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RESEARCH ARTICLE

COVID-19 in Acute Inpatient Rehabilitation (CARE): Factors Affecting Recovering Patient Outcomes

Christopher Amen, DO[1*], Claudia Echaide, MS[1], Bestin Kuriakose, DO[1], Mariyam Wasay, DO[1], Benjamin Birney, MD[1], Todd MacKenzie, PhD[2] and Jennifer Gray, DO[1]

[1]*St. Charles Hospital, New York, United States*

[2]*Geisel School of Medicine at Dartmouth College, New Hampshire, United States*

***Corresponding author:** *Christopher Amen, St. Charles Hospital, Department of Physical Medicine and Rehabilitation, 200 Belle Terre Rd, Suite E 140, Port Jefferson, NY 11777, USA, Tel: (631)-474-6879, Fax: (631)-474-6448*

Abstract

Objective: The aim of this study was to identify factors that affect the outcome of acute inpatient rehabilitation in patients recovering from COVID-19 infection.

Design: Retrospective chart review which included patients admitted to an acute inpatient rehabilitation service at a single center from April 2020 to July 2021. Rehabilitation outcomes assessed included discharge disposition, functional efficiency, change in self-care and mobility, and length of stay (LOS).

Results: Patients (N = 55) were predominantly Caucasian (56.36%), and male (65.45%). History of diabetes was associated with significantly lower change in mobility ($p = 0.013$) and self-care ($p = 0.035$) scores, and lower functional efficiency ($p = 0.045$). Tracheostomy and percutaneous gastric tube placed during acute care showed a greater gain in both mobility ($p = 0.025$, $p = 0.008$) and self care ($p = 0.015$, $p = 0.003$), respectively. Intubation during acute care also correlated to greater gains in mobility ($p < 0.001$) and self care ($p = 0.002$), as well as higher functional efficiency ($p = 0.002$). COVID recovering patients were discharged to home significantly more than non-COVID patients ($p = 0.013$). COVID recovering patients also had younger average age (59.45 years compared to non-COVID 67.40; $p < 0.001$).

Conclusions: These data add to the current knowledge regarding rehabilitation outcomes in the COVID recovering population and identify prognosticators for rehabilitation outcome.

Keywords

COVID-19, rehabilitation, functional outcomes, post-COVID

What is Known?

The severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has led to serious complications, extended hospital stays, and severe disability. The risk factors associated with acute admission for COVID-19 infection have been well studied.

What is New?

Patients with a history of diabetes appear to have worse functional outcomes than non-diabetics following COVID-19 infection. Patients with tracheostomy, percutaneous gastric tube placement and intubation during the acute care of COVID-19 appear to have favorable acute rehabilitation outcomes. There appears to be a younger mean age for acute inpatient rehabilitation patients recovering from COVID compared to non-COVID patients.

Introduction

The Coronavirus (COVID-19) pandemic, caused by a severe acute respiratory syndrome coronavirus 2 (SARSCoV-2), has had a historic impact on the world and the practice of medicine. With the global incidence continuing to rise and many patients moving into the post-infectious period, there is a growing need for physical and medical rehabilitation due to extended hospital stays, COVID-19 complications, and severe debility associated with the disease process. Researchers and clinicians are forced to adapt the

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standard practice of rehabilitation to the dynamic presentation of post-COVID patients [1,2]. Case reports, professional opinions, and clinician anecdotes are rapidly evolving the practice of rehabilitation in patients recovering from COVID-19; however, few studies have been done to analyze prognosticators for patient functional outcomes in acute rehabilitation. Outcomes through acute care stays have been researched, with studies showing older, age, respiratory failure, cardiac conditions and thromboembolic complications significantly contributing to functional dependence on discharge from acute care [3]. A paucity of knowledge exists regarding the post-infectious period of COVID-19 as it relates to acute inpatient rehabilitation. Early research, primarily conducted in China and Italy, have proposed rehabilitation protocols and identified specific trends in post-infectious patient populations, however, much of this information is anecdotal [4-6]. Current rehabilitation protocols suggest early mobilization, and immediate pulmonary rehabilitation when past the infectious period. Early rehabilitation has been shown to reduce Length of Stay (LOS), and improve rehabilitation outcomes, including fall risk, mobility, and cognition. The neurologic manifestations of COVID-19 specifically have shown to increase length of stay but may persist upon discharge [7]. Much of the recommendations are similar to guidelines for geriatric populations with extended ICU stays requiring intubation [8,9].

The goal of this study is to gather data from patients recovering from COVID-19 in an acute inpatient rehabilitation setting. We aim to identify risk factors associated with extended rehabilitation stays, poor outcomes, complications in the immediate post-infectious period, and other significant trends. This information may provide insight into prognosticating infected patients, predicting outcomes, and identifying risk factors associated with poor and favorable rehabilitation potential.

Methods

A retrospective chart review was conducted following approval from our institutional review board as part of our COVID-19 in Acute Inpatient Rehabilitation (CARE) database project. Informed consent was waived by the institutional review board as this was a chart review study. The cohort included patients admitted to the acute inpatient rehabilitation service from April 2020 through July 2021. Inclusion criteria were age 18 years or greater, treatment of COVID-19 related illness in the acute care admission immediately preceding transfer to rehabilitation, and rehabilitation stay of at least three days. The three day period was used as we are unable to collect adequate functional data in less time.

Data collected on patients following COVID- 19 infection included demographic data, body mass index (BMI), social history, functional history, and past medical history. Furthermore, the team collected data regarding the patient's acute hospital stay such as, having a tracheostomy tube or percutaneous gastric tube placed, development of pulmonary embolism (PE), deep venous thrombus (DVT), cerebral vascular accident (CVA), acute kidney injury (AKI), myocardial infarction (MI), polyneuropathy and any psychiatric complications (i.e. anxiety, depression or post-traumatic stress disorder). Finally, data was collected for conditions occurring during the rehabilitation stay including PE, DVE, CVA, AKI, MI, acute sepsis, polyneuropathy and psychiatric complications.

The functional outcomes that were collected were the following: discharge disposition (home, acute care, subacute rehabilitation), change in self-care, change in mobility, length of stay (LOS) and functional efficiency. These items are standard outcomes collected and reported by acute inpatient rehabilitation facilities. Self-care and mobility activities have been reported as the Section GG Functional Measures for the past several years when it was mandated by the Improving Post-Acute Care Transformation Act (IMPACT). This has replaced the Functional Independence Measure (FIM) as the standard quality functional measure used in many acute rehabilitation facilities. Metrics are collected by therapy and nursing staff on admission and discharge, then the change of each measure is calculated. The self-care metric evaluates items such as activities of daily living (dressing, toileting and eating), while the mobility scale evaluates items such as transfers and ambulation. The functional efficiency is the sum of the change in self-care and change in mobility divided by length of stay. It is a measure of the rate of improvement, with a higher number suggesting greater functional change in less time.

Additionally, we compared age, LOS and discharge disposition of the COVID recovering patients to data of non-COVID patients who stayed in the rehabilitation unit during the same time frame.

Associations between continuous outcomes and patient characteristics were evaluated using t-tests, Pearson correlation and linear models. The association of dichotomous outcomes with patient characteristics was evaluated using Pearson's chi-square and logistic regression. Patient characteristics, age, LOS and disposition were compared between the COVID-19 positive and negative patients using t-tests or Pearson's chi-square.

Results

Fifty five subjects were included in the final analysis. Table 1, Table 2, Table 3 and Table 4 summarize the characteristics of the subjects. The average number of days from COVID symptom onset to acute rehabilitation admission was 35.58 days. The average age was 59.45 years. There was a predominance of male patients (65.45%) and a racial predominance of Caucasians

Table 1: Summary of Patient Characteristics (n = 55) - Continuous Variables.

Continuous Variables	Mean (SD)
Age (years)	59.45 (12.7)
BMI	30.98 (7.5)
Onset to Rehab Admission (days)	35.58 (14.9)
Intubated (days)	21.52 (14.7)
Rehabilitation LOS (days)	14.89 (5.6)

SD: Standard Deviation; BMI: Body Mass Index; LOS: Length of Stay

Table 2: Summary of Patient Characteristics (n = 55) - Demographics and Past Medical History.

Variables	n (%)
Gender (male)	36 (65.45)
Race	
- White	31 (56.36)
- Hispanic or Latino	16 (29.09)
- Black or African American	7 (12.73)
- Asian	1 (1.82)
Smoking History (ever smoked)	19 (34.55)
Pre-existing mobility (Independent)	52 (94.55)
History of HTN (Y)	31 (56.36)
History of diabetes (Y)	19 (34.55)
History of pulmonary disease (Y)	9 (16.36)
History of neurological disease (Y)	9 (16.36)
History of gastrointestinal disease (Y)	8 (14.55)
History of autoimmune disease (Y)	7 (12.73)
History of psychiatric illness (Y)	7 (12.73)
History of chronic renal disease (Y)	6 (10.91)
History of CAD (Y)	4 (7.27)
History of stroke (Y)	5 (9.09)
History of hepatic disease (Y)	2 (3.64)

HTN: Hypertension; CAD: Coronary Artery Disease

(56.36%). The most common pre-existing comorbidities were HTN (56.36%) and diabetes (34.55%). Most subjects were independent in mobility without an assistive device prior to COVID diagnosis (94.55%) and the majority were discharged home after rehabilitation (90.91).

Table 5, Table 6 and Table 7 summarize the association between the outcome measures and patient demographic and clinical characteristics. Subjects with a past medical history of diabetes had significantly lower change in mobility ($p = 0.013$) and self-care ($p = 0.035$) scores, and lower functional efficiency ($p = 0.045$) than those without diabetes. Those that had a tracheostomy placed during acute care showed a greater gain in both mobility ($p = 0.025$) and self care ($p = 0.015$), which was similar for having had a gastric tube placed. Intubation during acute care also correlated to greater gains in mobility ($p < 0.001$) and self care ($p = 0.002$), as well as higher functional efficiency ($p = 0.002$).

Table 3: Summary of Patient Characteristics (n = 55) - Acute Care Course.

Variables	n (%)
Tracheostomy (Y)	15 (27.27)
Gastric tube placed (Y)	14 (25.45)
Intubated (Y)	35 (63.64)
PE (Y)	2 (3.64)
DVT (Y)	10 (18.18)
Stroke (Y)	9 (16.36)
Renal disease (Y)	16 (29.09)
Myocardial infarction (Y)	2 (3.64)
Peripheral neuropathy (Y)	9 (16.36)
PTSD (Y)	2 (3.64)
Depression (Y)	8 (14.55)
Anxiety (Y)	10 (18.18)
Any Psychiatric disease (Y)	14 (25.45)

PE: Pulmonary Embolism; DVT: Deep Vein Thrombosis; PTSD: Post-Traumatic Stress Disorder

Table 4: Summary of Patient Characteristics (n = 55) - Rehabilitation Course.

Variables	n (%)
PE (Y)	0
DVT (Y)	2 (3.64)
Stroke (Y)	1 (1.82)
Acute renal disease (Y)	4 (7.27)
Myocardial infarction (Y)	0
PTSD (Y)	4 (7.27)
Depression (Y)	6 (10.91)
Anxiety (Y)	6 (10.91)
Any Psychiatric disease (Y)	9 (16.36)
Peripheral Neuropathy (Y)	7 (12.73)
Sepsis (Y)	0
Required O2 on admission (Y)	33 (60)
Required O2 on discharge (Y)	11 (20)
Death (Y)	0
Discharge Disposition (home)	50 (90.91)

PE: Pulmonary Embolism; DVT: Deep Vein Thrombosis; PTSD: Post-Traumatic Stress Disorder

Subjects with a past medical history of stroke showed lower self care change scores ($p = 0.032$). Acute kidney injury that developed during rehabilitation was associated with a shorter LOS ($p = 0.027$) and higher functional efficiency ($p = 0.012$). Anxiety that presented during rehabilitation was also associated with higher functional efficiency ($p = 0.048$), and greater change in mobility scores when presenting during acute care ($p = 0.016$). Subjects with a past medical history of gastrointestinal disease showed better gains in self care ($p = 0.005$), and those with hepatic disease specifically showed shorter LOS ($p = 0.025$). Those with longer time from COVID symptom onset to rehabilitation admission

Table 5: Associations between outcome measures and clinical characteristics - Demographic and Past Medical History.

Variable	Length of Stay CC/SE/p value	Mobility Change CC/SE/p value	Self-Care Change CC/SE/p value	Functional Efficiency CC/SE/p value
Age	0.015/0.055/0.794	-0.254/0.141/0.078	-0.074/0.06/0.224	-0.041/0.018/**0.028**
Gender (M)	1.034/1.593/0.517	-3.494/3.963/0.382	-1.788/1.654/0.285	-0.519/0.521/0.324
BMI	0.140/0.087/0.115	0.227/0.227/0.322	0.162/0.092/0.830	0.014/0.030/0.649
Race	0.237/3.348/0.944	11.107/8.140/0.178	1.313/3.466/0.706	1.188/1.079/0.276
Smoking History (Y)	-0.057/1.591/0.971	-3.141/4.062/0.443	-2.242/1.689/0.190	-0.797/0.536/0.144
Pre-existing mobility (Independent)	-8.255/5.563/0.144	-19.6/13.785/0.161	-7.38/5.602/0.194	-0.256/1.839/0.89
History of HTN (Y)	1.433/1.521/0.350	1.309/3.882/0.737	0.694/1.625/0.671	-0.126/0.511/0.806
History of diabetes (Y)	1.694/1.582/0.289	-9.715/3.754/**0.013**	-3.463/1.601/**0.035**	-1.039/0.505/**0.045**
History of pulmonary disease (Y)	3.186/2.008/0.118	0.495/5.100/0.923	-0.823/2.133/0.701	-0.88/0.66/0.189
History of neurological disease (Y)	-3.855/1.986/0.576	-5.52/5.293/0.302	0.111/2.240/0.961	-0.198/0.704/0.78
History of gastrointestinal disease (Y)	-0.311/2.156/0.886	8.614/5.211/0.104	6.147/2.068/**0.005**	1.139/0.686/0.103
History of autoimmune disease (Y)	-1.348/2.274/0.556	-7.519/5.557/0.182	-1.373/2.361/0.564	-0.624/0.74/0.403
History of psychiatric illness (Y)	1.435/2.273/0.531	-4.556/5.62/0.421	0.932/2.365/0.695	-0.045/0.745/0.952
History of chronic renal disease (Y)	-2.122/2.422/0.385	-8.183/6.45/0.210	-2.104/2.728/0.444	-0.938/0.853/0.276
History of CAD (Y)	2.814/2.902/0.337	5.071/7.215/0.485	2.806/3.011/0.356	-0.431/0.953/0.653
History of stroke (Y)	-4.06/2.585/0.122	-10.612/7.096/0.141	-6.388/2.901/0.032	-1.156/0.941/0.225
History of hepatic disease (Y)	8.934/3.872/**0.025**	-1.882/10.046/0.852	-2.5/4.194/0.554	-1.886/1.297/0.152

M: Male; BMI: Body Mass Index; CC: correlation coefficient; SE: Standard Error

Table 6: Associations between outcome measures and clinical characteristics - Acute Care Course.

Variable	Length of Stay CC/SE/p value	Mobility Change CC/SE/p value	Self-Care Change CC/SE/p value	Functional Efficiency CC/SE/p value
Tracheostomy (Y)	0.608/1.705/0.723	9.575/4.131/**0.025**	4.302/1.716/**0.015**	0.857/0.559/0.132
Gastric tube placed (Y)	1.775/1.728/0.309	11.462/4.151/**0.008**	5.323/1.709/**0.003**	0.832/0.574/0.154
Intubated (Y)	2.186/1.552/0.165	14.638/3.427/**<0.001**	5.022/1.517/**0.002**	1.533/0.480/**0.002**
Intubated (days)	0.059/0.052/0.263	0.480/0.122/**<0.001**	0.190/0.052/**<0.001**	0.045/0.017/**0.011**
PE (Y)	-1.962/4.053/0.63	-5.52/10.02/0.584	4.255/4.166/0.312	-0.05/1.323/0.970
DVT (Y)	1.600/1.959/0.418	-3.342/4.872/0.496	-0.377/2.049/0.855	-0.652/0.638/0.312
Stroke (Y)	2.389/2.029/0.244	-3.458/5.327/0.519	-1.361/2.232/0.545	-1.258/0.682/0.071
Renal disease (Y)	0.947/1.669/0.573	-3.579/4.141/0.391	-0.491/1.746/0.779	0.359/0.547/0.515
Myocardial infarction (Y)	-0.925/4.06/0.821	6.431/10.009/0.523	7.892/4.061/0.057	0.928/1.317/0.484
Peripheral neuropathy (Y)	1.060/2.050/0.607	2.578/5.337/0.631	-0.772/2.238/0.731	-0.109/0.704/0.878
PTSD (Y)	4.264/4.020/0.294	7.990/9.987/0.427	-1.461/4.204/0.730	-0.612/1.321/0.645
Depression (Y)	-1.774/2.143/0.411	-2.133/5.341/0.691	-2.097/2.221/0.350	0.213/0.704/0.763
Anxiety (Y)	0.011/1.971/0.996	12.005/4.815/**0.016**	2.121/2.115/0.321	0.530/0.668/0.431
Any Psychiatric disease (Y)	-0.62/1.743/0.723	7.690/4.319/0.081	0.635/1.862/0.735	0.647/0.579/0.269
Onset to Rehab Admit	0.034/0.051/0.509	0.244/0.125/0.057	0.107/0.052/**0.045**	0.030/0.017/0.072

PE: Pulmonary Embolism; DVT: Deep Vein Thrombosis; PTSD: Post-Traumatic Stress Disorder; CC: Correlation Coefficient; SE: Standard Error

Table 7: Associations between outcome measures and clinical characteristics - Rehabilitation Course.

Variable	Length of Stay CC/SE/p value	Mobility Change CC/SE/p value	Self-Care Change CC/SE/p value	Functional Efficiency CC/SE/p value
PE (Y)	No cases			
DVT (Y)	-4.038/4.024/0.32	7.471/9.995/0.458	4.775/4.155/0.256	2.526/1.275/0.530
Stroke (Y)	No cases			
Acute renal disease (Y)	-6.353/2.795/**0.027**	-0.607/7.249/0.934	-0.168/3.036/0.956	2.344/0.897/**0.012**
Myocardial infarction (Y)	No cases			
PTSD (Y)	-2.039/2.915/0.487	1.556/7.246/0.831	0.102/3.036/0.973	1.200/0.940/0.207
Depression (Y)	-2.684/2.411/0.271	-3.922/6.019/0.518	-0.457/2.53/0.857	0.727/0.789/0.361
Anxiety (Y)	-3.432/2.393/0.157	2.468/6.034/0.684	3.114/2.493/0.218	1.554/0.766/**0.048**
Any Psychiatric disease (Y)	-2.261/2.032/0.271	0.093/5.100/0.985	0.248/2.136/0.908	0.896/0.660/0.181
Peripheral Neuropathy (Y)	-0.857/2.278/0.708	7.918/5.941/0.189	-1.585/2.521/0.532	0.170/0.796/0.831
Sepsis (Y)	No cases			
Required O_2 on admission (Y)	1.864/1.531/0.229	1.853/3.878/0.635	-0.783/1.624/0.632	-0.454/0.508/0.376
Required O_2 on discharge (Y)	0.591/1.899/0.757	-0.221/4.722/0.963	-0.34/1.977/0.864	-0.362/0.62/0.562
Death (Y)	No cases			

PE: Pulmonary Embolism; DVT: Deep Vein Thrombosis; PTSD: Post-Traumatic Stress Disorder

Table 8: Comparison of COVID (n = 55) and NON-COVID (n-1297) subjects.

Variables		COVID (SD)	NON-COVID (SD)	p value
Age (Mean)		59.45 (12.2)	67.40 (14.5)	**0.0001**
LOS (days)		14.89 (6.6)	13.71 (6.2)	0.1338
Discharge setting	Acute/subacute	9.09%	24.52%	**0.0136**
	Home	90.91%	75.48%	

SD: Standard Deviation; LOS: Length of Stay

showed greater self care change than those with shorter time (p = 0.045).

Evaluation of discharge disposition as an outcome measure was limited due to low variation in location for many variables (i.e., all subjects with a past history of CAD were discharged home). For the remaining variables, none were found to be significantly associated with discharge disposition.

Furthermore, data was collected on all the admissions to our acute inpatient rehabilitation unit during the study period to compare the length of stay, age and discharge disposition of rehabilitation patients recovering from COVID-19 to those who were not. These results can be found on Table 8.

When analyzing age difference between these two cohorts, the non-COVID group had an average age of 67.40, while the COVID group had an average age of 59.45 (t = 4.150, df = 60.264, p < 0.001). Next, LOS of the non-COVID group was compared to COVID patients. We found that the non- COVID group had an average LOS of 13.71 days compared to 14.89 days in the COVID group (t = -1.520, df = 60.510, p = 0.134). Finally, non- COVID patients were discharged home at a rate of 75.48% while COVID patients were discharged home at a rate of 90.91% (p = 0.013).

Discussion

The current analysis found several factors that may help predict the rehabilitation functional outcome of patients following COVID-19 infection. Multiple studies have demonstrated that males tend to have greater morbidity and mortality from acute COVID-19 infection [10,11]. This tendency may be expected to result in a higher male to female ratio requiring inpatient rehabilitation. Our population appears to follow this trend with a male predominance of 65.45%.

Research conducted in the acute care setting shows the highest rates of comorbidities related to severe infection in patients with COVID-19 are hypertension, coronary artery disease, stroke, and diabetes [12-14]. Our data redemonstrate some of these findings and further our understanding of prognostic indicators of prolonged rehabilitation stays. The highest rates of comorbidities in our study were obesity, hypertension, and diabetes mellitus.

Diabetes mellitus has been shown to be associated with more fulminant COVID-19 infection [15,16]. Our data show that a personal history of diabetes mellitus

was associated with lower scores in all three functional outcome measures. Patients demonstrated significantly lower change in mobility scores, change in self-care scores, and slower gains to functional efficiency. These data demonstrate that the deleterious effects of diabetes mellitus may continue during the immediate post-infectious period and cause delayed improvements in rehabilitation outcome measures. This may be related to the severity of the initial infection or be related to physiologic changes associated with diabetes mellitus.

Functional efficiency was used to evaluate rehabilitation success and analyzed against multiple variables for statistical significance. This outcome analyzes the change in self-care plus the change in mobility against length of stay. Patients with a history of diabetes mellitus and advanced age were both associated with lower functional efficiency scores on admission and at discharge. This finding may help stratify patients expected to need longer-term rehabilitation after COVID-19 hospitalization. Alternatively, anxiety and acute renal disease were associated with more significant improvements in functional efficiency measures and represent a patient population that is more likely to benefit from acute rehabilitation. A secondary analysis may help elucidate what makes these patients more likely to have improvements in functional efficiency compared to other variables.

Another primary goal for this retrospective chart review was to identify variables associated with favorable rehabilitation outcomes. This information may be used to identify the population that would benefit the most from inpatient rehabilitation following COVID-19 infection. Prior research done on critically-ill patients in the acute care setting have demonstrated high mortality and morbidity rates for patients who require intubation secondary to Acute Respiratory Distress Syndrome (ARDS) [17]. Patients with acute care intubation, tracheostomies and percutaneous endoscopic gastrostomy tubes showed significantly higher gains in mobility and self-care, while only acute care intubation was associated with increased gains in functional efficiency. These findings emphasize the importance of inpatient rehabilitation in this subset of patients with tracheostomy and/or PEG tubes prior to being discharged home. Another possible explanation for these findings is the degree of deconditioning and morbidity of the patient population that would require intubation, PEG tube feedings and subsequent tracheostomy compared to other critically-ill COVID-19 patients. Interestingly, a history of pulmonary disease did not demonstrate significance in this study for any outcome measure.

During a standard acute inpatient rehabilitation admission, physical and occupational therapies often target patient self-care in order to bridge the transition from their hospital stay to independence at home. Change in Self-Care is another widely used functional outcome which showed a significant trend in our data. Patients admitted to acute rehabilitation with diabetes, gastrointestinal disease, tracheostomy, history of intubation or PEG tube showed statistically significant improvements in Self-Care through admission. This highlights the importance and effectiveness of rehabilitation in patients with these specific morbidities. Acute inpatient rehabilitation serves as a medical transition from dependence on trach collar oxygen and PEG tube feedings to independence in respiration and feeding. Many patients are successfully weaned off of their tracheostomy and transitioned to oral food intake through their rehabilitation stay, which explains this impressive improvement in Self-Care through admission. It further emphasizes the importance of utilizing acute inpatient rehabilitation in post-COVID patients who experienced longer intubations, tracheostomy, and PEG tube feedings.

A final set of data analyses were performed to assess differences in age, length of stay (LOS), and discharge setting between COVID patients and the baseline population of acute rehabilitation patients at the facility. In the COVID group, the mean age was 59.45 compared to a mean age of 67.40 in the non-COVID group. This finding was found to be statistically significant and demonstrates the detriments of COVID infection among younger populations compared to the typical demographic admitted for acute rehabilitation patient. Insults to health in younger populations intuitively would be of lesser magnitude to disease-matched older patients. Significant impairments in physical function and fitness among younger post-COVID patients have been demonstrated in early studies [2]. Despite these findings, there existed no disparity between average length of stay when comparing COVID patients to the non-COVID. In addition, COVID patients had a higher likelihood of being discharged home and not requiring subacute rehabilitation or transfer back to acute care. There may exist a causative relationship between average age of COVID patients and their discharge disposition, which would warrant further research to confirm. The majority of the patients admitted for acute rehabilitation were ambulatory and were admitted for debility related to fatigue and prolonged respiratory symptoms which may not affect ADL measures or functional measures as significantly as other common neurologic or musculoskeletal conditions seen in acute rehabilitation populations.

Conclusion

This data adds to the paucity of specific knowledge related to acute inpatient rehabilitation and COVID-19. By identifying patient trends, this study helps guide future research and provides immediate information in prognosticating rehabilitation outcomes.

Limitations

The primary aim of the study was to identify factors that could influence recovery from COVID in an inpatient rehabilitation facility. Although the variables used in the study were collected in a thorough manner, there were certain limitations that should be considered. First, the retrospective design of the study poses intrinsic limitations in how data were collected. Additionally, our sample size for COVID patients was 55, which could impede finding significant relationships in the data set. Also, there was limited data when investigating discharge disposition in our study population due to low variability as most of our subjects were discharged home. A larger study population could possibly alleviate this issue.

Another potential limitation associated with this study includes the racial and gender disparities among the population. A multicenter study would offer larger diversity in the data set and may help diversify the patient population. Future studies should focus on using the general rehabilitation population demographic to act as a control for data analysis and further our understanding of the factors that affect the rehabilitation process of post-COVID patients.

Disclosures

There was no funding, grants or equipment provided for the project from any source. There are no financial benefits to the authors.

Competing Interests

There are no competing interests to report.

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References

1. De Biase S, Cook L, Skelton DA, Witham M, Ten Hove R (2020) The COVID-19 Rehabilitation Pandemic Age Ageing 49: 696-700.
2. Rooney S, Webster A, Paul L (2020) Systematic Review of Changes and Recovery in Physical Function and Fitness After Severe Acute Respiratory Syndrome-Related Coronavirus Infection: Implications for COVID-19 Rehabilitation. Phys Ther 100: 1717-1729.
3. Leigh AE, McCall J, Burke RV, Rome R, Raines AM (2021) Predictors of Functional Dependence After COVID-19: A Retrospective Examination Among Veterans. Am J Phys Med Rehabil 100: 34-38.
4. Curci C, Pisano F, Bonacci E, Camozzi DM, Ceravolo C, et al. (2020) Early rehabilitation in post-acute COVID-19 patients: data from an Italian COVID-19 Rehabilitation Unit and proposal of a treatment protocol. Eur J Phys Rehabil Med 56: 633-641.
5. Iannaccone S, Castellazzi P, Tettamanti A, Houdayer E, Brugliera L, et al. (2020) Role of Rehabilitation Department for Adult Individuals With COVID-19: The Experience of the San Raffaele Hospital of Milan. Arch Phys Med Rehabil 101: 1656-1661.
6. Li J (2020) Rehabilitation management of patients with COVID-19: lessons learned from the first experience in China. Eur J Phys Rehabil Med 56: 335-338.
7. Andrenelli E, Negrini F, de Sire A, Arienti C, Patrini M, et al. (2020) Systematic rapid living review on rehabilitation needs due to Covid-19: Update to May 31st 2020. Eur J Phys Rehabil Med 56: 508-514.
8. Sheehy LM (2020) Considerations for Postacute Rehabilitation for Survivors of COVID-19. JMIR Public Health Surveill 6: e19462.
9. Demeco A, Marotta N, Barletta M, Pino I, Marinaro C, et al. (2020) Rehabilitation of patients post-COVID-19 infection: A literature review. J Int Med Res 48: 300060520948382.
10. Pontecorvi G, Bellenghi M, Ortona E, Carè A (2020) microRNAs as new possible actors in gender disparities of Covid-19 pandemic. Acta Physiol (Oxf) 230: e13538.
11. Jin JM, Bai P, He W, Wu F, Liu XF, et al. (2020) Gender Differences in Patients With COVID-19: Focus on Severity and Mortality. Front Public Health 8: 152.
12. Lopez M, Bell K, Annaswamy T, Juengst S, Ifejika N (2020) COVID-19 Guide for the Rehabilitation Clinician: A Review of Nonpulmonary Manifestations and Complications. Am J Phys Med Rehabil 8: 669-673.
13. Kakodkar P, Kaka N, Baig MN (2020) A Comprehensive Literature Review on the Clinical Presentation, and Management of the Pandemic Coronavirus Disease 2019 (COVID-19). Cureus 12: e7560.
14. Hussain A, Mahawar K, Xia Z, Yang W, El-Hasani S (2020) Obesity and mortality of COVID-19. Meta-analysis. Obes Res Clin Pract 14: 295-300.
15. You JH, Lee SA, Chun SY, Song SO, Lee BW, et al. (2020) Clinical Outcomes of COVID-19 Patients with Type 2 Diabetes: A Population-Based Study in Korea. Endocrinol Metab (Seoul) 35: 901-908.
16. Gregg E, Sophiea M, Weldegiorgis M (2021) Diabetes and COVID-19: Population Impact 18 Months Into the Pandemic. Diabetes Care 44: 1916-1923.
17. COVID-ICU Group on behalf of the REVA Network and the COVID-ICU Investigators (2021) Clinical characteristics and day-90 outcomes of 4244 critically ill adults with COVID-19: A prospective cohort study. Intensive Care Med 47: 60-73.