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Table S1: STROBE Statement—Checklist of items for *cohort studies*

	Item No	Recommendation	Main text page
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	Page 2, Abstract
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	Page 2 and 3, Abstract
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	Page 4, Introduction
Objectives	3	State specific objectives, including any prespecified hypotheses	Page 4 and 5, Introduction
Methods			
Study design	4	Present key elements of study design early in the paper	Page 5, Methods
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Page 5 and 6, Methods
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	Page 6, Methods
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	Not applicable
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Page 5 to 7, Introduction and Methods
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Page 5 and 6, Methods
Bias	9	Describe any efforts to address potential sources of bias	Page 6 and 7, national cohort, adjusted statistical analyses
Study size	10	Explain how the study size was arrived at	Page 5, Methods, no sample size calculation
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Page 6, Methods/Statistical Analysis
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	Page 6 to 7, Methods/Statistical Analysis
		(*b*) Describe any methods used to examine subgroups and interactions	Page 6 to 7, Methods/Statistical Analysis
		(*c*) Explain how missing data were addressed	Page 8, Results, no missing data
		(*d*) If applicable, explain how loss to follow-up was addressed	Not applicable
		(*e*) Describe any sensitivity analyses	Page 7, Methods, Statistical Analysis
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	Page 8 and 10, Results; Table 1
		(b) Give reasons for non-participation at each stage	Page 6, Methods and Page 8, Results
		(c) Consider use of a flow diagram	Supplements eFigure 1
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Table 1, Supplements eTable 2
		(b) Indicate number of participants with missing data for each variable of interest	Page 8, Results, no missing data
		(c) Summarise follow-up time (eg, average and total amount)	Page 8, Results
Outcome data	15*	Report numbers of outcome events or summary measures over time	Page 8 and 10, Results; Tables 2 and 4
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Page 8 to 10, Results; Tables 2 to 4
		(*b*) Report category boundaries when continuous variables were categorized	Page 8 to 10, Results; Tables 2 to 4
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	Page 8 and 9, Results
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	Page 8 to 10, Results; Supplements eTables 2 to 13
Discussion			
Key results	18	Summarise key results with reference to study objectives	Page 10 and 14, Discussion
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	Page 13, Discussion
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Page 14, Discussion
Generalisability	21	Discuss the generalisability (external validity) of the study results	This is a nationwide survey, Page 5
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Page 15

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at http://www.strobe-statement.org.

Table S2: Additional Baseline characteristics of the entire study population as of November 1, 2022

	≥ 75 years	60 to < 75 years	40 to < 60 years	19 to < 40 years	< 19 years	Single previous infection	Repeated previous infections
Number	201,474	456,543	1,210,306	1,312,594	805,395	3,600,868	385,444
Females	114,667 (56.91%)	233,531 (51.15%)	634,882 (52.46%)	671,789 (51.18%)	392,585 (48.74%)	1,838,418 (51.05%)	209,036 (54.23%)
Age (years)	81 (78 - 85)	65 (62 - 69)	49 (44 - 54)	30 (25 - 35)	11 (8 - 15)	38 (22 - 54)	33 (21 - 47)
Five or more vaccine doses	353 (0.18%)	364 (0.08%)	337 (0.03%)	124 (0.01%)	7 (0.00%)	1,158 (0.03%)	27 (0.01%)
Four vaccine doses	75,622 (37.53%)	89,146 (19.53%)	76,921 (6.36%)	36,106 (2.75%)	3,496 (0.43%)	272,520 (7.57%)	8,771 (2.28%)
Three vaccine doses	86,591 (42.98%)	224,159 (49.10%)	589,794 (48.73%)	549,718 (41.88%)	94,980 (11.79%)	1,469,548 (40.81%)	75,694 (19.64%)
One or two vaccine doses	19,238 (9.55%)	61,905 (13.56%)	258,436 (21.35%)	386,909 (29.48%)	206,789 (25.68%)	815,687 (22.65%)	117,590 (30.51%)
Unvaccinated	19,670 (9.76%)	80,969 (17.74%)	284,818 (23.53%)	339,737 (25.88%)	500,123 (62.10%)	1,041,955 (28.94%)	183,362 (47.57%)
Time since last vaccination (days)	258 (63 - 348)	322 (118 - 342)	327 (291 - 346)	323 (290 - 346)	303 (271 - 335)	322 (278 - 344)	329 (287 - 358)
Repeated previous infections	7,820 (3.88%)	22,013 (4.82%)	117,158 (9.68%)	158,768 (12.10%)	79,685 (9.89%)	0 (0%)	385,444 (100%)
Time since last infection (days)	235 (202 - 292)	239 (209 - 286)	246 (217 - 285)	249 (220 - 285)	255 (228 - 284)	251 (222 - 289)	228 (139 - 258)
Most recent infection	2020	2021	2022				
Number	152,967	617,324	3,216,021				
Females	76,814 (50.22%)	301,193 (48.79%)	1,669,447 (51.91%)				
Age (years)	49 (31 - 61)	38 (21 - 54)	37 (22 - 53)				
Five or more vaccine doses	79 (0.05%)	100 (0.02%)	1,006 (0.03%)				
Four vaccine doses	14,920 (9.75%)	24,730 (4.01%)	241,641 (7.51%)				
Three vaccine doses	62,275 (40.71%)	134,710 (21.82%)	1,348,257 (41.92%)				
One or two vaccine doses	59,344 (38.80%)	191,734 (31.06%)	682,199 (21.21%)				
Unvaccinated	16,349 (10.69%)	266,050 (43.10%)	942,918 (29.32%)				
Time since last vaccination (days)	313 (265 - 337)	293 (192 - 353)	325 (287 - 344)				
Repeated previous infections	19 (0.01%)	8,989 (1.46%)	376,436 (11.71%)				
Time since last infection (days)	715 (699 - 727)	361 (343 - 546)	236 (210 - 264)				

Data are n (%) or median (interquartile range)

Table S3: Cox proportional hazard ratios (HRs) with 95% confidence intervals (95% CIs) for SARS-CoV-2 infections from November 1 to December 31, 2022, for four versus three vaccine doses in subgroups according to age, gender, presence or absence of repeated previous SARS-CoV-2 infections, and year of the last previous SARS-CoV-2 infection

	Four vaccine doses	Three vaccine doses	Four vaccine doses	Three vaccine doses	Four vaccine doses	Three vaccine doses
	Age groups					
	≥75 years		60 to <75 years		40 to < 60 years	
SARS-CoV-2 infections (n)	1,795	1,369	2,039	3,481	2,905	15,911
Events per 100,000 person days	29.97	31.22	23.17	29.77	30.94	48.58
Age and gender adjusted HR (95% CI)	0.99 (0.92 - 1.06)	Reference	0.92 (0.87 - 0.98)	Reference	0.81 (0.78 - 0.84)	Reference
	Age groups					
	19 to < 40 years		< 19 years		Females	
SARS-CoV-2 infections (n)	1,722	15,333	50	1,530	4,854	22,953
Events per 100,000 person days	35.36	48.71	12.63	26.45	31.76	50.84
Age and gender adjusted HR (95% CI)	0.91 (0.86 - 0.95)	Reference	0.58 (0.44 - 0.77)	Reference	0.79 (0.77 - 0.82)	Reference
			Repeated previous infections			
	Males		Yes		No	
SARS-CoV-2 infections (n)	3,657	14,671	247	1,611	8,264	36,013
Events per 100,000 person days	26.03	36.15	23.98	36.63	29.20	44.28
Age and gender adjusted HR (95% CI)	0.89 (0.86 - 0.93)	Reference	0.82 (0.71 - 0.94)	Reference	0.83 (0.81 - 0.86)	Reference
	Most recent SARS-CoV-2 infection					
	2020		2021		2022	
SARS-CoV-2 infections (n)	917	2,984	1,035	4,897	6,559	29,743
Events per 100,000 person days	68.19	84.14	45.85	63.00	25.49	39.97
Age and gender adjusted HR (95% CI)	0.98 (0.90 - 1.06)	Reference	0.93 (0.87 - 1.00)	Reference	0.83 (0.80 - 0.85)	Reference

Table S4: Cox proportional hazard ratios (HRs) with 95% confidence intervals (95% CIs) for SARS-CoV-2 infections from November 1 to December 31, 2022, for individuals with and without repeated previous SARS-CoV-2 infections stratified according to the number of vaccinations

	Repeated previous SARS-CoV-2 infections			
	Yes	No	Yes	No
	Four vaccine doses		Three vaccine doses	
SARS-CoV-2 infections (n)	247	8,264	1,611	36,013
Events per 100,000 person days	23.98	29.20	36.63	44.28
Age and gender adjusted HR (95% CI)	0.84 (0.74 - 0.95)	Reference	0.82 (0.78 - 0.86)	Reference
Age, gender and year of the last previous infection adjusted HR (95% CI)	0.94 (0.82 - 1.06)	Reference	0.89 (0.85 - 0.94)	Reference
	One or two vaccine doses		Unvaccinated	
	Yes	No	Yes	No
SARS-CoV-2 infections (n)	2,300	20,254	2,035	18,332
Events per 100,000 person days	33.50	42.43	18.66	29.63
Age and gender adjusted HR (95% CI)	0.78 (0.74 - 0.81)	Reference	0.62 (0.59 - 0.65)	Reference
Age, gender and year of the last previous infection adjusted HR (95% CI)	0.96 (0.92 -1.00)	Reference	0.63 (0.60 - 0.66)	Reference

Table S5: Cox proportional hazard ratios (HRs) with 95% confidence intervals (95% CIs) for SARS-CoV-2 infections from November 1 to December 31, 2022, for individuals according to the year of the most recent previous SARS-CoV-2 infection and stratified according to the number of vaccinations

	Year of the last previous SARS-CoV-2 infection					
	2020	2021	2022	2020	2021	2022
	Four vaccine doses			Three vaccine doses		
SARS-CoV-2 infections (n)	917	1,035	6,559	2,984	4,897	29,743
Events per 100,000 person days	68·19	45·85	25·49	84·14	63·00	39·97
Age and gender adjusted HR (95% CI)	Reference	0·67 (0·61 - 0·73)	0·37 (0·34 - 0·40)	Reference	0·74 (0·71 - 0·77)	0·45 (0·43 - 0·47)
Age, gender and presence of repeated previous infections adjusted HR (95% CI)	Reference	0·67 (0·61 - 0·73)	0·37 (0·35 - 0·40)	Reference	0·74 (0·70 - 0·77)	0·45 (0·44 - 0·47)
	One or two vaccine doses			Unvaccinated		
SARS-CoV-2 infections (n)	2,849	6,214	13,491	489	4,818	15,060
Events per 100,000 person days	84·44	55·75	33·66	50·69	30·50	26·88
Age and gender adjusted HR (95% CI)	Reference	0·67 (0·64 - 0·70)	0·41 (0·39 - 0·43)	Reference	0·66 (0·60 - 0·73)	0·59 (0·54 - 0·64)
Age, gender and presence of repeated previous infections adjusted HR (95% CI)	Reference	0·67 (0·64 - 0·70)	0·41 (0·40 - 0·43)	Reference	0·65 (0·59 - 0·72)	0·63 (0·58 - 0·70)

Table S6: Cox proportional hazard ratios (HRs) with 95% confidence intervals (95% CI) for SARS-CoV-2 infections according to each month from November 2022 to June 2023, comparing the group with four vaccinations versus groups with three, one to two and no vaccination

	November 2022	December 2022	January 2023	February 2023	March 2023	April 2023	May 2023	June 2023
	Age and gender adjusted HRs (95% CIs) for the group with four vaccine doses as compared to the respective reference group							
Three vaccine doses (reference)	0.79 (0.75-0.82)	0.87 (0.84-0.89)	0.90 (0.87-0.94)	1.05 (1.02-1.07)	1.18 (1.15-1.21)	1.34 (1.28-1.41)	1.56 (1.44-1.68)	1.43 (1.24-1.64)
One or two vaccine doses (reference)	0.66 (0.63-0.70	0.88 (0.85-0.91)	1.10 (1.05-1.15)	1.44 (1.39-1.48)	1.73 (1.68-1.79)	1.99 (1.86-2.12)	2.86 (2.57-3.18)	2.60 (2.14-3.15)
Unvaccinated (reference)	0.78 (0.74-0.82)	1,33 (1,28-1,39)	1.97 (1.87-2.07)	3.24 (3.13-3.36)	3.67 (3.53-3.82)	4.77 (4.41-5.17)	7.92 (6.93-9.06)	7.34 (5.75-9.37)

Table S7: Cox proportional hazard ratios (HRs) with 95% confidence intervals (95% CIs) for COVID 19-deaths and SARS-CoV-2 infections according to vaccination status from November 1 to December 31, 2022 in adults (all individuals aged at least 19 years)

	Four vaccine doses	Three vaccine doses	One or two vaccine doses	Unvaccinated
	COVID-19 deaths			
COVID-19 deaths (n)	31	20	7	11
Events per 100,000 person days	0.11	0.02	0.02	0.03
Age and gender adjusted HR (95% CI)	1.24 (0.70 - 2.20)	Reference	1.19 (0.50 - 2.82)	1.56 (0.75 - 3.26)
	SARS-CoV-2 infections			
SARS-CoV-2 infections (n)	8,461	36,094	18,965	14,445
Events per 100,000 person days	29.24	45.09	44.46	33.51
Age and gender adjusted HR (95% CI)	0.85 (0.83 - 0.87)	Reference	0.97 (0.95 - 0.98)	0.73 (0.71 - 0.74)

Table S8: Cox proportional hazard ratios (HRs) with 95% confidence intervals (95% CIs) for COVID 19-deaths and SARS-CoV-2 infections according to vaccination status from January 1 to June 30, 2023 in adults (all individuals aged at least 19 years)

	Four vaccine doses	Three vaccine doses	One or two vaccine doses	Unvaccinated
	COVID-19 deaths			
COVID-19 deaths (n)	95	75	26	29
Events per 100,000 person days	0.10	0.03	0.02	0.02
Age and gender adjusted HR (95% CI)	0.96 (0.71 - 1.31)	Reference	1.18 (0.76 - 1.85)	1.08 (0.70 - 1.65)
	SARS-CoV-2 infections			
SARS-CoV-2 infections (n)	29,488	75,813	31,391	16,554
Events per 100,000 person days	31.01	31.54	23.98	12.22
Age and gender adjusted HR (95% CI)	1.18 (1.17 - 1.20)	Reference	0.74 (0.73 - 0.75)	0.38 (0.37 - 0.39)

Table S9: Cox proportional hazard ratios (HRs) with 95% confidence intervals (95% CIs) for SARS-CoV-2 infections according to each month from November 2022 to June 2023, comparing the group with four vaccinations versus groups with three, one to two and no vaccination in adults (all individuals aged at least 19 years)

	November 2022	December 2022	January 2023	February 2023	March 2023	April 2023	May 2023	June 2023
	Age and gender adjusted HRs (95% CIs) for the group with four vaccine doses as compared to the respective reference group							
Three vaccine doses (reference)	0.81 (0.77-0.84)	0.88 (0.86-0.91)	0.92 (0.88-0.95)	1.07 (1.04-1.09)	1.19 (1.16-1.22)	1.36 (1.30-1.43)	1.57 (1.45-1.69)	1.44 (1.25-1.65)
One or two vaccine doses (reference)	0.69 (0.66-0.72)	0.90 (0.87-0.94)	1.11 (1.06-1.16)	1.45 (1.41-1.50)	1.73 (1.67-1.79)	1.97 (1.85-2.10)	2.72 (2.45-3.03)	2.49 (2.06-3.01)
Unvaccinated (reference)	0.85 (0.81-0.89)	1.37 (1.32-1.43)	1.98 (1.89-2.08)	3.03 (2.92-3.14)	3.42 (3.29-3.55)	4.23 (3.92-4.57)	6.56 (5.75-7.49)	5.86 (4.63-7.41)

Table S10: Cox proportional hazard ratios (HR) with 95% confidence intervals (95% CI) for COVID 19-deaths and SARS-CoV-2 infections according to vaccination status from November 1st to December 31st, 2022, in the entire study cohort excluding nursing home residents

	Four vaccine doses	Three vaccine doses	One or two vaccine doses	Unvaccinated
	COVID-19 deaths			
COVID-19 deaths (n)	11	10	2	9
Events per 100.000 person days	0.04	0.01	0.00	0.01
Age and gender adjusted HR (95% CI)	1.03 (0.43 - 2.45)	Reference	0.71 (0.16 - 3.24)	2.55 (1.03 - 6.29)
	SARS-CoV-2 infections			
SARS-CoV-2 infections (n)	7,618	37,131	22,402	20,217
Events per 100.000 person days	26.92	43.57	41.13	27.82
Age and gender adjusted HR (95% CI)	0.81 (0.79 - 0.83)	Reference	0.94 (0.93 - 0,96)	0.65 (0.64 - 0.67)

Table S11: Cox proportional hazard ratios (HR) with 95% confidence intervals (95% CI) for all-cause deaths according to vaccination status from November 1st to December 31st, 2022, in the entire study cohort excluding nursing home residents

	Four vaccine doses	Three vaccine doses	One or two vaccine doses	Unvaccinated
All cause deaths (n)	724	1,214	467	463
Events per 100.000 person days	2.54	1.41	0.85	0.63
Age and gender adjusted HR (95%)	0.63 (0.57 - 0.69)	Reference	1.22 (1.10 - 1.36)	1.03 (0.93 - 1.15)

Table S12: COVID-19 deaths and all-cause deaths according to vaccination status and nursing home residence status from November 1 to December 31, 2022, in the entire study cohort

Vaccine doses	Nursing home residency	Number of COVID 19 deaths (%)	Number of all-cause deaths (%)
Four vaccine doses	No	11 (35.5)	724 (46.2)
	Yes	20 (64.5)	844 (53.8)
Three vaccine doses	No	10 (50)	1,214 (69.5)
	Yes	10 (50)	534 (30.5)
One or two vaccine doses	No	2 (28.6)	467 (76.9)
	Yes	5 (71.4)	140 (23.1)
Unvaccinated	No	9 (81.8)	463 (81.8)
	Yes	2 (16.2)	103 (18.2)
All	No	32 (46.4)	2,868 (63.9)
	Yes	37 (53.6)	1,621 (36.1)

Table S13: Cox proportional hazard ratios (HRs) with 95% confidence intervals (95% CIs) for all-cause deaths in November 2022 and December 2022, comparing the group with four vaccinations versus groups with three, one to two and no vaccination

	November 2022	December 2022
	Age and gender adjusted HRs (95% CIs) for the group with four vaccinations as compared to the respective reference group	
Three vaccine doses (reference)	0.80 (0.72 - 0.89)	0.80 (0.73 - 0.87)
One or two vaccine doses (reference)	0.68 (0.58 - 0.79)	0.72 (0.63 - 0.81)
Unvaccinated (reference)	0.93 (0.79 - 1.09)	0.89 (0.78 - 1.01)

Figure S1: Participant selection chart