Additional file 1

Contents

Data sources

In this study, we use data from several national registries that were individually linked in the Norwegian preparedness registry (Beredt C19). The data sources and variables used are shown in Table S1. All sources contain individual level data and were linked by using hashed national identity numbers. More information can be found on: https://www.fhi.no/en/id/infectious-diseases/coronavirus/emergency-preparedness-register-for-covid-19/

Table S1. Data sources in the Norwegian preparedness registry (Beredt C19) used in this study and variables retrieved from each source

Norwegian Abbreviation	Full name of data source	Information obtained
DSF	The National Population Register	Age, Sex, County of residence*, Country of birth, Date of death
SYSVAK	The National Immunisation Register	Date of vaccination, Vaccine product type
NIPaR	Norwegian Intensive Care and Pandemic Registry	Date of hospitalisation, COVID-19 as main cause of admission, Date of ICU admission
MSIS	The Surveillance System for Infectious Diseases	Date of sample of SARS-CoV-2 positive test, Date of COVID-19 associated death
SSB	Statistics Norway	Crowding (see definition below)
Beredt C19 risikogrupper	Table prepared in Beredt C19 Source: Norwegian Patient Registry (NPR): individual level data from all public specialist health-care services in Norway.	Defines risk groups (see definition below)

* The county of residence was updated in January 2022, which might lead to some errors for individuals who have moved the last half year

Crowding[41]: Individuals are considered to live in crowded conditions if the number of rooms is lower than the number of residents or one resident lives in one room, and the number of square metres (P-area) is below 25 sq. m. per person. If the number of rooms or the P-area is not specified, a household will be regarded as crowded if one of these criteria is met.

Risk groups: Some underlying medical conditions increase the risk of severe COVID-19 outcomes, regardless of age. These individuals have been prioritised in the vaccination programme in Norway. The underlying comorbidities that have been defined as increasing the risk of severe COVID-19 are divided into two groups:

High risk: people with diseases/conditions that carry a high risk of severe COVID-19:
- Organ transplant
- Immunodeficiency
- Haematological cancer in the last five years
- Other active cancers
- Neurological or neuromuscular diseases that cause impaired cough or lung function (e.g., ALS and cerebral palsy)
- Chronic kidney disease, or significant renal impairment.

Medium risk: people with diseases/conditions that entail a moderate risk of severe COVID-19:
- Chronic liver disease or significant hepatic impairment
- Diseases requiring immunosuppressive therapy
- Diabetes
- Chronic lung disease including cystic fibrosis and severe asthma which have required the use of high dose inhaled or oral steroids within the past year
- Obesity with a body mass index (BMI) of ≥35 kg/m2
- Dementia
- Chronic heart and vascular disease (with the exception of high blood pressure) and stroke

The COVID-19 epidemic in Norway July-Nov 2021

Figure S1 shows the number of infections and hospitalisation and Figure S2 shows the changing proportion of the different vaccine status categories from July 15th to November 30th, 2021.
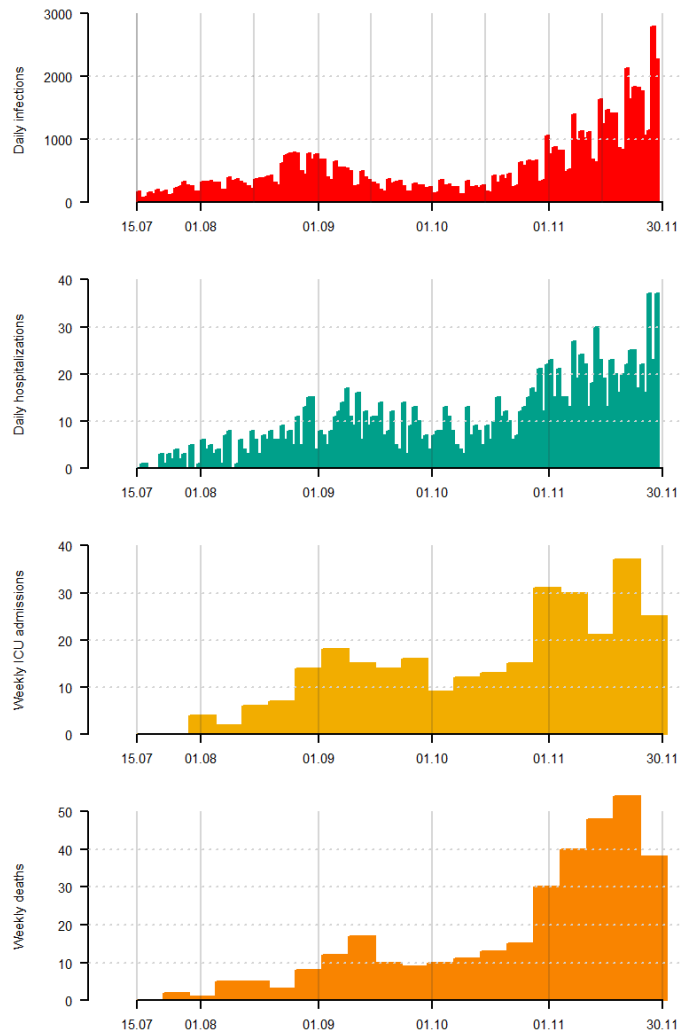

Figure S1. Daily reported cases of SARS-CoV-2 infections (top, red) and number of hospitalisations (upper middle panel, green), and weekly admissions to intensive care unit (ICU, lowed middle, yellow) and deaths (lower, orange) with Covid listed in death certificate in Norway, 15 July-30 November 2021.
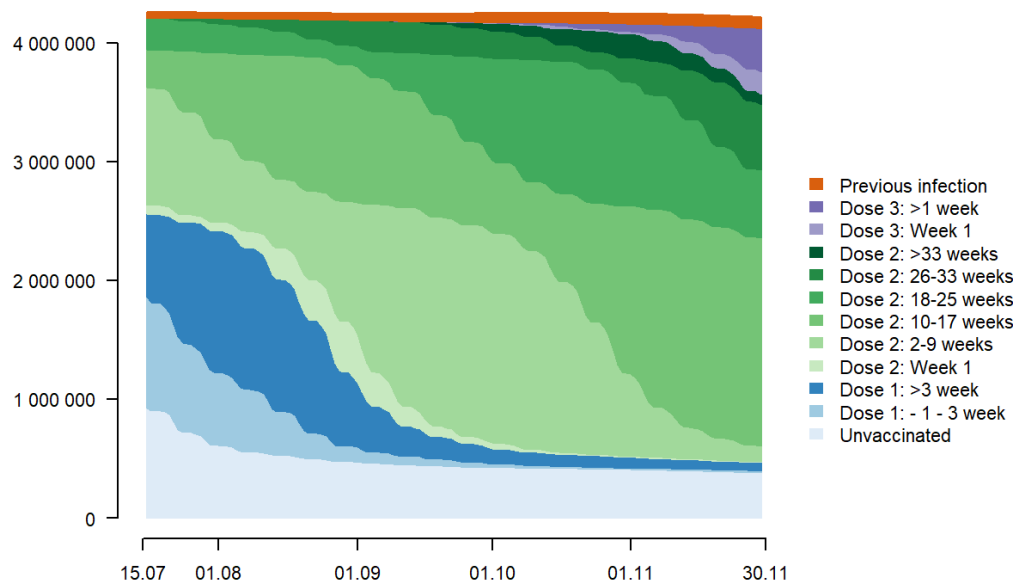
Figure S2. Distribution of vaccine statuses over time in study population in the period 15th of July – 30th of November 2021. The initial cohort had 4 253 872 individuals, with a maximum of 4 253 982 on 19th of July, ending with 4 214 429 on 30th of November 2021.

Modelling vaccine effectiveness

Using Cox proportional hazard models, we estimated the COVID-19 vaccine effectiveness against SARS-CoV-2 infection, hospitalisation, ICU admission, and death associated with COVID-19. We ran three sets of model structures:

- Unadjusted models only using vaccine status as a time-varying covariate. This yields crude vaccine effectiveness estimates.
- Adjusted models with vaccine status as well as age, sex, crowding, country of birth, county of residence and risk group as fixed covariates assuming proportional impact on hazard rates. These were performed to test for impact of covariates.
- Adjusted models with all covariates, except vaccine status, implemented as stratification variables. This allows each combination of covariate groups to have their own baseline hazard rate, while still assuming that vaccination leads to a proportional change in risk of infection, i.e. a less restrictive assumption on the impact of confounders.

For adjusted models where covariates were included as factors whose effect was assumed proportional and directly estimated, for all covariates at least some levels had significant impacts when in models for all adults and not split by vaccine type. We therefore report adjusted vaccine effectiveness estimates in the manuscript from the third model structure allowing impacts of all covariates except vaccine status to possibly be non-proportional.

Table S2. Vaccine effectiveness against SARS-CoV-2 infection for all adults (18+) in Norway, 15 July-30 November 2021. Unadjusted are given for the full cohort, adjusted (aVE) use all covariates as stratification variables in a Cox regression. Subcohort 1 excludes unvaccinated individuals who did not get a SARS-CoV-2 PCR test from December 2020 – January 2022. Subcohort 2 excludes all with comorbidities yielding a high or moderate risk of severe illness.

Vaccine status	Unadjusted VE full cohort	aVE - full cohort	aVE - subcohort 1	Infections full cohort & subcohort 1	Personyears full cohort (subcohort 1)	aVE - subcohort 2	Infections subcohort 2	Person years subcohort 2
Unvaccinated				19 670	183 997 (128 982)		18 162	165 757
1 week before until 3 weeks after dose 1	39·1 % (36·3 – 41·8)	46·0 % (43·4 – 48·5)	60·0 % (58·0 – 61·8)	2 276	73 784	45·7 % (43·0 – 48·3)	2 155	69 623
>3 weeks after dose 1	18·9 % (16·7 – 21·0)	21·2 % (19·0 – 23·3)	43·3 % (41·8 – 44·9)	9 191	163 708	20·8 % (18·5 – 23·1)	8 613	151 116
<1 week after dose 2	53·7 % (51·3 – 56·1)	56·0 % (53·6 – 58·2)	68·4 % (66·7 – 70·0)	1 665	40 638	55·8 % (53·4 – 58·2)	1 570	37 257
Dose 2: 2-9 weeks	82·8 % (82·2 – 83·3)	81·3 % (80·7 – 81·9)	87·0 % (86·6 – 87·4)	5 528	377 421	81·6 % (81·0 – 82·2)	5 003	327 953
Dose 2: 10-17 weeks	72·2 % (71·6 – 72·8)	63·8 % (62·9 – 64·6)	75·4 % (74·8 – 76·0)	17 189	389 106	63·9 % (63·0 – 64·8)	15 094	293 973
Dose 2: 18-25 weeks	66·5 % (65·7 – 67·3)	44·3 % (42·7 – 45·9)	63·3 % (62·2 – 64·3)	9 985	218 114	43·2 % (41·3 – 45·0)	6 512	129 799
Dose 2: 26-33 weeks	64·9 % (63·8 – 65·9)	35·1 % (32·8 – 37·4)	57·1 % (55·5 – 58·6)	5 233	80 587	35·4 % (32·7 – 38·1)	3 396	45 235
Dose 2: >33 weeks	49·3 % (47·0 – 51·5)	8·6 % (4·0 – 13·1)	39·2 % (36·0 – 42·2)	2 174	23 851	6·7 % (1·2 – 11·8)	1 478	13 724
Previous infection	92·0 % (91·0 – 92·9)	93·1 % (92·3 – 93·9)	95·2 % (94·7 – 95·8)	289	26 078	93·0 % (92·0 – 93·8)	254	21 840
Dose 3: First week	77·0 % (75·1 – 78·7)	45·4 % (40·6 – 49·7)	64·5 % (61·4 – 67·4)	669	9 540	42·0 % (35·5 – 47·9)	392	4 778
Dose 3: > 1 week	90·5 % (89·6 – 91·3)	75·6 % (73·1 – 77·8)	84·2 % (82·6 – 85·7)	502	16 872	79·1 % (75·5 – 82·2)	173	6 803

Table S3. Vaccine effectiveness against hospitalisation due to SARS-CoV-2 for all adults (18+) in Norway, 15 July-30 November 2021. Unadjusted are given for the full cohort, adjusted (aVE) use all covariates as stratification variables in a Cox regression. Subcohort 1 excludes unvaccinated individuals who did not get a PCR test from December 2020 – January 2022. Subcohort 2 excludes all with comorbidities yielding a high or moderate risk of severe illness.

Vaccine status	Unadjusted VE full cohort	aVE - full cohort	aVE - subcohort 1	Hospital full cohort & subcohort 1	Person-years full cohort (subcohort 1)	aVE subcohort 2	Hospital subcohort 2	Person-years subcohort 2
Unvaccinated				652	186 688 (131 673)		481	168
1 week before until 3 weeks after dose 1	76·5% (65·1 – 84·2)	62·3% (43·2 – 74·9)	74·3% (61·6 – 82·8)	27	73 892	66·0% (45·9 – 78·7)	21	69 725
>3 weeks after dose 1	83·9% (79·0 – 87·7)	74·6% (66·6 – 80·7)	84·2% (79·2 – 87·9)	63	166 291	79·0% (70·7 – 85·0)	43	153 552
<1 week after dose 2	n.a.	n.a.	n.a.	4	40 668	n.a.	3	37 285
Dose 2: 2-9 weeks	99·0% (98·3 – 99·4)	98·6% (97·5 – 99·2)	99·2% (98·6 – 99·6)	13	378 084	99·1% (98·1 – 99·6)	7	328 570
Dose 2: 10-17 weeks	96·1% (95·0 – 96·9)	96·1% (95·0 – 97·0)	97·8% (97·2 – 98·3)	71	390 477	97·8% (96·7 – 98·6)	25	295 163
Dose 2: 18-25 weeks	78·8% (75·1 – 81·9)	89·0% (86·7 – 90·8)	93·2% (91·8 – 94·4)	207	219 068	92·6% (89·7 – 94·7)	49	130 431
Dose 2: 26-33 weeks	55·2% (47·2 – 62·0)	83·9% (80·4 – 86·8)	90·2% (88·0 – 92·0)	189	81 074	90·5% (86·0 – 93·5)	37	45 559
Dose 2: >33 weeks	-11·3% (-34·4 – 7·8)	66·6% (57·9 – 73·6)	80·2% (75·0 – 84·4)	143	24 095	73·3% (59·6 – 82·3)	36	13 892
Previous infection				4	24 984		2	21 287
Dose 3: First week	61·1% (41·6 – 74·1)	90·3% (85·2 – 93·7)	94·3% (91·3 – 96·3)	25	9 548	94·3% (85·6 – 97·7)	5	4 782
Dose 3: > 1 week	73·3% (61·3 – 81·5)	95·0% (92·6 – 96·6)	96·8% (95·2 – 97·8)	31	16 905		2	6 815

Table S4. **Vaccine effectiveness against admission to intensive care unit (ICU) with SARS-CoV-2 for all adults (18+) in Norway, 15 July-30 November 2021.** Unadjusted are given for the full cohort, adjusted (aVE) use all covariates as stratification variables in a Cox regression. Subcohort 1 excludes unvaccinated individuals who did not get a PCR test from December 2020 – January 2022. Subcohort 2 excludes all with comorbidities yielding a high or moderate risk of severe illness.

Vaccine status	Unadjusted VE full cohort	aVE - full cohort	aVE - subcohort 1	ICU admission full cohort & subcohort 1	Person-years full cohort (subcohort 1)	aVE subcohort 2	ICU admissions subcohort 2	Person-years subcohort 2
Unvaccinated	n.a.	n.a.	n.a.	167	186 757 (131 742)	n.a.	101	168 333
1 week before until 3 weeks after dose 1	n.a.	n.a.	n.a.	3	73 894	n.a.	2	69 727
>3 weeks after dose 1	94·3% (86·1 – 97·7)	90·1% (75·5 – 96·0)	94·7% (86·7 – 97·9)	5	166 309	n.a.	4	153 567
<1 week after dose 2	n.a.	n.a.	n.a.	0	40 668	n.a.	0	37 286
Dose 2: 2-9 weeks	n.a.	n.a.	n.a.	1	378 086	n.a.	1	328 572
Dose 2: 10-17 weeks	96·2% (93·9 – 97·7)	96·9% (94·8 – 98·1)	98·3% (97·1 – 99·0)	18	390 481	98·1% (95·5 – 99·2)	6	295 164
Dose 2: 18-25 weeks	84·3% (77·8 – 88·9)	94·1% (91·3 – 96·0)	96·1% (94·2 – 97·4)	41	219 082	97·3% (93·0 – 99·0)	5	130 435
Dose 2: 26-33 weeks	72·4% (59·3 – 81·3)	92·2% (87·8 – 95·0)	94·9% (91·9 – 96·8)	31	81 090	n.a.	4	45 562
Dose 2: >33 weeks	66·1% (38·5 – 81·3)	86·6% (73·9 – 93·2)	91·7% (83·6 – 95·8)	12	24 110	n.a.	4	13 896
Previous infection	n.a.	n.a.	n.a.	1	25 934	n.a.	1	21 794
Dose 3: First week	n.a.	n.a.	n.a.	4	9 548	n.a.	1	4 782
Dose 3: > 1 week	77·2% (50·5 – 89·5)	95·2% (89·0 – 97·9)	n.a.	7	16 906	n.a.	0	6 815

Table S5. **Vaccine effectiveness against mortality with SARS-CoV-2 for all adults (18+) in Norway, 15 July-30 November 2021.** Unadjusted are given for the full cohort, adjusted (aVE) use all covariates as stratification variables in a Cox regression. Subcohort 1 excludes unvaccinated individuals who did not get a PCR test from December 2020 – January 2022. Subcohort 2 excludes all with comorbidities yielding a high or moderate risk of severe illness.

| Vaccine status	Unadjusted VE full cohort	aVE - full cohort	aVE - subcohort 1	Deaths full cohort & subcohort 1	Person-years full cohort (subcohort 1)	aVE - subcohort 2	Deaths subcohort 2	Person-years subcohort 2
Unvaccinated	n.a.	n.a.	n.a.	81	186 777 (131 762)	n.a.	32	168 345
1 week before until 3 weeks after dose 1	n.a.	n.a.	n.a.	1	73 894	n.a.	1	69 727
>3 weeks after dose 1	77·2% (55·1 – 88·4)	45·2% (-6·4 – 71·8)	70·5% (42·9 – 84·8)	10	166 311	n.a.	1	153 568
<1 week after dose 2	n.a.	n.a.	n.a.	1	40 668	n.a.	1	37 286
Dose 2: 2-9 weeks	n.a.	n.a.	n.a.	3	378 086	n.a.	0	328 572
Dose 2: 10-17 weeks	96·6% (93·0 – 98·4)	93·4% (85·5 – 97·0)	96·9% (93·2 – 98·6)	8	390 481	n.a.	3	295 165
Dose 2: 18-25 weeks	61·2% (44·2 – 73·1)	84·9% (77·1 – 90·0)	91·9% (87·7 – 94·6)	48	219 085	94·5 % (85·4 – 97·9)	6	130 435
Dose 2: 26-33 weeks	-17·3% (-63·3 – 15·8)	82·1% (74·2 – 87·6)	89·9% (85·4 – 93·0)	67	81 092	80·1 % (57·8 – 90·6)	13	45 563
Dose 2: >33 weeks	-373·5% (-559·1 – -240·1)	68·7% (55·5 – 77·9)	82·1% (74·5 – 87·4)	80	24 112	73·0 % (42·7 – 87·2)	14	13 896
Previous infection	n.a.	n.a.	n.a.	3	26 116	n.a.	0	21 874
Dose 3: First week	-49·4% (-168·7 – 16·9)	88·6% (79·4 – 93·7)	93·6 % (88·5 – 96·5)	14	9 548	62·3 % (5·9 – 84·9)	7	4 782
Dose 3: > 1 week	10·9% (-57·9 – 49·7)	95·8% (92·6 – 97·7)	97·6 % (95·7 – 98·7)	15	16 907	n.a.	0	6 816
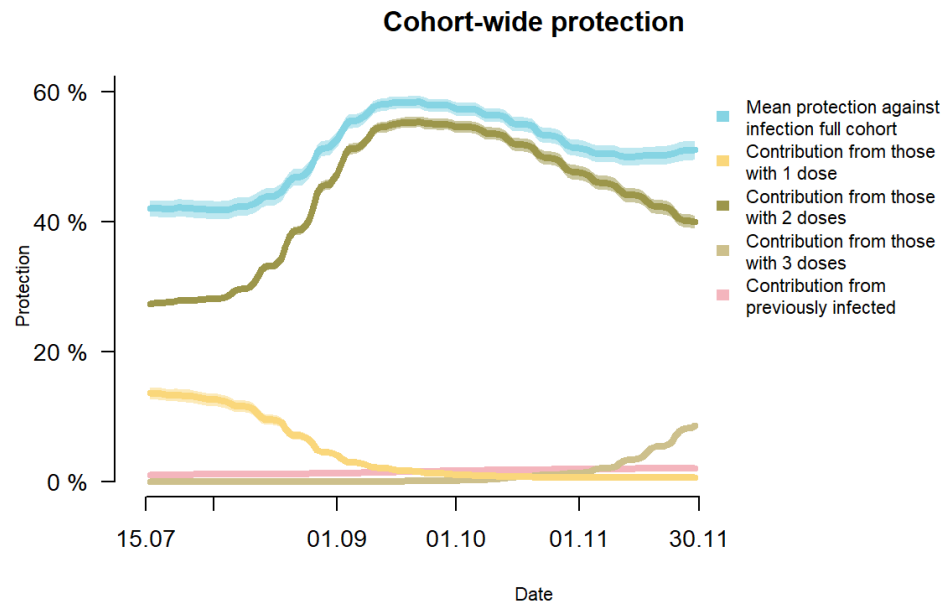
Figure S3. Cohort-wide level of protection against infection over time, 15 July - 30 November 2021. On any individual day the fraction of individuals belonging to the different vaccination categories (see Figure S2) were multiplied with the estimate vaccine effectiveness in the main model without splitting by age and product-types (Table S2). In essence the figure shows the weighted mean vaccine effectiveness over time (blue), with contributions to the overall mean from those with 1 dose (yellow, including period right before and 1 week after 1st dose), individuals with 2 doses (green, including 1st week after 2nd dose), those with 3rd dose (light green, including 1st week after 3rd dose) and those included as previously infected (pink). Note that these contributions are also weighted, i.e. the reason why the pink line for the previously infected is low is that they contribute very little to the overall protection because they constitute a very little part of the cohort, though at the group level they are estimated to have very high protection.

Table S6. Adjusted vaccine effectiveness (aVE) against SARS-CoV-2 infection by age groups (18-44, 45-64 and ≥65 years) among individuals in Norway, 15 July – 30 November 2021. Result split for complete study population (full cohort) and excluding unvaccinated without any SARS-CoV-2 PCR test recorded (subcohort 1). Adjusted using strata for risk groups, county of residence, country of birth, living conditions, sex and age.

Vaccine status	aVE - full cohort	aVE - subcohort 1	Infections	Personyears full cohort (subcohort 1)	Number of individuals at start of study	Number of individuals at end of study
18-44 year old						
Unvaccinated	Ref	Ref	15 085	122 546 (93 827)	712 140	240 519
1 week before until 3 weeks after dose 1	48·9 % (46·3 – 51·4)	60·4 % (58·4 – 62·4)	2 025	62 454	704 570	13 607
>3 weeks after dose 1	24·4 % (22·0 – 26·7)	42·8 % (41·0 – 44·5)	7 464	98 454	183 407	49 184
<1 week after dose 2	58·0 % (55·5 – 60·5)	68·3 % (66·4 – 70·1)	1 313	24 710	22 459	5 388
Dose 2: 2-9 weeks	83·2 % (82·6 – 83·8)	87·6 % (87·1 – 88·1)	3 629	202 928	160 459	106 106
Dose 2: 10-17 weeks	66·4 % (65·4 – 67·4)	75·5 % (74·8 – 76·2)	9 623	133 290	36 572	1 092 202
Dose 2: 18-25 weeks	46·6 % (44·3 – 48·9)	60·8 % (59·1 – 62·5)	2 878	32 526	32 296	146 778
Dose 2: 26-33 weeks	40·8 % (37·3 – 44·0)	56·5 % (54·0 – 58·9)	1 434	11 001	53	104 309
Dose 2: >33 weeks	5·2 % (-1·9 – 11·8)	30·7 % (25·5 – 35·5)	828	4 309	0	0
Dose 3: First week	36·1 % (22·1 – 47·5)	53·4 % (43·2 – 61·8)	101	448	1	16 435
Dose 3: > 1 week	76·5 % (67·9 – 82·8)	82·8 % (76·5 – 87·4)	40	655	9	13 001
Previous infection	92·6 % (91·5 – 93·5)	94·5 % (93·8 – 95·2)	223	15 585	26 518	57 759
45-64 year old						
Unvaccinated	Ref	Ref	3 930	44 019 (27 286)	161 288	101 063
1 week before until 3 weeks after dose 1	25·5 % (14·6 – 35·0)	53·2 % (46·4 – 59·1)	234	10 465	227 992	3 189
>3 weeks after dose 1	8·4 % (2·2 – 14·2)	42·7 % (38·9 – 46·3)	1 632	60 959	497 004	13 564
<1 week after dose 2	49·2 % (42·9 – 54·9)	68·3 % (64·4 – 71·8)	337	15 280	41 275	1 169
Dose 2: 2-9 weeks	75·6 % (74·1 – 77·0)	85·0 % (84·1 – 85·9)	1 827	147 044	352 643	18 822
Dose 2: 10-17 weeks	57·4 % (55·5 – 59·2)	74·3 % (73·2 – 75·4)	6 897	151 677	47 073	644 461
Dose 2: 18-25 weeks	36·4 % (33·3 – 39·4)	61·8 % (59·9 – 63·7)	4 444	61 704	32 855	323 660
Dose 2: 26-33 weeks	32·7 % (28·2 – 37·0)	59·5 % (56·8 – 62·1)	1 454	13 546	133	166 741
Dose 2: >33 weeks	0·5 % (-9·4 – 9·5)	40·1 % (34·1 – 45·5)	514	4 175	0	0
Dose 3: First week	33·1 % (17·8 – 45·6)	59·8 % (50·6 – 67·3)	95	769	0	0
Dose 3: > 1 week	72·1 % (64·7 – 77·9)	83·2 % (78·8 – 86·7)	74	1 720	7	26 554
Previous infection	95·1 % (93·6 – 96·3)	97·0 % (96·1 – 97·7)	52	8 084	14 445	28 351
≥ 65 years old						
Unvaccinated	Ref	Ref	655	17 432 (7 869)	53 030	41 285
1 week before until 3 weeks after dose 1	31·9 % (-10·5 – 58·0)	70·2 % (51·7 – 81·6)	17	865	4 657	1 632
>3 weeks after dose 1	19·3 % (-0·2 – 35·0)	64·7 % (56·2 – 71·6)	95	4 296	20 768	5 411
<1 week after dose 2	2·7 % (-62·8 – 41·8)	57·2 % (28·4 – 74·4)	15	648	7 589	1 097

Dose 2: 2-9 weeks	74·9 % (67·2 – 80·7)	88·9 % (85·5 – 91·5)	72	27 448	477 474	6 295
Dose 2: 10-17 weeks	59·1 % (53·5 – 64·0)	82·0 % (79·5 – 84·1)	669	104 140	232 857	13 493
Dose 2: 18-25 weeks	41·5 % (35·9 – 46·7)	74·7 % (72·2 – 76·9)	2 663	123 884	197 746	103 626
Dose 2: 26-33 weeks	22·4 % (14·8 – 29·3)	66·3 % (63·0 – 69·3)	2 345	56 040	1 554	281 425
Dose 2: >33 weeks	8·4 % (-2·8 – 18·5)	59·9 % (55·0 – 64·3)	832	15 367	0	0
Dose 3: First week	43·3 % (35·7 – 50·0)	75·4 % (72·1 – 78·3)	473	8 324	0	0
Dose 3: > 1 week	73·7 % (69·8 – 77·0)	88·5 % (86·9 – 90·0)	388	14 497	5	325 970
Previous infection	89·0 % (81·3 – 93·5)	95·2 % (91·8 – 97·2)	14	2 408	4 993	7 570

Table S7. Adjusted vaccine effectiveness (aVE) against hospitalisation by age groups (18-44, 45-64 and ≥65 years) among individuals in Norway, 15 July– 30 November 2021. Result split for complete study population (full cohort) and excluding unvaccinated without any SARS-CoV-2 PCR test recorded (subcohort 1). Adjusted using strata for risk groups, county of residence, country of birth, living conditions, sex and age.

Vaccine status	aVE - full cohort	aVE - subcohort 1	Hospitalisations	Personyears full cohort (subcohort 1)
18–44-year-old				
Unvaccinated	Ref	Ref	253	124 757 (96 038)
1 week before until 3 weeks after dose 1	75·1 % (55·0 – 86·2)	80·6 % (65·0 – 89·2)	13	62 552
>3 weeks after dose 1	82·9 % (73·0 – 89·2)	87·0 % (79·4 – 91·7)	22	100 596
<1 week after dose 2	n.a.	n.a.	1	24 735
Dose 2: 2-9 weeks	98·4 % (96·4 – 99·3)	98·8 % (97·3 – 99·5)	6	203 405
Dose 2: 10-17 weeks	98·3 % (96·4 – 99·2)	98·8 % (97·4 – 99·4)	7	134 065
Dose 2: 18-25 weeks	89·8 % (81·4 – 94·5)	92·3 % (86·0 – 95·8)	13	32 833
Dose 2: 26-33 weeks	86·7 % (70·3 – 94·1)	89·9 % (77·5 – 95·5)	7	11 146
Dose 2: >33 weeks	n.a.	n.a.	3	4 398
Dose 3: First week	n.a.	n.a.	0	449
Dose 3: > 1 week	n.a.	n.a.	1	658
Previous infection	n.a.	n.a.	1	15 390
45–64-year-old				
Unvaccinated	Ref	Ref	239	44 450 (27 717)
1 week before until 3 weeks after dose 1	38·4 % (-14·5 – 66·9)	60·5 % (26·7 – 78·7)	11	10 474
>3 weeks after dose 1	71·4 % (56·2 – 81·4)	81·9 % (72·3 – 88·2)	27	61 387
<1 week after dose 2	n.a.	n.a.	1	15 285
Dose 2: 2-9 weeks	99·1 % (97·7 – 99·6)	99·4 % (98·6 – 99·8)	5	147 227
Dose 2: 10-17 weeks	96·4 % (94·7 – 97·5)	97·9 % (97·0 – 98·6)	35	152 227
Dose 2: 18-25 weeks	90·9 % (87·4 – 93·5)	94·8 % (92·7 – 96·3)	57	62 141
Dose 2: 26-33 weeks	91·5 % (84·7 – 95·2)	95·0 % (91·1 – 97·2)	14	13 687
Dose 2: >33 weeks	65·3 % (33·3 – 82·0)	80·5 % (62·3 – 89·9)	10	4 232
Dose 3: First week	n.a.	n.a.	1	770
Dose 3: > 1 week	85·4 % (65·3 – 93·9)	91·5 % (79·8 – 96·4)	6	1 725
Previous infection	n.a.	n.a.	2	7 589
≥ 65 years old				
Unvaccinated	Ref	Ref	160	17 481 (7 917)
1 week before until 3 weeks after dose 1	n.a.	n.a.	3	866
>3 weeks after dose 1	56·5 % (24·6 – 74·9)	79·2 % (64·0 – 88·0)	14	4 307
<1 week after dose 2	n.a.	n.a.	2	649
Dose 2: 2-9 weeks	n.a.	n.a.	2	27 452
Dose 2: 10-17 weeks	93·6 % (89·9 – 96·0)	96·9 % (95·2 – 98·1)	29	104 185
Dose 2: 18-25 weeks	86·2 % (82·2 – 89·4)	93·5 % (91·5 – 94·9)	137	124 093
Dose 2: 26-33 weeks	79·9 % (74·5 – 84·1)	90·4 % (87·9 – 92·4)	168	56 240
Dose 2: >33 weeks	61·9 % (50·1 – 70·9)	81·7 % (76·1 – 86·0)	130	15 465
Dose 3: First week	88·8 % (82·5 – 92·8)	94·7 % (91·7 – 96·6)	24	8 329
Dose 3: > 1 week	95·3 % (92·6 – 97·0)	97·8 % (96·5 – 98·6)	24	14 522
Previous infection	n.a.	n.a.	1	2 005

Table S8. Adjusted vaccine effectiveness (aVE) against SARS-CoV-2 infection and hospitalisation by vaccine product type among individuals in Norway, 15 July – 30 November 2021. Adjusted using strata for risk groups, county of residence, country of birth, living conditions, sex, and age.

Vaccine status	SARS-CoV-2 infections			Hospitalisations		
	Adjusted VE	Events	Person years	Adjusted VE	Events	Person years
Comirnaty						
Unvaccinated	n.a.	19 670	183 997	n.a.	652	186 688
1 week before until 3 weeks after dose 1	43·7 % (40·7 – 46·6)	1 823	60 651	58·8 % (34·5 – 74·1)	21	60 735
>3 weeks after dose 1	15·5 % (12·9 – 18·0)	7 532	133 878	75·3 % (66·4 – 81·9)	48	136 031
<1 week after dose 2	52·8 % (49·4 – 56·0)	891	23 179	n.a.	3	23 196
Dose 2: 2-9 weeks	77·7 % (76·8 – 78·5)	3 352	231 500	97·5 % (95·6 – 98·6)	13	231 883
Dose 2: 10-17 weeks	60·0 % (58·9 – 61·0)	10 998	278 007	95·4 % (93·9 – 96·5)	62	278 910
Dose 2: 18-25 weeks	43·9 % (42·1 – 45·7)	7 509	176 006	87·5 % (84·8 – 89·7)	189	176 680
Dose 2: 26-33 weeks	34·3 % (31·4 – 37·1)	3 429	67 758	81·8 % (77·7 – 85·2)	172	68 071
Dose 2: >33 weeks	8·2 % (3·4 – 12·8)	2 100	23 227	63·9 % (54·3 – 71·5)	141	23 461
Spikevax						
1 week before until 3 weeks after dose 1	50·0 % (45·0 – 54·5)	452	13 119	70·8 % (34·0 – 87·0)	6	13 142
>3 weeks after dose 1	38·1 % (34·7 – 41·3)	1 579	28 914	77·1 % (58·9 – 87·3)	12	29 332
<1 week after dose 2	67·7 % (62·7 – 72·0)	192	5 302	n.a.	0	5 305
Dose 2: 2-9 weeks	86·6 % (85·6 – 87·6)	753	46 456	n.a.	0	46 540
Dose 2: 10-17 weeks	72·3 % (70·9 – 73·5)	2 170	43 097	n.a.	4	43 268
Dose 2: 18-25 weeks	55·2 % (52·4 – 57·9)	1 193	21 826	95·3 % (91·5 – 97·4)	12	21 962
Dose 2: 26-33 weeks	44·4 % (40·1 – 48·3)	835	7 588	91·1 % (84·9 – 94·8)	15	7 665
Dose 2: >33 weeks	28·6 % (9·6 – 43·6)	72	603	n.a.	1	613
mRNA combined						
<1 week after dose 2	53·7 % (49·6 – 57·5)	579	12 098	n.a.	1	12 107
Dose 2: 2-9 weeks	84·1 % (83·2 – 85·0)	1 386	95 094	n.a.	0	95 288
Dose 2: 10-17 weeks	68·5 % (67·2 – 69·7)	3 495	47 688	n.a.	4	47 950
Dose 2: 18-25 weeks	40·7 % (23·9 – 53·8)	64	451	n.a.	0	454
Dose 2: 26-33 weeks	n.a.	3	36	n.a.	0	36
Dose 2: >33 weeks	n.a.	1	9	n.a.	0	10

Table S9. Adjusted vaccine effectiveness (aVE) against SARS-CoV-2 infection and hospitalisation after receiving a booster dose by vaccine product type among individuals in Norway, 15 July – 30 November 2021. Adjusted using strata for risk groups, county of residence, country of birth, living conditions, sex, and age.

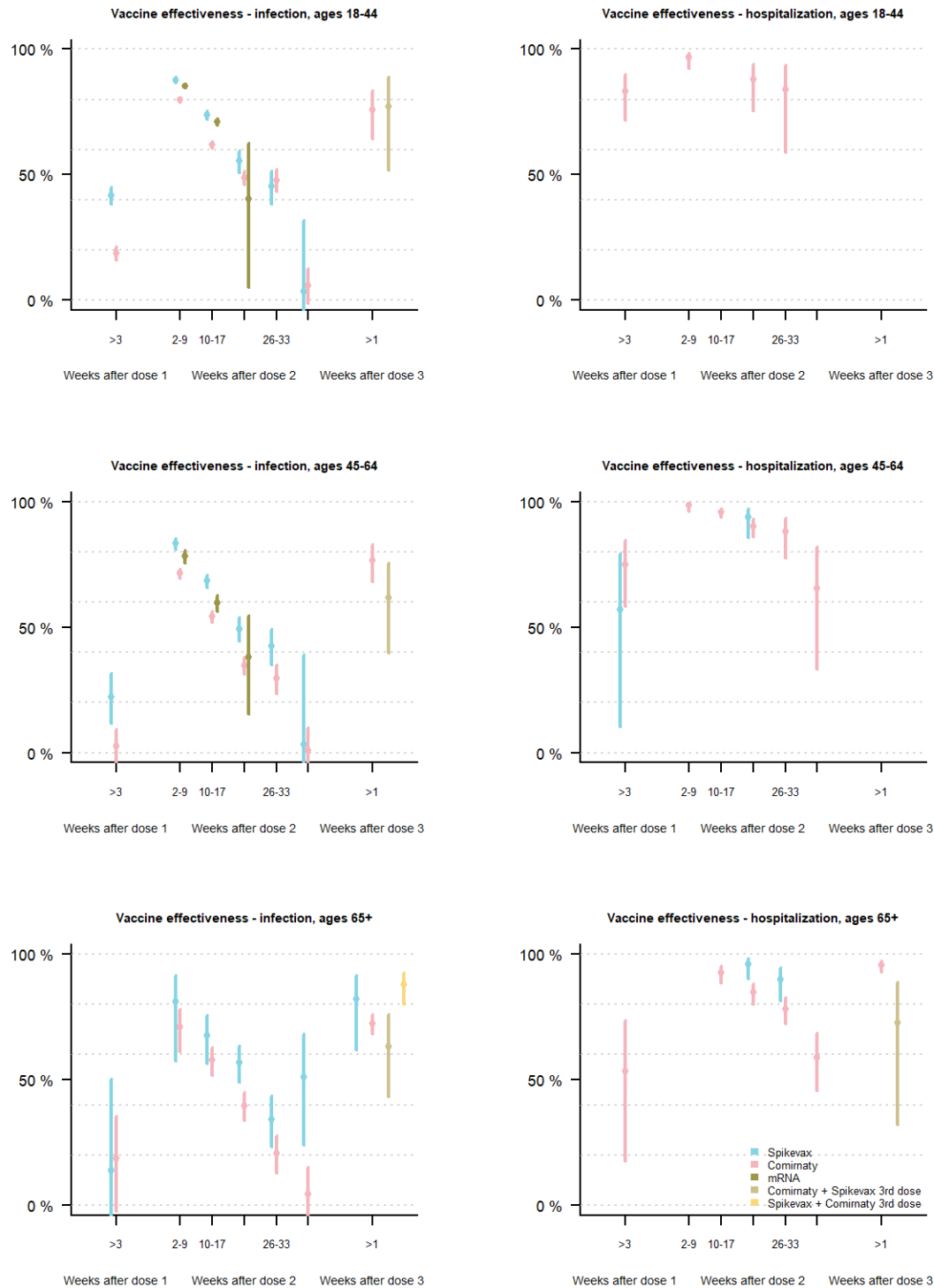| Vaccination			SARS-CoV-2 infections			Hospitalisations		
Primary	Booster		Adjusted VE	Events	Person years	Adjusted VE	Events	Person years
Comirnaty	Comirnaty	Dose 3: 1st week	45·3 % (39·8 – 50·2)	515	7 934	89·1 % (83·0 – 93·0)	23	7 940
		Dose 3: >1 week	75·3 % (72·5 – 77·8)	408	13 994	95·6 % (93·1 – 97·2)	22	14 021
	Spikevax	Dose 3: 1st week	39·9 % (22·0 – 53·7)	58	601	n.a.	2	602
		Dose 3: >1 week	68·2 % (57·6 – 76·1)	48	1 137	73·5 % (45·7 – 87·1)	8	1 140
Spikevax	Spikevax	Dose 3: 1st week	56·1 % (33·0 – 71·2)	22	265	n.a.	0	265
		Dose 3: >1 week	84·9 % (71·8 – 91·9)	10	354	n.a.	1	355
	Comirnaty	Dose 3: 1st week	67·6 % (48·4 – 79·7)	18	423	n.a.	0	423
		Dose 3: >1 week	87·1 % (80·1 – 91·6)	21	1 135	n.a.	0	1 136

Figure S4. Vaccine effectiveness against infection (left panels) and hospitalisations (right panels) for different vaccine products and combinations of booster doses when splitting the cohort by age, 15 July - 30 November 2021. Top panels show vaccine effectiveness estimates for ages 18-44 years, middle panels 45-64 years and lowermost panels for individuals 65 years and older. The qualitatively same pattern appears as in the analyses shown in figure 3 in the main manuscript.