

Supplemental Online Content

Nordström P, Ballin M, Nordström A. Association Between risk of COVID-19 infection in nonimmune individuals and COVID-19 immunity in their family members. *JAMA Intern Med.* Published online October 11, 2021. doi:10.1001/jamainternmed.2021.5814

eTable 1. Baseline Characteristics When Immunity Was Defined as Previous Infection

eTable 2. Risk of Covid-19 Infection in Families with Two-Five Members.

eTable 3. Baseline Characteristics When Immunity Was Defined as 1 Dose of Vaccine

eTable 4. Risk of Covid-19 Infection in Families with Two-Four Members.

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

eTable 1. Baseline Characteristics When Immunity Was Defined as Previous Infection. Baseline characteristics for individuals with no immunity (N=1,430,339) in families with 2-5 family members. Data is presented based on number of immune individuals in each family at baseline. Immunity was defined as previous Covid-19 infection.

	All families 1,430,339	Characteristics based on number of individuals with immunity in each family at baseline				
		0 immune family members (N=1,262,464)	1 immune family member (N=140,707)	2 immune family members (N=21,747)	3 immune family members (N=4,721)	4 immune family members (N=700)
Age, mean, SD	50.8±17.6	51.9±17.3	44.8±17.1	35.1±18.3	31.0±17.0	27.4±15.6
Range	1.4-104.2	1.4-104.2	1.3-100.8	1.4-85.6	2.6-77.0	2.2-74.0
Female sex, N (%)	713,037 (49.9%)	633,630 (50.2%)	66,827 (47.5%)	10,098 (46.4%)	2,149 (45.5%)	333 (47.6%)
Highest education, N (%)						
Elementary school < 9yrs	55,704 (3.9%)	50,692 (4.0%)	4,338 (3.1%)	543 (2.5%)	113 (2.4%)	18 (2.6%)
Elementary school 9yrs	175,403 (12.3%)	153,390 (12.2%)	17,578 (12.5%)	3,406 (15.7%)	887 (18.8%)	142 (20.3%)
Secondary school, 2 yrs	329,821 (23.1%)	299,897 (23.8%)	26,758 (19.0%)	2,698 (12.4%)	427 (9.0%)	41 (5.9%)
Secondary school, >2 yrs	255,095 (17.8%)	222,313 (17.6%)	27,357 (19.4%)	4,280 (19.7%)	989 (20.9%)	156 (22.3%)
University education	504,084 (35.2%)	447,584 (35.5%)	49,674 (35.3%)	5,677 (26.1%)	1,026 (21.7%)	123 (17.6%)
Unknown ^a	110,232 (7.7%)	88,588 (7.0%)	15,002 (10.7%)	5,143 (23.6%)	1,279 (27.1%)	220 (31.4%)
Income (Euro), mean, SD	23,607±85,786	29,365±70,985	30,313±148,764	22,849±123,736	17,340±22,807	13,283±18,575
Early retirement pension, N (%)	57,505 (4.0%)	52,720 (4.2%)	4,213 (3.0%)	474 (2.2%)	83 (1.8%)	15 (2.1%)
Born in Sweden, N (%)	1,163,140 (81.3%)	1,032,526 (81.8%)	109,516 (77.8%)	16,944 (77.9%)	3,648 (77.3%)	506 (72.3%)
Diagnoses, N (%)						
Myocardial infarction	26,236 (1.8%)	24,483 (1.9%)	1,584 (1.1%)	139 (0.6%)	26 (0.6%)	4 (0.6%)
Stroke	17,352 (1.2%)	16,252 (1.3%)	996 (0.7%)	81 (0.4%)	20 (0.4%)	3 (0.4%)
Diabetes	106,335 (7.4%)	97,132 (7.7%)	8,093 (5.8%)	904 (4.2%)	179 (3.8%)	27 (3.9%)
Hypertension	365,753 (25.6%)	338,741 (26.8%)	24,383 (17.3%)	2,238 (10.3%)	349 (7.4%)	42 (6.0%)
Kidney failure	10,468 (0.7%)	9,623 (0.8%)	738 (0.5%)	84 (0.4%)	22 (0.5%)	1 (0.1%)
COPD [#]	11,662 (0.8%)	10,990 (0.9%)	591 (0.4%)	67 (0.3%)	12 (0.3%)	2 (0.3%)
Cancer	54,834 (3.8%)	51,186 (4.1%)	3,301 (2.3%)	299 (1.4%)	42 (0.9%)	6 (0.9%)

^aEducation and income were registered for individuals born earlier than October 2005. SD = standard deviation.

[#] Chronic obstructive pulmonary disease

eTable 2. Risk of Covid-19 Infection in Families with Two-Five Members. Cox regression was used to calculate hazard ratios (HR) with the number of immune members in each family as exposure, and the outcome of Covid-19 infection in non-immune family members. Analyses were performed separately for families with 2-5 members, using families with no immunity as reference. Immunity was defined as a previous infection.

Families with two relatives		Model 1 [#]		Model 2 [*]	
Number of individuals with immunity in each family	Incident Covid-19 cases, (%)	HR	95% CI	HR	95% CI
None (N=1,004,018)	36,450 (3.5%)	1	(ref)	1	(ref)
One (N=83,530)	2,258 (2.7%)	0.48	0.46-0.50	0.47	0.45-0.49
Families with three relatives		Model 1 [#]		Model 2 [*]	
Number of individuals with immunity in each family	Incident Covid-19 cases, (%)	HR	95% CI	HR	95% CI
None (N=181,437)	24,258 (13.4%)	1	(ref)	1	(ref)
One (N=45,968)	2,558 (5.6%)	0.44	0.42-0.46	0.43	0.41-0.45
Two (N=15,962)	643 (4.0%)	0.23	0.21-0.25	0.22	0.21-0.24
Families with four relatives		Model 1 [#]		Model 2 [*]	
Number of individuals with immunity in each family	Incident Covid-19 cases, (%)	HR	95% CI	HR	95% CI
None (N=33,944)	14,490 (42.7%)	1	(ref)	1	(ref)
One (N=10,161)	1,580 (15.5%)	0.33	0.31-0.35	0.33	0.32-0.35
Two (N=5,266)	365 (6.9%)	0.13	0.12-0.15	0.13	0.12-0.15
Three (N=4,131)	220 (5.3%)	0.09	0.08-0.10	0.09	0.08-0.10
Families with five relatives		Model 1 [#]		Model 2 [*]	
Number of individuals with immunity in each family	Incident Covid-19 cases, (%)	HR	95% CI	HR	95% CI
None (N=5,065)	3,529 (69.7%)	1	(ref)	1	(ref)
One (N=1,048)	416 (39.7%)	0.45	0.41-0.50	0.45	0.41-0.50
Two (N=519)	73 (14.1%)	0.14	0.11-0.17	0.14	0.11-0.17
Three (N=590)	39 (6.6%)	0.06	0.04-0.08	0.06	0.04-0.08
Four (N=700)	22 (3.1%)	0.03	0.02-0.04	0.03	0.02-0.04

eTable 3. Baseline Characteristics When Immunity Was Defined as 1 Dose of Vaccine.

Baseline characteristics for individuals with no immunity (N=1,453,545) in families with 2-4 family members. Data is presented based on number of immune individuals in each family at baseline. Immunity was defined as a single dose of any vaccine.

	All families (N=1,453,545)	Characteristics based on number of individuals with immunity in each family at baseline			
		0 immune family members (N=1,291,760)	1 immune family member (N=157,148)	2 immune family members (N=4,493)	3 immune family members (N=144)
Age, mean, SD	52.2±17.4	51.7±17.3	56.0±17.9	39.4±16.3	23.4±12.8
Range	1.4-104.2	1.4-104.2	1.3-99.0	3.0-86.7	9.9-68.3
Female sex, N (%)	732,782 (50.4%)	649,534 (50.3%)	81,585 (51.9%)	1,602 (35.7%)	61 (42.4%)
Highest education, N (%)					
Elementary school < 9yrs	59,340 (4.1%)	51,667 (4.0%)	7597 (4.8%)	72 (1.6%)	4 (2.8%)
Elementary school 9yrs	177,413 (12.2%)	156,534 (12.1%)	20171 (12.8%)	682 (15.2%)	26 (18.1%)
Secondary school, 2 yrs	348,428 (24.0%)	304,717 (23.6%)	42862 (27.3%)	837 (18.6%)	12 (8.3%)
Secondary school, >2 yrs	254,367 (17.5%)	227,904 (17.6%)	25322 (16.1%)	1,105 (24.6%)	36 (25.0%)
University education	513,961 (35.4%)	460,247 (35.6%)	52458 (33.4%)	1,224 (27.2%)	32 (22.2%)
Unknown ^a	100,036 (6.9%)	90,691 (7.0%)	8738 (5.6%)	573 (12.8%)	34 (23.6%)
Income (Euro), mean, SD	29,257±80,790	29,616±84,138	26,624±46,454	18,426±19,776	15,065±17,589
Early retirement pension, N (%)	60,378 (4.2%)	53,220 (4.1%)	6,778 (4.3%)	374 (8.3%)	6 (4.2%)
Born in Sweden, N (%)	1,193,374 (82.1%)	1,054,641 (81.6%)	134,663 (85.7%)	3,950 (87.9%)	120 (83.3%)
Diagnoses, N (%)					
Myocardial infarction	28,390 (2.0%)	24,747 (1.9%)	3,609 (2.3%)	32 (0.7%)	2 (1.4%)
Stroke	19,179 (1.3%)	16,408 (1.3%)	2,739 (1.7%)	30 (0.7%)	2 (1.4%)
Diabetes	112,797 (7.8%)	98,521 (7.6%)	14,001 (8.9%)	264 (5.9%)	11 (7.6%)
Hypertension	396,572 (27.3%)	343,103 (26.6%)	52,814 (33.6%)	635 (14.1%)	20 (13.9%)
Kidney failure	11,332 (0.8%)	9,700 (0.8%)	1,592 (1.0%)	38 (0.8%)	2 (1.4%)
COPD [#]	13,184 (0.9%)	11,064 (0.9%)	2,103 (1.3%)	16 (0.4%)	1 (0.7%)
Cancer	60,895 (4.2%)	51,803(4.0%)	8,992 (5.7%)	97 (2.2%)	3 (2.1%)

^aEducation and income was registered for individuals born earlier than October 2005. SD = standard deviation.

[#] Chronic obstructive pulmonary disease

eTable 4. Risk of Covid-19 Infection in Families with Two-Four Members. Cox regression was used to calculate hazard ratios (HR) with the number of immune members in each family as exposure, and the outcome of Covid-19 infection in non-immune family members. Analyses were performed separately for families with 2-4 members, using families with no immunity as reference. Immunity was defined as single dose of vaccine, and individuals with two doses of vaccine or a previous infection were excluded.

Families with two relatives			
Number of individuals with immunity in each family	Incident Covid-19 cases, (%)	HR	95% CI
None (N=1,069,442)	41,058 (3.8%)	1	(ref)
One (N=129,151)	2,464 (1.6%)	0.53	0.51-0.55
Families with three relatives			
Number of individuals with immunity in each family	Incident Covid-19 cases, (%)	HR	95% CI
None (N=187,878)	26,034 (13.9%)	1	(ref)
One (N=23,794)	1,714 (7.2%)	0.51	0.48-0.53
Two (N=3,883)	181 (4.7%)	0.34	0.29-0.39
Families with four relatives			
Number of individuals with immunity in each family	Incident Covid-19 cases, (%)	HR	95% CI
None (N=34,440)	14,949 (43.4%)	1	(ref)
One (N=4,203)	791 (18.8%)	0.37	0.35-0.40
Two (N=610)	59 (9.7%)	0.18	0.14-0.24
Three (N=144)	10 (6.9%)	0.12	0.07-0.23