Population-Based Evaluation of Postacute Coronavirus Disease-2019 (COVID-19) Chronic Sequelae in Patients Who Tested Positive for Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2)

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The true incidence and comprehensive characteristics of Long Coronavirus Disease-19 (COVID-19) are currently unknown. This is the first population-based outreach study of Long COVID within an entire health system, conducted to determine operational needs to care for patients with Long COVID.

Keywords. chronic sequelae COVID-19; Long COVID; post-acute COVID-19.

Many patients who have been infected with severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) continue to experience a constellation of symptoms for months after the initial phase of the infection, often referred to as "Long COVID" [1–4]. Common symptoms include fatigue, shortness of breath, and cognitive dysfunction, which may impact daily functioning [5]. The true incidence of Long COVID remains unknown, with estimates ranging from 10% to 30% of all acute infections leading to persistent coronavirus disease 2019 (COVID-19) symptoms. However, previous studies have largely been conducted in patients after hospitalization or those already engaged in care [6–8], and, to our knowledge, there has been no systematic, population-based follow-up with large cohorts of ambulatory patients who tested positive for COVID-19 to characterize the prevalence of Long COVID within a health system. Between March 2020 and October 2021, UC San Diego Health (UCSDH) administered more than 1 million SARS-CoV-2 polymerase chain reaction tests, and more than 15 000 tests resulted as positive. A multidisciplinary Post-COVID Care Clinic was established to offer comprehensive medical care to patients with Long COVID. To guide programmatic planning, we sought empirical data on the potential number of patients experiencing Long COVID symptoms who may benefit from specialized services.

METHODS

We conducted an electronic survey of patients in our electronic health record (EHR) who met these inclusion criteria: age 18 years or older, tested positive for COVID-19 at UCSDH between March 1, 2020 and July 1, 2021, and not deceased. As the region's only academic medical center, UCSDH provides inpatient (808 beds) and specialty care at 2 main campuses as well as primary and urgent care at clinics throughout the region. Building on several validated survey instruments, our survey identified patients experiencing symptoms consistent with Long COVID and characterized the nature and severity of these symptoms and their impact on daily functioning. This survey was sent via email and/or SMS message to all eligible patients (Supplementary Figure 1). Rates of Long COVID symptoms were tabulated from patient responses and aligned with demographics from EHR. The project was approved by the Institutional Review Board (IRB).

Patient Consent

The design of the work has been approved by local ethical committees (University of California San Diego IRB [Protocol Number 801403] as well as the UCSD Aligning and Coordinating Quality Improvement, Research and Evaluation [ACQUIRE] Committee Project Number 235) and was conducted in compliance with applicable hospital policies and ethical standards as well as local, state, and federal regulations. As a Quality Improvement project, the voluntary patient survey does not include factors necessitating patient consent.
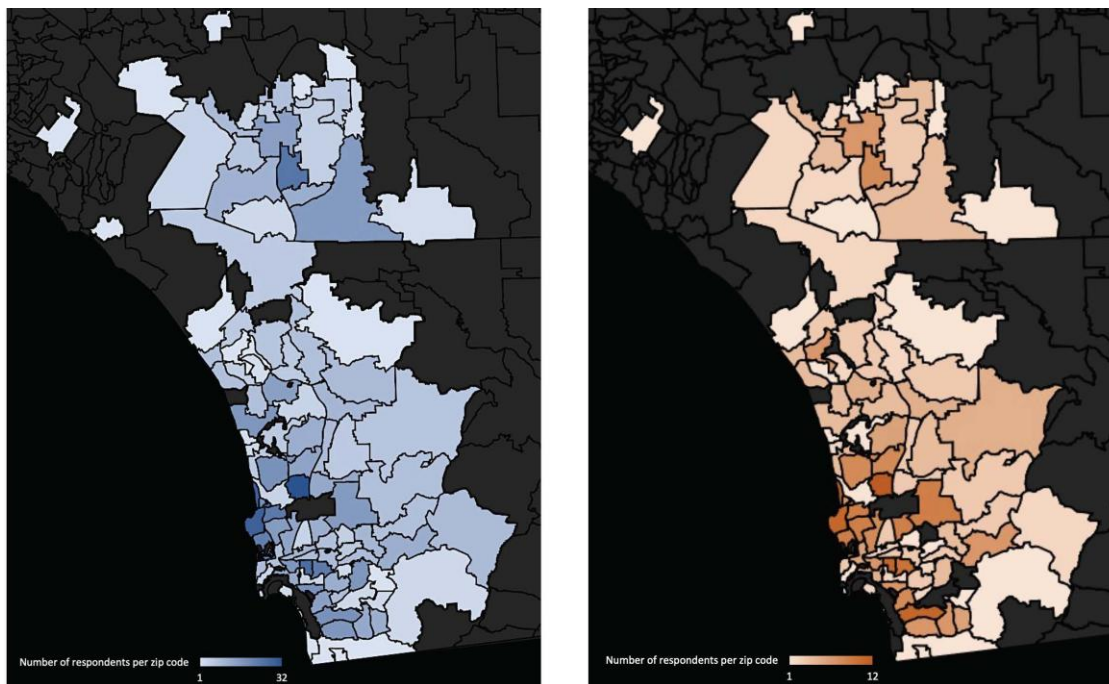
RESULTS

The survey was sent to 9619 patients and achieved a 10.4% response rate. A total of 51.4% of respondents completed the survey via email, and 48.7% completed the survey via SMS text messaging. The median time to complete the survey was 2.59 minutes.

Figure 1. Zip code heat maps of total survey respondents and those with chronic symptoms after coronavirus disease 2019 (COVID-19) infection. The heat map in blue displays the zip codes of the 999 survey respondents with the maximum in one zip code being 32 respondents and the minimum being 1 respondent. The heat map in orange displays the zip codes of the 421 respondents who said yes or maybe to still having symptoms after COVID-19 infection with the maximum respondents in one zip code being 12 and the minimum being 1.

Of the 999 respondents, 406 (41%) identified as male, 592 (59%) identified as female, and 1 (0.1%) identified as other. The average age of respondents was 51.5 years (range, 18–89 years), and 525 (53%) identified as White, 229 (23%) identified as Other Race or Mixed Race, 91 (9%) identified as Asian, 44 (4%) identified as Black or African American, 5 (0.5%) identified as American Indian or Alaska Native, 5 (0.5%) identified as Native Hawaiian or Other Pacific Islander, and 100 (10%) were unknown. The UCSDH uses the Healthy Places Index as a marker of socioeconomic status, of which the average for our respondents was 57.0 (range, 2–99), with 150 (16%) in the first quartile, 209 (22%) in the second quartile, 313 (33%) in the third quartile, and 290 (30%) from the fourth quartile. Figure 1 displays the distribution of total participants, as well as participants who answered yes or maybe to having Long COVID symptoms, by zip code.

Approximately half (421, 46.3%) of the respondents replied "yes" or "maybe" to currently having symptoms believed to be caused by having COVID-19. The breakdown of symptoms is depicted in Figure 2, with weakness/tiredness (77.8%), sleep disturbances (67.2%), and difficulty thinking/concentrating ("brain fog") (64.3%) reported most frequently. Of those experiencing chronic symptoms, 343 (83.9%) had at least 3 symptoms, with a mean, median, and mode of 6 symptoms (range, 0–16). Seventy-five of 216 (34.7%) patients reported absences

from work/school due to symptoms, 143 of 216 (66.2%) reported disruption of daily activities, but only 123 of 216 (56.9%) reported seeking medical care. One hundred thirty (14.8%) reported being hospitalized due to COVID-19, and 74 (8.4%) reported being treated with monoclonal antibodies for COVID-19. A total of 21.7% and 22.6% of respondents scored 3 or above on the Patient Health Questionnaire 2-item (PHQ-2) and Generalized Anxiety Disorder 2-item (GAD-2) depression and anxiety screening questions, respectively, suggesting a large burden of mood disorders in patients suffering long-term COVID sequelae.

DISCUSSION

To determine operational needs to care for patients with Long COVID, we surveyed almost 10 000 patients who tested positive for COVID-19 at our institution. To our knowledge, this represents the first population-based outreach study of Long COVID symptoms in this spectrum of patients within an entire health system, particularly because most were not hospitalized for COVID-19 (>85% of respondents). In our experience at the UCSDH Post-COVID Care Clinic (over 150 unique patients seen to date), many patients seeking care for Long COVID symptoms are self-referred, referred by Workers Compensation or another specialist physician within the health
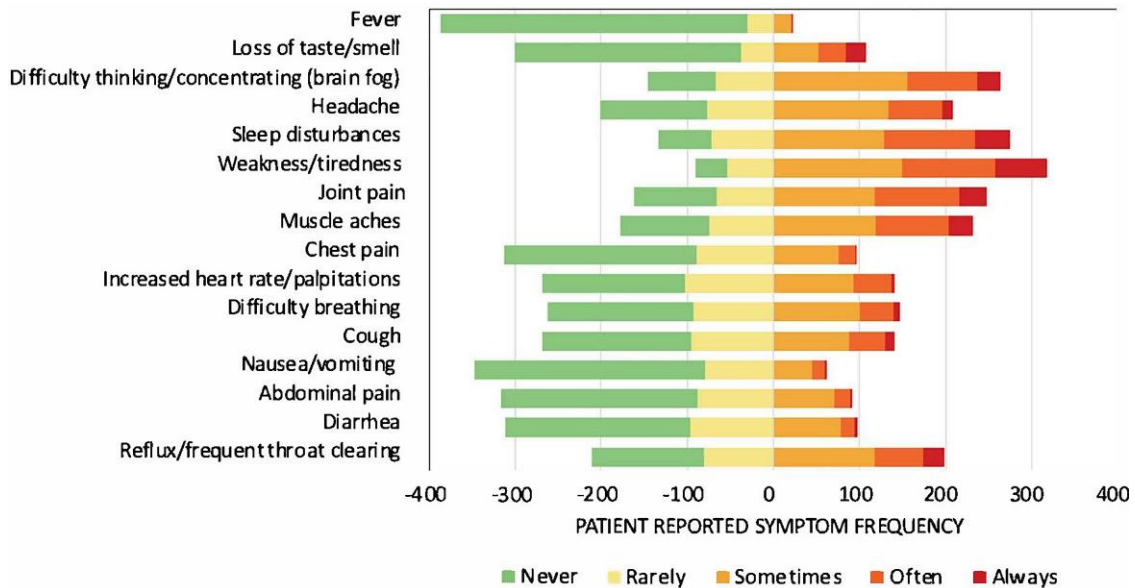
Figure 2. Reported symptom frequency by patients at least 90 days after coronavirus disease 2019 infection. The graphic displays the patient reported frequency of 16 symptoms that were listed on the survey on a 5-point Likert scale: Never, Rarely, Sometimes, Often, and Always with the number of patients versus percentage on the x-axis.

system; suggesting our clinic cohort may not represent the full spectrum of patients within our health system.

The survey results demonstrate that patients experiencing Long COVID symptoms have a significant impact on their daily functioning and mental health, with approximately one third reporting absenteeism and two thirds reporting daily impact on functioning, and one fourth screening positive for depression and anxiety, which has major implications for population-based screening for post-COVID morbidity. To identify patients who may be experiencing these post-COVID sequalae, large population-based surveys like ours can be used across health systems to better triage patients who may need closer follow-up care with their primary care provider.

As a single-institution technology-based assessment, this study is limited due to inherent biases and perhaps limited diversity due to EHR recording constraints on ethnicity; however, the relatively large number of respondents suggests the symptom distribution may still be representative. Furthermore, the response rate may suggest underestimation of individuals affected by Long COVID who have yet to be diagnosed or linked to care and may benefit from comprehensive services for Long COVID.

CONCLUSIONS

Our survey results confirm prior studies showing that many patients experience symptoms months after testing positive for COVID-19 [1–4]. Ongoing studies will further define the pathophysiology of Long COVID as well as protective factors in primary prevention and therapeutics [7, 9]. Long COVID

prevalence assessments can be used at a health system level to improve operational strategy for patient outreach and longitudinal clinical support. Nationally, further evaluations are needed to better understand the impact of Long COVID to the general population.

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