

Supplemental Online Content

DeVries A, Shambhu S, Sloop S, Overhage JM. One-year adverse outcomes among US adults with post–COVID-19 condition vs those without COVID-19 in a large commercial insurance database. *JAMA Health Forum*. 2023;4(3):e230010. doi:10.1001/jamahealthforum.2023.0010

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This supplemental material has been provided by the authors to give readers additional information about their work.

eTable 1. Baseline characteristics of initial Covid population vs post covid conditions (PCC) cohort

	Initial Covid Population		PCC		Standardized Difference
	n/mean	%/SD	n/mean	%/SD	
Number of Patients	205,307		13,435		
Age, (mean, Sd)	44.9	16.5	50.1	15.1	-0.3312
Age categories					
18-29	45,375	22.1%	1,452	10.8%	0.3082
30-44	55,582	27.1%	3,131	23.3%	0.0869
45-64	83,305	40.6%	6,939	51.6%	-0.2235
65-74	12,006	5.8%	1,212	9.0%	-0.1212
75+	9,039	4.4%	701	5.2%	-0.0381
Sex (Female %)	109,438	53.3%	7,874	58.6%	
Residence region					
Northeast	58,534	28.5%	4,290	31.9%	-0.0745
Midwest	29,479	14.4%	1,890	14.1%	0.0083
South	68,808	33.5%	4,098	30.5%	0.0646
West	48,170	23.5%	3,156	23.5%	-0.0007
Missing	316	0.2%	1	0.0%	0.0516
Zip-code level measures of social determinants of health:					
Race (proportion from census block group data)					
Black	0.14	0.2	0.14	0.2	0.0000
White	0.70	0.3	0.70	0.3	0.0000
Asian	0.06	0.1	0.06	0.1	0.0000
Hispanic ethnicity (proportion from census block group data)	0.20	0.2	0.20	0.2	0.0000

Education status					
Education attainment High-school and above	0.87		0.87	0.1	0.0000
Socio-economic status					
1 (most disadvantaged)	38,747	18.9%	2,737	20.4%	-0.0378
2	39,599	19.3%	2,734	20.3%	-0.0266
3	47,681	23.2%	3,264	24.3%	-0.0252
4 (least disadvantaged)	67,946	33.1%	4,531	33.7%	-0.0134
5 (missing)	11,334	5.5%	169	1.3%	0.2372
Elixhauser comorbidity score (mean, Sd)	1.2	1.9	2.4	2.7	-0.5355
ECI categories					
0	111,800	54.5%	3,548	26.4%	0.5964
1	38,658	18.8%	2,903	21.6%	-0.0692
2	22,180	10.8%	2,169	16.1%	-0.1569
3	12,978	6.3%	1,534	11.4%	-0.1800
4+	19,691	9.6%	3,281	24.4%	-0.4027
Baseline comorbidities					
Asthma	11,818	5.8%	1,777	13.2%	-0.2570
Chronic obstructive lung disorder	18,395	9.0%	2,561	19.1%	-0.2942
Any cardiovascular disease	12,804	6.2%	1,710	12.7%	-0.2229
Coronary artery disease	8,310	4.0%	1,173	8.7%	-0.1924
Peripheral vascular disorders	5,527	2.7%	697	5.2%	-0.1286
Cerebrovascular disease	1,926	0.9%	269	2.0%	-0.0885
Cirrhosis	518	0.3%	102	0.8%	-0.0715
Hypertension	47,828	23.3%	5,278	39.3%	-0.3501

Chronic kidney disease	14,487	7.1%	1,879	14.0%	-0.2273
End stage renal disease on dialysis	883	0.4%	159	1.2%	-0.0843
Diabetes type 1	1,513	0.7%	189	1.4%	-0.0651
Diabetes type 2	22,899	11.2%	2,772	20.6%	-0.2615
Severe obesity (BMI >=40)	9,425	4.6%	1,385	10.3%	-0.2191
Cancer	7,207	3.5%	964	7.2%	-0.1635
Arrhythmias	11,715	5.7%	1,664	12.4%	-0.2345
Inflammatory bowel disorder	1,223	0.6%	129	1.0%	-0.0415
Rheumatoid arthritis	2,184	1.1%	364	2.7%	-0.1212
Pregnancy	3,731	1.8%	190	1.4%	0.0320
Depression	17,905	8.7%	3,170	23.6%	-0.4126
Anxiety	23,120	11.3%	3,753	27.9%	-0.4296
Baseline all-cause 6-month utilization (mean, SD)					
Inpatient hospitalizations count	0.07	0.39	0.18	0.63	-0.2100
Emergency department visits count	0.15	0.5	0.35	1.0	-0.2548
Office visits count	3	3.5	6	6.1	-0.6543
Baseline all-cause 6-month cost (mean, SD) (PMPM)					
Overall Medical Cost	\$ 709	\$ 4,002	\$ 2,093	\$ 7,984	-0.2192

eTable 2. List of symptoms and Covid diagnosis used to identify PCC cases with their ICD 10 codes and description

Symptoms	ICD10 codes	Code Description
Anosmia and Parageusia	R43.0	Anosmia
	R43.2	Parageusia
Cough	R05	Cough
Covid Dx	B34.2	Coronavirus infection, unspecified

	B97.21	SARS-associated coronavirus as the cause of diseases classified elsewhere
	B97.29	Other coronavirus as the cause of diseases classified elsewhere
	J12.81	Pneumonia due to SARS-associated coronavirus
	U07.1	COVID-19
Covid Sequelae	B94.8	Sequelae of other specified infectious and parasitic diseases
Diarrhea	K59.1	Functional diarrhea
	R19.7	Diarrhea, unspecified
Fever or chills	R50.9	Fever, unspecified
	R56.00	Simple febrile convulsions
	R50.81	Fever presenting with conditions classified elsewhere
	R50.2	Drug induced fever
	R50.84	Febrile nonhemolytic transfusion reaction
Headaches	G44.009	Cluster headache syndrome, unspecified, not intractable
	G44.301	Post-traumatic headache, unspecified, intractable
	G44.319	Acute post-traumatic headache, not intractable
	G44.59	Other complicated headache syndrome
	G44.81	Hypnic headache
	G44.82	Headache associated with sexual activity
	G44.83	Primary cough headache
	G44.85	Primary stabbing headache
	R51	Headache
	G44.001	Cluster headache syndrome, unspecified, intractable
	G44.021	Chronic cluster headache, intractable
	G44.049	Chronic paroxysmal hemicrania, not intractable
	G44.051	Short lasting unilateral neuralgiform headache with conjunctival injection and tearing (SUNCT), intractable
	G44.211	Episodic tension-type headache, intractable
	G44.311	Acute post-traumatic headache, intractable

	G44.52	New daily persistent headache (NDPH)
	G44.53	Primary thunderclap headache
	G44.091	Other trigeminal autonomic cephalgias (TAC), intractable
	G44.099	Other trigeminal autonomic cephalgias (TAC), not intractable
	G44.209	Tension-type headache, unspecified, not intractable
	G44.221	Chronic tension-type headache, intractable
	G44.321	Chronic post-traumatic headache, intractable
	G44.40	Drug-induced headache, not elsewhere classified, not intractable
	G44.84	Primary exertional headache
	G44.89	Other headache syndrome
	G44.1	Vascular headache, not elsewhere classified
	R51.0	Headache with orthostatic component, not elsewhere classified
	R51.9	Headache, unspecified
	G44.019	Episodic cluster headache, not intractable
	G44.041	Chronic paroxysmal hemicrania, intractable
	G44.059	Short lasting unilateral neuralgiform headache with conjunctival injection and tearing (SUNCT), not intractable
	G44.201	Tension-type headache, unspecified, intractable
	G44.309	Post-traumatic headache, unspecified, not intractable
	G44.329	Chronic post-traumatic headache, not intractable
	G44.41	Drug-induced headache, not elsewhere classified, intractable
	G44.51	Hemicrania continua
	G44.011	Episodic cluster headache, intractable
	G44.029	Chronic cluster headache, not intractable
	G44.031	Episodic paroxysmal hemicrania, intractable

	G44.039	Episodic paroxysmal hemicrania, not intractable
	G44.219	Episodic tension-type headache, not intractable
	G44.229	Chronic tension-type headache, not intractable
Joint Pain	M25.50	Pain in unspecified joint
Muscle and body aches	M79.10	Myalgia, unspecified site
	M79.11	Myalgia of mastication muscle
	M79.12	Myalgia of auxiliary muscles, head and neck
	M79.18	Myalgia, other site
	R52	Pain, unspecified
Myalgic encephalitis (chronic fatigue syndrome)	R53.82	Chronic fatigue, unspecified
	R53.83	Other fatigue
	G93.3	Post viral fatigue syndrome
Night Sweats	R61	Generalized hyperhidrosis
Persistent chest pain or pressure	R07.89	Other chest pain
	R07.9	Chest pain, unspecified
Shortness of breath or difficulty breathing codes	R06.00	Dyspnea, unspecified
	R06.01	Orthopnea
	R06.02	Shortness of breath
	R06.09	Other forms of dyspnea
Sore Throat	J02.9	Acute pharyngitis, unspecified
Tachycardia	I47.2	Ventricular tachycardia
	I47.0	Re-entry ventricular arrhythmia
	I47.1	Supraventricular tachycardia
	I47.9	Paroxysmal tachycardia, unspecified
Anxiety	F40.241	Acrophobia
	F43.0	Acute stress reaction
	F40.01	Agoraphobia with panic disorder
	F40.02	Agoraphobia without panic disorder
	F40.00	Agoraphobia, unspecified
	F40.290	Androphobia
	F06.4	Anxiety disorder due to known physiological condition
	F41.9	Anxiety disorder, unspecified
	F40.210	Arachnophobia
	F40.240	Claustrophobia

	F44.9	Dissociative and conversion disorder, unspecified
	F42.4	Excoriation (skin-picking) disorder
	F40.230	Fear of blood
	F40.242	Fear of bridges
	F40.243	Fear of flying
	F40.231	Fear of injections and transfusions
	F40.233	Fear of injury
	F40.232	Fear of other medical care
	F40.220	Fear of thunderstorms
	F41.1	Generalized anxiety disorder
	F40.291	Gynephobia
	F42.3	Hoarding disorder
	R45.5	Hostility
	F99	Mental disorder, not otherwise specified
	F42.2	Mixed obsessional thoughts and acts
	F48.9	Nonpsychotic mental disorder, unspecified
	F42	Obsessive-compulsive disorder
	F42.9	Obsessive-compulsive disorder, unspecified
	F40.218	Other animal type phobia
	F93.8	Other childhood emotional disorders
	F41.3	Other mixed anxiety disorders
	F40.228	Other natural environment type phobia
	F42.8	Other obsessive-compulsive disorder
	F40.8	Other phobic anxiety disorders
	F40.248	Other situational type phobia
	F45.8	Other somatoform disorders
	F41.8	Other specified anxiety disorders
	F48.8	Other specified nonpsychotic mental disorders
	F40.298	Other specified phobia
	F41.0	Panic disorder [episodic paroxysmal anxiety]
	F40.9	Phobic anxiety disorder, unspecified
	F43.11	Post-traumatic stress disorder, acute

	F43.12	Post-traumatic stress disorder, chronic
	F43.10	Post-traumatic stress disorder, unspecified
	F40.11	Social phobia, generalized
	F40.10	Social phobia, unspecified
	R45.7	State of emotional shock and stress, unspecified
	R45.2	Unhappiness
	R45.6	Violent behavior
Depression	F43.21	Adjustment disorder with depressed mood
	F43.23	Adjustment disorder with mixed anxiety and depressed mood
	F31.31	Bipolar disorder, current episode depressed, mild
	F31.30	Bipolar disorder, current episode depressed, mild or moderate severity, unspecified
	F31.32	Bipolar disorder, current episode depressed, moderate
	F31.5	Bipolar disorder, current episode depressed, severe, with psychotic features
	F31.4	Bipolar disorder, current episode depressed, severe, without psychotic features
	F31.61	Bipolar disorder, current episode mixed, mild
	F31.62	Bipolar disorder, current episode mixed, moderate
	F31.64	Bipolar disorder, current episode mixed, severe, with psychotic features
	F31.63	Bipolar disorder, current episode mixed, severe, without psychotic features
	F31.60	Bipolar disorder, current episode mixed, unspecified
	F31.76	Bipolar disorder, in full remission, most recent episode depressed
	F31.78	Bipolar disorder, in full remission, most recent episode mixed

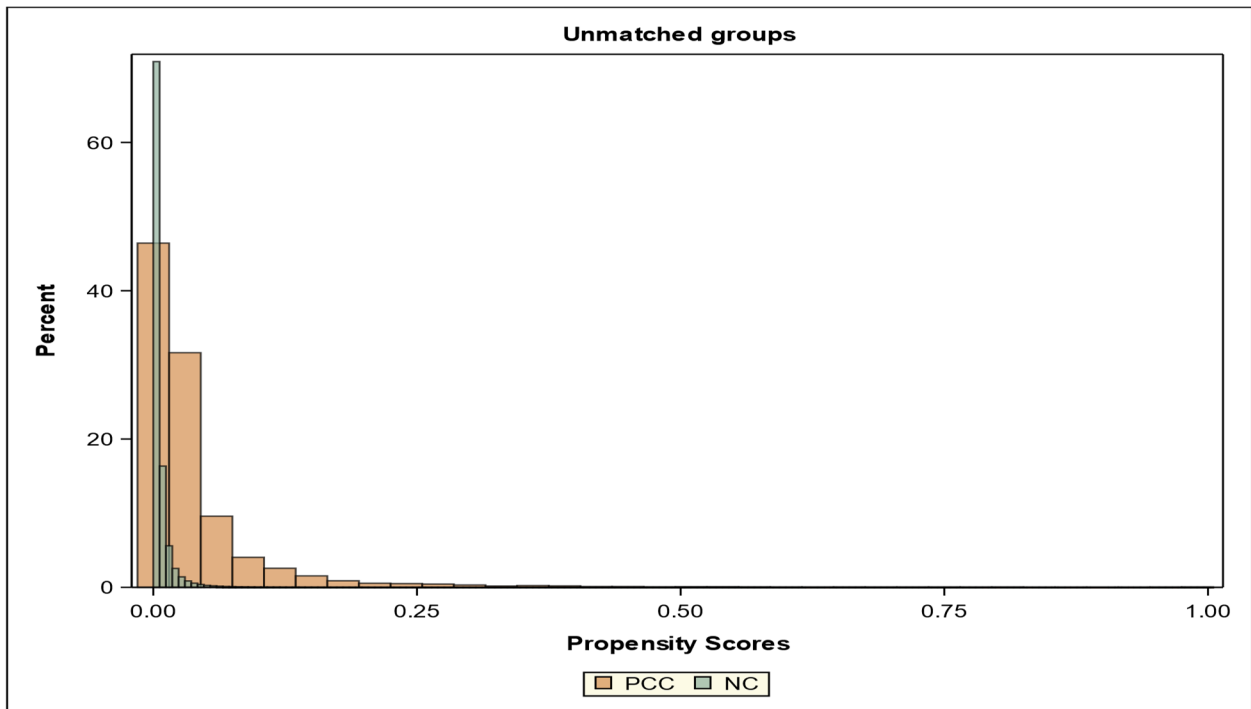
	F31.75	Bipolar disorder, in partial remission, most recent episode depressed
	F31.77	Bipolar disorder, in partial remission, most recent episode mixed
	F31.81	Bipolar II disorder
	F34.1	Dysthymic disorder
	F33.2	Major depressive disorder, recurrent severe without psychotic features
	F33.42	Major depressive disorder, recurrent, in full remission
	F33.41	Major depressive disorder, recurrent, in partial remission
	F33.40	Major depressive disorder, recurrent, in remission, unspecified
	F33.0	Major depressive disorder, recurrent, mild
	F33.1	Major depressive disorder, recurrent, moderate
	F33.3	Major depressive disorder, recurrent, severe with psychotic symptoms
	F33.9	Major depressive disorder, recurrent, unspecified
	F32.5	Major depressive disorder, single episode, in full remission
	F32.4	Major depressive disorder, single episode, in partial remission
	F32.0	Major depressive disorder, single episode, mild
	F32.1	Major depressive disorder, single episode, moderate
	F32.3	Major depressive disorder, single episode, severe with psychotic features
	F32.2	Major depressive disorder, single episode, severe without psychotic features
	F32.9	Major depressive disorder, single episode, unspecified
	F33.8	Other recurrent depressive disorders

Brain Fog	F06.8	Other specified mental disorders due to known physiological condition
	R41.82	Altered mental status, unspecified
	R41.0	Disorientation, unspecified
	R41.840	Attention and concentration deficit
Insomnia	G47.00	Insomnia, unspecified
	G47.01	Insomnia due to medical condition
Pneumonia	J18.0	Bronchopneumonia, unspecified organism
	J18.2	Hypostatic pneumonia, unspecified organism
	J84.111	Idiopathic interstitial pneumonia, not otherwise specified
	J18.1	Lobar pneumonia, unspecified organism
	J18.8	Other pneumonia, unspecified organism
	J12.89	Other viral pneumonia
	J12.81	Pneumonia due to SARS-associated coronavirus
	J17	Pneumonia in diseases classified elsewhere
	J18.9	Pneumonia, unspecified organism
	J12.9	Viral pneumonia, unspecified
Hypoxia	R09.02	Hypoxemia

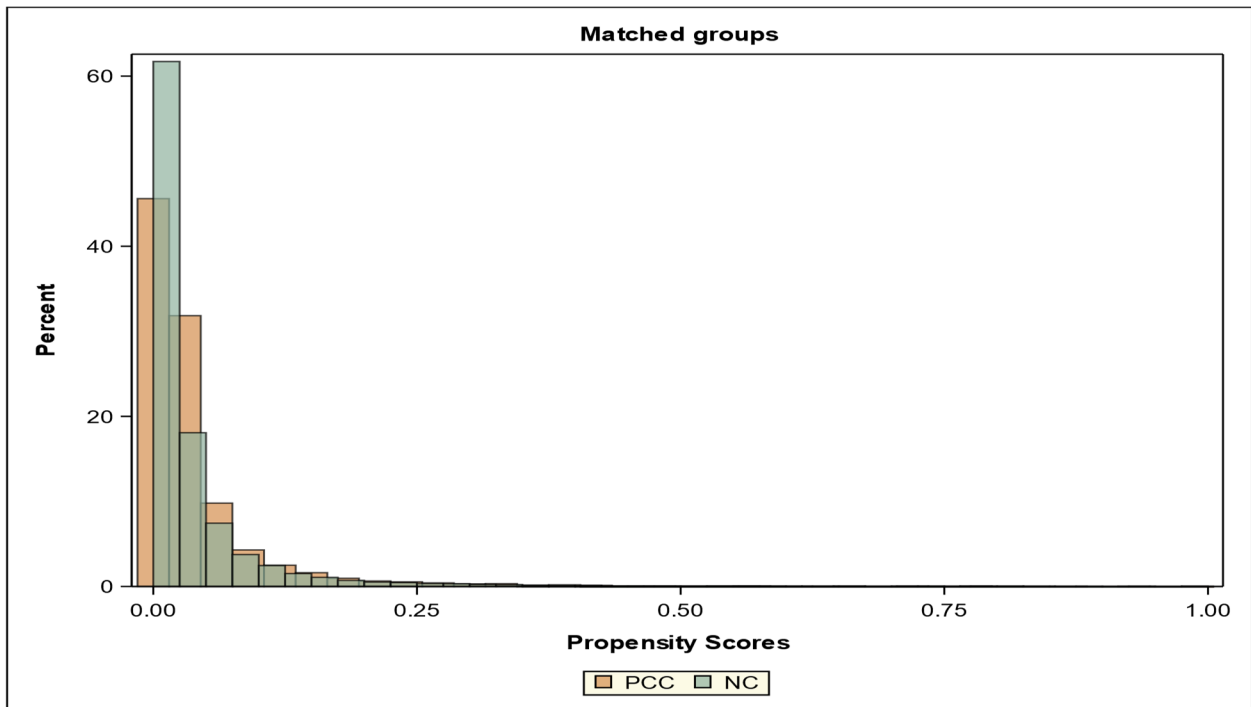
eTable 3. Index month distributions among the overall cohort

Index Month	PCC		NC		Standardized Difference
	n	%	n	%	
April	3,823	29%	7,726	29%	-0.0066
May	2,446	18%	4,876	18%	0.0026
June	2,621	20%	5,233	20%	0.0000
July	4,545	34%	9,035	34%	0.0042

eFigure. Propensity score balance checks for common support
Before matching graph between PCC and NC cohort



After matching graph between PCC and NC cohort



eTable 4. Distribution of PCC symptoms during the weeks 5 to 12 post index among the PCC cohort

Diagnosis and symptoms	PCC
COVID Diagnosis	12,376 (92.1%)
Hypoxia or Shortness of breath	5,825 (43.4%)
Cough	4,554 (33.9%)
Muscle or Body aches Weakness	3,073 (22.9%)
Fever or Chills	3,004 (22.4%)
Anxiety	2,927 (21.8%)
Depression	2,282 (17%)
Chronic Fatigue Syndrome	2,200 (16.4%)
Persistent Chest Pain or Pressure	2,273 (16.9%)
Headache	1,274 (9.5%)
Diarrhea	940 (7%)
Sore Throat	625 (4.7%)
Brain Fog	597 (4.4%)
Insomnia	469 (3.5%)
Anosmia or Parageusia	282 (2.1%)
Tachycardia	255 (1.9%)
Joint Pain	184 (1.4%)
Night Sweats	51 (0.4%)

eTable 5. Sensitivity analysis among members with 6 months continuous enrollment

	Individuals with Continuous Enrollment*			
	PCC (n=12,028)	NC (n=25,106)	Relative Risk	p -value
Outcomes of interest	n (%)	n (%)		
COPD	3,889 (32.3%)	4,220 (16.8%)	1.92	< 0.0001
Asthma (moderate/severe)	2,954 (24.6%)	3,175 (12.6%)	1.94	< 0.0001
Pulmonary embolism/DVT	905 (7.5%)	553 (2.2%)	3.42	< 0.0001
Cardiac arrhythmia	3,461 (28.8%)	3,170 (12.6%)	2.28	< 0.0001
Coronary artery disease	2,045 (17%)	2,459 (9.8%)	1.74	< 0.0001
Peripheral vascular Disease	1,194 (9.9%)	1,594 (6.3%)	1.56	< 0.0001
Ischemic stroke	452 (3.8%)	441 (1.8%)	2.14	< 0.0001
Heart failure	1,349 (11.2%)	1,500 (6%)	1.88	< 0.0001

* Among members with 6 months continuous enrollment