

Table S1: Incidence of COVID-19 outcomes in the cohort, by demographic and clinical attributes.

Attribute		Total <i>N</i>	Frequency of COVID-19 outcomes						
			Any COVID-19 diagnosis ¹		COVID-19 hospitalizations ¹		Fatal COVID-19 hospitalizations ¹		
			<i>N</i>	Inc. ²	<i>N</i>	Inc. ²	<i>N</i>	Inc. ²	
Age on 1 March 2020									
	65-69 years	139,336	1,033	198.4	160	30.7	25	4.8	
	70-74 years	155,424	919	158.0	210	36.1	46	7.9	
	75-79 years	103,626	629	162.2	206	53.1	71	18.3	
	80-84 years	68,643	477	185.8	204	79.3	67	26.0	
	85-89 years	41,015	359	234.2	172	112.0	72	46.8	
	≥90 years	22,989	260	302.9	123	143.0	53	61.5	
Sex									
	Female	294,352	1,955	177.6	502	45.5	136	12.3	
	Male	236,681	1,722	194.6	573	64.7	198	22.3	
Race and ethnicity									
	White, non-Hispanic	259,428	1,216	125.2	386	39.7	133	13.7	
	Black, non-Hispanic	49,822	364	195.5	140	75.1	44	23.6	
	Asian or Pacific Islander, non-Hispanic	62,865	320	136.1	98	41.6	25	10.6	
	Hispanic (any race)	140,049	1,709	326.8	439	83.7	130	24.8	
	Other, mixed, or unknown race	18,869	68	96.2	12	17.0	2	2.8	
Tobacco smoking									
	Current smoker	17,007	86	135.1	31	48.7	8	12.6	
	Former smoker	172,170	1,292	200.7	475	73.7	167	25.9	
	Never smoker	299,120	2,182	195.1	554	49.5	154	13.7	
	Unknown	42,736	117	73.1	15	9.4	5	3.1	
Body mass index									
	<18.5 (underweight)	9,355	62	177.2	29	82.8	12	34.2	
	18.5-24.9 (normal weight)	146,062	868	158.9	303	55.4	109	19.9	
	25.0-29.9 (overweight)	182,056	1,313	192.9	361	52.9	105	15.4	
	30.0-39.9 (obese)	128,836	1,059	219.9	276	57.2	86	17.8	
	≥40.0 (morbidly obese)	15,721	152	258.7	39	66.2	9	15.3	
	Unknown	49,003	223	121.6	67	36.5	13	7.1	
Comorbid conditions									
	Myocardial infarction								
		Yes	24,223	265	293.0	121	133.5	50	55.1
		No	506,810	3,412	180.0	954	50.3	284	15.0
	Congestive heart failure								
		Yes	37,583	476	339.5	222	158.0	87	61.8
		No	493,450	3,201	173.4	853	46.2	247	13.4
	Peripheral vascular disease								
		Yes	192,733	1,646	228.5	624	86.5	223	30.9
		No	338,300	2,031	160.5	451	35.6	111	8.8
	Cerebrovascular disease								
		Yes	33,232	407	328.3	189	152.1	76	61.0
		No	497,801	3,270	175.6	886	47.5	258	13.8
	Hypertension								
		Yes	319,740	2,554	213.7	838	70.0	278	23.2
		No	211,293	1,123	142.1	237	29.9	56	7.1
	Hyperlipidemia								

	Yes	348,420	2,590	198.8	797	61.1	263	20.1
	No	182,613	1,087	159.1	278	40.6	71	10.4
Diabetes								
	Yes	137,582	1,392	270.8	488	94.8	159	30.8
	No	393,451	2,285	155.2	587	39.8	175	11.9
Chronic obstructive pulmonary disease								
	Yes	86,098	786	244.2	266	82.5	86	26.7
	No	444,935	2,891	173.7	809	48.5	248	14.9
Renal disease								
	Yes	96,735	879	243.1	387	106.9	142	39.2
	No	434,298	2,798	172.2	688	42.3	192	11.8
Moderate or severe liver disease								
	Yes	1,774	22	332.4	11	165.9	2	30.1
	No	529,259	3,655	184.7	1,064	53.7	332	16.7
Malignancy								
	Yes	29,187	197	180.5	73	66.8	23	21.0
	No	501,846	3,480	185.5	1,002	53.3	311	16.5
Metastatic solid tumor								
	Yes	8,968	56	167.1	25	74.5	8	23.8
	No	522,065	3,621	185.5	1,050	53.7	326	16.7
Asthma								
	Yes	48,338	425	235.2	122	67.4	38	21.0
	No	482,695	3,252	180.1	953	52.7	296	16.4
Obstructive sleep apnea								
	Yes	33,709	266	211.1	86	68.1	28	22.2
	No	497,324	3,411	183.4	989	53.1	306	16.4
HIV/AIDS								
	Yes	181	2	295.9	0	0.0	0	0.0
	No	530,852	3,675	185.1	1,075	54.1	334	16.8
Organ transplant								
	Yes	588	4	181.9	3	136.4	3	136.3
	No	530,445	3,673	185.2	1,072	54	331	16.6
Other immunocompromising condition								
	Yes	23,922	271	303.6	124	138.6	50	55.8
	No	507,111	3,406	179.6	951	50.1	284	14.9
Hypothyroidism								
	Yes	72,325	523	193.4	166	61.3	55	20.3
	No	458,708	3,154	183.9	909	52.9	279	16.2
Rheumatologic/inflammatory condition								
	Yes	12,534	104	222.0	43	91.7	11	23.4
	No	518,499	3,573	184.3	1,032	53.1	323	16.6
Depression								
	Yes	70,823	720	272.1	244	92	89	33.5
	No	460,210	2,957	171.8	831	48.2	245	14.2
Zoster vaccination								
	Any zoster vaccine dose received ³	233,780	1,282	146.5	356	40.6	113	12.9
	No zoster vaccine dose received	297,253	2,395	215.5	719	64.6	221	19.8
Influenza vaccination								
	Received in 2019-20 season	410,428	2,963	193.1	898	58.4	284	18.5
	Not received in 2019-20 season	120,605	714	158.2	177	39.2	50	11.1

PPSV23 vaccination ⁴	PPSV23 received	418,309	2,969	190.3	934	59.8	303	19.4
	PPSV23 not received	116,558	708	166.3	141	33.1	31	7.3
PCV13 vaccination ⁴	PCV13 received	451,068	3,212	190.5	984	58.3	311	18.4
	PCV13 not received	80,600	465	155.3	91	30.3	23	7.7
Prior year outpatient visits	0-9	141,306	846	160.1	202	38.2	57	10.8
	10-19	156,375	984	168.2	247	42.2	73	12.5
	20-29	98,247	706	192.1	207	56.3	69	18.7
	30-39	56,007	425	202.9	134	63.9	43	20.5
	≥40	79,098	716	242.3	285	96.3	92	31.0
Prior year inpatient visits	0	488,987	3,150	172.2	831	45.4	253	13.8
	1	32,489	359	296.0	151	124.3	39	32.0
	2	6,538	102	418.9	57	233.5	24	98.1
	≥3	3,019	66	589.0	36	320.2	18	159.5
	Prior year emergency department visits	0	408,102	2,389	156.5	567	37.1	173
1		78,391	699	238.6	239	81.4	64	21.8
2		24,833	290	312.8	113	121.6	40	43.0
≥3		19,707	299	407.2	156	211.9	57	77.2
Census tract median household income		\$0-\$29,999	6,627	87	351.8	24	96.7	2
	\$30,000-\$49,999	79,942	801	268.2	246	82.2	78	26.0
	\$50,000-\$69,999	118,754	984	221.7	280	63.0	87	19.5
	\$70,000-\$89,999	123,836	835	180.3	220	47.4	68	14.7
	\$90,000-\$109,999	91,183	489	143.3	144	42.2	42	12.3
	\$110,000-\$129,999	61,126	281	122.8	93	40.6	37	16.1
	≥\$130,000	48,549	193	106.2	63	34.6	20	11.0
	Unknown	1,016	7	184.5	5	131.7	0	0.0

¹We define any COVID-19 diagnosis as a positive result of a molecular test for SARS-CoV-2 infection or a clinically confirmed COVID-19 diagnosis, a COVID-19 hospitalization as a new inpatient admission (excluding observational admissions lasting <24 hours) between 7 days before and 28 days after a COVID-19 diagnosis, and fatal COVID-19 hospitalization as death ≥60 days of admission.

²Incidence per 10,000 person-years at risk.

³Receipt of ≥1 dose of live or recombinant zoster vaccine.

⁴Values may not sum to the total number of individuals enrolled, as time within each exposure group is included for individuals who received PCV13 or PPSV23 during the study period.

Table S2: Descriptive attributes of the cohort before and after reweighting by inverse propensity of receipt of PCV13.

Attribute	Proportion, unweighted (weighted)		
	PCV13 received	PCV13 not received	
Age on 1 March 2020			
	65-69 years	21.5 (26.7)	53.2 (31.9)
	70-74 years	30.3 (29.1)	23.6 (29.8)
	75-79 years	20.9 (19.4)	11.8 (17.8)
	80-84 years	14.1 (12.8)	6.2 (10.1)
	85-89 years	8.5 (7.7)	3.2 (6.4)
	≥90 years	4.7 (4.3)	2.0 (3.9)
Sex			
	Female	55.4 (55.4)	55.4 (56.6)
	Male	44.6 (44.6)	44.6 (43.4)
Race and ethnicity			
	White, non-Hispanic	49.2 (48.8)	46.7 (46.2)
	Black, non-Hispanic	8.8 (9.4)	12.9 (9.0)
	Asian/Pacific Islander, non-Hispanic	12.5 (11.9)	8.2 (11.8)
	Hispanic (any race)	27.2 (26.8)	21.9 (29.3)
	Other, mixed, or unknown race	2.4 (3.1)	10.3 (3.8)
Tobacco smoking			
	Current smoker	3.1 (3.2)	3.7 (3.7)
	Former smoker	34.6 (32.1)	20.1 (29.2)
	Never smoker	57.9 (56.1)	47.6 (57.0)
	Unknown	4.4 (8.5)	28.6 (10.2)
Body mass index			
	<18.5 (underweight)	1.8 (1.8)	1.4 (2.0)
	18.5-24.9 (normal weight)	28.7 (27.2)	20.7 (26.1)
	25.0-29.9 (overweight)	35.9 (34.0)	25.1 (33.5)
	30.0-39.9 (obese)	25.4 (24.1)	18.0 (23.6)
	≥40.0 (morbidly obese)	3.1 (2.9)	2.4 (2.8)
	Unknown	5.1 (10.0)	32.4 (11.9)
Comorbid conditions			
	Myocardial infarction	5.0 (4.5)	2.1 (4.3)
	Congestive heart failure	7.9 (7.0)	2.5 (6.7)
	Peripheral vascular disease	40.3 (35.8)	13.8 (31.3)
	Cerebrovascular disease	6.9 (6.2)	2.8 (6.1)
	Hypertension	64.7 (59.7)	35.1 (57.1)
	Hyperlipidemia	70.5 (64.9)	38.2 (60.8)
	Diabetes	28.4 (25.7)	12.1 (24.4)
	Chronic obstructive pulmonary disease	17.9 (16.0)	6.8 (14.4)
	Renal disease	20.2 (17.9)	6.9 (15.5)
	Moderate or severe liver disease	0.4 (0.3)	0.1 (0.5)
	Malignancy	6.0 (5.4)	3.0 (5.1)
	Metastatic solid tumor	1.8 (1.7)	1.0 (1.5)
	Asthma	10.0 (9.0)	4.0 (8.2)
	Obstructive sleep apnea	7.0 (6.3)	2.8 (5.8)
	HIV/AIDS	<0.1 (<0.1)	<0.1 (<0.1)
	Organ transplant	0.1 (0.1)	<0.1 (0.2)
	Other immunocompromising condition	4.9 (4.5)	2.3 (4.7)
	Hypothyroidism	14.7 (13.5)	7.7 (13.0)
	Rheumatologic/inflammatory condition	2.6 (2.3)	1.2 (2.3)
	Depression	14.6 (13.2)	6.0 (12.9)
Zoster vaccination			
	Any zoster vaccine dose received ²	49.7 (43.7)	11.9 (40.9)
Influenza vaccination			
	Vaccinated in 2019-20 season	86.5 (76.7)	25.6 (73.0)
PPSV23 vaccination			
	PPSV23 ever received	89.7 (77.5)	17.1 (74.3)
Prior year outpatient visits			
	0-9	21.7 (27.4)	54.0 (31.1)
	10-19	30.4 (29.3)	23.8 (29.6)
	20-29	19.8 (18.3)	11.0 (16.8)
	30-39	11.5 (10.4)	5.3 (9.2)
	≥40	16.5 (14.7)	6.0 (13.3)
Prior year inpatient visits			
	0	91.3 (92.2)	96.4 (91.8)
	1	6.7 (6.1)	3.0 (6.2)
	2	1.4 (1.2)	0.4 (1.4)

Prior year emergency department visits	≥3	0.6 (0.6)	0.2 (0.7)
	0	75.2 (77.0)	86.2 (78.2)
	1	15.6 (14.6)	9.9 (14.1)
	2	5.1 (4.6)	2.4 (4.3)
	≥3	4.1 (3.7)	1.5 (3.5)
Census tract median household income			
	\$0-\$29,999	1.2 (1.2)	1.5 (1.4)
	\$30,000-\$49,999	14.9 (15.1)	15.9 (16.2)
	\$50,000-\$69,999	22.3 (22.5)	22.9 (22.9)
	\$70,000-\$89,999	23.4 (23.3)	23.0 (23.4)
	\$90,000-\$109,999	17.2 (17.2)	17.0 (16.9)
	\$110,000-\$129,999	11.7 (11.4)	10.6 (10.8)
	≥\$130,000	9.2 (9.1)	8.6 (8.4)
	Unknown	0.1 (0.2)	0.4 (0.2)

ACIP: Advisory Committee on Immunization Practices; PCV13: 13-valent pneumococcal conjugate vaccine; PPSV23: 23-valent pneumococcal polysaccharide vaccine.

Values in the table show the proportion of individuals within each exposure group who exhibit the indicated factor, before and after IPW weighting.

¹Receipt of PCV13 ≥1 year before PPSV23 for immunocompetent individuals, or ≥8 weeks before PPSV23 for immunocompromised individuals, or (for individuals who had previously received PPSV23) receipt of PCV13 ≥1 year after the most recent PPSV23 dose.

²Receipt of ≥1 dose of live or recombinant zoster vaccine.

Table S3: Effectiveness of receipt of PCV13 against COVID-19 outcomes.

Exposure	Effect measure	Endpoint		
		<u>Any COVID-19 diagnosis¹</u>	<u>COVID-19 hospitalization¹</u>	<u>Fatal COVID-19 hospitalization¹</u>
PCV13 vs. no receipt of PCV13 (without negative control)	Adjusted hazard ratio (95% CI)	0.55 (0.51, 0.59)	0.54 (0.47, 0.62)	0.46 (0.36, 0.57)
PCV13 vs. no receipt of PCV13 (any zoster vaccine dose as negative control) ²	Negative control corrected adjusted hazard ratio (95% CI)	0.65 (0.59, 0.72)	0.68 (0.57, 0.83)	0.68 (0.49, 0.95)

COVID-19: coronavirus disease 2019; PCV13: 13-valent pneumococcal conjugate vaccine.

We obtain estimates presented in the table via Cox proportional hazards models; adjusted estimates are obtained from doubly robust inverse propensity weighted models that include covariates presented in **Table 1**. We indicate reweighted sample characteristics in **Table S2**. In analyses using zoster vaccine receipt as negative control exposures, we define the null effect size as the adjusted hazard ratio of each outcome associated with receipt of any zoster vaccine dose, as presented in **Table S6**.

¹We define any COVID-19 diagnosis as a positive result of a molecular test for SARS-CoV-2 infection or a clinically confirmed COVID-19 diagnosis, COVID-19 hospitalization as a new inpatient admission (excluding observational admissions lasting <24 hours) between 7 days before and 28 days after a COVID-19 diagnosis, and fatal COVID-19 hospitalization as death ≤60 days following admission.

²Receipt of ≥1 dose of live or recombinant zoster vaccine.

Table S4: Effectiveness of receipt of both PCV13 and PPSV23 against COVID-19 outcomes.

Exposure	Effect measure	Endpoint		
		Any COVID-19 diagnosis ¹	COVID-19 hospitalization ¹	Fatal COVID-19 hospitalization ¹
PCV13 and PPSV23 per 2015 ACIP guidelines vs. no pneumococcal vaccine (without negative control) ²	Adjusted hazard ratio (95% CI)	0.56 (0.49, 0.63)	0.43 (0.33, 0.55)	0.39 (0.24, 0.61)
PCV13 and PPSV23 per 2015 ACIP guidelines vs. no pneumococcal vaccine (any zoster vaccine dose as negative control) ^{2,3}	Negative control corrected adjusted hazard ratio (95% CI)	0.66 (0.56, 0.76)	0.54 (0.41, 0.73)	0.57 (0.33, 0.97)

ACIP: Advisory Committee on Immunization Practices; COVID-19: coronavirus disease 2019; PCV13: 13-valent pneumococcal conjugate vaccine; PPSV23: 23-valent pneumococcal polysaccharide vaccine.

We obtain estimates presented in the table via Cox proportional hazards models; adjusted estimates are obtained from doubly robust inverse propensity weighted models that include covariates presented in **Table 1**. We indicate reweighted sample characteristics in **Table S2**. In analyses using zoster vaccine receipt as negative control exposures, we define the null effect size as the adjusted hazard ratio of each outcome associated with receipt of any zoster vaccine dose, as presented in **Table S6**.

¹We define any COVID-19 diagnosis as a positive result of a molecular test for SARS-CoV-2 infection or a clinically confirmed COVID-19 diagnosis, COVID-19 hospitalization as a new inpatient admission (excluding observational admissions lasting <24 hours) between 7 days before and 28 days after a COVID-19 diagnosis, and fatal COVID-19 hospitalization as death ≤60 days following admission.

²Receipt of PCV13 ≥1 year before PPSV23 for immunocompetent individuals, or ≥8 weeks before PPSV23 for immunocompromised individuals, or (for individuals who had previously received PPSV23) receipt of PCV13 ≥1 year after the most recent PPSV23 dose. Individuals receiving sequences incompatible with these intervals are excluded from analyses.

³Receipt of ≥1 dose of live or recombinant zoster vaccine.

Table S5: Estimates of PPSV23 effectiveness against COVID-19 outcomes, and relative effectiveness of PCV13 alone versus PPSV23 alone.

Exposure	Effect measure	Any COVID-19 diagnosis ¹	Endpoint COVID-19 hospitalization ¹	Fatal COVID-19 hospitalization ¹
PPSV23 vs. no receipt of PPSV23 (without negative control)	Adjusted hazard ratio (95% CI)	1.01 (0.91, 1.12)	0.80 (0.65, 0.98)	0.85 (0.56, 1.24)
	Negative control corrected adjusted hazard ratio (95% CI)	1.19 (1.05, 1.36)	1.02 (0.78, 1.29)	1.28 (0.77, 2.01)
PPSV23 vs. no receipt of PPSV23 (any zoster vaccine dose as negative control) ²	Adjusted hazard ratio (95% CI) ³	0.55 (0.48, 0.62)	0.68 (0.53, 0.87)	0.56 (0.35, 0.87)
PCV13 only versus PPSV23 only ³				

COVID-19: coronavirus disease 2019; PCV13: 13-valent pneumococcal conjugate vaccine; PPSV23: 23-valent pneumococcal polysaccharide vaccine.

We obtain estimates presented in the table via Cox proportional hazards models; adjusted estimates are obtained from doubly robust inverse propensity weighted (IPW) models that include covariates presented in **Table 1**. We indicate reweighted sample characteristics in **Table S3**. In analyses using zoster vaccine receipt as negative control exposures, we define the null effect size as the adjusted hazard ratio of each outcome associated with receipt of any zoster vaccine dose, as presented in **Table S6**.

¹We define any COVID-19 diagnosis as a positive result of a molecular test for SARS-CoV-2 infection or a clinically confirmed COVID-19 diagnosis, COVID-19 hospitalization as a new inpatient admission (excluding observational admissions lasting <24 hours) between 7 days before and 28 days after a COVID-19 diagnosis, and fatal COVID-19 hospitalization as death ≤60 days following admission.

²Receipt of ≥1 dose of live or recombinant zoster vaccine.

³Analyses do not include negative control exposures, as both groups received pneumococcal vaccines. Negative control corrected aHR measures are equivalent to aHR measures due to cancellation of the negative control term in the denominators.

Table S6: Negative control association of zoster vaccination with COVID-19 outcomes, in models fitted with inverse propensity weighting for PCV13 receipt.

Effect measure	Endpoint		
	Any COVID-19 diagnosis ¹	COVID-19 hospitalization ¹	Fatal COVID-19 hospitalization ¹
Unadjusted hazard ratio (95% CI)	0.68 (0.63, 0.73)	0.63 (0.55, 0.71)	0.65 (0.52, 0.81)
Adjusted hazard ratio (95% CI)	0.86 (0.81, 0.93)	0.75 (0.66, 0.86)	0.72 (0.58, 0.90)

ACIP: Advisory Committee on Immunization Practices; COVID-19: coronavirus disease 2019.

We obtain estimates presented in the table via Cox proportional hazards models; adjusted estimates are obtained from doubly robust inverse propensity weighted models that include covariates presented in **Table 1**. We define the exposure of zoster vaccination as receipt of ≥ 1 dose of live or recombinant zoster vaccine. We indicate reweighted sample characteristics in **Table S2**. We indicate the distribution of each covariate in association with zoster vaccine receipt in **Table S7**. We present estimates of the association of zoster and 2019-2020 seasonal influenza vaccination with COVID-19 outcomes in **Table S8**, based on analyses that include inverse propensity weighting for these exposures.

¹We define any COVID-19 diagnosis as a positive result of a molecular test for SARS-CoV-2 infection or a clinically confirmed COVID-19 diagnosis, COVID-19 hospitalization as a new inpatient admission (excluding observational admissions lasting <24 hours) between 7 days before and 28 days after a COVID-19 diagnosis, and fatal COVID-19 hospitalization as death ≤ 60 days following admission.

Table S7: Descriptive attributes of the cohort before and after reweighting by inverse propensity of receipt of zoster vaccines and 2019-2020 seasonal influenza vaccines.

Attribute	Proportion, unweighted (weighted), %			
	Zoster vaccination		2019-2020 seasonal influenza vaccination	
	Any zoster vaccine dose received ¹	No zoster vaccine dose received	Received	Not received
Age on 1 March 2020				
65-69 years	20.0 (27.9)	31.1 (26.9)	23.3 (27.7)	36.3 (30.7)
70-74 years	30.6 (28.4)	28.2 (28.9)	29.4 (29.0)	28.8 (28.6)
75-79 years	22.3 (18.9)	17.3 (19.3)	20.5 (19.0)	16.3 (18.2)
80-84 years	14.6 (12.7)	11.6 (12.8)	13.9 (12.5)	9.5 (11.6)
85-89 years	8.4 (7.7)	7.2 (7.7)	8.4 (7.4)	5.5 (7.0)
≥90 years	4.0 (4.4)	4.6 (4.4)	4.5 (4.2)	3.7 (3.9)
Sex				
Female	58.0 (55.6)	53.4 (55.4)	55.2 (55.5)	56.1 (56.1)
Male	42.0 (44.4)	46.6 (44.6)	44.8 (44.5)	43.9 (43.9)
Race and ethnicity				
White, non-Hispanic	57.6 (48.5)	42.0 (48.7)	50.2 (49.0)	44.2 (48.4)
Black, non-Hispanic	7.1 (9.4)	11.2 (9.4)	8.1 (9.2)	13.6 (9.3)
Asian/Pacific Islander, non-Hispanic	13.4 (11.9)	10.6 (11.9)	12.6 (11.9)	9.1 (12.1)
Hispanic (any race)	19.9 (27.3)	31.5 (26.5)	26.6 (26.4)	25.8 (26.6)
Other, mixed, or unknown race	2.1 (2.9)	4.7 (3.5)	2.4 (3.4)	7.3 (3.7)
Tobacco smoking				
Current smoker	2.3 (3.1)	3.9 (3.2)	2.9 (3.2)	4.2 (3.3)
Former smoker	35.3 (32.6)	30.1 (32.4)	35.2 (31.8)	23.1 (31.3)
Never smoker	58.7 (57.1)	54.5 (56.3)	58.7 (55.7)	48.1 (56.9)
Unknown	3.7 (7.3)	11.4 (8.0)	3.2 (9.3)	24.5 (8.5)
Body mass index				
<18.5 (underweight)	1.8 (1.8)	1.8 (1.8)	1.8 (1.7)	1.7 (1.7)
18.5-24.9 (normal weight)	31.0 (27.4)	24.8 (27.3)	29.1 (27.0)	21.9 (27.0)
25.0-29.9 (overweight)	36.3 (34.5)	32.7 (34.3)	36.5 (33.7)	26.8 (34.0)
30.0-39.9 (obese)	23.9 (24.7)	24.5 (24.4)	25.7 (23.9)	19.3 (24.2)
≥40.0 (morbidly obese)	2.7 (3.1)	3.1 (3.0)	3.1 (2.9)	2.6 (3.1)
Unknown	4.4 (8.5)	13.1 (9.3)	3.8 (10.8)	27.6 (9.9)
Comorbid conditions				
Myocardial infarction	4.5 (4.6)	4.6 (4.6)	5.0 (4.4)	2.9 (4.2)
Congestive heart failure	7.1 (7.1)	7.1 (7.1)	8.0 (6.9)	3.9 (6.4)
Peripheral vascular disease	41.2 (36.2)	32.4 (36.2)	40.7 (35.4)	21.4 (33.8)
Cerebrovascular disease	6.6 (6.3)	6.0 (6.3)	6.9 (6.1)	4.0 (6.0)
Hypertension	62.9 (60.7)	58.1 (60.2)	65.1 (59.1)	43.6 (58.4)
Hyperlipidemia	72.0 (66.0)	60.6 (65.5)	71.2 (64.4)	46.6 (63.9)
Diabetes	24.9 (25.8)	26.7 (25.9)	28.2 (25.3)	18.0 (24.6)
Chronic obstructive pulmonary disease	17.9 (16.3)	14.9 (16.2)	18.3 (15.9)	9.1 (15.3)
Renal disease	19.7 (18.3)	17.1 (18.2)	20.5 (17.7)	10.6 (16.9)
Moderate or severe liver disease	0.3 (0.3)	0.4 (0.3)	0.4 (0.3)	0.2 (0.3)
Malignancy	5.9 (5.5)	5.2 (5.5)	6.2 (5.4)	3.2 (5.2)
Metastatic solid tumor	1.7 (1.7)	1.7 (1.7)	1.9 (1.6)	1.0 (1.5)
Asthma	10.3 (9.1)	8.2 (9.1)	10.3 (8.9)	5.1 (8.6)
Obstructive sleep apnea	7.9 (6.4)	5.1 (6.4)	7.3 (6.2)	3.0 (6.2)
HIV/AIDS	<0.1 (<0.1)	<0.1 (<0.1)	<0.1 (<0.1)	<0.1 (<0.1)
Organ transplant	0.1 (0.1)	0.1 (0.1)	0.1 (0.1)	<0.1 (0.1)
Other immunocompromising condition	4.8 (4.5)	4.3 (4.5)	5.0 (4.4)	2.7 (4.3)
Hypothyroidism	15.6 (13.7)	12.0 (13.6)	14.9 (13.4)	9.2 (13.3)
Rheumatologic/inflammatory condition	2.4 (2.4)	2.4 (2.4)	2.6 (2.3)	1.4 (2.3)
Depression	15.2 (13.5)	11.9 (13.4)	15.0 (13.1)	7.8 (12.9)
Zoster vaccination				
Any zoster vaccine dose received ¹	100.0 (100.0)	0.0 (0.0)	51.2 (43.6)	19.5 (44.2)
Influenza vaccination				
Vaccinated in 2019-20 season	89.9 (78.4)	67.4 (77.3)	100.0 (100.0)	0.0 (0.0)
Pneumococcal vaccination				

	Both PCV13 and PPSV23 per ACIP guidelines ²	90.2 (76.4)	65.2 (75.6)	87.1 (74.5)	39.2 (75.0)
	PCV13 only	6.2 (9.2)	11.8 (9.2)	9.7 (9.2)	11.5 (9.5)
	PPSV23 only	1.3 (2.7)	3.6 (2.6)	1.1 (2.8)	7.5 (2.6)
	No pneumococcal vaccine	2.9 (11.7)	20.4 (12.6)	4.0 (13.5)	42.4 (12.9)
Prior year outpatient visits					
	0-9	19.6 (26.4)	32.1 (26.8)	19.8 (28.2)	49.9 (29.0)
	10-19	30.4 (29.8)	28.7 (29.5)	30.4 (28.9)	26.3 (30.0)
	20-29	20.4 (18.4)	17.0 (18.4)	20.4 (18.0)	12.1 (17.7)
	30-39	12.0 (10.5)	9.4 (10.5)	12.0 (10.3)	5.6 (9.8)
	≥40	17.6 (14.9)	12.8 (14.8)	17.5 (14.6)	6.1 (13.5)
Prior year inpatient visits					
	0	92.2 (92.1)	92.0 (92.1)	91.1 (92.3)	95.5 (92.6)
	1	6.1 (6.1)	6.1 (6.1)	6.8 (6.0)	3.7 (5.7)
	2	1.2 (1.2)	1.3 (1.2)	1.4 (1.2)	0.6 (1.2)
	≥3	0.5 (0.6)	0.6 (0.6)	0.7 (0.6)	0.2 (0.5)
Prior year emergency department visits					
	0	76.8 (76.7)	76.9 (76.8)	74.7 (77.2)	84.2 (77.9)
	1	15.0 (14.9)	14.6 (14.8)	15.9 (14.5)	11.0 (14.2)
	2	4.7 (4.7)	4.7 (4.7)	5.2 (4.6)	2.9 (4.4)
	≥3	3.6 (3.8)	3.8 (3.7)	4.3 (3.6)	1.8 (3.4)
Census tract median household income					
	\$0-\$29,999	0.9 (1.3)	1.5 (1.2)	1.1 (1.3)	1.6 (1.2)
	\$30,000-\$49,999	11.7 (15.3)	17.7 (15.1)	14.4 (14.9)	17.3 (14.9)
	\$50,000-\$69,999	19.6 (22.5)	24.6 (22.4)	22.0 (22.3)	23.6 (22.2)
	\$70,000-\$89,999	23.3 (23.2)	23.4 (23.3)	23.5 (23.3)	22.8 (23.2)
	\$90,000-\$109,999	19.0 (17.0)	15.8 (17.1)	17.4 (17.2)	16.3 (17.3)
	\$110,000-\$129,999	13.8 (11.5)	9.7 (11.5)	11.9 (11.6)	10.1 (11.6)
	≥\$130,000	11.7 (9.0)	7.1 (9.1)	9.5 (9.2)	7.9 (9.4)
	Unknown	0.1 (0.2)	0.2 (0.2)	0.1 (0.2)	0.4 (0.2)

ACIP: Advisory Committee on Immunization Practices; PCV13: 13-valent pneumococcal conjugate vaccine; PPSV23: 23-valent pneumococcal polysaccharide vaccine.

Values in the table show the proportion of individuals within each exposure group who exhibit the indicated factor, before and after IPW weighting.

¹Receipt of ≥1 dose of live or recombinant zoster vaccine.

²Receipt of PCV13 ≥1 year before PPSV23 for immunocompetent individuals, or ≥8 weeks before PPSV23 for immunocompromised individuals, or (for individuals who had previously received PPSV23) receipt of PCV13 ≥1 year after the most recent PPSV23 dose.

Table S8: Estimated effectiveness of zoster vaccines and 2019-2020 seasonal influenza vaccines against COVID-19 outcomes after inverse propensity weighting for these exposures.

Vaccine	Effect measure	Endpoint		
		Any COVID-19 diagnosis ¹	COVID-19 hospitalization ¹	Fatal COVID-19 hospitalization ¹
Any zoster vaccine dose ²	Adjusted hazard ratio (95% CI)	0.82 (0.74, 0.90)	0.71 (0.59, 0.86)	0.70 (0.49, 0.99)
2019-2020 seasonal influenza vaccine	Adjusted hazard ratio (95% CI)	1.04 (0.95, 1.15)	1.11 (0.92, 1.33)	0.93 (0.67, 1.29)

We obtain estimates presented in the table via Cox proportional hazards models; adjusted estimates are obtained from doubly robust inverse propensity weighted models that include covariates presented in **Table 1**. We indicate the distribution of each covariate in association with zoster and influenza vaccine receipt in **Table S7**.

¹We define any COVID-19 diagnosis as a positive result of a molecular test for SARS-CoV-2 infection or a clinically confirmed COVID-19 diagnosis, COVID-19 hospitalization as a new inpatient admission (excluding observational admissions lasting <24 hours) between 7 days before and 28 days after a COVID-19 diagnosis, and fatal COVID-19 hospitalization as death ≤60 days following admission.

²Receipt of ≥1 dose of live or recombinant zoster vaccine.