

Research Letter

Post-Acute Sequelae of SARS-CoV-2 Infection

Characterization of Community-Treated Patients in a Case–Control Study Based on Nationwide Claims Data

Long-term health impairments due to coronavirus disease 2019 (COVID-19) following infection with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)—also known as post-acute COVID-19 syndrome or long COVID—are of great importance for public health and medical care needs (1, 2). With the introduction in 2021 of the ICD code U 09.9 ! (post-COVID-19 status, unspecified), it will now be possible to identify patients with post-acute COVID-19 in the claims data of German statutory health insurance (SHI)-authorized physicians. The aim of the present study is to characterize patients with post-acute COVID-19 in the outpatient care sector with regard to risk factors and the use of care services.

Materials and methods

A case-control study was carried out based on comprehensive health insurance and nationwide claims data for SHI physicians from statutory health insurance providers. The case group included all cases of patients for whom reliable information was available for age (0 to 109 years), sex (male/female), and place of residence, and that were assigned a confirmed post-acute COVID-19 code (U 09.9 !) (n = 160 663) in the second quarter of the year 2021 (Q2 2021). The control group was formed from a random sampling of all patients treated in Q2 2021, in a ratio of 1:2 to the case group, with the following inclusion criteria:

- No post-COVID-19 code in 2021
- No confirmed COVID-19 diagnosis (ICD code U 07.1 !) in 2020 and 2021
- Valid age, sex, and place of residence (n = 321 326)

The control group was selected based on a preliminary consideration of comparing patients with post-acute COVID-19 with an average patient clientele “outside” the pandemic, in order to uncover differences in the care needs of both groups. Case and control groups were characterized according to demographic characteristics, post-acute COVID-19 symptoms (based on [3]), frequent previous conditions (prevalence > 10%), and use of outpatient medical care. A logistic regression analysis modeling was used to assess the relationship between the presence of pre-existing conditions and the likelihood of post-acute COVID-19 syndrome, as well as the relationship between the presence of post-acute COVID-19 syndrome and the use of selected primary care and specialist outpatient services.

Results

The main characteristics by case (patients with post-acute COVID-19) and control groups are given in Table 1. The case group included more women and middle-aged patients than the control group, with a higher proportion of those who were already receiving treatment from SHI physicians in 2020. Patients with post-acute COVID-19 generated almost twice as many outpatient treatment cases as the control group (median four versus two treatment cases). At least one of the examined post-acute COVID-19 symptoms occurred in 61% of the cases, and in 33% of the controls.

TABLE 1

Description of the study population, n = 481 989, 2nd quarter 2021

Characteristics ^{*1}	Cases (n = 160 663)	Controls (n = 321 326)
Male, n (%)	66 331 (41.3)	142 551 (44.4)
0–17 years old, n (%)	3 693 (2.3)	44 388 (13.8)
18–64 years old, n (%)	129 342 (80.5)	189 060 (58.8)
65+ years old, n (%)	27 628 (17.2)	87 878 (27.3)
Service use in 2020, n (%)	155 947 (97.1)	304 162 (94.7)
Age, years ^{*2}	51 (38/61)	51 (29/66)
Number of post-COVID-19 symptoms ^{*2, *3}	1 (0/1)	0 (0/1)
Number of treatment cases, Q2 2021 ^{*2, *4}	4 (2/6)	2 (1/3)
Number of treatment cases with post-COVID-19, Q2 2021 ^{*2, *4}	1 (1/1)	–
Most common post-COVID-19 symptoms, n (%)		
Sore throat/hoarseness	29 910 (18.6)	28 206 (8.8)
Fatigue/exhaustion	29 358 (18.3)	11 260 (3.5)
Shortness of breath	27 788 (17.3)	7 293 (2.3)
Headache	13 170 (8.2)	19 419 (6.0)
Cough	13 151 (8.2)	7 419 (2.3)
Sleep disorders	11 814 (7.4)	18 653 (5.8)
Disorders of smell/taste	5 095 (3.2)	547 (0.2)

^{*1} All p-values (t-test for continuous variables and χ^2 test for categorical variables) are 0.0001
^{*2} Values are median (25th/75th percentile)

^{*3} Out of 18 symptoms: abdominal pain, chest pain, sore throat / hoarseness, shortness of breath, fatigue / exhaustion, delirium, diarrhea, loss of appetite, cough, muscle pain, loss of smell / taste, headache, hair loss, nausea, sleep disorder, post-traumatic stress disorder, pain disorder, fever (based on [3])

^{*4} Defined according to § 21 Abs. 1 Bundesmantelvertrag-Ärzte (BMV-Ä): Treatment of the same insured person by the same medical practice in a calendar quarter at the expense of the same health insurance provider.

With respect to the types of previous conditions treated in 2020, it was observed that back pain, abdominal pain, obesity, depression, adjustment disorders, and somatoform disorders were documented more frequently as a reason for treatment in the case group than in the control group (Table 2). For all of these conditions mentioned, the logistic regression analysis showed a higher probability of post-acute COVID-19 syndrome after controlling for age, sex, and comorbidities (Table 2). Overall, 76% of patients with post-acute COVID-19 were exclusively treated in primary care. The case and control groups differed with regard to the use of SHI medical services. In particular, the problem-oriented discussion conducted by a primary care physician and telephone consultations were billed more frequently for patients in the case group than for those in the control group, as was treatment by pulmonology and cardiology services and the

TABLE 2

Prevalence of pre-existing conditions and service utilization of cases and controls and regression analysis associated with occurrence of post-acute COVID-19, n = 481 989, 2nd quarter 2021

	Prevalence, %		Logistic regression ^{*1}	
	Cases	Controls	OR	[95% CI]
Pre-existing conditions ^{*2}				
Hypertension	37.1	34.1	0.90	[0.88; 0.91]
Lipid metabolism disorder	25.2	22.4	0.97	[0.96; 0.99]
Obesity	18.5	12.6	1.39	[1.37; 1.42]
Type 2 diabetes mellitus	12.9	11.8	0.94	[0.92; 0.96]
Back pain	41.4	27.5	1.53	[1.50; 1.55]
Abdominal pain	16.5	11.1	1.30	[1.27; 1.32]
Depression	18.3	13.3	1.05	[1.03; 1.07]
Adjustment disorder	13.1	8.4	1.25	[1.22; 1.28]
Somatoform disorder	18.8	12.2	1.21	[1.19; 1.23]
Service use according to UVS ^{*3}				
Problem-oriented discussion	44.0	26.9	1.96	[1.93; 1.98]
Telephone consultation	14.9	7.3	2.09	[2.05; 2.13]
Rehabilitation prescription	0.6	0.1	6.88	[6.00; 7.90]
Department-specific use (basic flat rate)				
Otorhinolaryngology	2.0	8.3	0.20	[0.19; 0.20]
Cardiology	4.7	3.7	1.22	[1.18; 1.26]
Pulmonology	13.1	2.5	5.23	[5.09; 5.38]
Radiology	3.4	5.6	0.53	[0.51; 0.54]

^{*1} Odds ratios (OR) and 95% confidence intervals [95% CI] adjusted for age sex, and all (other) pre-existing conditions, including asthma, hay fever, upper respiratory tract infection, and coronary artery disease

^{*2} Coded diagnoses in 2020; Logistic regression model estimates the relationship between the presence of comorbidities and likelihood of treatment due to post-acute COVID-19.

^{*3} Uniform Value Scale (EBM), used in Q2 20221; logistic regression model estimates the association between the presence of post-acute COVID-19 and the likelihood of use of services.

prescription of rehabilitation measures, although this proportion was relatively small (0.6% of cases compared to 0.1% of controls). The increased use of the services mentioned by patients with post-acute COVID-19 compared to the controls persisted even after other influencing factors were taken into account (Table 2).

Discussion

The present secondary data analysis revealed a higher probability of post-acute COVID-19 syndrome in patients with previous somatic and mental conditions, in line with reports from previous studies (3–5). In particular, back pain, obesity, adjustment disorders and somatoform conditions appear to be age-independent risk factors for post-acute COVID-19 syndrome. By examining

the use of SHI physician services, the present study adds new insight to post-acute COVID-19 care. Three out of four patients with post-acute COVID-19 syndrome were treated exclusively by a primary care physician, especially through time-intensive consultations, such as the problem-oriented discussion. In addition, one of six patients required specialist pulmonology and cardiology attention, and one in 200 patients with a post-acute COVID-19 diagnosis was prescribed medical rehabilitation, which is indicative of the particular severity of a disease of this magnitude. This results in a quantity structure for a tiered care of patients with post-acute COVID-19 in Germany.

The present study is based on claims data from the second quarter of 2021 and thus describes a situation based on a mostly unvaccinated population and the consequence of the “wild-type/alpha wave”. Whether the present results can be extrapolated to subsequent waves occurring with higher population immunity remains to be investigated. It should also be noted that the definition of the case group is based on the treating physician’s post-acute COVID-19 diagnosis documented in the claims data for SHI physicians, even if in some cases this is not preceded by a laboratory-confirmed COVID-19 diagnosis (ICD 10 code U 07.1) in the available database. Due to the quarterly mode of claims, no statements can be made about chronological sequences of care received.

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Conflict of interest statement

The authors declare that no conflict of interest exists.

Manuscript received on 15 December 2021, revised version accepted on 7 February 2022

Translated from the original German by Veronica A. Raker, PhD.

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Cite this as:

Schulz M, Mangiapane S, Scherer M, Karagiannidis C, Czihal T: Post-acute sequelae of SARS-CoV-2 infection—characterization of community-treated patients in a case-control study based on nationwide claims data. *Dtsch Arztebl Int* 2022; 119: 177–8. DOI: 10.3238/arztebl.m2022.0134