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Long Term Health and Economic Impacts Faced By COVID-19 Patients After Discharge from Inpatient Health Care Facilities

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An abstract submitted to the Faculty of the Hubert Department of Global Health
Rollins School of Public Health of Emory University in partial fulfillment of the requirements
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Abstract

The coronavirus disease 2019 (COVID-19) pandemic has resulted in long-term symptoms experienced by patients several months post discharge from their initial hospitalization for COVID-19 treatment. The prevalence and risk factors for persistent symptoms as well as patients' costs of care are not fully known for patients who experienced COVID-related inpatient care. The goal of the research is to gather new information to improve long-term patient care for patients who have had a COVID-19 diagnosis and have been admitted to an inpatient facility in Atlanta, Georgia more than 6 months ago, and to understand the long-term consequences faced by these patients. Participants discharged from Emory University Hospitals for COVID-19 were contacted to complete a self-administered survey about long-term symptoms, hospitalization, costs of care, and their quality of life >6months post discharge. Bivariate and multivariable analyses were performed to evaluate associations between participant demographics and persistent symptoms. Two hundred and ten participants provided responses to the survey, of which 91 patients (36.99%) had reported experiencing at least 1 persistent symptom, a median of 10 months post-discharge, and 155 individuals (63.01%) did not have ongoing symptoms. The median age was 54 (range 21-95), and 110 (52.38%) participants were Black. The median length of stay was 5 days (mean=9.86, range=0,100) for their hospitalization. For overall health at present compared to before covid, 111 participants (46.44%) reported feeling about the same, whereas 27.2% mentioned that their thinking and memory are worse after COVID-19, which did not vary by presence of "long" COVID-19. Common symptoms associated with reports of worse physical health included fatigue (n= 48, 53.33%) and shortness of breath with activity (n=46, 51.1%). Following those symptoms, joint pain (n= 32, 35.56%), muscle aches (n= 29, 32.22%), weakness (n= 28, 31.11%), and back pain (n= 23, 25.56%) were most prevalent in the study population. In this cohort study of COVID-19–related long-term symptoms, physical and psychosocial symptoms highlighted the impacts on complete recovery months after diagnosis. Early identification of these symptoms could help prepare patients for long-term symptoms several months post discharge after being hospitalized for COVID-19.

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CHAPTER 1 - INTRODUCTION

Globally, the COVID-19 pandemic has resulted in a shift in understanding health care and health services for patients on a large scale. With the number of cases increasing in inpatient facilities, it is necessary to measure the health and economic impacts faced by patients after their hospital discharge. Post-acute COVID-19 symptoms, psychosocial impacts and economic burden play important roles in the management of patients who have had COVID-19 treatment in inpatient settings (Carfi et al., 2020). Ongoing symptoms that continue to affect individuals are still being researched months after the rapid increase in the number of COVID-19 positive individuals in the United States, and there is still much that needs to be understood in patient health care access gaps such as financial/economic health care expenditures, demographics, and social/cultural considerations.

The goal of this research study is to gather new information to improve patient care for patients who have had a COVID-19 diagnosis and have been admitted into an acute care hospital. A major factor in improving long-term health care outcomes is in recognizing ongoing symptoms faced by patients. With many patients facing distress, it is important to have a holistic approach to understanding symptoms and future impacts on patients' lives in order to provide recommendations for effective health care and management.

As COVID-19 continues to be a major public health issue worldwide currently, understanding patient perspectives in order to inform and/or implement future programs, policies and research in which better public health outcomes can be achieved is necessary to combat the pandemic and improve the wide-scale management of novel infectious diseases.

This project will be in collaboration with Emory Healthcare and Emory University's School of Medicine, a leading institution in COVID-19 treatment and management in the state of Georgia.

CHAPTER 2: REVIEW OF RELEVANT LITERATURE

There is a need to understand long-term health effects and consequences on quality of life, after being diagnosed and treated for COVID-19. The purpose of this literature review is to identify important content that may be necessary to guide survey methodology, analyses, and the overall patient experience post-COVID-19 hospitalization. Moreover, there is a need to evaluate symptoms and health access for patients who have been discharged after being admitted for COVID-19 at inpatient facilities, which this literature review aims to bring to light. To identify the content, a web and database search for relevant peer reviewed literature was performed, as well as a review of health care and COVID-19 response websites. The review resulted in the following seven topical areas for which this literature review is structured:

1. COVID-19: Background
2. Covid Implications
3. Long term symptoms
4. Post discharge impacts
5. Psychosocial impacts
6. Economic impacts

COVID-19: Background

Between the months of March and August 2020, 6 months post the surge of the COVID-19 virus in the United States, the total number of laboratory confirmed COVID-19 associated hospitalizations was 49, 451 (Centers for Disease Control and Prevention (n.d.), 2020). The CDC mentions that at the end of the 33rd week of widespread COVID-19 cases, the overall cumulative COVID-19 hospitalization rate was 151.7 per 100,000, with the highest rates in people aged 65 years and older (412.9 per 100,000) and 50-64 years (228.1 per 100,000) (Centers for Disease Control and Prevention (n.d.), 2020).

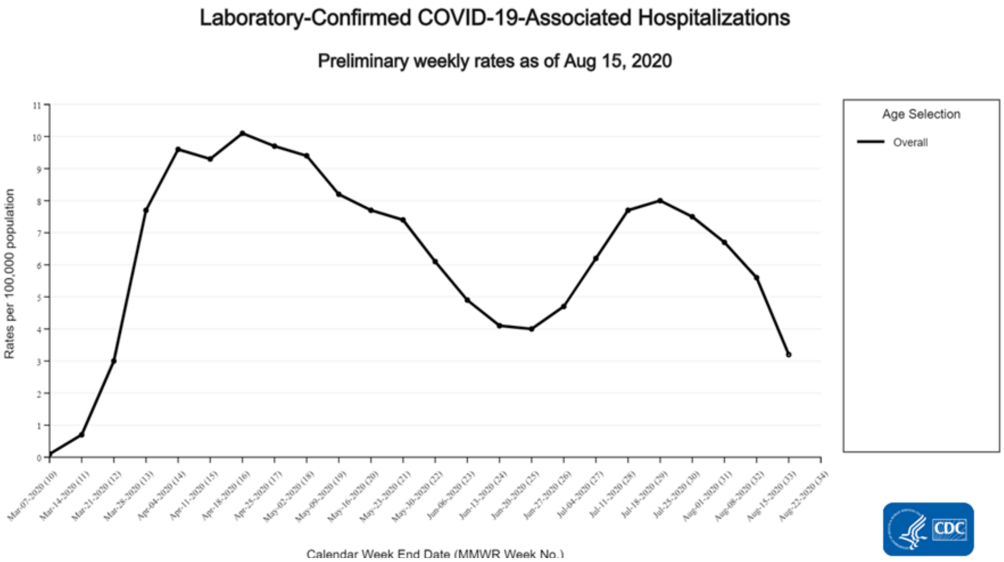

Figure 1: Total Number of Hospitalizations Between March and August 2020, (CDC, 2020)

COVID-19, an infectious disease that has caused a global pandemic in 2020, has been found to cause mild to moderate respiratory illness among other symptoms in affected populations. Risks are elevated for people who are older or have certain underlying medical conditions; they are at higher risk of getting very sick from COVID-19 (Centers for Disease Control and Prevention (n.d.), 2020).

The World Health Organization states that slowing transmission of the disease requires populations "to be well informed about the COVID-19 virus, the disease it causes, and how it spreads" (World Health Organization. (n.d.), 2020). Given the rapid spread of infection, and populations with comorbidities having higher likelihoods of developing serious illnesses, it is important to understand the mechanism, needs, and overall public health impacts.

Covid-19 Implications

Following the global COVID-19 pandemic, health systems in the United States rapidly restructured patient treatment and care after March 2020 to create home monitoring programs (Hick J.L. et al., 2020, O'Keefe et al., 2021). The prolonged symptoms following acute coronavirus disease were unknown, and management of these chronic symptoms on a large scale were not prioritized by health systems. Following that, persistent symptoms were found to be common in both hospitalized (Carfi et al., 2020) and non-hospitalized (Tenforde M.W., et al., 2020) patients, and these patients have described challenges with stigma as well as difficulty in accessing care for their symptoms (Tenforde M.W., et al., 2020). Some studies suggested patients facing interferences or disruptions in their day-to-day activities as well as experiencing reduced quality of life post their recovery from COVID-19. Studies of patients who were diagnosed of other respiratory syndromes such as SARS, experienced ongoing pulmonary issues (Ngai J.C. et al., 2010) as well as long-term symptoms such as fatigue, weakness and psychiatric illnesses (Lam et al., 2009). In understanding the role of hospitalizations in chronic effects in COVID-19 patients post-discharge, there is also a need to evaluate the long-term impact on individuals' health and wellbeing will inform future standards of care for treating patients with COVID-19. Moreover, as individuals with COVID-19 may have persistent symptoms following their acute illness which impact on their quality of life and economic burden experienced by patients need to be investigated.

Long Term Symptoms

The clinical syndrome of “long COVID” is described symptoms lasting for more than 3 weeks as “post-acute COVID” and greater than 12 weeks as “chronic COVID” (Amenta E.M. et al., 2020, O'Keefe et al., 2021). The pathophysiology or mechanisms resulting in chronic symptoms are not fully known, however, it is known that elevated inflammatory markers, lung dysfunction and muscle weakness (Doykov I. et al., 2020) could be involved in causing chronic symptoms. In a study that had a meta-analysis of 47,910 patients found the most frequent symptoms include fatigue, headache, attention disorder, hair loss, and dyspnea (Lopez-Leon S. et al., 2021). Research studies that stratify symptoms by patient baseline characteristics and disease severity are still needed to be researched to fully understand long-term health consequences for patients that wre hospitalized. Individual cohort studies have reported certain risk factors for prolonged symptoms, such as female sex (Bliddal S. et al., 2021), middle age (Carvalho-Schneider C. et al., 2021) and older age, and other factors(O'Keefe et al., 2021). Long term symptoms in patients can lead to multiorgan effects of COVID-19, including conditions such as multisystem inflammatory syndrome (MIS) and autoimmune conditions (Tenforde M.W., et al., 2020). The longer-term effects of COVID-19 are similar to patients who have been hospitalized for other respiratory conditions (Centers for Disease Control and Prevention (n.d.), 2020). Management of chronic health symptoms and consequences post-discharge, specifically related to psychosocial impacts are still unknown. Likelihood of chronic symptoms in hospitalized patients are supported with evidence from cohort studies finding increasing risk for: patients with more than 5 acute symptoms (Sudre C.H. et al., 2021), presence of particular acute symptoms such as chest pain, fatigue, fever, muscle pain, headaches, or diarrhea (Walsh-Messinger J. et al., 2020), and hospitalization (Carvalho-Schneider C. et al., 2021, O'Keefe et al).

Post discharge impacts

Following hospitalization and discharge after COVID-19 treatment, patients have been reported to experience ongoing symptoms. The most common symptoms experienced during COVID-19 illness have included cough, fever, dyspnea, musculoskeletal symptoms (myalgia, joint pain, fatigue), gastrointestinal symptoms, and anosmia/dysgeusia (Carfi et al., 2020). In post-acute care assessments, a large proportion of patients experience persistence of at least 1 symptom (Carfi et al., 2020). The most common symptoms reported post-discharge are fatigue and dyspnea (Carfi et al., 2020). This study in Italy also noted that patients with community-acquired pneumonia may have persistent symptoms; however, that may not be restricted to COVID-19 illness.

For the emergency response for COVID-19 globally, response strategies were implemented to various extents in health care settings. This included "early diagnosis, patient isolation, symptomatic monitoring of contacts as well as suspected and confirmed cases, and public health quarantine" (Ohannessian R. et al., 2020). Not only did this create a burden on long-term care for health systems, but patients also faced post-discharge impacts. Post-discharge symptoms as well as post-intensive care syndrome were some of the impacts that were associated with health and economic challenges (Biehl M., 2020). Post-intensive care syndrome is described as "worsening physical, cognitive, or mental impairments in a patient following critical illness or intensive care" (Biehl M., 2020), and has been found in thirty to eighty percent of patients, resulting in memory loss and difficulty with concentration, comprehension, and critical thinking (Garrigues E. et al., 2020).

Psychosocial Impacts

Quarantining, self-isolation, and reductions in social or mass gatherings are some of the important public health recommendations that were made over the course of the pandemic worldwide. Due to the rapid spread of the coronavirus disease, "stay at home" orders, otherwise referred to as "lockdown" measures have been in place for prolonged periods of time causing consequences for many aspects of society. The challenges on psychological well-being during the COVID-19 pandemic, has led to elevated prevalence of mental health problems, owing to contracting COVID-19 and managing care and recovery, reduced access to mental health services, loss of family and friends, reduced interactions with community or society, loss of employment and/or health insurance, as well as many more factors (Iob E. et al., 2020).

In a cohort study conducted in the United Kingdom, depressive symptoms were measured using a 9-item Patient Health Questionnaire (PHQ-9) about the last 2 weeks during March 21 to April 2, 2020. The results of the research study indicated that people with psychosocial and health-related risk factors, as well as those with low socio-economic statuses, were at the most risk of experiencing moderate or severe depressive symptoms during the COVID-19 pandemic (Iob E. et al., 2020).

Following hospitalization and discharge for COVID-19, there are findings indicating that the circumstances during health care management and responses to the pandemic are likely to have influenced psychosocial health, nutrition and physical fitness, resulting in reduced quality of life (Ping W. et al, 2020, Rando H. M. et al., 2021). These problems undermine the relevance and usefulness of this evidence for decision-making, and the research does not focus on what is most important to patients. Because evidence suggests long-term effects of COVID-19 on health-related quality of life, working to identify the domains and corresponding measures (e.g., Patient Reported Outcomes Measurement Information System [PROMIS] item banks) that are most relevant to COVID-19 patients following the acute infection is urgently needed given the rapid expansion of clinical research in this group. The incidence of those with Long COVID will climb, and soon, much clinical care and research will be directed at this group, as evidenced by the increase in research in the area. In order to address the various psychosocial impacts associated with COVID-19, the WHO (World Health Organization (n.d.), 2020) released recommendations to support psychosocial health in light of the pandemic including mental health and psychosocial considerations during the COVID-19 outbreak.

Economic Impacts

The rampant community spread of COVID-19 worldwide, and the steep increase in the number of cases between March and August 2020, resulted in the World Health Organization declaring the pandemic a global emergency (World Health Organization (n.d.), 2020). Many health systems faced economic and financial challenges related to cost of supplies (such as Personal and Protective Equipment (PPE)), workforce shortages and managing the overwhelming growing number of cases (Kaye, A. D. et al., 2020). A study conducted using the National Collaborating Center for Determinants of Health, concluded that marginalized populations in the United States faced disproportionate negative impacts heightened due to low-income status, lower socio-economic status, and lack of access to health care as well as post COVID-19 follow-up care (Kaye, A. D. et al., 2020).

Health outcomes needed to be evaluated during widescale treatment and management of COVID-19 patients, as well as following their discharge. Among hospitalized COVID-19 patients between April 1st, 2020 to October 31st, 2020 in the United States, it was found that the average length of stay for hospitalizations was 5 days (mean=8.3 days), and the median hospital costs were $12,046 (Di Fusco et al., 2021). Although hospitalized patients are at higher risks for higher cost of care to be incurred, the health outcomes were determined to also be more severe (Di Fusco et al., 2021). The lack of pertinent data on the economic impacts on patients many months after the start of the pandemic indicate the need for comprehensive studies aimed at comparing long-term post-COVID-19 health outcomes and economic impact research studies.

CHAPTER 3: MANUSCRIPT

ABSTRACT

IMPORTANCE:

The coronavirus disease 2019 (COVID-19) pandemic has resulted in long-term symptoms experienced by patients several months post discharge from their initial hospitalization for COVID-19 treatment. The prevalence and risk factors for persistent symptoms as well as patients' costs of care are not fully known for patients who experienced COVID-related inpatient care.

OBJECTIVE:

The goal of the research is to gather new information to improve long-term patient care for patients who have had a COVID-19 diagnosis and have been admitted to an inpatient facility in Atlanta, Georgia 6 months ago, and to understand the long-term consequences faced by these patients.

DESIGN, SETTING, AND PARTICIPANTS:

In this retrospective cohort study, eligible participants for this study had been hospitalized (primarily at Emory Healthcare) between the months of March and August 2020 for COVID-19 and were surveyed from December 2020 to March 2021 to understand long term symptoms, quality of life, and costs of care.

METHODS:

Participants discharged from Emory University Hospitals for COVID-19 were contacted to complete a self-administered survey about long-term symptoms, hospitalization, costs of care, and their quality of life >6months post discharge. Bivariate and multivariable analyses were performed to evaluate associations between participant demographics and persistent symptoms.

EXPOSURES

Confirmed or suspected COVID-19 test; confirmed COVID-19 infection diagnosed by real-time polymerase chain reaction testing.

OUTCOMES AND MEASURES

Prevalence of ongoing symptoms >6 months post discharge, quality of life, and costs of care.

RESULTS

Two hundred and ten participants out of eight hundred and ninety-five individuals (23.4%) provided responses to the survey, of which 91 patients (36.99%) had reported experiencing at least 1 persistent symptom, a median of 10 months post-discharge, and 155 individuals (63.01%) did not have ongoing symptoms. The median age was 54 (range 21-95), and 110 (52.38%) participants were Black. The median length of stay was 5 days (mean=9.86, range=0,100) for their hospitalization. When looking at overall health at present compared to before covid, 111 participants (46.44%) reported feeling about the same, whereas 27.2% mentioned that their thinking and memory are worse after COVID-19, which did not vary by presence of "long" COVID-19. Common symptoms associated with reports of worse physical health included fatigue (n= 48, 53.33%) and shortness of breath with activity (n=46, 51.1%). Following those symptoms, joint pain (n= 32, 35.56%), muscle aches (n= 29, 32.22%), weakness (n= 28, 31.11%), and back pain (n= 23, 25.56%) were most prevalent in the study population.

CONCLUSION AND PUBLIC HEALTH IMPLICATIONS

In this cohort study of COVID-19–related long-term symptoms, physical and psychosocial symptoms highlighted the impacts on complete recovery months after diagnosis. Early identification of these symptoms could help prepare patients for long-term symptoms several months post discharge after being hospitalized for COVID-19.

INTRODUCTION

A major factor in improving long-term health care outcomes from the COVID-19 pandemic is in recognizing on-going symptoms faced by patients. Given a confluence of biological and social risk factors, patients discharged from inpatient settings are vulnerable to long-term symptoms. This study proposes to describe the interplay of psychosocial influences on physical and mental health, in an inpatient setting.

Globally, the COVID-19 pandemic has resulted in a shift in understanding health care and health services for patients on a large scale. With the number of cases increasing in in-patient facilities, it is necessary to recognize the health and economic impacts faced by patients after their hospital discharge. Post-acute COVID-19 symptoms, psychosocial impacts, and economic burdens play important roles in the management of patients who have had COVID-19 diagnoses and treatment. Ongoing symptoms that continue to affect individuals are still being researched months after the rapid increase in the number of COVID-19 positive individuals in the United States, however there is still much that needs to be understood in patient health care access gaps such as financial/economic health care expenditures, demographics and social/cultural considerations.

The goal of the research is to gather new information to improve patient care for patients who have had a COVID-19 diagnosis and have been admitted into an inpatient facility. A major factor in improving long-term health care outcomes is in recognizing ongoing symptoms faced by patients. With many patients facing distress, it is important to have a holistic approach to understanding symptoms and future impacts on patients’ lives in order to provide recommendations for effective health care and management. In this study, measures to characterize patient quality of life after a global pandemic, including factors such as home health, access to care, and socio-economic factors will be assessed. The study findings may be able to provide insight into conceptualizing appropriate interventions to enhance physical, economic and psychosocial implications faced by patients as well as address gaps in health care access.

As COVID-19 continues to be a major public health issue worldwide currently, understanding patient perspectives in order to inform and/or implement future programs, policies and research in which better public health outcomes can be achieved is necessary to combat the pandemic and improve the wide-scale management of novel infectious diseases.

This project will be in collaboration with Emory Healthcare and Emory University's School of Medicine, a leading institution in COVID-19 treatment and management in the state of Georgia.

Specific Aims

Aim 1: To collect data regarding the long-term effects experienced by patients at Emory Healthcare.

Aim 2: To identify long-term physical, psychosocial, and economic implications faced by patients after being discharged from inpatient hospital settings.

METHODS

Electronic Medical Records (EMR) Data

To identify patients for the study, potential participant details were extracted from Emory Healthcare's Electronic Medical Record (EMR system). The study was approved by Emory University's Institutional Review Board, and patient data was kept confidential throughout the study. Using EMR information, eligible participants were then contacted to collect data using a self-administered survey. The patient information from EMR included the following:

1. Patient's First and Last Name
2. Date of Birth
3. Email Address
4. Healthcare Entity Name
5. Number of COVID-19 Positive Encounters
6. Admission Date
7. Discharge Date
8. Number of Hospital Encounters
9. Total Census Days
10. Patient Death Date

Eligibility Criteria and Study Population

Participants for this research study included patients who were hospitalized for COVID-19 treatment at Emory Healthcare in Atlanta, Georgia between the months of March and August 2020. An EMR query was performed to find all the patients who had a positive SARS-CoV-2 nasopharyngeal reverse transcription polymerase chain reaction (RT-PCR) test and had been admitted at the Emory University Hospital Midtown, Emory University Hospital at Wesley Woods, Emory Decatur Hospital, or Emory Johns Creek Hospital for at least 24 hours for treatment, and then discharged (to a home or rehabilitation facility) between March 1st and August 31st, 2020. In addition, all participants were aged 18 years or older. A total of 895 patients were contacted to participate in this research study.

Informed Consent

Electronic consent of participants was received in the survey prior to using their data as part of the survey administered. The study was approved by the Emory University Institutional Review Board.

Survey Methods

A comprehensive 66-question quantitative survey was developed using Qualtrics Online Survey Software and was distributed to participants of the study. The survey included the following sections:

1. Introduction and Consent Forms
2. Hospitalization and Symptoms Information
3. Home Health
4. Work/Occupation Information
5. Home Environment
6. Cost of Care
7. Demographic Information

The survey was developed with the Seavey Clinic Research Team. The survey included a section for research consent in Spanish, in the case participants needed to be further contacted if Spanish was their primary language. General demographic information (race, sex, education, occupation, first generation immigration status income level) was collected. The Symptoms information included a list of 34 individual symptoms, based on a previous study conducted on patients who were treated for COVID-19 in outpatient settings at Emory University.

Data Collection

Data was collected between December 2020 and March 2021. An email was sent to each participant requesting survey completion, along with the survey link and instructions. As a token of appreciation for survey completion, participants were eligible to receive gift cards approved by Emory University's School of Medicine. Non-respondent patients were initially sent reminder emails, followed by at least 2 phone calls by the Seavey Clinic's research team and/or staff members. Participant survey responses for the self-administered survey were closely monitored on Qualtrics and participants with partially completed surveys were recontacted for the third time via phone calls. After three months of data collection, the survey was closed and participants who completed the entire survey were emailed their gift card compensation.

Data analysis

Data collected from survey responses on Qualtrics were exported into Microsoft Excel using STATA/SE 16.1. For the analyses, a p-value of 0.05 was considered statistically significant. Duplicate entries of patients were removed, and partially completed surveys were included in the data analyses where they were appropriate.

Descriptive statistics were reported using frequencies, percentages, and means/medians where appropriate. Bivariate analyses using chi-sq and crude logistic regression were performed between the main exposures (hospitalization for COVID-19) with the main outcome (persistent symptoms). Age, sex, race, education, hospitalization, and household income were covariates that were included in the analyses. Sex and persistent symptoms were also compared to see if the prevalence in symptoms differed between males and females. Quality of life variables including cost of care, self-reported physical and emotional health ratings, as well as overall health rating post-discharge compared to before having COVID-19 were included in the analyses. Multivariable logistic regression was conducted for each of the descriptive statistics, as well as covariates of the population using the exposure (COVID-19 diagnosis). Bivariate chi square analyses were performed for each of the 34 symptoms included in the quantitative survey.

RESULTS

Descriptive Variables

Out of 895 patients identified in the EMR, a total of 210 participants had completed the survey (Table 1), of whom 133 participants were women (63.33%) and 77 were men (36.67%). The median age was 54 (range 21-95), and 110 (52.38%) participants were Black. The median length of stay was 5 days (mean=9.86, range=0,100) for their hospitalization. The most common household income was over $100,000 (n=63, 30%). The median length of follow up for patients was 10 months.

Long-Term/Persistent Symptoms

Of this sample of hospitalized patients, 91 patients (36.99%) had persistent symptoms many months post-discharge (Table 1), and 155 individuals (63.01%) did not have ongoing symptoms. A total of 145 participants (60.67%) reported weight loss with a mean weight loss of 18.8lbs (SD=14.87) (Table 2). When looking at overall health at present compared to before covid, 111 participants (46.44%) reported feeling about the same, whereas 27.2% mentioned that their thinking and memory are worse after COVID-19.

The most common persistent symptoms (Table 2) were fatigue (n= 48, 53.33%) and shortness of breath with activity (n=46, 51.1%). Following those symptoms, joint pain (n= 32, 35.56%), muscle aches (n= 29, 32.22%), weakness (n= 28, 31.11%), and back pain (n= 23, 25.56%) were most prevalent in the study population.

As part of quality-of-life ratings, the majority of patients felt that they had not experienced any problems as a result of COVID-19 affecting their physical or emotional health.

Some participants reported that they had difficulties in performing the work or other activities due to their physical health (n=48, 20.17%) and accomplished less than they would like (n=48, 20.17%) due to the impact on their emotional health.

Hospitalizations

The median length of stay for hospitalizations (Table 4) for COVID-19 treatment was 5 days for hospitalizations. Of the participant responses compiled, 155 participants (64.85%) had received care for on-going symptoms post their COVID-19 discharge, which included in-person visits, video visits, or scheduled telephone calls with a physician, nurse practitioner, or physician assistant at Emory Healthcare. Lastly, many participants reported that they did not encounter difficulties in accessing necessary care (n=132, 55.23%) or they did not need any specific care (n=70, 29.29%).

Cost of Care and Economic Impact

From the survey responses, the mean out of pocket cost (Table 4) for treatment of persistent symptoms was $9,860 (SD=75,200.95) with out-of-pocket costs ranging from 0-$186,000 for the 153 participants that shared their cost of care details in the survey. Nearly one quarter of the participants had more than $20,000 in out-of-pocket costs (n=66, 24.63%) for COVID-19 treatment or for on-going symptoms, followed by $0-$1,000 spent in out-of-pocket costs (n=54, 20.15%).

From the bivariate and multivariable logistic regression models (Table 3) conducted to find associations between demographic characteristics and persistent symptoms, Black race was associated with persistent symptoms with an OR of 1.092 (95% CI 0.58, 2.30). The other descriptive variables such as age, sex(male), and education did not show any associations with persistent symptoms.

DISCUSSION

From the results, chronic and on-going symptoms are common in a follow-up survey of patients who were treated at Emory Healthcare for COVID-19 and had been hospitalized in an inpatient facility. Of the participants responding, over an average of 10 months since their discharge from hospital, over one third (36.99%) of participants in the study population reported experiencing at least one symptom. Among the population, females had a slightly higher rate of experiencing persistent symptoms (39.85%) as opposed to males (36.36%). In addition, Black patients had higher rates of persistent symptoms in comparison to other races.

The main processes leading to the persistence of symptoms post COVID-19 treatment at in-patient facilities remain uncertain. There are studies that suggests a possible role for acute inflammation and/or viral burden (Amenta E.M. et al, 2020). Readmissions or re-hospitalizations of patients due to COVID-19 could potentially affect onset and persistence of symptoms, yet the correlations of this are not clear from the data. This may be due to the low number of hospitalizations, but also that risk factors for hospitalization such as demographic variables used in this study (age, sex, education, household income) may not be directly related to persistent symptoms being experienced.

The impact on physical and emotional health in the study population highlighted the necessity to understand co-morbidities, such as in people with preexisting physical or mental health conditions, people with experiences of physical and psychological abuse, and people of lower socioeconomic status. Physical and emotional health symptoms reported following COVID-19 hospitalization were higher for females which aligned with studies addressing the severity of COVID-19 hospitalization on emotional and physical health (Iob et al, 2020).

The economic impact experienced by patients due to cost of care for long term health consequences or symptoms is unclear. Approximately 30% of the population reported their household income being over $100,000 and the out-of-pocket costs being over $20,000 for the majority of patients. The wide range of out-of-pocket costs (0-$186,000) could be due to the participants not knowing or reporting their final out of pocket costs, or due to participants not being discharged from the hospital long enough to receive their final bill. Biases that may have influenced are findings included: low response rate of participants; and extreme responses due to recall or reporting biases. The out-of-pocket costs incurred due to COVID-19 treatment and/or persistent symptoms in the study population align with a research study that indicates that more than one-quarter of hospitalized patients will be economically impacted due to COVID-19 hospitalization costs (Cutler D. et al., 2021). Furthermore, there are implications for both public and private insurers, for health care delivery systems and for patients (Cutler D. et al., 2021). The implications of the estimated out of pocket costs as well as the steep increase in capital costs associated with a higher demand for hospital services indicate the need for changes in healthcare policies to expand treatment capacity.

Studies on the economic impact on health systems and their patients provide support for the out-of-pocket costs for pneumonia and upper respiratory illness hospitalizations being particularly high, especially for consumer-directed health plans. (Eisenberg M. D. et al., 2020). The research agenda going forward would need to include assessment of policy creation and implementation, in order to reduce the financial burden on patients with private or consumer-directed health plans (Eisenberg M. D. et al., 2020).

Limitations

This study had some important limitations, including possible incompleteness of data collected rapidly during an outbreak and inconsistency in data collection. To be part of this study, patients had to have a confirmed COVID-19 laboratory result and be admitted into Emory University's in patient settings. During data collection, it was found that 8 participants were deceased after their COVID-19 diagnoses; however, 2 of the patients had partially responded surveys. This could have affected accuracy in capturing data from the patients appropriately.

As the study relied on self-report data, social desirability bias and recall bias could have affected survey responses. Although the study aimed to understand patient experiences and long-term health consequences many months after COVID-19 onset in patients, their responses could have been affected by recall bias. Given the timing of the data collection, readmissions and/or hesitancy to complete the survey may have affected initial data collection methods, as most participants completed the survey 2 months after they were first contacted. A related concern is response bias, as a relatively low response rate to the survey was found (29.99%). Over 895 participants were contacted, however 268 participants had fully and/or partially completed their survey responses 3 months after the survey was administered. In that timeframe, readmission and re-infection of COVID-19 was not captured.

To reduce response bias, the survey length could have been more concise, and improvements to question flow to capture more accurate data from participants, specifically regarding onset of symptoms and/or hospitalization. Additionally, demographic comparisons between survey respondents and non-respondents, and imputing missing data could have addressed this bias. Reporting frequency and range of persistent symptoms based on if no individuals had reported persistence in contrast with all participants that had not responded experiencing persistent symptoms could have been provided a range but is likely too wide to be meaningful.

Another limitation of this study was the quantitative survey that may have restricted qualitative data from patients which could have provided a holistic view of the patients' experience many months after facing and being treated for COVID-19. Quality of life variables (noted in Table 4) may have been restrictive, and not truly captured patients' perspectives. In further studies, this study could be expanded to capture those themes, particularly related to economic burden, medical costs and/or difficulties or barriers in health care access due to quarantining, isolation and protective methods to prevent further spread of COVID-19. Furthermore, patient information on co-morbidities, BMI, ICU admission status and medications used was not captured in the survey and the study did not have IRB approval to use that data from patient records. Including questions regarding ICU length of stay could have strengthened the study, as patients who had ICU admissions as part of their hospitalization as patients with ICU admissions have generally worse long-term symptoms and onset of symptoms (Huang et al., 2020).

Finally, a limitation of this study could have been in interpretation of the results due to the uncertainty regarding the definition of hospitalizations. Although "hospitalization" was described as being admitted at the hospital for at least 24 hours for treatment and then discharged (to a home or rehabilitation facility), certain participants who were admitted for more than 1 day did not reveal this information in the survey. This data had to be verified with Emory Healthcare data and then used for data analyses. This was not a known factor at the time of survey design and data collection, hence, the questions focused more on the presence of ongoing symptoms, economic impact and overall quality of life measures.

APPENDIX

Table 1. Characteristics of COVID-19 positive patients seen at Emory Hospital, March 1 – August 31 , 2020 (n=210)

CHARACTERISTIC	No. (%)	Persistent Symptoms No. (%)	No Persistent Symptoms No. (%)
Sex			
Female	133 (63.33)	53 (39.85)	80 (60.15)
Male	77 (36.67)	28 (36.36)	49 (63.64)
Age			
Median	54	-	-
Range	21-95	-	-
Race			
Asian	4 (1.90)	1 (25)	3 (75)
Black	110 (52.38)	43 (39.09)	67 (60.91)
White non-Hispanic	71 (33.81)	41 (57.75)	30 (42.25)
Hispanic or Latino	11 (5.24)	2 (18.18)	9 (81.82)
Other	6 (2.86)	3 (50)	3 (50)
Do not wish to Answer	8 (3.81)	2 (25)	6 (75)
First Generation Immigrant			()
Yes	23 (10.95)	9 (39.13)	14 (60.87)
No	187 (89.05)	72 (38.5)	115 (61.5)
Education			
High School diploma or equivalent	55 (26.19)	17 (30.91)	38 (69.09)
Associate Degree (Junior College)	30 (14.29)	8 (26.67)	22 (73.33)
Bachelor's Degree	59 (28.10)	24 (40.68)	35 (59.32)
Advanced Degree	55 (26.19)	26 (47.27)	29 (52.73)
Other	11 (5.24)	6 (54.55)	5 (45.45)
Experiencing Symptoms after COVID-19	91 (36.99)	91 (36.99)	155 (63.01)
Household Income			
Less than $30,000	48 (22.86)	14 (29.17)	34 (70.83)
$30,000-$60,000	56 (26.67)	23 (41.07)	33 (58.93)
$60,000-$100,000	39 (18.57)	16 (41.03)	23 (58.97)
Over $100,000	63 (30)	27 (42.86)	36 (57.14)
Other	4 (1.9)	1 (25)	3 (75)

Table 2. Symptoms in confirmed COVID-19 encounters > 6 months post discharge
(n = 91)

Symptom Reported	All Encounters No. (%)	Female No. (%)	Male No. (%)	P-value
Fever	1 (1.11)	1 (100)	0 (0)	0.019
Chills	4 (4.44)	4 (100)	0 (0)	0.007
Muscle aches	29 (32.22)	19 (76)	6 (24)	0.010
Back pain	23 (25.56)	13 (61.9)	8 (38.1)	0.023
Joint pain	32 (35.56)	22 (78.57)	6 (21.43)	0.005
Sinus congestion (nasal, sinus or facial fullness, pressure, or blockage)	20 (22.22)	12 (66.67)	6 (33.33)	0.005
Nasal or sinus drainage, drip, or “runny”	0 (0)	0 (0)	0 (0)	0.004
Loss of smell	13 (14.44)	8 (66.67)	4 (33.33)	0.025
Loss of taste	11 (12.22)	8 (80)	2 (20)	0.015
Cough – “dry” (no or minimal mucous/sputum)	0 (0)	0 (0)	0 (0)	0.000
Cough – “wet” (you can bring up mucous/sputum)	0 (0)	0 (0)	0 (0)	0.000
Ear fullness/pressure	8 (8.89)	7 (100)	0 (0)	0.004
Sore throat	3 (3.33)	3 (100)	0 (0)	0.010
Shortness of breath at rest	16 (17.78)	9 (64.29)	5 (35.71)	0.025
Shortness of breath with activity	46 (51.11)	28 (68.29)	13 (31.71)	0.022
Chest tightness	13 (14.44)	8 (72.73)	3 (27.27)	0.020
Heart racing/palpitations	22 (24.44)	16 (80)	4 (20)	0.008
Heartburn	12 (13.33)	8 (72.73)	3 (27.27)	0.022
Loss of appetite	8 (8.89)	5 (62.5)	3 (37.5)	0.020
Nausea	8 (8.89)	5 (71.43)	2 (28.57)	0.024
Vomiting	4 (4.44)	3 (75)	1 (25)	0.021
Abdominal pain	7 (7.78)	3 (60)	2 (40)	0.013
Diarrhea	5 (5.56)	2 (50)	2 (50)	0.018
Fatigue "tired"	48 (53.33)	53 (65.43)	28 (34.57)	0.000
Weakness	28 (31.11)	20 (76.92)	6 (23.08)	0.008
Headaches	18 (20)	14 (77.78)	4 (22.22)	0.006
Dizziness with standing	13 (14.44)	7 (53.85)	6 (46.15)	0.011
Difficulty sleeping (hard to fall asleep or stay asleep)	26 (28.89)	17 (70.83)	7 (29.17)	0.020

Nervous or anxious symptoms or difficulty calming down	16 (17.78)	14 (87.5)	2 (12.5)	0.002
Low mood or depressed mood	20 (22.22)	15 (83.33)	3 (16.67)	0.005
Irritability	11 (12.22)	8 (80)	2 (20)	0.015
Rash	4 (4.44)	2 (100)	0 (0)	0.004
Difficulty concentrating or unclear thinking, referred to as “brain fog”	0 (0)	0 (0)	0 (0)	0.004
Other	10 (11.11)	9 (100)	0 (0)	0.002

Table 3. Bivariate analyses and multivariate logistic regression showing odds ratio for persistent symptoms.

Variable	**B Coefficient**	**Standard Error**	**95% CI**		**Persistent Symptoms OR**	**95% CI**	
Age	0.015	0.010	-0.004	0.035	0.010	0.996	1.035
Sex (n=210)							
Female	-----	-----	-----	-----	1 (ref)	-----	-----
Male	-0.325	0.325	-0.962	0.313	0.723	0.382	1.367
Race / Ethnicity							
Asian	-0.749	1.213	-3.126	1.628	0.473	0.044	5.092
Black	0.088	0.380	-0.658	0.833	1.092	0.518	2.300
Hispanic	-0.980	0.875	-2.695	0.736	0.375	0.068	2.087
Other	0.288	0.934	-1.542	2.119	1.334	0.214	8.321
White	-----	-----	-----	-----	1 (ref)	-----	-----
Do not wish to answer	-0.850	0.894	-2.602	0.902	0.427	0.074	2.463
Education							
High School diploma or equivalent	-0.420	0.452	-1.306	0.466	0.657	0.271	1.594
Associate Degree	-0.792	0.524	-1.818	0.235	0.453	0.162	1.265

(Junior College)							
Bachelor's Degree	-----	-----	-----	-----	1 (ref)	-----	-----
Advanced Degree	0.241	0.404	-0.551	1.033	1.273	0.393	6.254
Other	0.449	0.706	-0.935	1.833	1.567	0.393	6.254
Annual Income							
Less than $30,000	-0.379	0.523	-1.404	0.645	0.684	0.246	1.906
$30,000-$60,000	0.098	0.471	-0.826	1.022	1.103	0.438	2.778
$60,000 - $100,000	-0.023	0.456	-0.917	0.872	0.977	0.400	2.391
Over $100,000 (ref)	-----	-----	-----	-----	1 (ref)	-----	-----
Other	-1.222	1.207	-3.588	1.145	0.295	0.028	3.141

Table 4. Other Survey Variables (n=221)	
CHARACTERISTIC	No. (%)
Length of Stay for Hospitalization (n=221)	
Mean (SD)	9.86 (SD=15.05)
Range	1-100
Weight loss due to COVID-19	145 (60.67)
Mean weight lost in lbs (SD)	18.8 (SD=14.87)
Received care (in-person visit, video visit, or scheduled telephone call with a physician, nurse practitioner, or physician assistant) for ongoing symptoms post-discharge	
Yes	155 (64.85)
No	84 (35.15)
Please indicate what type of facility you received care from.	
Emergency Room	35 (22.58)
Urgent Care	11 (7.10)
Primary Care	92 (59.35)
Specialist	67 (43.23)
Other	24 (15.48)
Out of Pocket Costs (n=153)	
Range	0-186,000
Interquartile Range	0-2800
Median	$150
Mean (SD)	9860.95 (SD=75200.95)
$0 to $1,000	54 (20.15)
$1,000 to $5,000	31 (11.57)
$5,000 to $10,000	2 (0.75)
$10,000 to $15000	0 (0)
$15,000 to 20,000	0 (0)
More than $20,000	66 (24.63)
Difficulty in accessing care	
Difficulty because I needed care, but I am still under "isolation" or "quarantine" due to having COVID-19 and being directed to stay home	5 (2.09)
Difficulty because the primary care or specialist office was not open for usual hours due to COVID-19 pandemic	10 (4.18)

Difficulty because of the cost of care, or my income or insurance status had changed due to the pandemic	10 (4.18)
Difficulty because I do not have an established source for primary care	5 (2.09)
I did not encounter any difficulty in accessing necessary care	132 (55.23)
Not applicable to me - I did not need any specific care	70 (29.29)
Other	14 (5.22)

Table 5: Quality of Life Variables

PHYSICAL HEALTH	Affected* No. (%)	Females Affected No. (%)	Males Affected No. (%)
Cut down the amount of time you spent on work or other activities	35 (14.71)	21 (70)	9 (30)
Accomplished less than you would like	36 (15.13)	22 (73)	8 (27)
Were limited in your work or other activities	20 (8.4)	12 (67)	6 (33)
Had difficulty performing the work or other activities (e.g. it took extra effort)	48 (20.17)	31 (70)	13 (30)
Not Applicable to me - I have not experienced any of the problems mentioned as a result of COVID-19 affecting my physical or emotional health	127 (53.56)	70 (61.95)	43 (38.05)
Other	19 (7.98)	10 (62.5)	6 (37.5)
EMOTIONAL HEALTH	Affected No. (%)	Female No. (%)	Male No. (%)
Cut down the amount of time you spent on work or other activities	26 (10.92)	17 (73.91)	6 (26.09)
Accomplished less than you would like	48 (20.17)	30 (73.17)	73.17 (11)
Were limited in your work or other activities	17 (7.14)	12 (80)	80 (3)
Had difficulty performing the work or other activities (e.g. it took extra effort)	32 (13.45)	23 (79.31)	79.31 (6)
Not Applicable to me - I have not experienced any of the problems mentioned as a result of COVID-19 affecting my physical or emotional health	143 (60.08)	73 (57.94)	57.94 (53)
Other	9 (3.78)	6 (75)	75 (2)
If yes to any of above, do you have symptoms that feel like anxiety, depression, or both?	42 (17.65)	28 (75.68)	75.68 (9)

*Data available for 210 participants.

CHAPTER 4: CONCLUSION AND RECOMMENDATIONS

Conclusion

The main aims of this research study were to collect and synthesize data regarding the long-term effects experienced by patients at Emory Healthcare, as well as identify physical, psychosocial, and economic implications faced by patients admitted in in-patient hospital settings. The study provided valuable information regarding on-going symptoms in patients treated for COVID-19 in inpatient setting at Emory University. As over one third (36.99%) of participants in the study population reported experiencing at least one symptom after being discharged from in-patient settings (more than 6 months after their discharge), the study aligns with other studies and is a stepping stone for further research studies to assess chronic symptoms in the future, specifically for this study population.

Through survey development, primary data collection and data analyses, the research study aimed to evaluate symptoms experienced and to have a better understanding of persistent symptoms occurring in a study population that was treated at Emory University.

Recommendations

As the associations between patient demographics and persistent symptoms were unclear, further research would be required to understand persistence of symptoms based on socio-economic status, education levels, and household income. Furthermore, the limitations of this study such as bias in responses (recall bias, social desirability bias and/or others) drive the need for future studies that aim to better understand patient experiences months after being hospitalized. In future studies, quality of life variables could be prioritized to better understand patient perspectives. Using this study, recommendations for isolation, home health, and care post-discharge could be improved to prevent symptoms such as fatigue and weakness experienced by patients.

Certain recommendations to improve understanding of long terms symptoms and the economic impacts of COVID-19 are to identify long-term physical, economic, psychosocial implications faced by patients admitted in in-patient hospital settings. Increasing research studies that prioritize patient experiences post-treatment, could prepare health systems with regard to the array of and length of services needed by their populations.

Public Health Implications

Long term Symptoms - Patient Care and Follow-Up

Long-term symptoms following COVID-19 hospitalizations impacted patient care and follow up treatment. As COVID-19 continues to be a major public health issue worldwide for the upcoming foreseeable months, understanding patient perspectives in order to inform and/or implement future programs, policies and research in which better public health outcomes can be achieved is necessary to combat the pandemic and improve the wide-scale management of novel infectious diseases. The patient's age, comorbidities, length of stay during hospitalization, and the severity of the acute disease (such as the need for ICU admission) and the type of medications administered (such as antiviral or corticosteroid therapy) are probably among the most important determinants (Carfi et al., 2020). Long-term follow-up of survivors of COVID-19 is needed for a better understanding of the possible irreversible damages. Additionally, prioritization of patient care following treatment is necessary. The constellation of symptoms that are experienced following recovery from initial stages of COVID-19 and the persistent symptoms that last many months following recovery imply that there is a need to better understand symptom onset, including new symptoms evolving much later than the time of infection (Letizia, A. G., 2020).

Many organizations and health systems faced challenges in implementing effective strategies to address gaps in care and manage long-term treatment of patients (Horesh D. et al., 2020). Those challenges have been exacerbated as health care outcomes, cost of care, and patient recovery following hospitalizations are negatively impacted (Huang et al., 2020). Although the factors predicting persistent symptoms remain unclear, this research study represents a single institution's report of persistent symptoms in patients after COVID-19 diagnoses following patients' discharge. The findings from this study provide support for possible changes needed in patient care, especially in individual risk communication and treatment plans following COVID-19 illness and hospitalization. The relatively high rate of persistent symptoms in this study population wherein patients' median age was 54 years, aligns with other studies conducted in hospitalized patients (Carfi et al., 2020, Huang et al, 2020).

Finally, the economic impacts of prolonged health consequences of COVID-19 have implications on recovery from "long" COVID. The spectrum of recovery may vary for patients with different socio-economic status, especially for follow up care such as home health, access to care, access to physical therapy and/or rehabilitation services (Darley et al., 2021). On a larger scale, it is pertinent to assess factors that can influence patient’s vulnerability to long term symptoms following COVID-19 hospitalizations, and to facilitate changes that need to be made in health systems to prepare patients for changes following treatment. Economic ramifications based on the severity of symptoms and quality of life measures could provide better understanding of overall recovery for patients. In a similar study aimed towards assessing recovery from post-acute sequelae after eight months, a considerable proportion of (around 20%) of the total cohort did not feel confident returning to pre-COVID work, had not returned to usual activities of daily living or had not returned to normal exercise level (Darley DR et al, 2020). The economic ramifications due to persistent symptoms including disability, psychosocial impacts and or reduced quality of life are concerning and could have larger wide-scale economic impacts in populations (Nicola M. et al., 2020). A considerable proportion of patients experience persistent symptoms after hospitalization for COVID-19, and the long-term symptoms impact overall health, recovery and quality of life.

The long-term health consequences and public health ramifications are necessary to address gaps in treatment and access to services to facilitate recovery as many months post-discharge patients face long-term physical, emotional and economic impacts.

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