sleep and Stress (0.581>0.5), Stress and Fatigue (0.662>0.5) and After Long COVID, Sleep and Fatigue (0.796>0.5) Sleep and Stress (0.761>0.5) and Stress and Fatigue (0.738>0.5) The correlation coefficient is >0.5 indicating that the groups are significant i.e. if the probable error is not much and if the coefficient of correlation is 0.5 or more it is generally considered to be significant.

CONCLUSION

With many people having been infected and continuing to be infected with COVID-19, the long term implications are of increasing concern. We have explored the persisting symptoms of Long COVID. Hypertension has been reported as the highest pre-existing comorbidity followed by of diabetes mellitus and obesity or overweight. The most prevalent symptoms among the study subjects during COVID were dry cough, headache, breathlessness, diarrhoea, loss of smell/taste, and fever. On studying the symptoms among the subjects during Long COVID, the most prevalent symptoms were breathing difficulty, joint pain, weakness, shortness of breath, abdominal pain, dry cough, sore throat, bowel sensations, muscle aches, tightness of chest, difficulty in swallowing, loss of appetite, palpitation, sensitivity to light, extreme thirst and tachycardia. Most of the Long COVID symptoms were more common over the first 3 months than in later months. The presence of post-COVID-19 manifestations is related to comorbidities and disease severity COVID-19 survivors presented a high prevalence of emergent fatigue level, perceived stress and sleeplessness. According to the ANOVA analysis of different parameters among the subjects During COVID, we reject the null hypothesis for the variables fatigue, stress and sleep. It was concluded as there is a significant effect of exercise on stress and fatigue. For the variable diet accept the null hypothesis at 5% level of significance. Hence with 95 % of confidence, there is no significant effect of exercise on diet. On alalyzing Long COVID cases we reject the null hypothesis for the variables fatigue, stress, sleep and diet and this means exercise will affect the stress level, fatigue level diet pattern and sleeplessness and. the null hypothesis under consideration is means are equal. Pearson correlation analysis between sleep and fatigue, sleep and stress, fatigue and stress, stress and diet shows positive correlation during COVID and after Long COVID while sleep and diet, fatigue and diet shows negative correlation.

Limitations of the Study

- The COVID -19 pandemic limited the interaction that could have been possible by personal interviews among the study subjects.
- Patient outcome measures were assessed by self-reporting, which may differ from findings of formal and actual physical testing.

- Study was not extended to COVID patients exhibiting very severe symptoms during the infection period.
- The study duration was for six months, thus a yearlong follow-up that is necessary for Long COVID was not possible.

Recommendation for future research

- Patient outcome measures were assessed by self-reporting, which may differ from findings at formal, physical testing to actually assess fatigue, stress, and insomnia associated with the infection.
- Study could be extended to include COVID patients exhibiting very severe symptoms during the infection period.
- For more intensive findings, the research can be continued for at least a year of follow-up.

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APPENDIX

APPENDIX 1

HEALTH AND WELLBEING OF LONG COVID PATIENTS IN KANNUR DISTRICT OF KERALA

I, Jesnet Sebastian, am currently pursuing MSc in Food Science and Nutrition from St Teresa's College (Autonomous), Ernakulam. As a part of research entitled **"HEALTH AND WELLBEING OF LONG COVID PATIENTS IN KANNUR DISTRICT OF KERALA ''**. This study will conduct under the guidance of Dr. Rashmi H. Poojara, Assistant Professor, Department of Home Science St Teresa's College, Ernakulam.

I request you to provide the information requested in this questionnaire. The information provided will be used for academic purposes and kept confidential. Honestly requesting your co-operation for the conduct of the study. Thank you.

I voluntarily consent to participate in the study

◯ Yes

◯ No

GENERAL INFORMATION

1. Name

   Mr./Ms./Mrs./Dr.____________________

2. Designation

   ____

3. Age

◯ 18 – 29
◯ 30 – 39
◯ 40 – 49
◯ 50 – 59
◯ Above 60

4. Gender

◯ Male
◯ Female

5. Education

◯ PG and above
◯ Graduation
◯ Higher secondary
◯ Secondary

ANTHROPOMETRIC ASSESSMENT

1. Enter your height in cm.

____

2. Enter your weight in kg.

____

PHYSICAL ACTIVITY

1. Do you exercise regularly?

◯ Yes
◯ No
◯ Sometimes

2. Have you enrolled yourself in any online activities like Yoga/Dance/Gym classes?

◯ Yes
◯ No

COMORBIDITY ASSESSMENT

1. Do you have any of the following lifestyle diseases?

Lifestyle diseases	**Yes**	**No**
Hypertension / High blood pressure		
Diabetes mellitus		
Cardiovascular disease		
Obesity / overweight		
Chronic lung disease		
Kidney disease		
Liver disease		
Cancer		

MEDICAL HISTORY

1. Do you take any regular medication?

◯ Yes
◯ No

2. If yes, did you take your regular medication during the period of COVID infection?

◯ Yes
◯ No

3. What was the system of medicine adopted to treat COVID – 19?

◯ Ayurveda
◯ Allopathy
◯ Homeopathy

◯ Other

SYMPTOMS

- During Covid

On a scale of 0 – 4, with 0 being no symptoms and 4 being severe. Please respond to the question to your best knowledge.

i. Fever

0 1 2 3 4

No symptoms ◯◯◯◯◯ Severe

ii. Dry cough

0 1 2 3 4

No symptoms ◯◯◯◯◯ Severe

iii. Tiredness

0 1 2 3 4

No symptoms ◯◯◯◯◯ Severe

iv. Headache

0 1 2 3 4

No symptoms ◯◯◯◯◯ Severe

v. Diarrhoea

0 1 2 3 4

No symptoms ◯◯◯◯◯ Severe

vi. Loss taste/smell

0 1 2 3 4

No symptoms ◯◯◯◯◯ Severe

vii. Skin rash

0 1 2 3 4

No symptoms ◯◯◯◯◯ Severe

viii. Breathlessness

0 1 2 3 4

No symptoms ◯◯◯◯◯ Severe

ix. Chest pain

0 1 2 3 4

No symptoms ◯◯◯◯◯ Severe

- Long - Covid

Cardiovascular	**Scale**	**Time (Weeks)**
Palpitations	0 1 2 3 4 ◯◯◯◯◯	0-5 5-10 10-15 15-20 20-25 25-30 ◯ ◯ ◯ ◯ ◯ ◯

Tachycardia	0 1 2 3 4 ○○○○○	0-5 5-10 10-15 15-20 20-25 25-30 ○ ○ ○ ○ ○ ○
Pain or burning in the chest	0 1 2 3 4 ○○○○○	0-5 5-10 10-15 15-20 20-25 25-30 ○ ○ ○ ○ ○ ○
Swelling	0 1 2 3 4 ○○○○○	0-5 5-10 10-15 15-20 20-25 25-30 ○ ○ ○ ○ ○ ○
Fainting	0 1 2 3 4 ○○○○○	0-5 5-10 10-15 15-20 20-25 25-30 ○ ○ ○ ○ ○ ○

Systemic	Scale	Time (Weeks)
Malaise	0 1 2 3 4 ○○○○○	0-5 5-10 10-15 15-20 20-25 25-30 ○ ○ ○ ○ ○ ○
Elevated temperature	0 1 2 3 4 ○○○○○	0-5 5-10 10-15 15-20 20-25 25-30 ○ ○ ○ ○ ○ ○
Chill / flushing/ sweats	0 1 2 3 4 ○○○○○	0-5 5-10 10-15 15-20 20-25 25-30 ○ ○ ○ ○ ○ ○
Weakness	0 1 2 3 4 ○○○○○	0-5 5-10 10-15 15-20 20-25 25-30 ○ ○ ○ ○ ○ ○
Sexual dysfunction	0 1 2 3 4 ○○○○○	0-5 5-10 10-15 15-20 20-25 25-30 ○ ○ ○ ○ ○ ○

Extreme thirst	0 1 2 3 4 ○○○○○	0-5 5-10 10-15 15-20 20-25 25-30 ○ ○ ○ ○ ○ ○
Menstrual issues	0 1 2 3 4 ○○○○○	0-5 5-10 10-15 15-20 20-25 25-30 ○ ○ ○ ○ ○ ○

Musculoskeletal	**Scale**	**Time (Weeks)**
Tightness of chest	0 1 2 3 4 ○○○○○	0-5 5-10 10-15 15-20 20-25 25-30 ○ ○ ○ ○ ○ ○
Muscle aches	0 1 2 3 4 ○○○○○	0-5 5-10 10-15 15-20 20-25 25-30 ○ ○ ○ ○ ○ ○
Joint pain	0 1 2 3 4 ○○○○○	0-5 5-10 10-15 15-20 20-25 25-30 ○ ○ ○ ○ ○ ○
Stiff neck	0 1 2 3 4 ○○○○○	0-5 5-10 10-15 15-20 20-25 25-30 ○ ○ ○ ○ ○ ○
Muscle spasms	0 1 2 3 4 ○○○○○	0-5 5-10 10-15 15-20 20-25 25-30 ○ ○ ○ ○ ○ ○
Bone ache or burning	0 1 2 3 4 ○○○○○	0-5 5-10 10-15 15-20 20-25 25-30 ○ ○ ○ ○ ○ ○

Immunologic	Scale	Time (Weeks)
Reactions to mold allergies	0 1 2 3 4 ◯◯◯◯◯	0-5 5-10 10-15 15-20 20-25 25-30 ◯ ◯ ◯ ◯ ◯ ◯
New allergies	0 1 2 3 4 ◯◯◯◯◯	0-5 5-10 10-15 15-20 20-25 25-30 ◯ ◯ ◯ ◯ ◯ ◯

Dermatologic	Scale	Time (Weeks)
Itchy skin	0 1 2 3 4 ◯◯◯◯◯	0-5 5-10 10-15 15-20 20-25 25-30 ◯ ◯ ◯ ◯ ◯ ◯
Skin rashes	0 1 2 3 4 ◯◯◯◯◯	0-5 5-10 10-15 15-20 20-25 25-30 ◯ ◯ ◯ ◯ ◯ ◯
Peeling skin	0 1 2 3 4 ◯◯◯◯◯	0-5 5-10 10-15 15-20 20-25 25-30 ◯ ◯ ◯ ◯ ◯ ◯

HEENT	Scale	Time (Weeks)
Sore throat	0 1 2 3 4 ◯◯◯◯◯	0-5 5-10 10-15 15-20 20-25 25-30 ◯ ◯ ◯ ◯ ◯ ◯
Blurred vision	0 1 2 3 4 ◯◯◯◯◯	0-5 5-10 10-15 15-20 20-25 25-30 ◯ ◯ ◯ ◯ ◯ ◯

Difficulty in swallowing	0 1 2 3 4 ○○○○○	0-5 5-10 10-15 15-20 20-25 25-30 ○ ○ ○ ○ ○ ○
Sensitivity to light	0 1 2 3 4 ○○○○○	0-5 5-10 10-15 15-20 20-25 25-30 ○ ○ ○ ○ ○ ○
Running nose	0 1 2 3 4 ○○○○○	0-5 5-10 10-15 15-20 20-25 25-30 ○ ○ ○ ○ ○ ○
Dry eyes	0 1 2 3 4 ○○○○○	0-5 5-10 10-15 15-20 20-25 25-30 ○ ○ ○ ○ ○ ○
Changes in voice	0 1 2 3 4 ○○○○○	0-5 5-10 10-15 15-20 20-25 25-30 ○ ○ ○ ○ ○ ○
Eye pain	0 1 2 3 4 ○○○○○	0-5 5-10 10-15 15-20 20-25 25-30 ○ ○ ○ ○ ○ ○
Ear pain	0 1 2 3 4 ○○○○○	0-5 5-10 10-15 15-20 20-25 25-30 ○ ○ ○ ○ ○ ○

Pulmonary	**Scale**	**Time (Weeks)**
Shortness of breath	0 1 2 3 4 ○○○○○	0-5 5-10 10-15 15-20 20-25 25-30 ○ ○ ○ ○ ○ ○
Dry cough	0 1 2 3 4 ○○○○○	0-5 5-10 10-15 15-20 20-25 25-30 ○ ○ ○ ○ ○ ○

Breathing difficulty	0 1 2 3 4 ○○○○○	0-5 5-10 10-15 15-20 20-25 25-30 ○ ○ ○ ○ ○ ○
Sneezing	0 1 2 3 4 ○○○○○	0-5 5-10 10-15 15-20 20-25 25-30 ○ ○ ○ ○ ○ ○
Coughing of blood	0 1 2 3 4 ○○○○○	0-5 5-10 10-15 15-20 20-25 25-30 ○ ○ ○ ○ ○ ○

Gastrointestinal	**Scale**	**Time (Weeks)**
Diarrhea	0 1 2 3 4 ○○○○○	0-5 5-10 10-15 15-20 20-25 25-30 ○ ○ ○ ○ ○ ○
Vomiting	0 1 2 3 4 ○○○○○	0-5 5-10 10-15 15-20 20-25 25-30 ○ ○ ○ ○ ○ ○
Constipation	0 1 2 3 4 ○○○○○	0-5 5-10 10-15 15-20 20-25 25-30 ○ ○ ○ ○ ○ ○
Loss of appetite	0 1 2 3 4 ○○○○○	0-5 5-10 10-15 15-20 20-25 25-30 ○ ○ ○ ○ ○ ○
Nausea	0 1 2 3 4 ○○○○○	0-5 5-10 10-15 15-20 20-25 25-30 ○ ○ ○ ○ ○ ○
Abdominal pain	0 1 2 3 4 ○○○○○	0-5 5-10 10-15 15-20 20-25 25-30 ○ ○ ○ ○ ○ ○
Bowel sensations	0 1 2 3 4 ○○○○○	0-5 5-10 10-15 15-20 20-25 25-30 ○ ○ ○ ○ ○ ○

FATIGUE ASSESSMENT (Chalder Fatigue Scale)

Fatigue was assessed by using the Chalder fatigue scale (CFQ-11). The Chalder fatigue scale (CFQ-11) was used to measure fatigue or tiredness. It was assessed during COVID and after Long COVID.

Did you feel tired during your quarantine days?

- ◯ Yes
- ◯ No

	Less than usual	Better than usual	No more than usual	No worse than usual	More than usual	Worse than usual	Much more than usual	Much verse than usual
Do you have problems with tiredness?								
Do you need to rest more?								
Do you feel sleepy or drowsy?								
Do you have problems starting things?								
Do you lack energy?								
Do you have less strength in your muscles?								
Do you feel weak?								
Do you have difficulties concentrating?								
Do you make slips of the tongue when speaking?								
Do you find it more difficult to find the right word?								
How is your memory?								

STRESS ASSESSMENT (Perceived Stress Scale - 10-C)

Personal stress was assessed using the Perceived Stress Scale (PSS-10-C). It is a measure of how stressful a situation one's life is. It was assessed during COVID and after long COVID.

Did you feel stressed during your quarantine days?

- ◯ Yes
- ◯ No

	Never	Hardly ever	Occasionally	Almost always	Always
I have felt as if something serious was going to happen unexpectedly with the epidemic					
I have felt that I am unable to control the important things in my life because of the epidemic					
I have felt nervous or stressed about the epidemic					
I have been confident about my ability to handle my problems related to the epidemic					
I have felt optimistic that things are going well with the epidemic					
I have felt unable to cope with the things I have to do to monitor for a possible infection					
I have felt that I can control the difficulties that could appear in my life as a result of the infection					
I have felt that I have everything under control about the epidemic					
I have been upset that things related to the epidemic are out of my control					
I have felt that the difficulties are increasing in these days of the epidemic and I feel unable to overcome them					

SLEEP QUALITY ASSESSMENT (Insomnia Severity Index [ISI])

The Insomnia Severity Index has seven questions. The seven answers are added up to get a total score. When you haveyour total score, look at the 'Guidelines for Scoring/Interpretation' below to see where your sleep difficulty fits.

Insomnia Problem	None	Mild	Moderate	Severe	Very Severe
1. Difficulty falling asleep	0	1	2	3	4
2. Difficulty staying asleep	0	1	2	3	4
3. Problems waking up too early	0	1	2	3	4

4. How SATISFIED/DISSATISFIED are you with your CURRENT sleep pattern?

Very Satisfied	Satisfied	Moderately Satisfied	Dissatisfied	Very Dissatisfied
0	1	2	3	4

5. How NOTICEABLE to others do you think your sleep problem is in terms of impairing the quality of your life?

Not at all Noticeable	A Little	Somewhat	Much	Very Much Noticeable
0	1	2	3	4

6. How WORRIED/DISTRESSED are you about your current sleep problem?

Not at all Worried	A Little	Somewhat	Much	Very Much Worried
0	1	2	3	4

7. To what extent do you consider your sleep problem to INTERFERE with your daily functioning (e.g. daytimefatigue, mood, ability to function at work/daily chores, concentration, memory, mood, etc.) CURRENTLY?

Not at all Interfering	A Little	Somewhat	Much	Very Much Interfering
0	1	2	3	4

DIETARY ASSESSMENT (DDS)

Please describe the foods (meals and snacks) that you ate or drank during the last 2 days. Start with the first food or drink of the morning.

Write down all foods and drinks mentioned. When composite dishes are mentioned, ask for the list of ingredients.

24 HOUR DIETARY RECALL FOR TWO CONSECUTIVE DAYS

MEAL	MENU	QUANTITY (gm/ml)
	DAY 1	
EARLY MORNING		
BREAKFAST		
MID-MORNING		
LUNCH		
EVENING		
DINNER		
BED TIME		
	DAY 2	
EARLY MORNING		
BREAKFAST		
MID-MORNING		
LUNCH		

EVENING		
DINNER		
BED TIME		

DIETARY DIVERSITY SCORE: WDDS

Question number	**Food group**	**Examples**	**Yes=1** **No=0**
1,2	Starchy staples1		
4	Dark green leafy vegetables		
3,6 and red palm oil if applicable	Vitamin A rich fruits and vegetables		
5,7	Other fruits and vegetables		
8	Organ meat		
9,11	Meat and fish		
10	Eggs		
12	Legumes, nuts and seeds		

ABSTRACT

ABSTRACT

The present study was a survey which was open to individuals 18 years of age and older who experienced symptoms consistent with COVID-19, including those with and without positive SARS-CoV-2 diagnostic or antibody test results. An interview schedule was used among 250 subjects to gather details such as sociodemographic characteristics, assessment of comorbidity and medical history, assessment of COVID and Long COVID symptoms, assessment of stress, assessment of fatigue, assessment of sleep and dietary assessment.

The aim of the present study is to evaluate the Health and Wellbeing of Long COVID patients in Kannur district of Kerala. The broad objectives were to assess the general health profile of COVID patients and to obtain an insight into health related problems during and post recovery. The present study provides valuable data on health and nutritional status of Long COVID patients. With many people having been infected and continuing to be infected with COVID-19, the long term implications are of increasing concern. We have explored the persisting symptoms of Long COVID. The present study provides valuable data on health and nutritional status of Long COVID patients.

Hypertension has been reported as the highest pre-existing comorbidity (43.1 percent) followed by of diabetes mellitus (32.8%). The occurrence of obesity is 26.8 %, and 22% of the subjects suffering from kidney diseases. Carcinoma found among 21% of the study subjects and 15.2% of the subjects reported with the occurrence of cardiovascular diseases. Lung disease was reported among 10% of the subjects, 9.2% of the subjects had liver disease. Among the study subject majority choose allopathy for treating the complications of COVID -19. The most prevalent symptoms among the study subjects during COVID were dry cough (92.4%), headache (92 %), tiredness (92 %) and breathlessness (90 %) followed by diarrhoea (71.2%), loss of taste (62.4%), and fever (56.8%). Chest pain found (58%) and skin rashes (44.8%) found to be the least prevalent symptoms among the study subjects.

On studying the symptoms among the subjects during Long COVID, the most prevalent symptoms were breathing difficulty (94.4%), joint pain (92.4%), weakness (89.2 %), shortness of breath (88.4%) abdominal pain (87.2%), dry cough (86%), sore throat (86%), bowel sensations (85.6%) muscle aches (83.2%) and tightness of chest (82 %), difficulty in swallowing (76.4%), loss of appetite (75.6%), palpitation (73.6 %), sensitivity to light (70.4),

extreme thirst (70 %)., and tachycardia (60.4 %) .Most of the Long COVID symptoms were more common over the first 3 months than in later months.

COVID-19 survivors presented a high prevalence of emergent fatigue level, perceived stress and sleeplessness. According to the ANOVA analysis of different parameters among the subjects During COVID, we reject the null hypothesis for the variables fatigue, stress and sleep. It was concluded as there is a significant effect of exercise on stress and fatigue. For the variable diet accept the null hypothesis at 5% level of significance. Hence with 95 % of confidence, there is no significant effect of exercise on diet. On alalyzing Long COVID cases we reject the null hypothesis for the variables fatigue, stress, sleep and diet and this means exercise will affect the stress level, fatigue level diet pattern and sleeplessness and. the null hypothesis under consideration is means are equal. Pearson correlation analysis between sleep and fatigue, sleep and stress, fatigue and stress, stress and diet shows positive correlation during COVID and after Long COVID while sleep and diet, fatigue and diet shows negative correlation.