

Supplementary Results

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Supplementary Results

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Table S6. Distribution of X users by the number of COVID-19 vaccine-related tweets sent by one user during our study period.

<i>Number of COVID-19 vaccine-related tweets sent by one X user</i>	<i>Number of X users</i>	<i>Percentage</i>
1	2,320,786	69.40%
2	486,166	14.54%
3	192,091	5.74%
4	100,228	3.00%
5	59,471	1.78%
6	39,208	1.17%
7	27,188	0.81%
8	20,478	0.61%
9	15,341	0.46%
10	11,710	0.35%
11-20	47,437	1.42%
21-30	12,368	0.37%
31-40	4,908	0.15%
41-50	2,460	0.07%
51-100	3,450	0.10%
≥ 101	854	0.03%
<i>Total</i>	3,344,144	100%

Note: Totally, 7,047,223 human-generated tweets in this study were sent by a total of 3,344,144 X users.

Table S7. Associations between country-level characteristics and COVID-19 vaccine acceptance by univariate linear regressions (n=135 countries or territories).

- Only countries or territories with COVID-19 vaccination-related tweets from >100 X users were analysed.

Variables	Intent to accept COVID-19 vaccination				Intent to reject COVID-19 vaccination			
	Coefficient <i>t</i>	95% CI ^a	<i>p</i> -value	R ²	Coefficient <i>nt</i>	95% CI ^a	<i>p</i> -value	R ²
Vaccine-related discourse on X								
Belief that COVID-19 vaccine is effective	1.880***	[1.523,2.237]	<0.001	44.9%	-0.497***	[-0.733,-0.260]	<0.001	11.5%
Belief that COVID-19 vaccine is not safe	-1.351***	[-1.678,-1.440]	<0.001	33.5%	0.376***	[0.176,0.575]	<0.001	9.4%
Distrust in government	-0.591**	[-0.995,-0.187]	0.004	5.9%	0.547***	[0.351,0.744]	<0.001	18.6%
Misinformation or rumours on COVID-19 vaccine	-1.886***	[-2.332,-1.353]	<0.001	34.5%	0.978***	[0.744,1.212]	<0.001	33.9%
COVID-19 vaccine accessibility	0.810***	[0.489,1.132]	<0.001	15.7%	-0.447***	[-0.613,-0.280]	<0.001	17.5%
COVID-19 vaccine equity	0.667**	[0.255,1.079]	0.002	7.2%	-0.243*	[-0.462,-0.023]	0.031	3.5%
Governance								
Government effectiveness	0.182	[-1.115,1.479]	0.782	0.1%	-1.008**	[-1.660,-0.358]	0.003	6.8%
Control of corruption	0.098	[-1.207,1.404]	0.882	0.0%	-1.012**	[-1.667,-0.356]	0.003	6.8%
State fragility	-0.124	[-0.638,0.391]	0.635	0.2%	0.456**	[0.199,0.712]	0.001	9.3%
Pandemic preparedness								
Epidemic Ready Score	0.061	[-0.037,0.158]	0.217	2.5%	-0.081**	[-0.129,-0.033]	0.001	15.9%
Global Health Security Index	-0.006	[-0.099,0.087]	0.906	0.0%	-0.058*	[-0.105,-0.010]	0.018	4.7%
Doctors per 1000 people	0.001	[-0.072,0.073]	0.983	0.0%	-0.022	[-0.06,0.016]	0.257	1.1%
Trust								
Trust in government, %	0.127**	[0.039,0.216]	0.005	9.6%	-0.056*	[-0.105,-0.007]	0.025	6.3%
Trust in science, %	0.057	[-0.081,0.196]	0.413	0.8%	-0.024	[-0.096,0.048]	0.504	0.6%
Interpersonal trust, %	-0.059	[-0.246,0.129]	0.530	1.0%	-0.036	[-0.135,0.062]	0.460	1.4%
Culture-related index								
Individualism	0.002	[-0.086,0.089]	0.973	0.0%	-0.027	[-0.073,0.018]	0.235	2.6%
Uncertainty avoidance	-0.068	[-0.156,0.021]	0.131	4.3%	0.088***	[0.047,0.129]	<0.001	25.8%
Social development status								
Socio-Demographic Index	0.419	[-6.830,7.668]	0.909	0.0%	-5.268**	[-8.911,-1.625]	0.005	6.1%
Ln (GDP per capita)	-0.134	[-1.048,0.780]	0.772	0.1%	-0.474*	[-0.941,-0.007]	0.047	3.3%
School enrolment, %	0.005	[-0.035,0.045]	0.806	0.0%	-0.021*	[-0.042,0.001]	0.042	3.3%
Internet coverage, %	0.140*	[0.024,0.257]	0.020	10.6%	-0.067*	[-0.133,-0.001]	0.048	7.8%
Demographics								
Population density	0.001	[-0.000,0.003]	0.144	1.7%	-0.001**	[-0.002,-0.001]	0.002	7.3%
Population ages 0-14, %	-0.029	[-0.157,0.099]	0.654	0.2%	0.085*	[0.018,0.151]	0.013	4.9%
Population ages 65 and above, %	-0.160	[-0.343,0.023]	0.087	2.4%	-0.048	[-0.146,0.050]	0.338	0.7%
Urban population, %	0.008	[-0.054,0.071]	0.790	0.1%	-0.011	[-0.044,0.022]	0.508	0.3%

Note: ^a Confidence Interval. Significance level: *p<0.05; **p<0.01; ***p<0.001.

Table S8. Country-level determinants of COVID-19 vaccine coverage by univariate linear regression in 135 countries and territories

Variables	Coefficient	95% Confidence Interval	p-value	R ²
<i>Vaccine acceptance on X</i>				
Intent to accept COVID-19 vaccination	1.007**	[0.389, 1.625]	0.002	7.50%
Intent to reject COVID-19 vaccination	-1.983**	[-3.166, -0.800]	0.001	7.90%
<i>Governance</i>				
Government effectiveness	19.916***	[16.979, 22.853]	<0.001	53.50%
Control of corruption	17.008***	[13.665, 20.352]	<0.001	39.30%
State fragility	-8.033***	[-9.199, -6.868]	<0.001	55.30%
<i>Pandemic preparedness</i>				
Epidemic Ready Score	1.161***	[0.955, 1.366]	<0.001	61.80%
Global Health Security Index	1.331***	[1.089, 1.573]	<0.001	44.40%
Doctors per 1000 people	0.973***	[0.779, 1.167]	<0.001	39.30%
<i>Trust</i>				
Trust in government, %	0.292**	[0.054, 0.530]	0.017	5.70%
Trust in science, %	1.294***	[0.972, 1.616]	<0.001	37.90%
Interpersonal trust, %	0.734***	[0.356, 1.113]	<0.001	23.70%
<i>Culture-related index</i>				
Individualism	0.292*	[0.035, 0.548]	0.026	7.50%
Uncertainty avoidance	0.195	[-0.077, 0.467]	0.157	3.10%
<i>Social development status</i>				
Socio-Demographic Index	106.417***	[88.687, 124.146]	<0.001	47.60%
Ln (GDP per capita)	13.315***	[11.158, 15.472]	<0.001	50.00%
School enrolment, %	0.576***	[0.472, 0.680]	<0.001	43.70%
Internet coverage, %	0.548***	[0.257, 0.839]	<0.001	18.60%
<i>Demographics</i>				
Population density	0.007**	[0.002, 0.012]	0.003	5.50%
Population ages 0-14, %	-1.997***	[-2.284, -1.709]	<0.001	55.50%
Population ages 65 and above, %	2.24***	[1.702, 2.778]	<0.001	31.00%
Urban population, %	0.73***	[0.565, 0.896]	<0.001	32.90%

*p<0.05; **p<0.01; ***p<0.001

Figure S2. Trajectories in numbers of COVID-19 vaccine-related tweets, mortality, and vaccination

- Data on mortality and vaccination were collected from [Our World in Data](#).

Figure S2a. Global temporal trends at daily level.

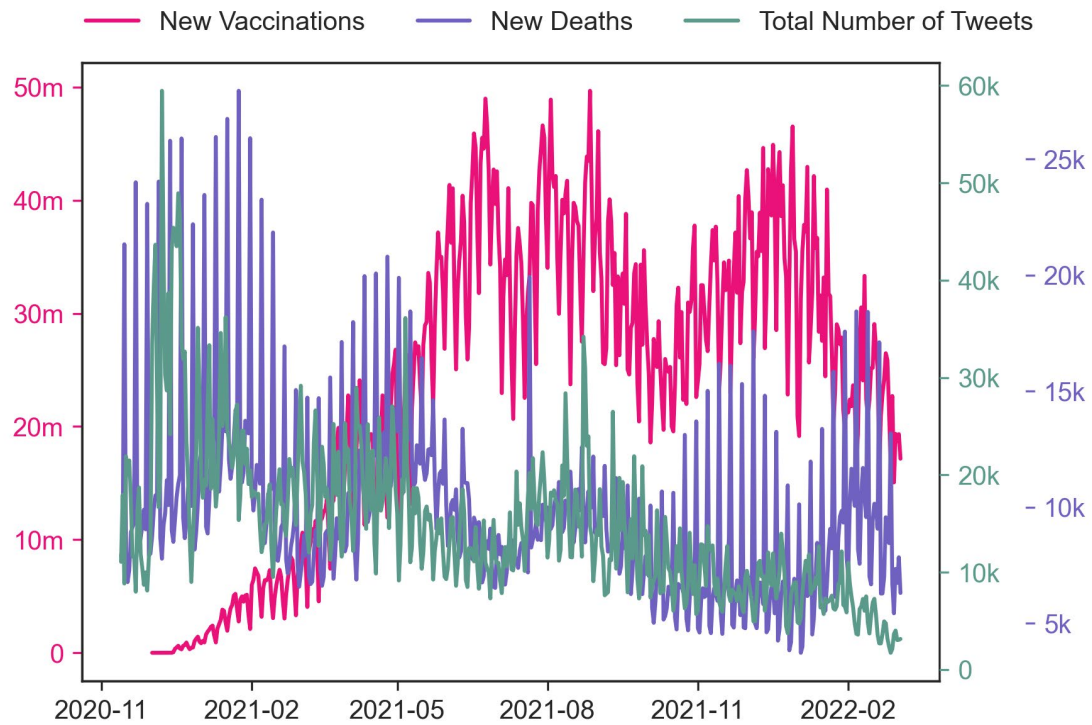


Figure S2b. Country-level trajectories at monthly-level in 50 countries with sufficient data.

- Countries with COVID-19 vaccination-related tweets from a total of over 2500 X users (and at least 30 users per month) were displayed.
- To supplement the trend in EMR and SEAR, countries with a total number of X users < 2500, but at least 30 users per month (Egypt and Nepal) were also displayed.
- Vaccination data were not available in selected countries. (Please refer to the graph for details.)

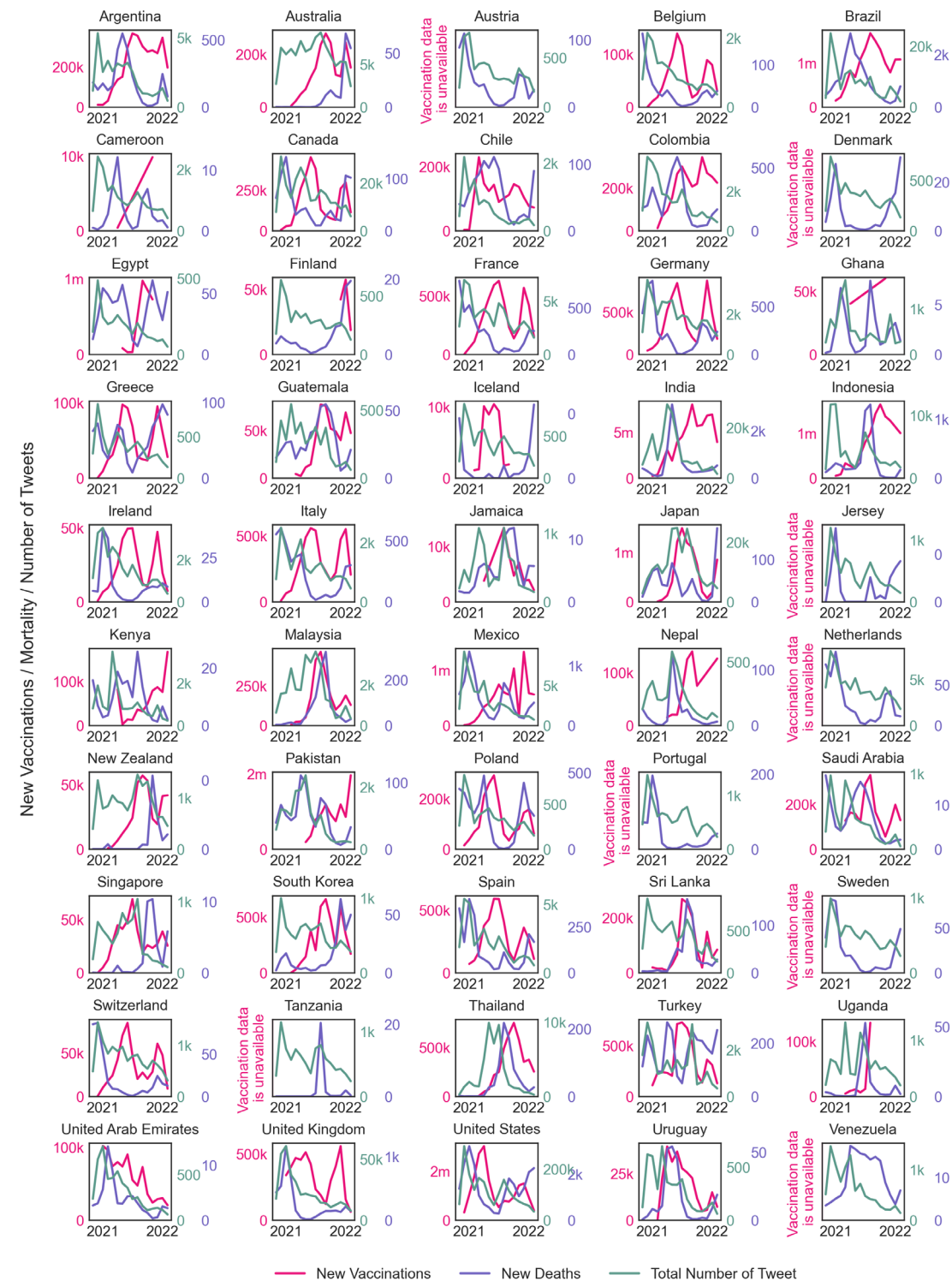


Figure S3. Regional variations in COVID-19 vaccine acceptance, vaccine confidence, information environment, and perceived barriers to accessing vaccines among X users, November 13, 2020 – March 5, 2022.

- Each point in the plot represents a country or territory.

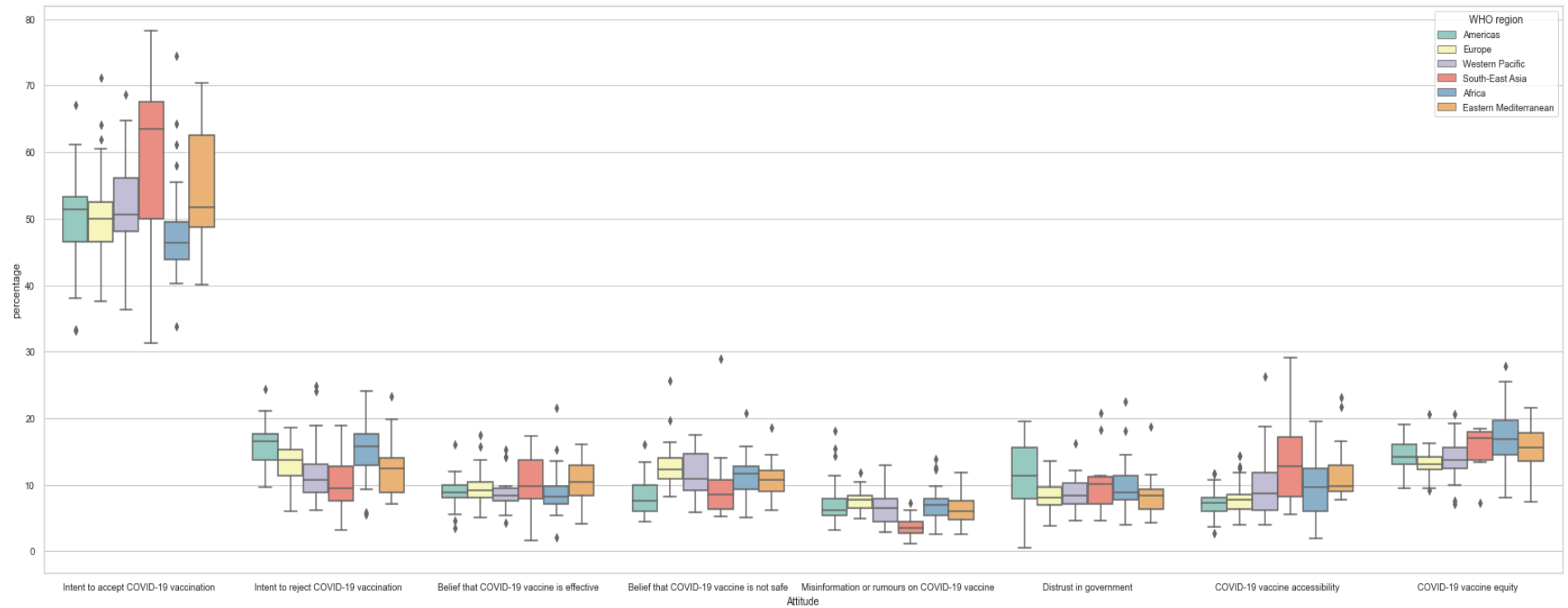


Figure S4. Regional weekly-level trends of COVID-19 vaccine acceptance, vaccine confidence, information environment, and perceived barriers to accessing vaccines among X users, November 13, 2020 – March 5, 2022

- Each point in the figure represents the weekly-level prevalence of a specific category among all X users in a given region.
- A point with a deeper colour suggests that a higher proportion of X users expressed a specific opinion.

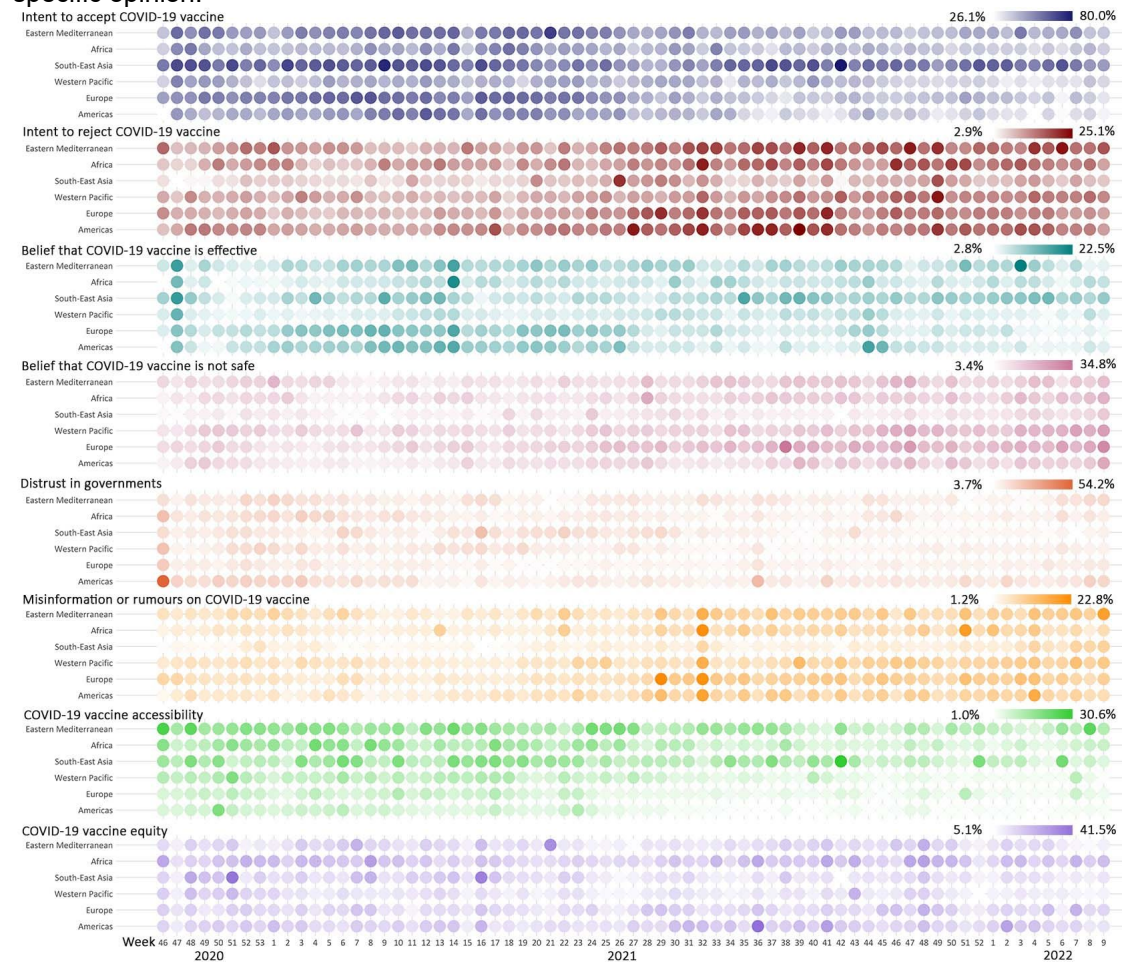


Figure S5. Weekly-level trends of weighted COVID-19 vaccine acceptance among X users in 26 countries, November 13, 2020 – March 5, 2022

- Only the 26 countries or territories with sufficient X data (total number of X users mentioning COVID-19 vaccination >5000; weekly number >28 before and on the week of February 20, 2022, weekly number >18 after February 20, 2022).

Figure S5a. Weekly-level trends of weighted COVID-19 vaccine acceptance.



Figure S5b. Weekly-level trends of weighted COVID-19 vaccine refusal.



