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Impact and efficacy of the COVID vaccination programme

1. Plots of all-cause mortality rates in England by age, gender and vaccination status for the period January 2021 to May 2022

Thea Newman, July 25th 2022

OUTLINE

Background on the ONS dataset
"Age-standardised mortality rates for deaths by vaccination status, England: deaths occurring between 1 January 2021 and 31 May 2022"

Methodology on creating plots

Step-by-step example (females 50–59) of how a plot is created

The plots (using age ranges from the ONS data)

Comments

Data sources

Background

Since November 2021 the UK Office for National Statistics (ONS) has provided detailed datasets on mortality rates (all-cause and COVID) delineated by age, sex and COVID vaccination status for England (cf datasets and notes for more details).

The datasets cover roughly 79% of the population (aged 10 and over), and have been updated approximately every two months. The most recent dataset was released on July 6th and covers the period January 2021 to May 2022. This is the dataset used for this presentation.

The datasets are publicly available, and the ONS provides graphical summaries of key points.

Despite this, the datasets prompt many questions relating to the impact and efficacy of the COVID vaccination programme in England.

Background cont.

As stressed, quite rightly, by the ONS, care must be taken in directly comparing mortality rate data for different vaccination status groups, because of differences in the health status and other factors between groups at different times.

For this reason, as a first step, we provide here time-lines of all-cause mortality rates for the different vaccination status groups (first dose, second dose, booster/third dose), delineated by sex and age.

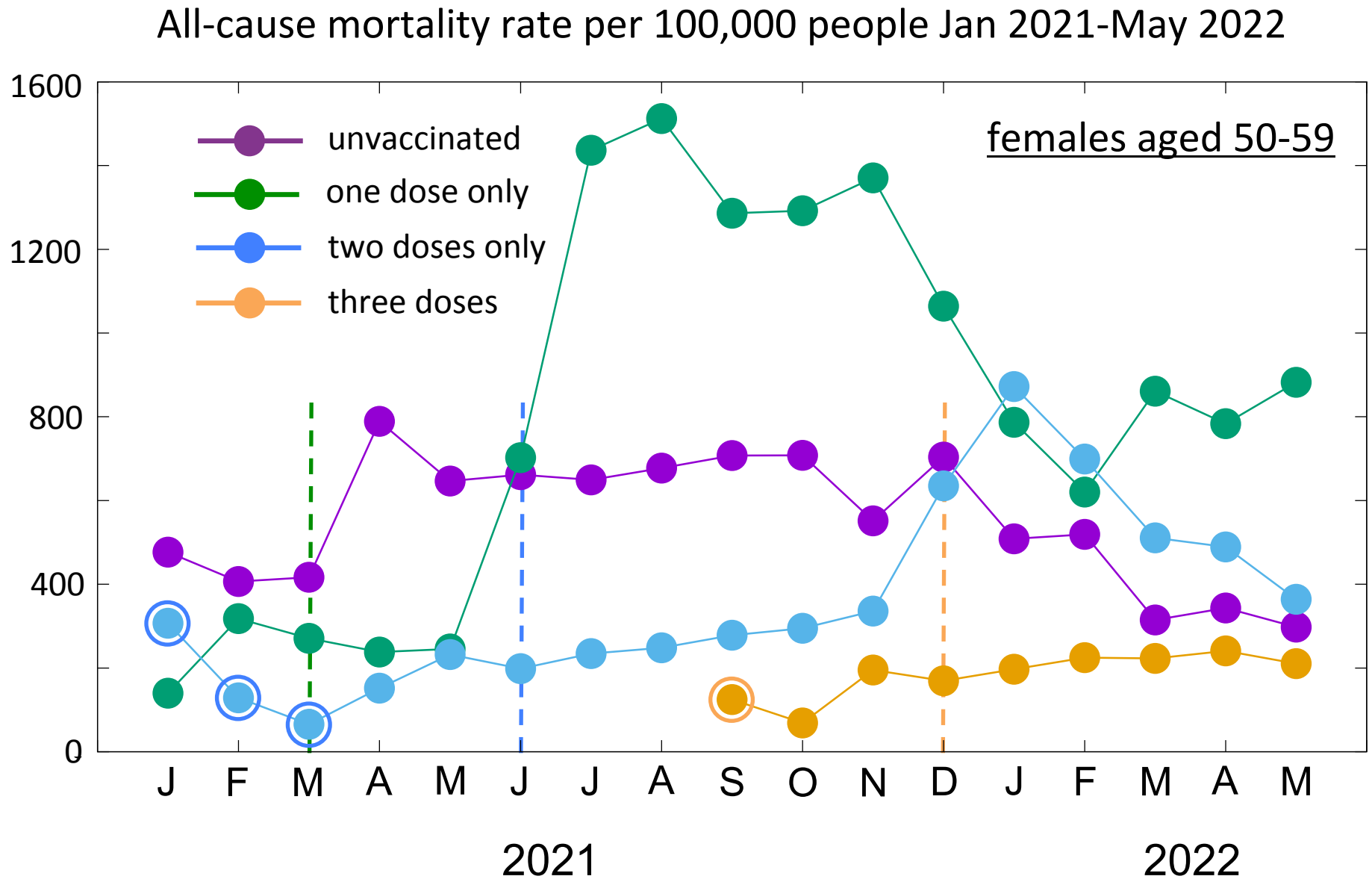
Methodology

We use the ONS data with as little additional calculation as possible.

For clarity we concatenate recent/not recent status for each dosage, requiring us to calculate mortality rates without age standardisation..

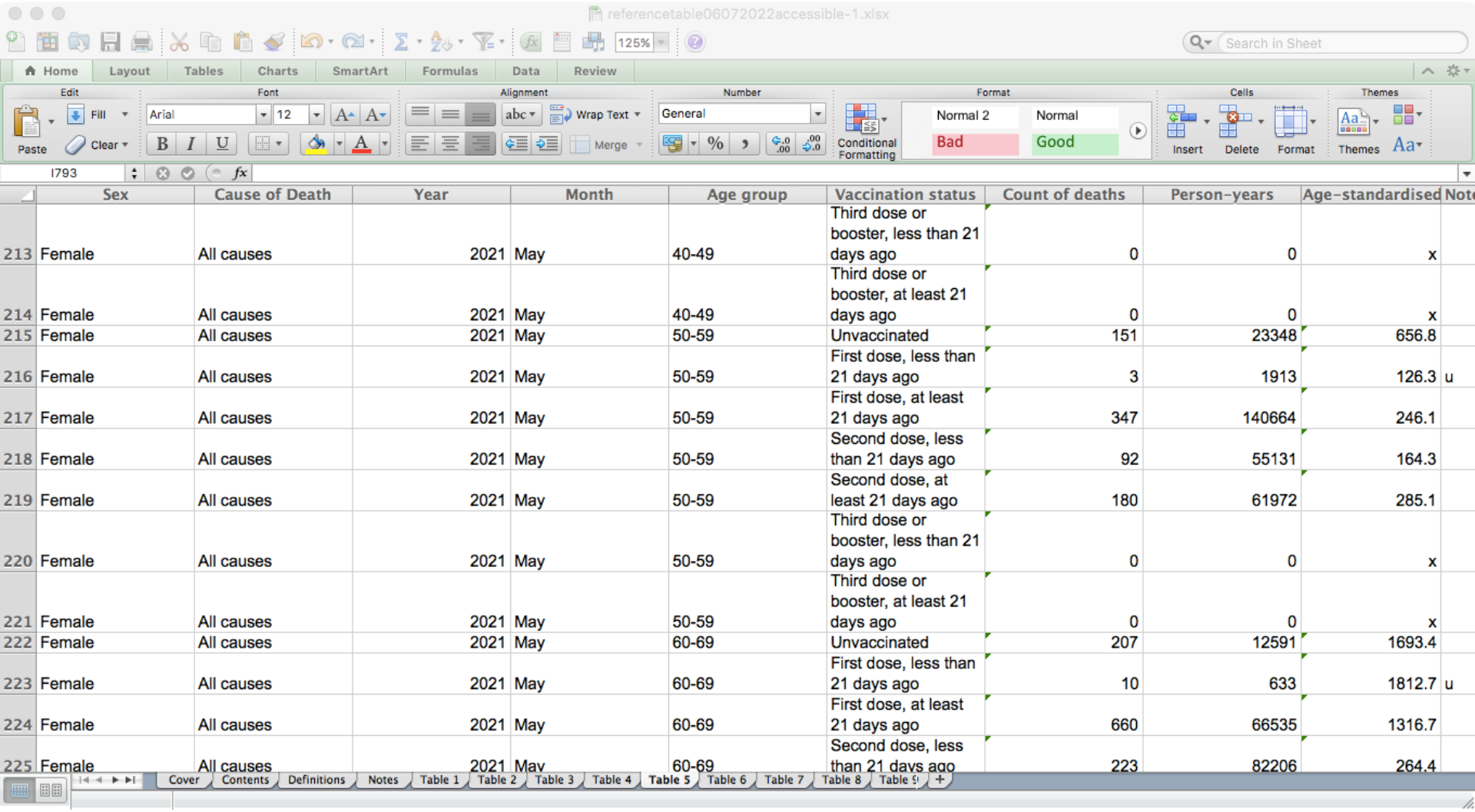
We stress that group sizes change dramatically over the time period (see datasets for details).

Step by step of how we construct the plots: e.g. females aged 50–59



This is an example of a final plot – the sex and age range are given in the top right-hand corner

Step by step of how we construct the plots: e.g. females aged 50–59



referencetable06072022accessible-1.xlsx

	Sex	Cause of Death	Year	Month	Age group	Vaccination status	Count of deaths	Person-years	Age-standardised	Note
213	Female	All causes	2021	May	40-49	Third dose or booster, less than 21 days ago	0	0	x	
214	Female	All causes	2021	May	40-49	Third dose or booster, at least 21 days ago	0	0	x	
215	Female	All causes	2021	May	50-59	Unvaccinated	151	23348	656.8	
216	Female	All causes	2021	May	50-59	First dose, less than 21 days ago	3	1913	126.3	u
217	Female	All causes	2021	May	50-59	First dose, at least 21 days ago	347	140664	246.1	
218	Female	All causes	2021	May	50-59	Second dose, less than 21 days ago	92	55131	164.3	
219	Female	All causes	2021	May	50-59	Second dose, at least 21 days ago	180	61972	285.1	
220	Female	All causes	2021	May	50-59	Third dose or booster, less than 21 days ago	0	0	x	
221	Female	All causes	2021	May	50-59	Third dose or booster, at least 21 days ago	0	0	x	
222	Female	All causes	2021	May	60-69	Unvaccinated	207	12591	1693.4	
223	Female	All causes	2021	May	60-69	First dose, less than 21 days ago	10	633	1812.7	u
224	Female	All causes	2021	May	60-69	First dose, at least 21 days ago	660	66535	1316.7	
225	Female	All causes	2021	May	60-69	Second dose, less than 21 days ago	223	82206	264.4	

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A small portion of the ONS dataset

Here showing data (death counts and person years) for females 50–59 across the seven vaccination status groups in May 2021

Step by step of how we construct the plots: e.g. females aged 50–59

ons_vac_f_50-59.dat

month	d_uv	py_uv	d_v1a	py_v1a	d_v1b	py_v1b	d_v2a	py_v2a	d_v2b	py_v2b	d_v3a	py_v3a	d_v3b	py_v3b
01	1232	258383	25	19014	7	3833	3	1235	1.5	231	0	0	0	0
02	778	191442	104	31268	92	30359	1.5	619	1.5	1715	0	0	0	0
03	454	108928	116	83793	324	78692	6	7924	1.5	3544	0	0	0	0
04	200	25341	28	38656	456	164468	38	26326	31	19058	0	0	0	0
05	151	23348	3	1913	347	140664	92	55131	180	61972	0	0	0	0
06	137	20700	6	1225	182	25542	61	75472	389	151050	0	0	0	0
07	131	20177	1.5	806	108	6817	15	7334	584	248021	0	0	0	0
08	132	19480	3	473	80	5015	8	1742	633	256508	0	0	0	0
09	130	18380	1.5	340	56	4130	1.5	866	694	249098	1.5	1203	0	0
10	132	18646	1.5	248	52	3892	1.5	575	689	233679	12	20366	6	5754
11	98	17777	1.5	212	48	3400	1.5	498	603	179474	46	36668	96	35989
12	127	18046	1.5	262	35	3168	1.5	468	467	73302	87	82624	231	105295
13	90	17701	1.5	263	24	2977	1.5	384	268	30512	33	17393	423	213836
14	82	15799	1.5	129	16	2693	1.5	219	170	24305	4	1893	473	210534
15	55	17465	1.5	40	24	2921	1.5	168	132	25964	1.5	890	525	235416
16	58	16902	1.5	26	20	2718	1.5	106	119	24534	3	601	549	228666
17	52	17482	1.5	20	23	2757	1.5	62	89	24806	1.5	518	498	236850

-:--- **ons_vac_f_50-59.dat** Top L6 (Fundamental)

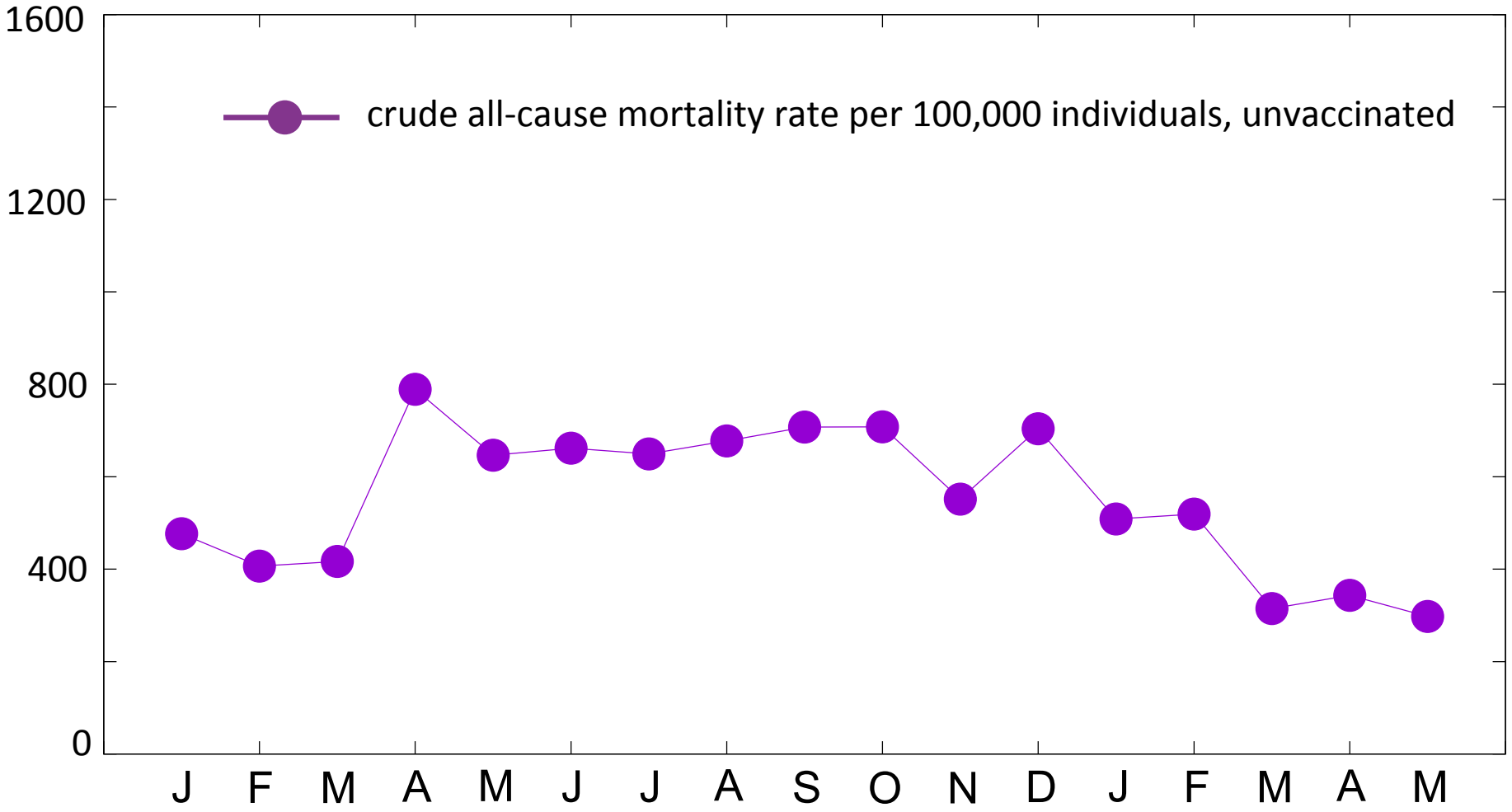
A data file containing death counts and person years collated for each month in the period Jan 2021 – May 2022 for females 50–59 across the seven vaccination status groups

A similar file is created for females and males in each of the seven available age ranges:

18–39, 40–49, 50–59, 60–69, 70–79, 80–89, 90+

(Note, the ONS privacy protected low death count “<3” is replaced here by “1.5”)

Step by step of how we construct the plots: e.g. females aged 50–59

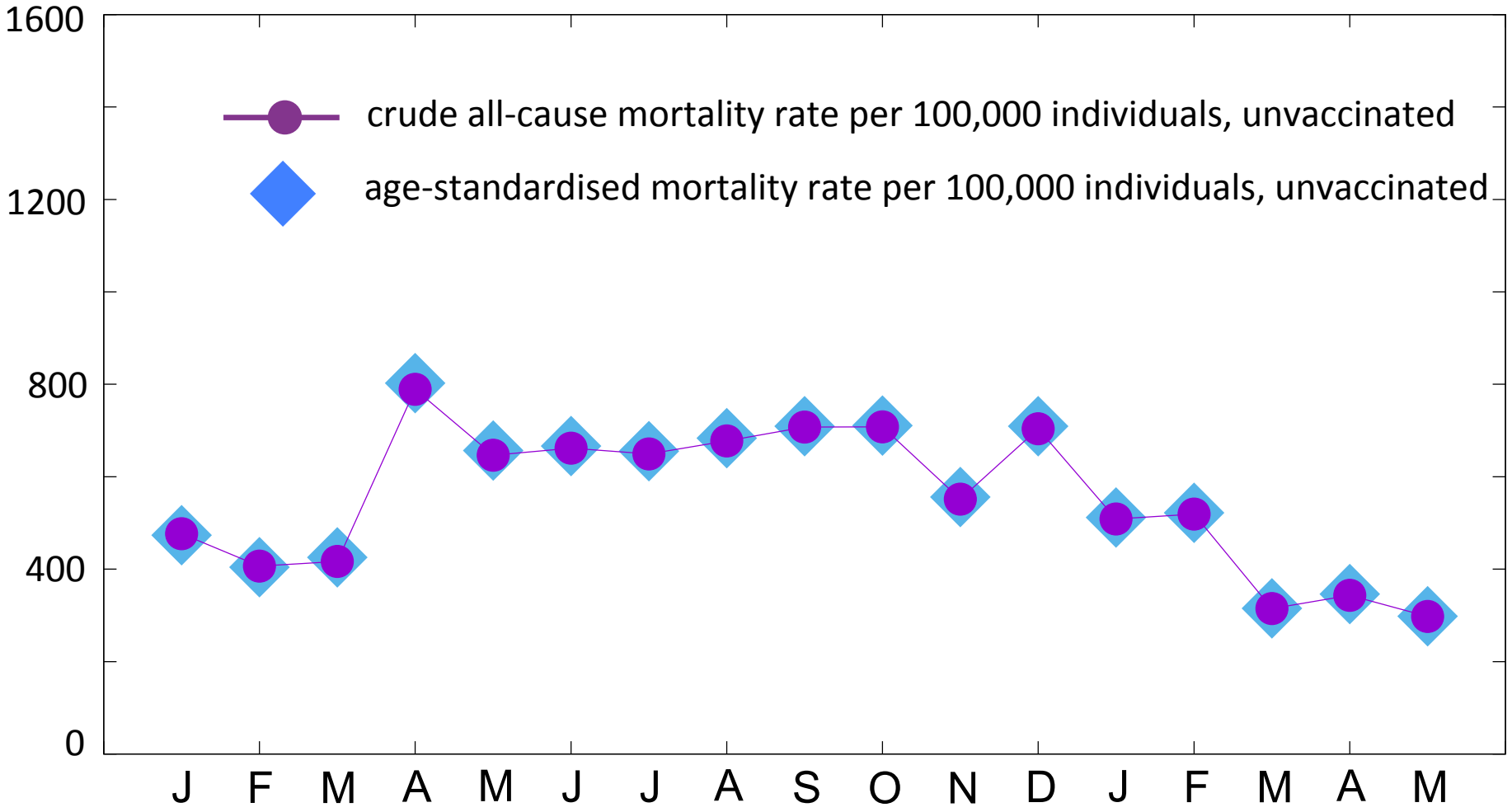


"Crude mortality rate" is defined as: number of deaths / number of individuals

"Number of individuals" for month X is inferred from "person years" registered in that month. This rate is multiplied by 100,000 to give the crude mortality rate per 100,000 individuals.

This is plotted above for the "unvaccinated status" (females 50–59)

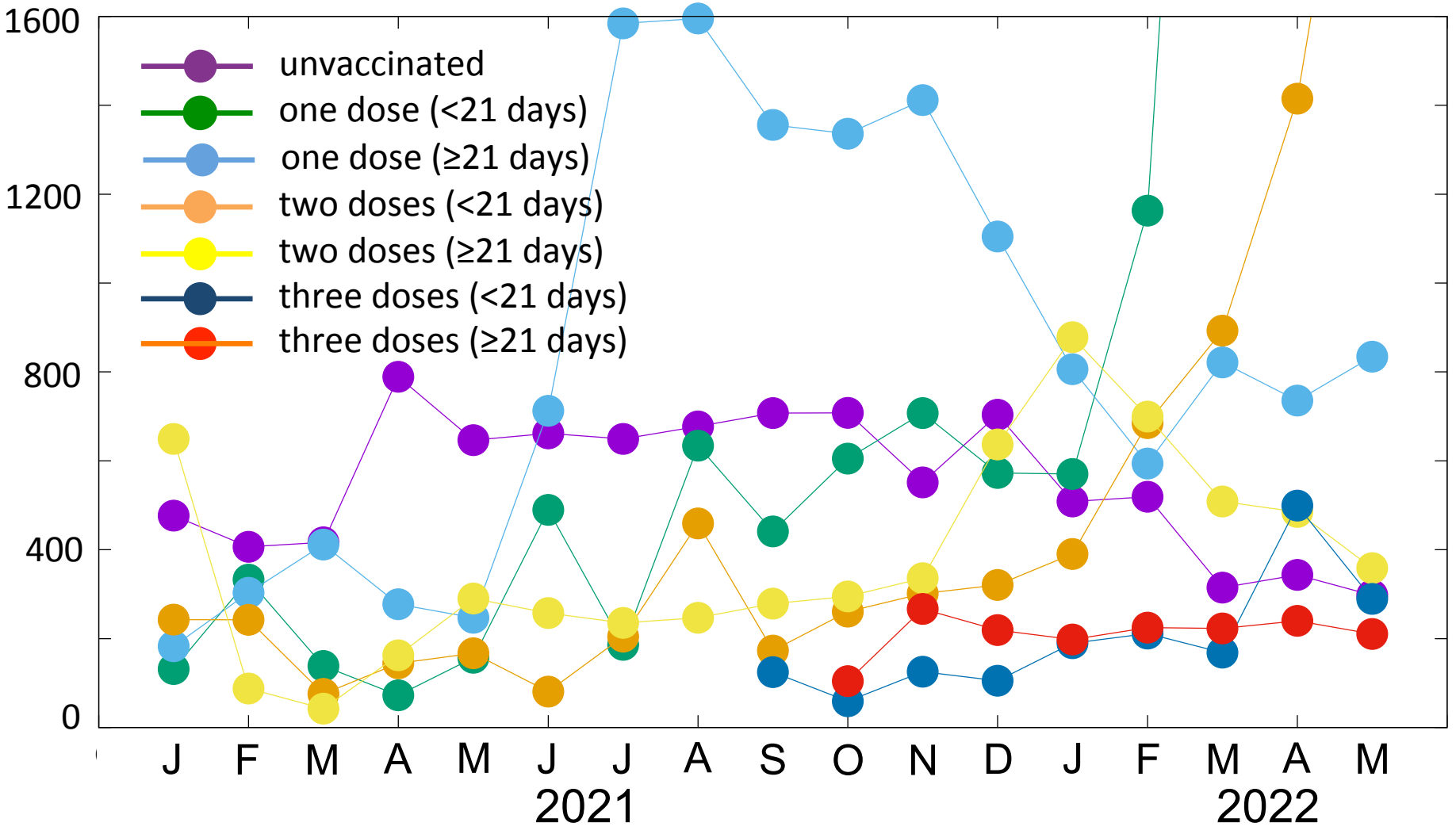
Step by step of how we construct the plots: e.g. females aged 50–59



We can check that the crude mortality rate agrees (within a small tolerance) with the ONS figures for age-standardised mortality rate

(independent calculation of ASMR requires raw data that we do not have access to presently)

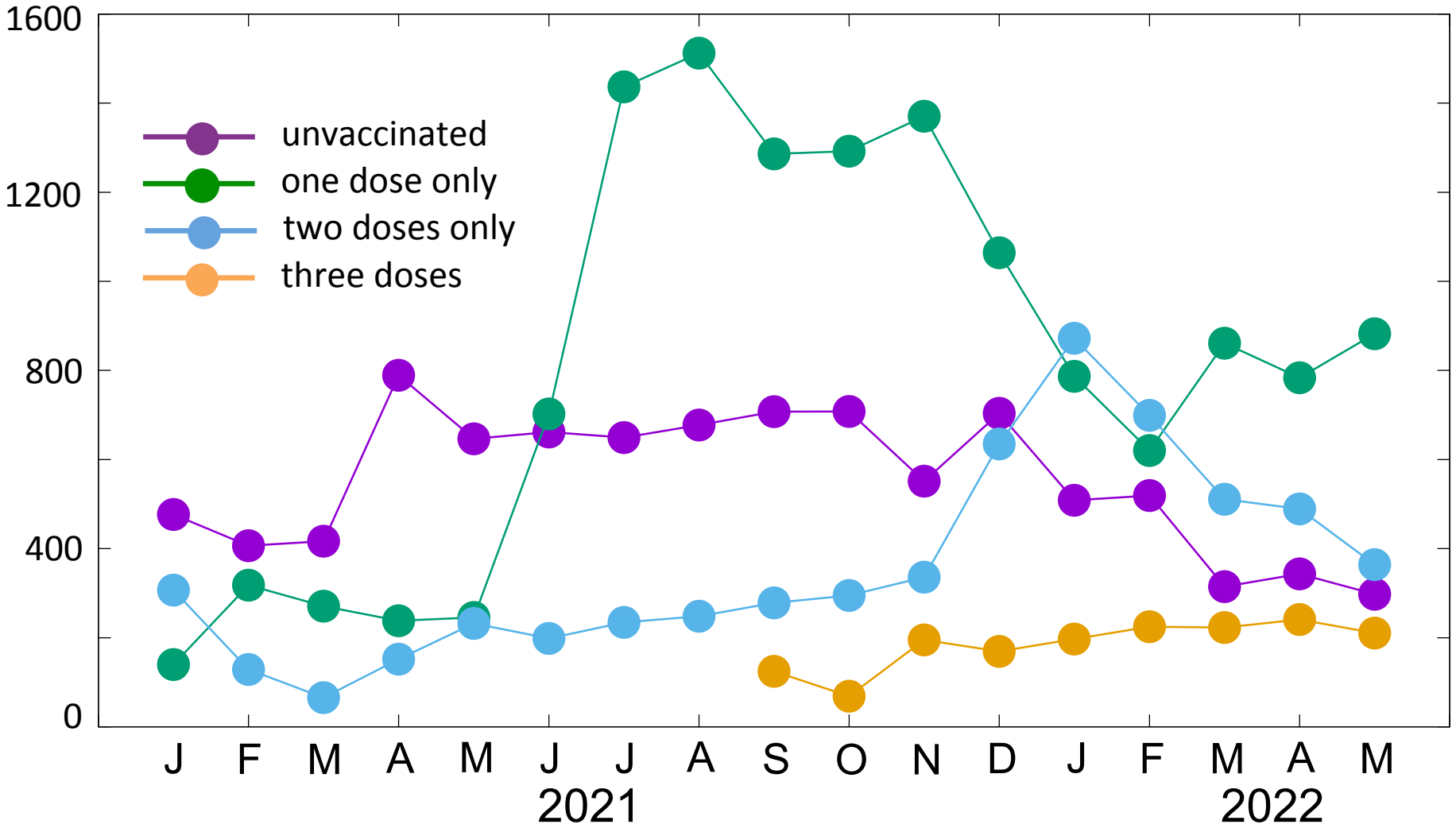
Step by step of how we construct the plots: e.g. females aged 50–59



Crude all-cause mortality rates per 100,000 individuals: all seven vaccination status groups

This is too much information on one graph…

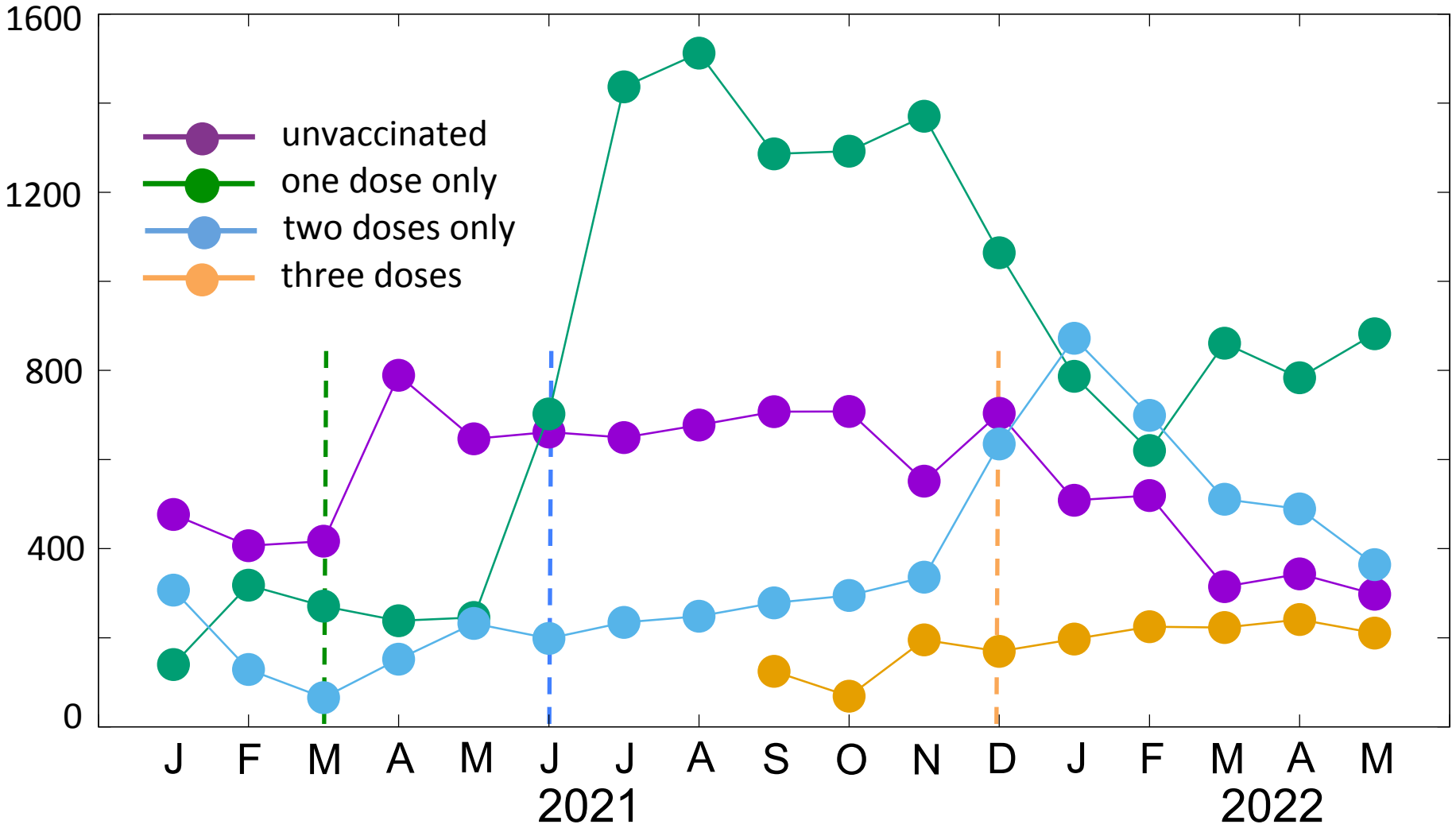
Step by step of how we construct the plots: e.g. females aged 50–59



Crude mortality rates per 100,000 individuals plotted for four concatenated vaccination groups

Therefore, for clarity, we concatenate to four vaccination status groups:
i) unvaccinated, ii) one dose only, ii) two doses only, iii) three doses (two doses plus booster)

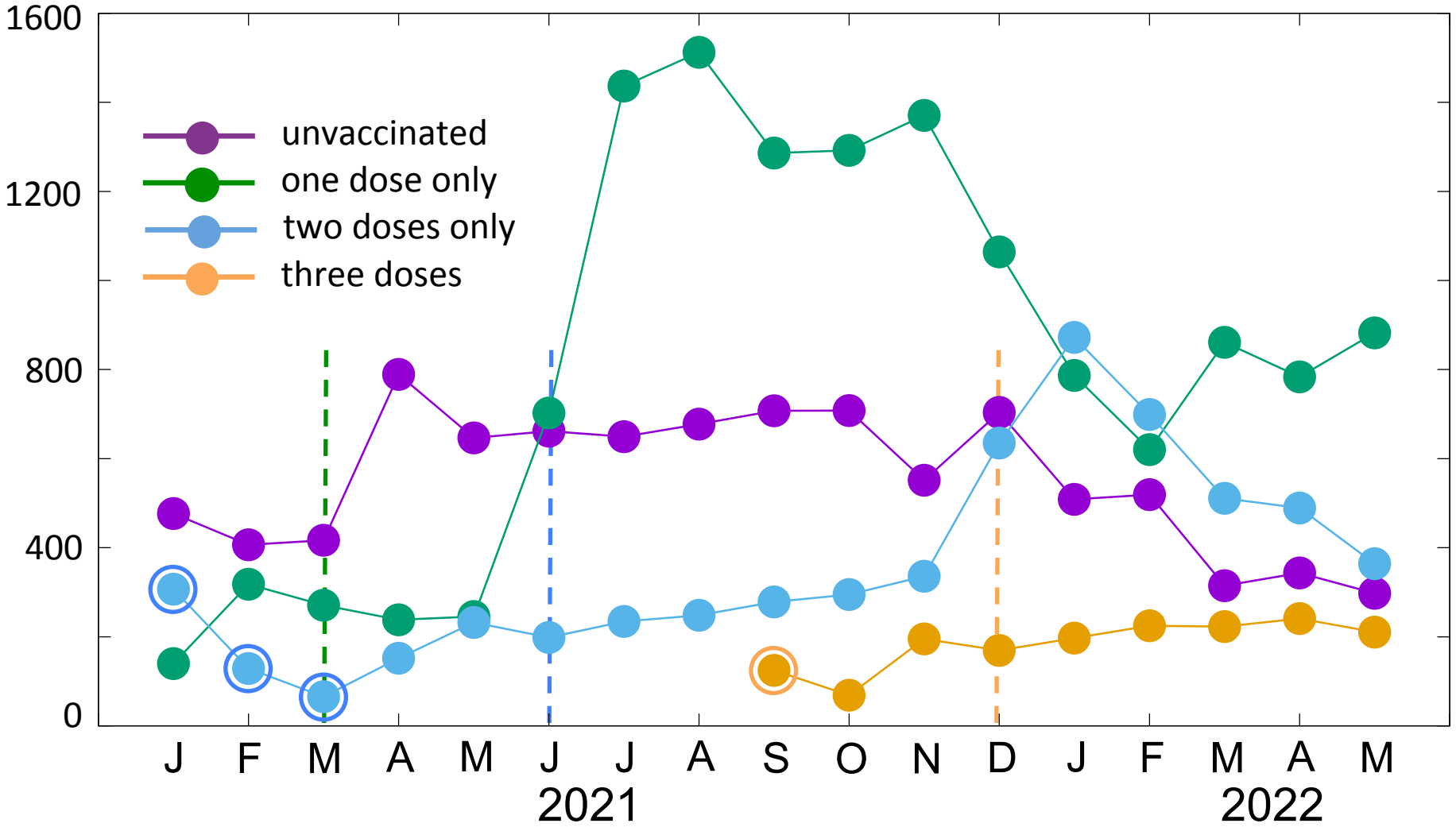
Step by step of how we construct the plots: e.g. females aged 50–59



Crude mortality rates per 100,000 individuals plotted for four concatenated vaccination groups

We indicate by dashed lines the month of peak vaccination for each vaccination status, since these vary significantly for the different age groups

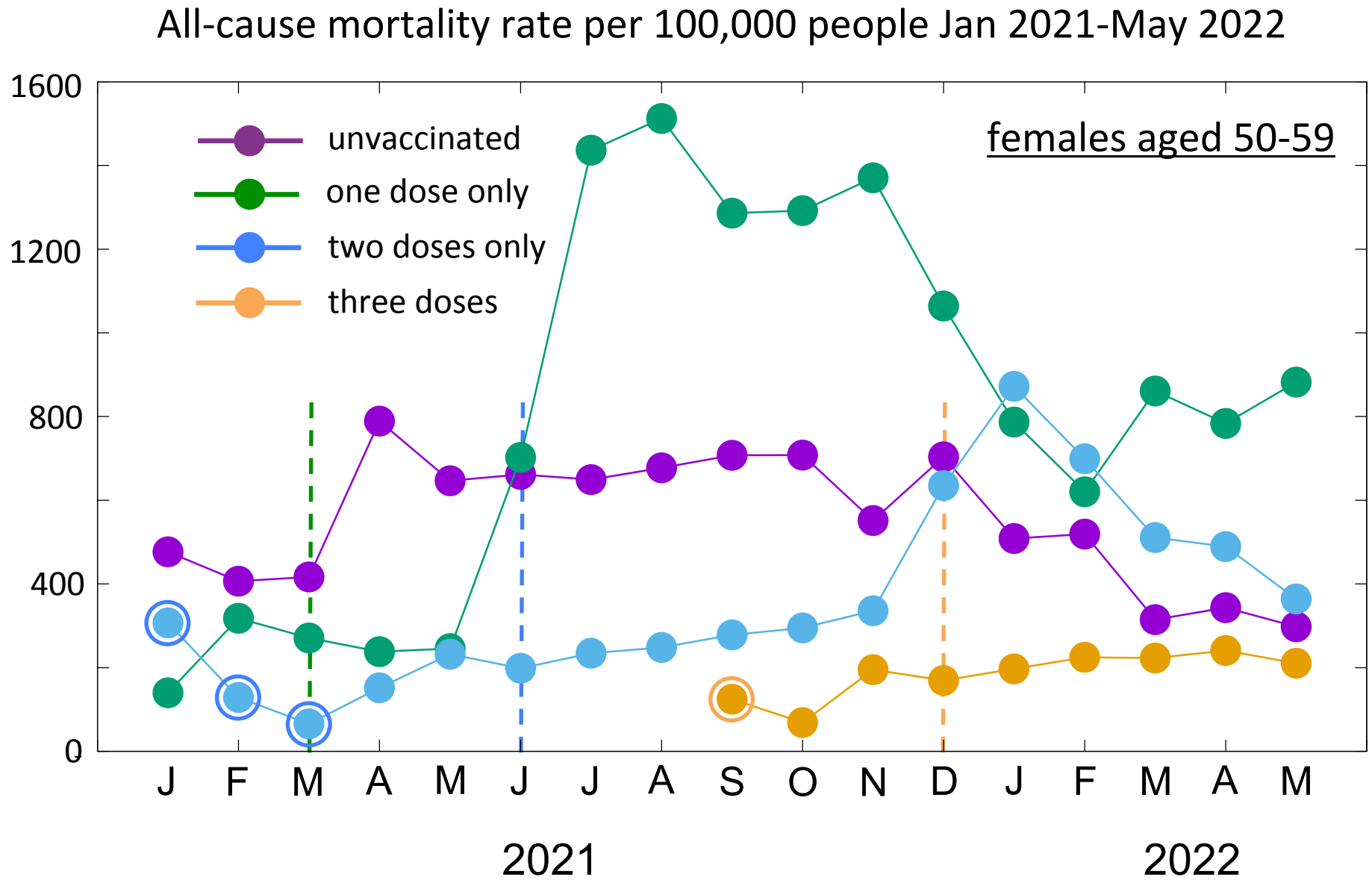
Step by step of how we construct the plots: e.g. females aged 50–59



Crude mortality rates per 100,000 individuals plotted for four concatenated vaccination groups

And, finally we indicate those points for which the uncertainty is particularly large (<10 deaths)

Step by step of how we construct the plots: e.g. females aged 50–59



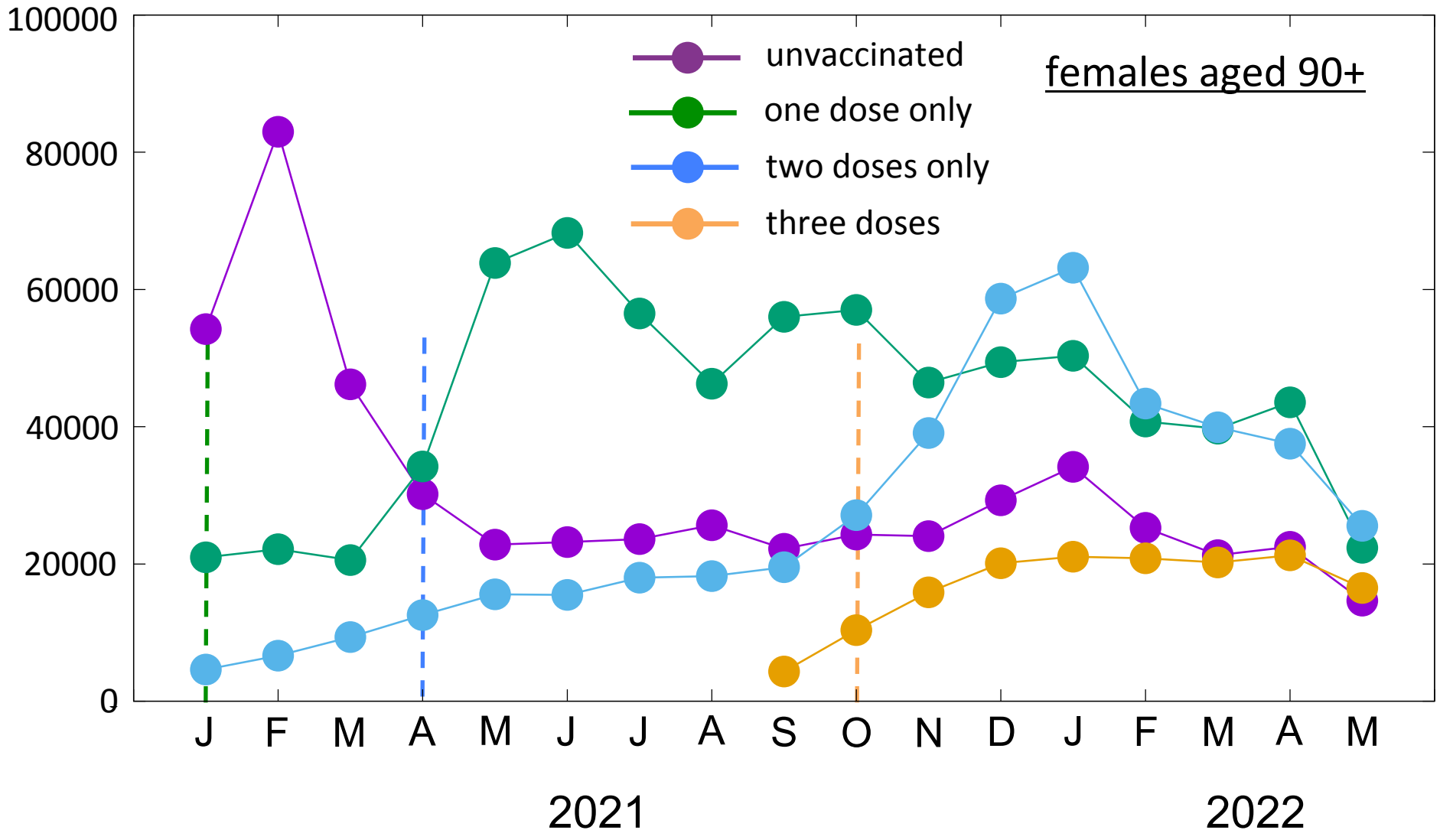
This is the final plot – the sex and age range are given in the top right-hand corner

The plots

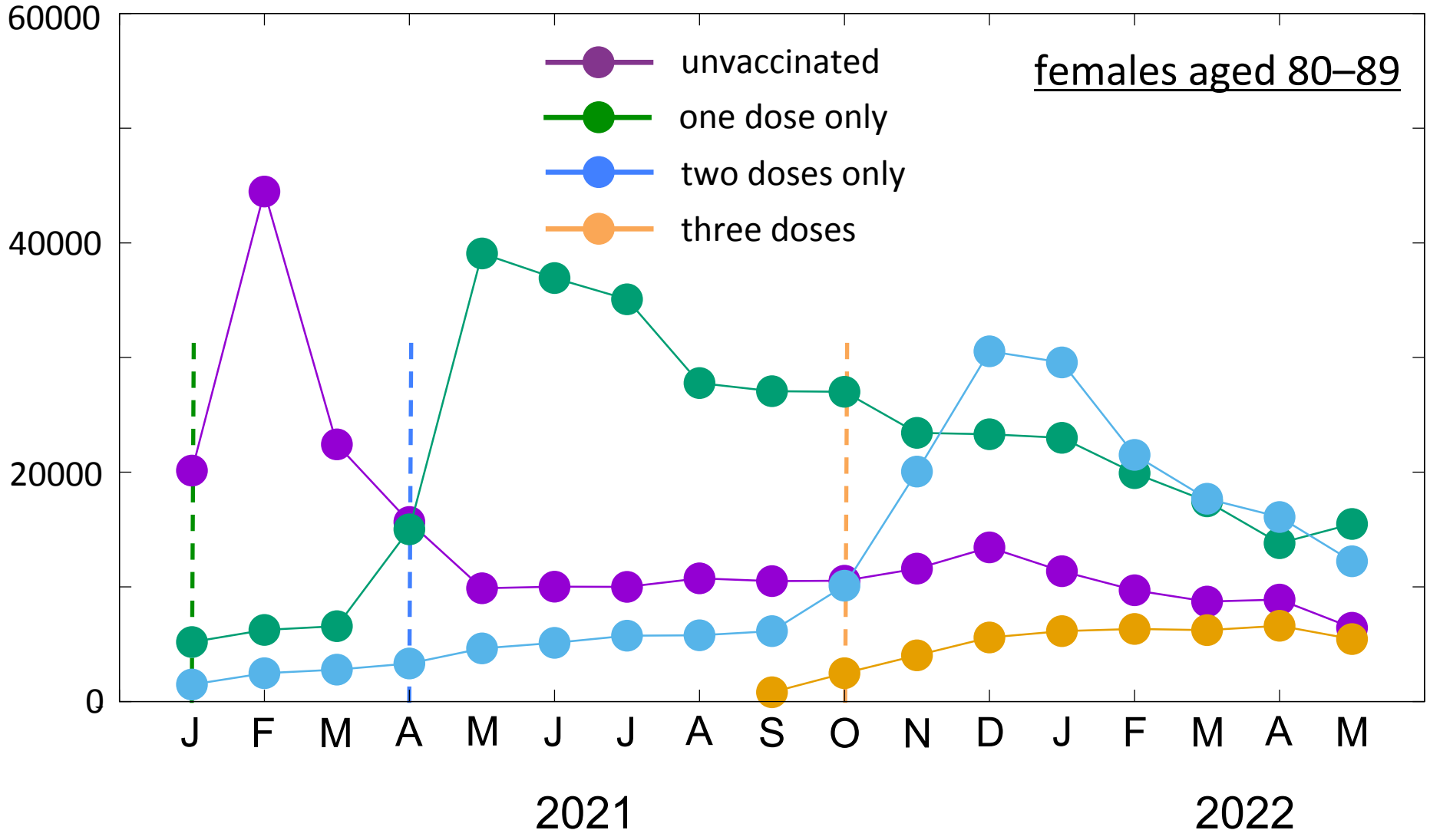
We use the narrowest age ranges from the ONS data, and present them from oldest to youngest:

Female	90+, 80–89, 70–79, 60–69, 50–59, 40–49, 18–39
Male	90+, 80–89, 70–79, 60–69, 50–59, 40–49, 18–39

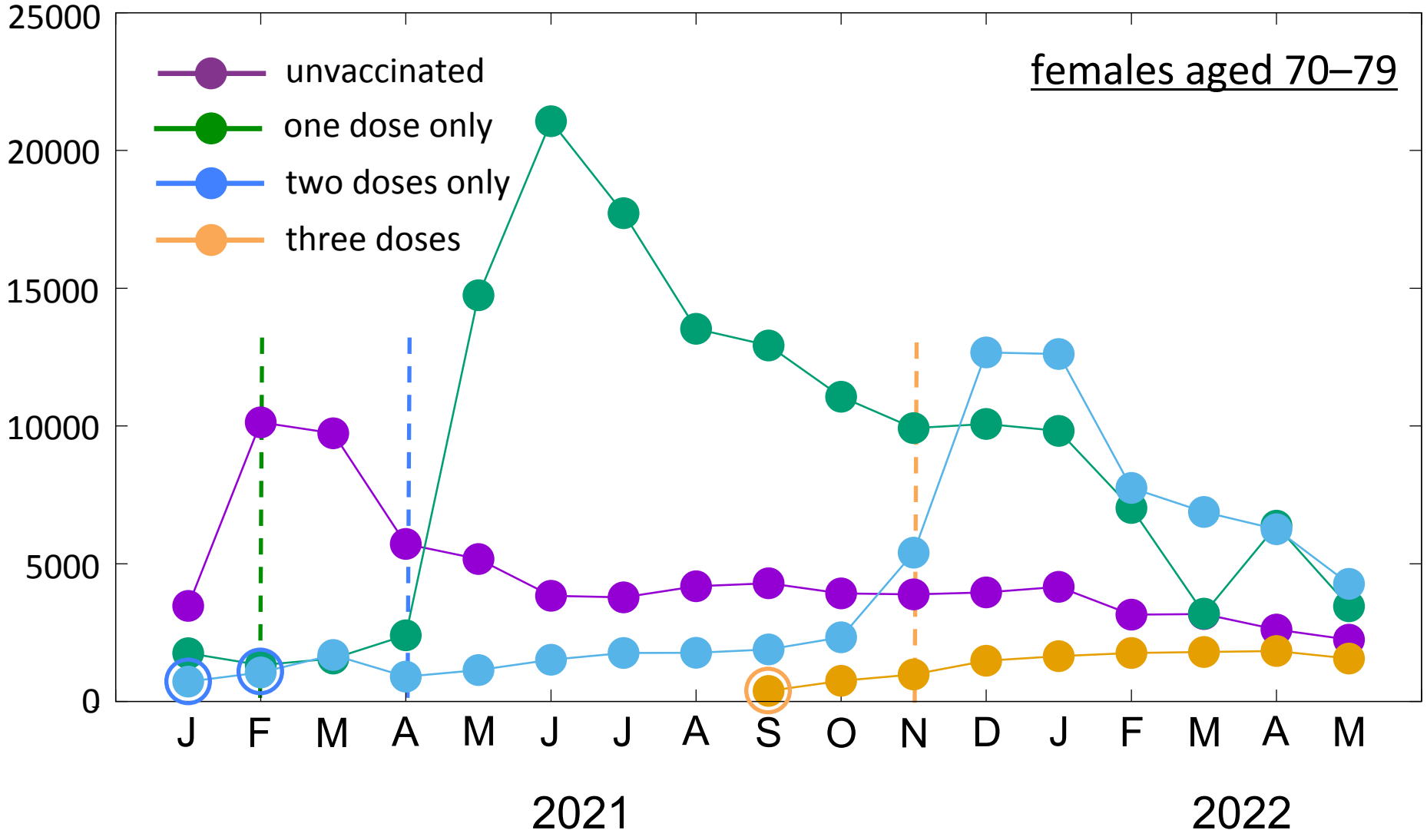
All-cause mortality rate per 100,000 people Jan 2021-May 2022



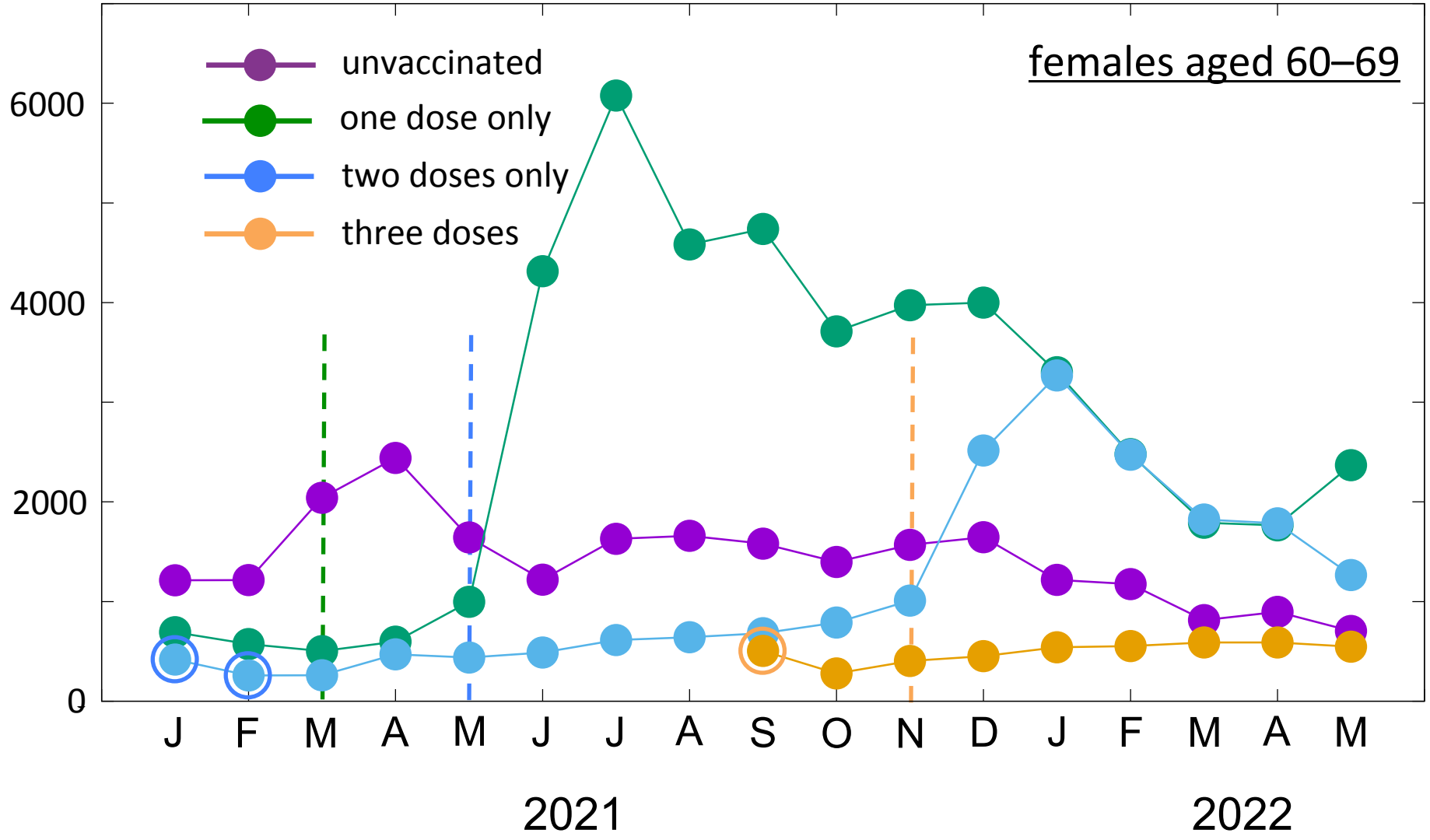
All-cause mortality rate per 100,000 people Jan 2021-May 2022



All-cause mortality rate per 100,000 people Jan 2021-May 2022



All-cause mortality rate per 100,000 people Jan 2021-May 2022



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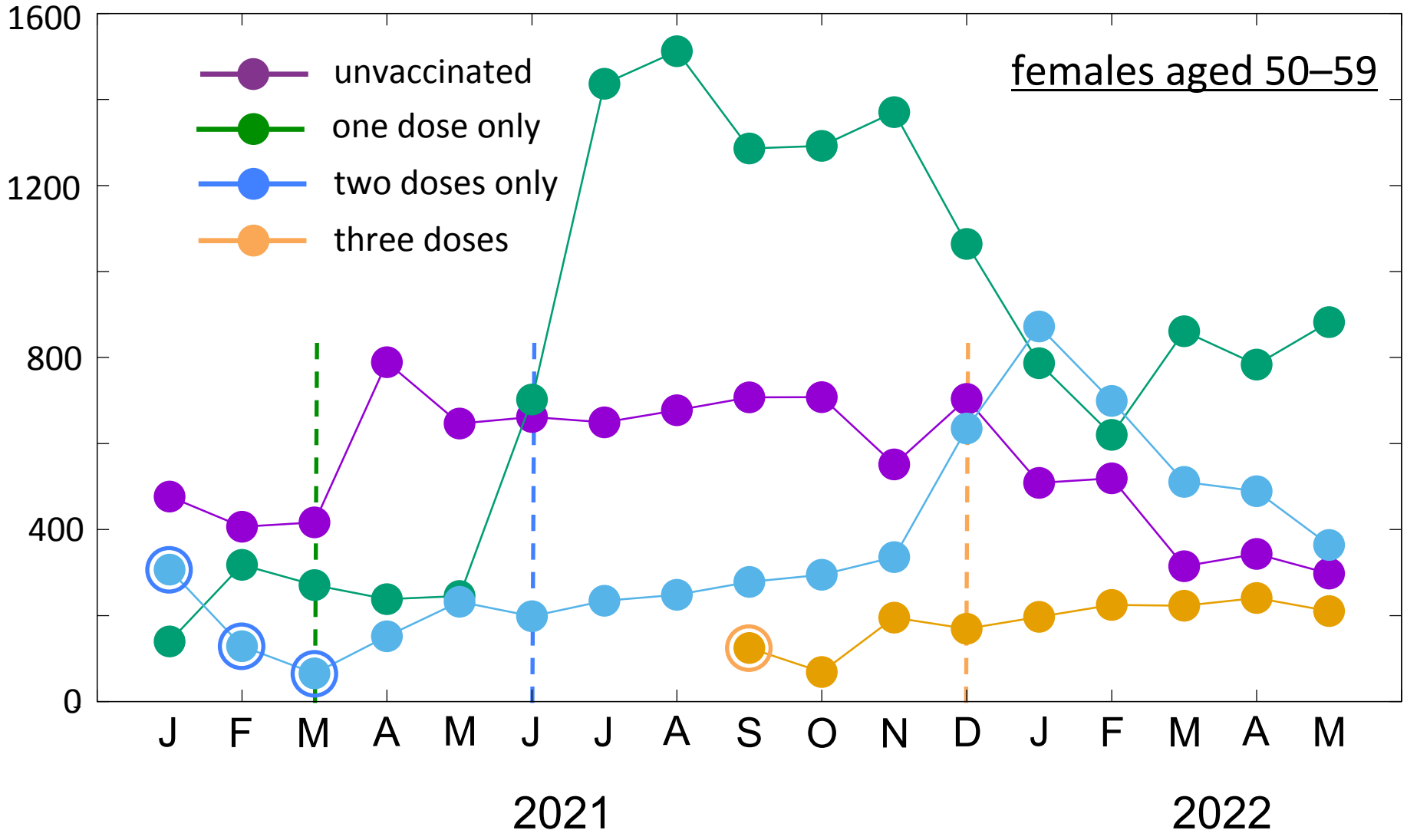

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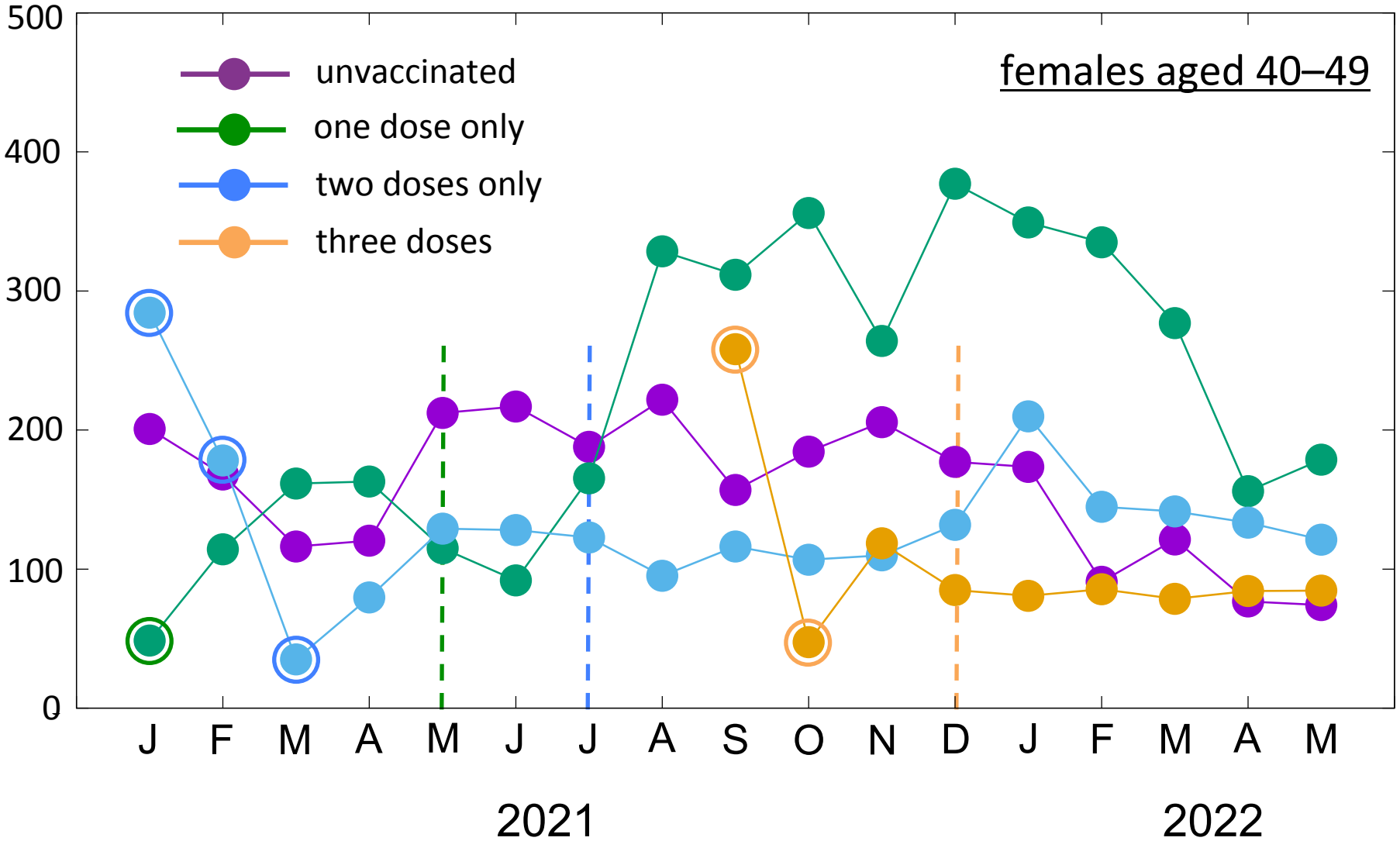

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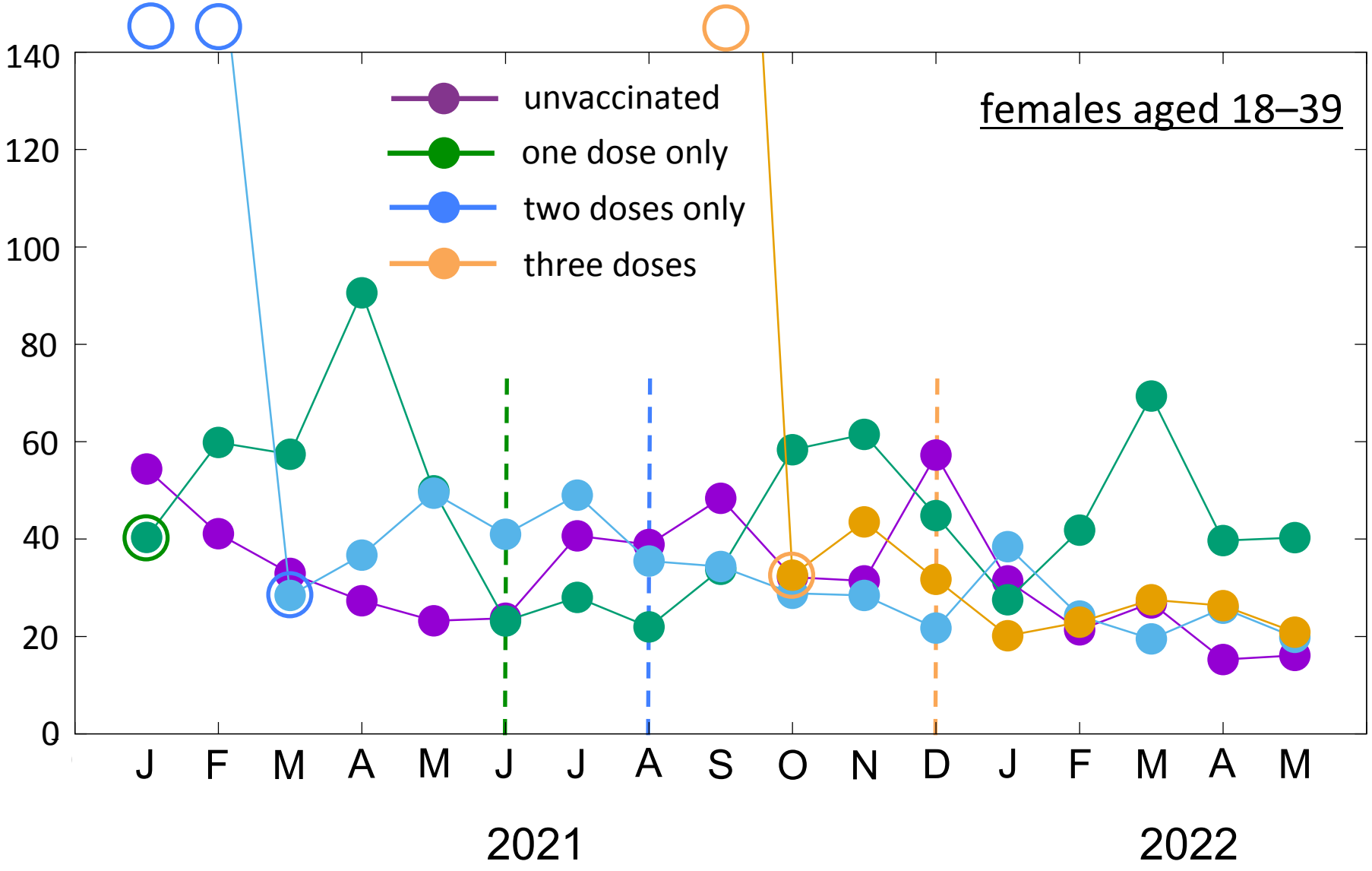
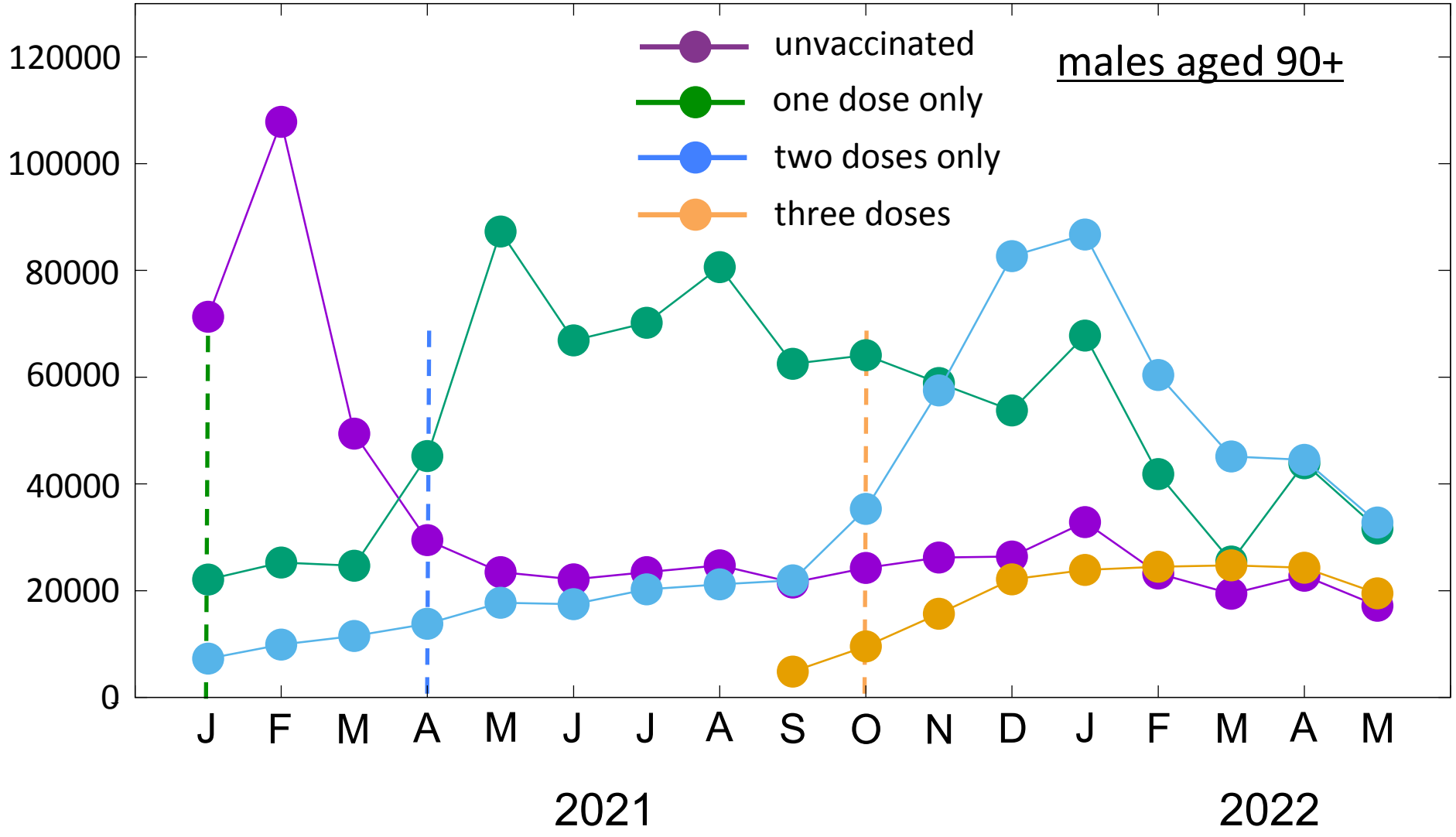
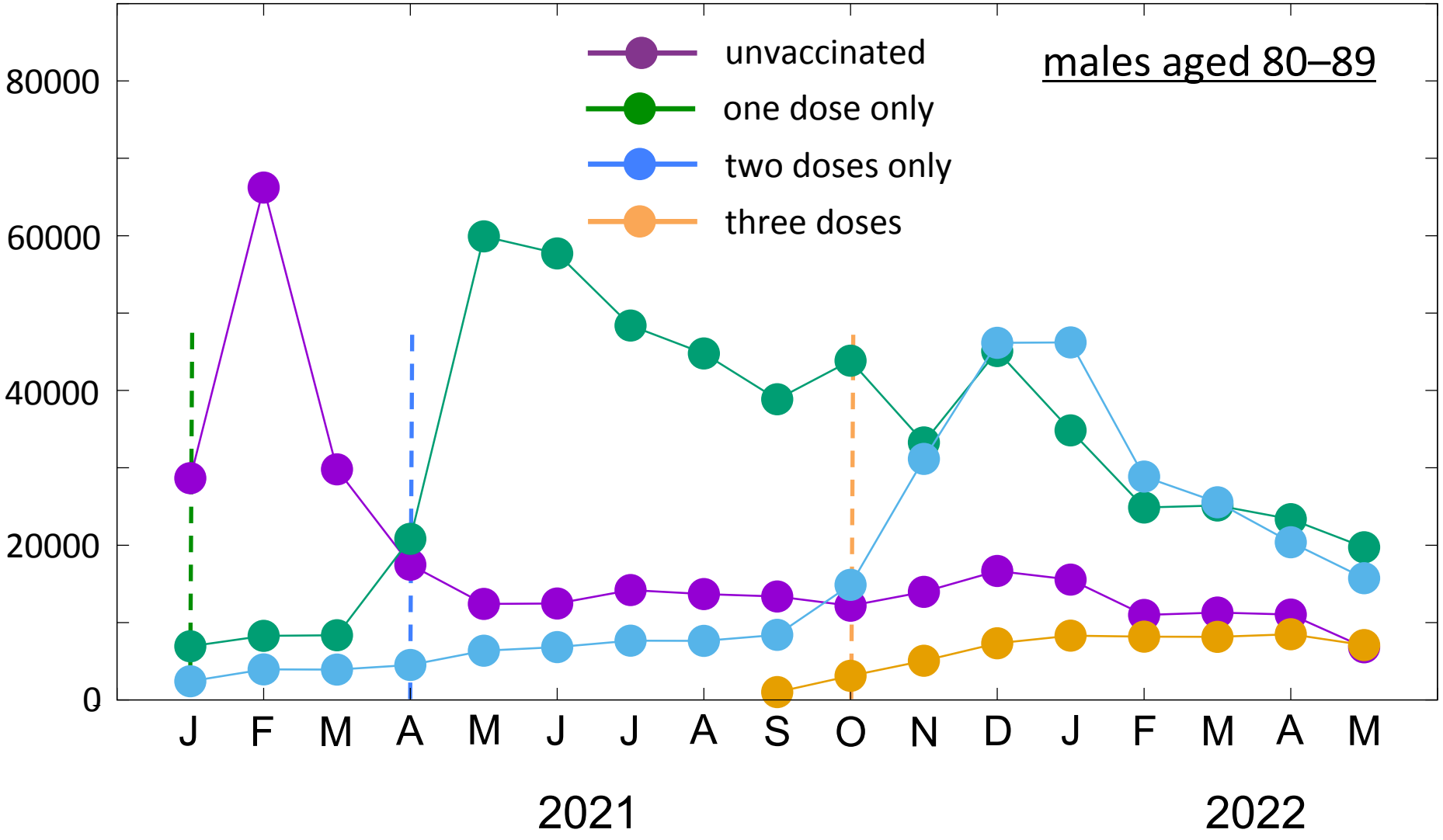


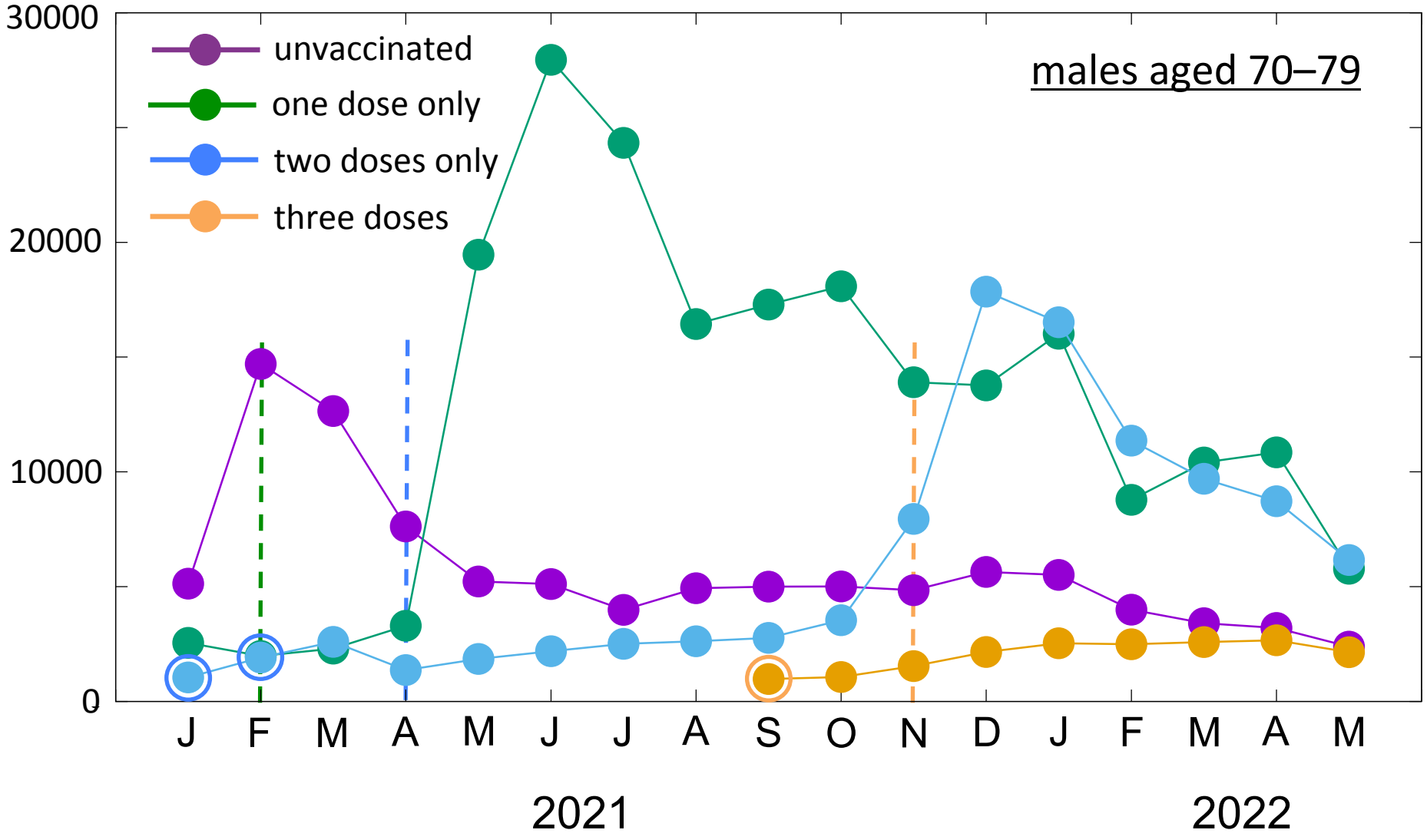
All-cause mortality rate per 100,000 people Jan 2021-May 2022



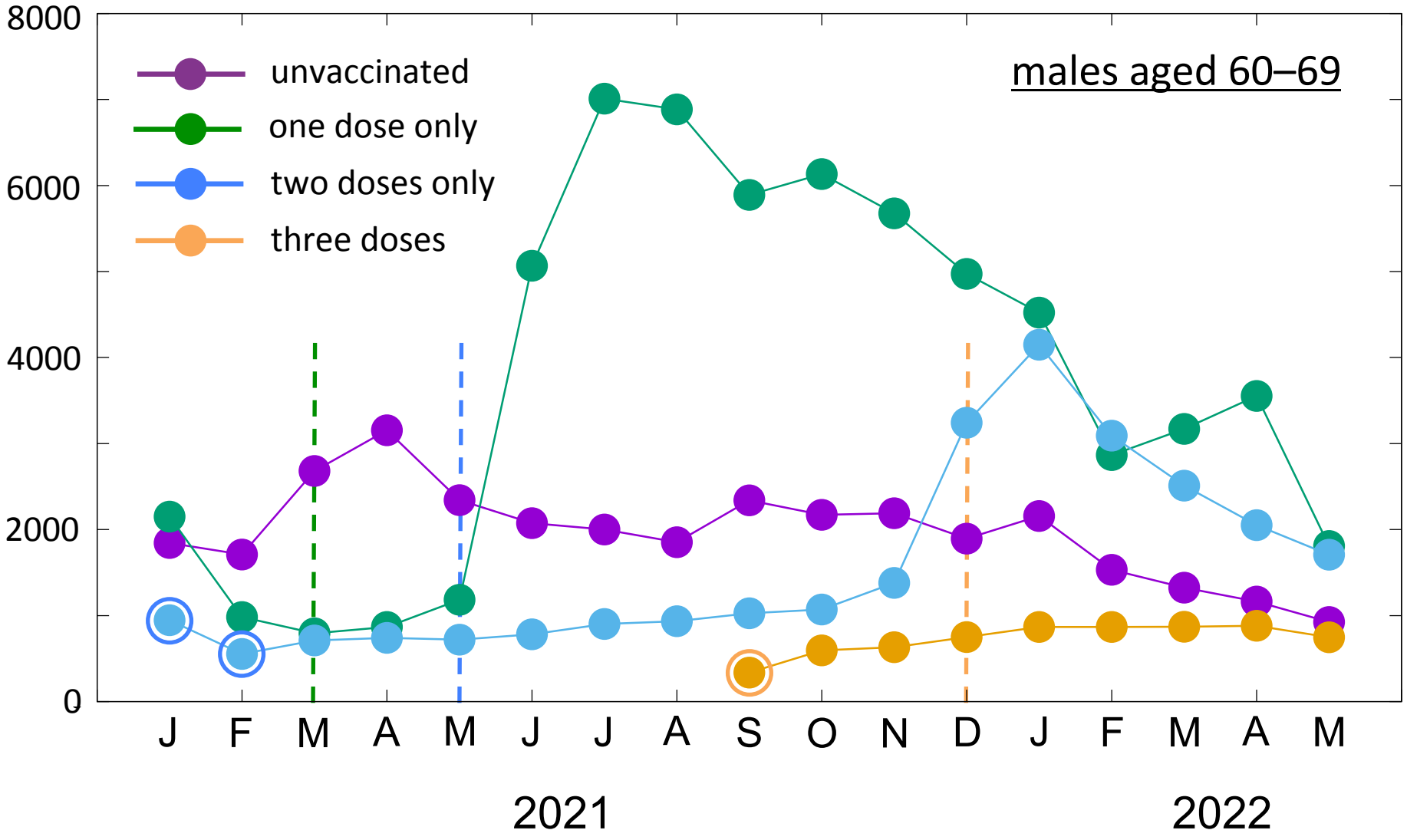
All-cause mortality rate per 100,000 people Jan 2021-May 2022



All-cause mortality rate per 100,000 people Jan 2021-May 2022



All-cause mortality rate per 100,000 people Jan 2021-May 2022



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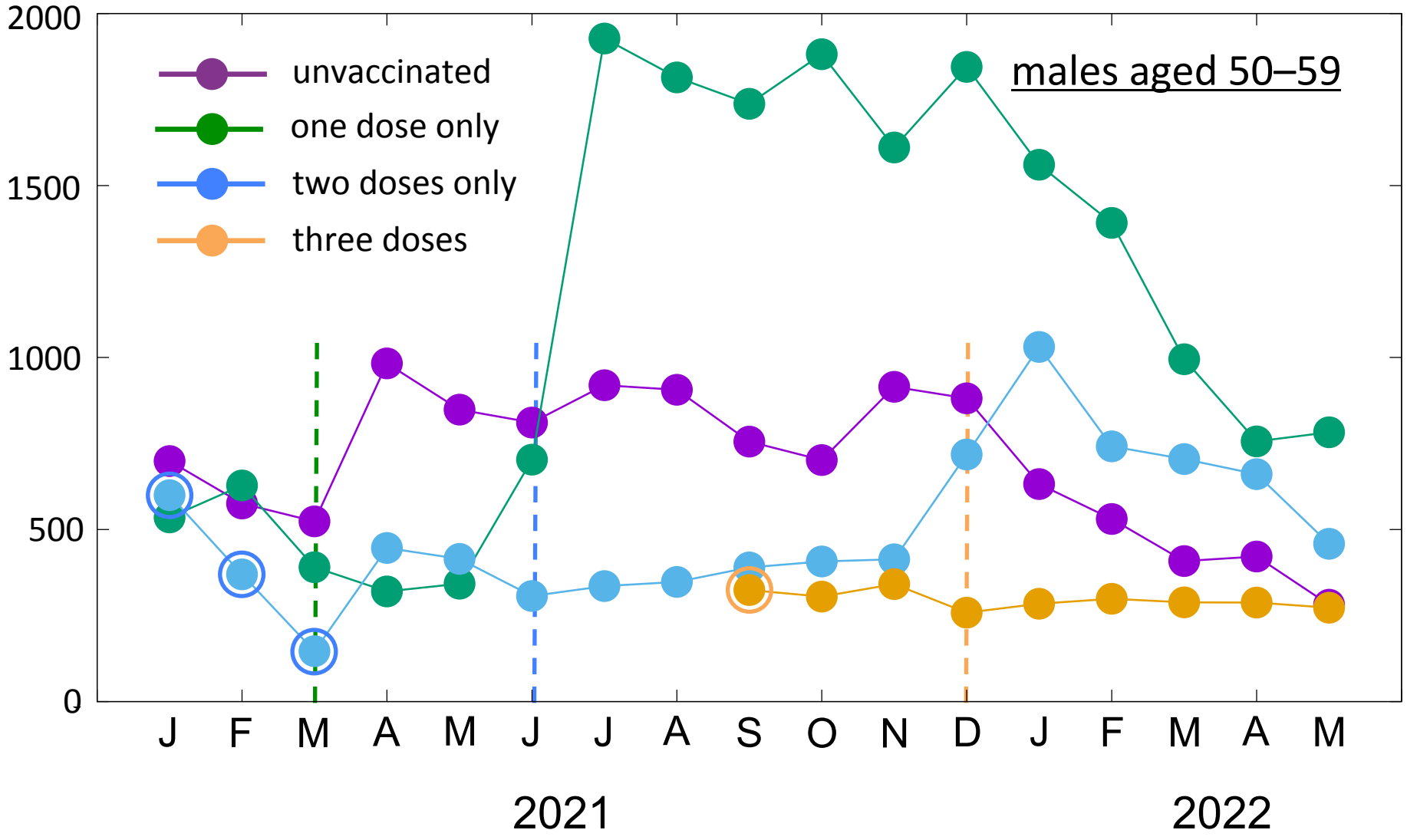

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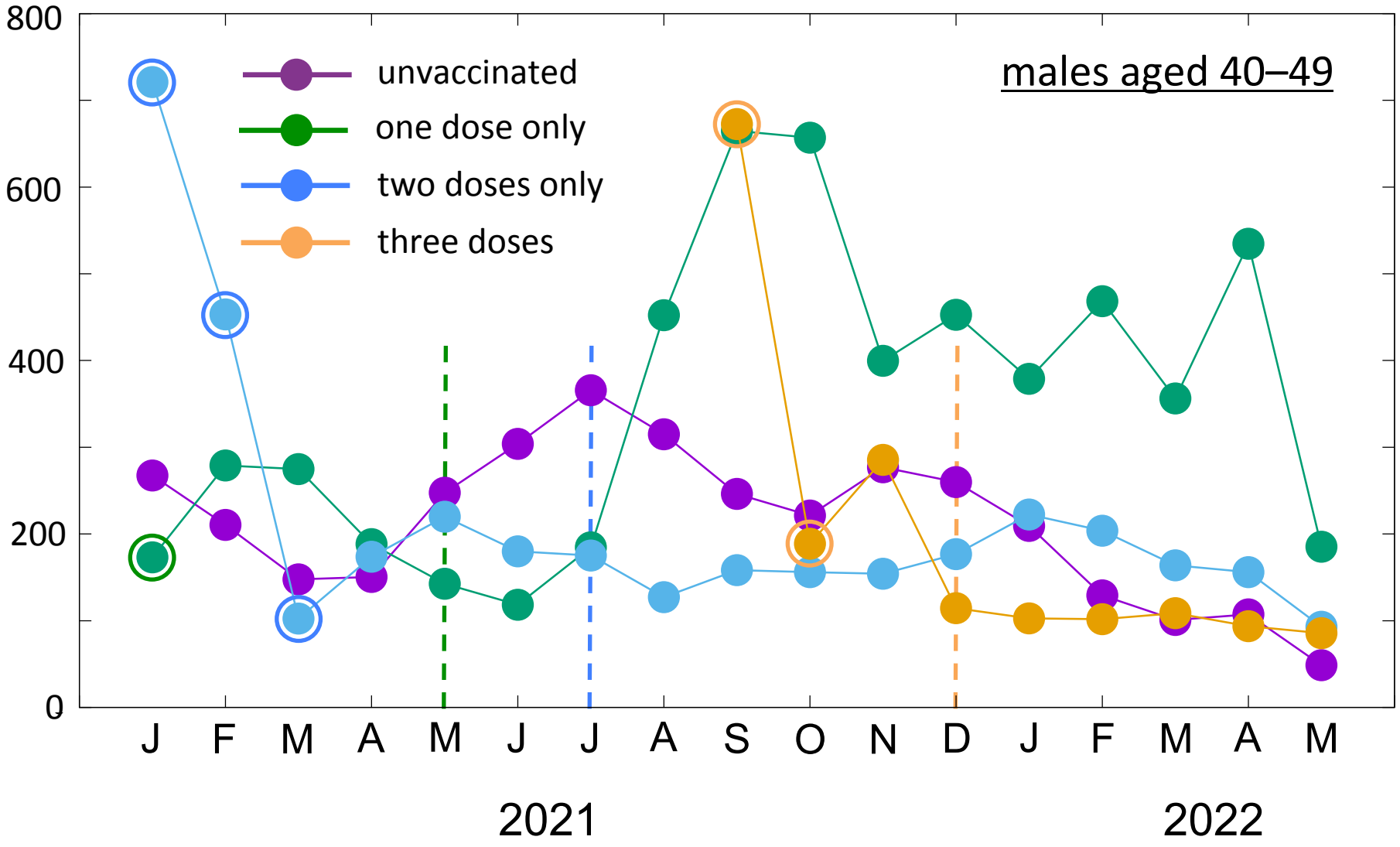

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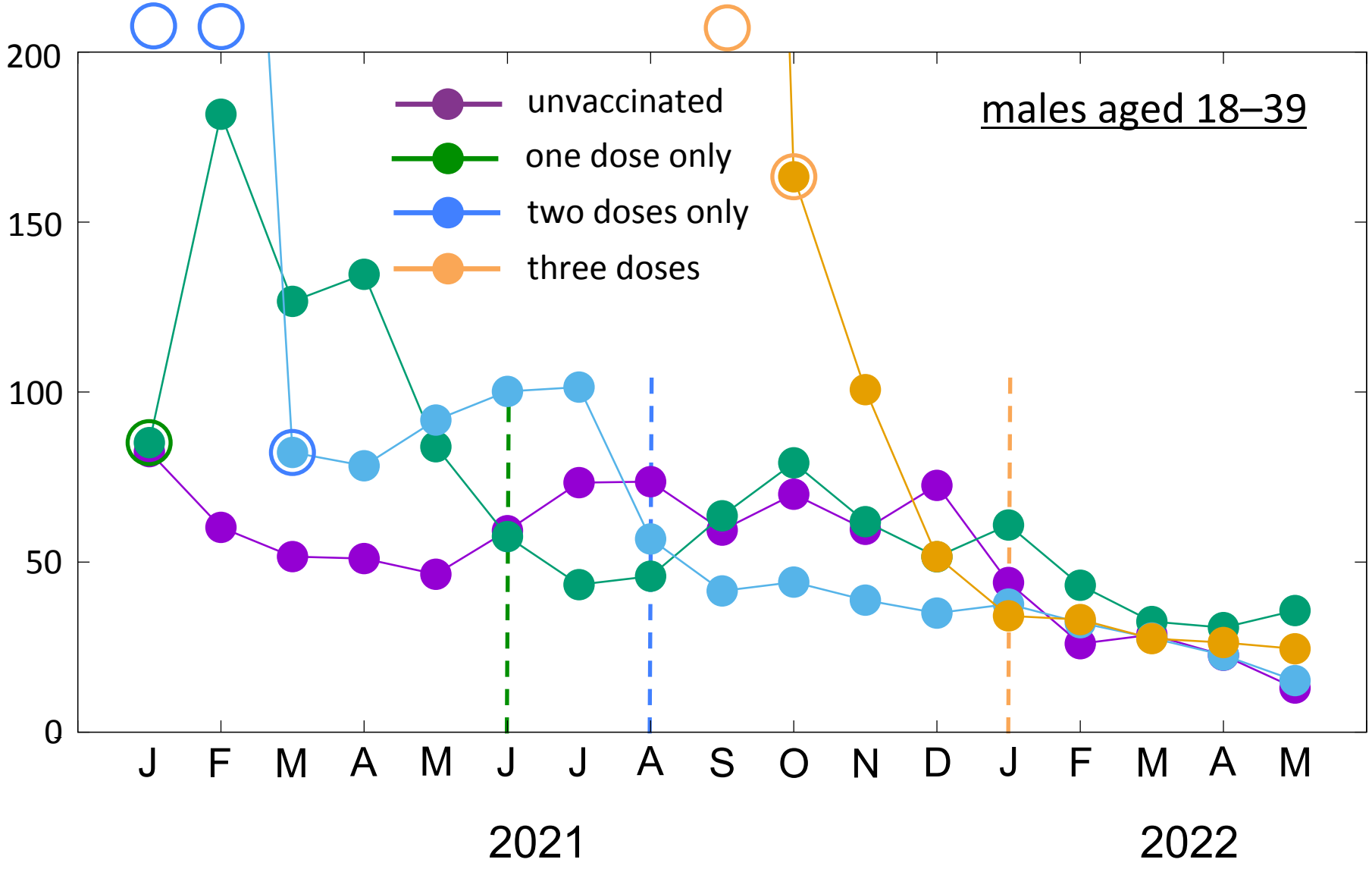

Comments

Some initial observations of timeline trends across the groups:

- The main features reported below hold for both female and male datasets.
- There are abrupt changes in mortality rates for the one-dose and two-dose groups – from low to a sustained high. These tend to occur with the introduction of subsequent doses.
- (Note, these changes are also in close proximity to the surges of the Delta variant and the initial Omicron variant, circa July, December 2021 respectively.)
- The three-dose group generally has the lowest mortality rates from October 2021 (the booster roll-out) onward.
- Three-dose group mortality rates remain relatively constant over January to May 2022, whilst mortality rates in the other vaccination groups fall significantly (that being the typical trend in all-cause mortality rates from winter to spring).
- Mortality trajectories for the unvaccinated group tend to converge to that for the three-dose group over January–May 2022.
- For younger age groups (18–39 and 40–49) and the oldest age group (90+), the mortality rates for the unvaccinated and three-dose groups cross over.

The full ONS dataset can be obtained at:
https://www.ons.gov.uk/peoplepopulationandcommunity/
birthsdeathsandmarriages/deaths/bulletins/
deathsinvolvingcovid19byvaccinationstatusengland/
deathsoccurringbetween1january2021and31may2022

The ONS methodology is explained here:
https://www.ons.gov.uk/peoplepopulationandcommunity/
birthsdeathsandmarriages/deaths/methodologies/
weeklycovid19agestandardisedmortalityratesbyvaccinationstatusenglandmethodology

A useful technical briefing on calculating mortality rates in the context of public health statistics can be found at:
https://fingertips.phe.org.uk/documents/
APHO%20Tech%20Briefing%203%20Common%20PH%20Stats%20and%20CIs.pdf

I would like to extend my thanks to G at MTL for prompting my interest
in this ONS dataset and for subsequent discussions

I would also like to thank E Lundell and H Newman for assistance with data checking