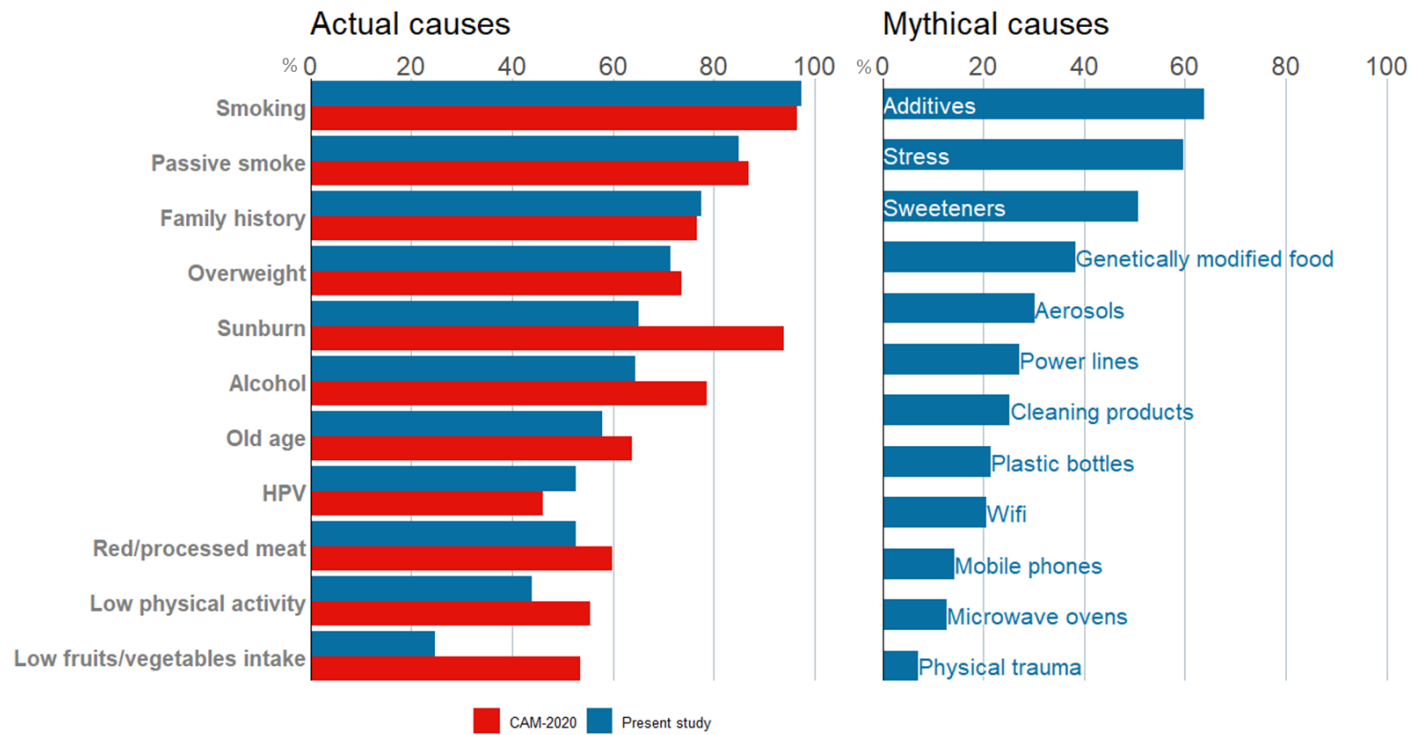# Everything causes cancer? Beliefs and attitudes towards cancer prevention among anti-vaxxers, flat-earthers, and reptilian conspiracists: online cross-sectional survey

Supplemental material

Supplemental Figure 1. Overall endorsement of actual and mythical causes.

Endorsement of actual and mythical causes of cancer

Benchmark data from the Cancer Research UK were included for comparison; cancer awareness measure (CAM-2020) responses refer to the responses online from Connor et al. Awareness of the signs, symptoms, and risk factors of cancer and the barriers to seeking help in the UK: Comparison of survey data collected online and face-to-face. JMIR Cancer 2020;6:e14539. doi:10.2196/14539. HPV= human papillomavirus

Supplemental Table 1. Descriptive characteristics by type of responders

	Partial responders * (n=260)		Full responders (n=1494)		
	N	(%)	N	(%)	*P*-value †
Age					0.021
<25	60	(23.1)	243	(16.3)	
25–34	101	(38.8)	657	(44.0)	
35–44	56	(21.5)	402	(26.9)	
45+	34	(13.1)	192	(12.9)	
NK/NO	9	(3.5)	0	(0.0)	
Sex					0.003 ‡
Female	41	(15.8)	263	(17.6)	
Male	205	(78.8)	1198	(80.2)	
Non binary/others	11	(4.2)	19	(1.3)	
NK/NO	3	(1.2)	14	(0.9)	
Region					0.013
Europe	208	(80.0)	1311	(87.8)	
South America	18	(6.9)	73	(4.9)	
North America	17	(6.5)	83	(5.6)	
Asia and Oceania	1	(0.4)	15	(1.0)	
Africa	3	(1.2)	2	(0.1)	
NK/NO	13	(5.0)	10	(0.7)	
Education					0.001
Less than college	142	(54.6)	670	(44.8)	
College or more	112	(43.1)	818	(54.8)	
NK/NO	6	(2.3)	6	(0.4)	
Medical occupation					0.715
No	219	(84.2)	1289	(86.3)	
Yes	34	(13.1)	186	(12.4)	
NK/NO	7	(2.7)	19	(1.3)	
COVID-19 vaccination					0.591
1 dose or more	205	(78.8)	1285	(86.0)	
Unvaccinated	37	(14.2)	209	(14.0)	
NK/NO	18	(6.9)	0	(0.0)	
Believes in flat earth or shapeshifting lizards					<0.001
No	7	(2.7)	1375	(92.0)	
Yes	7	(2.7)	62	(4.1)	
NK/NO	246	(94.6)	57	(3.8)	
Preferences on type of medicine					0.090
Conventional or unsure	225	(86.5)	1367	(91.5)	
Alternative	27	(10.4)	112	(7.5)	
NK/NO	8	(3.1)	15	(1.0)	
Source					0.030
Cancer blog	14	(5.4)	62	(4.1)	
4Chan, Hispachan, Reddit, and others	62	(23.8)	263	(17.6)	
ForoCoches	184	(70.8)	1169	(78.2)	

* Includes low quality surveys (N=14)

† Chi squared, calculated without missing values

‡ P-value= 0.613 excluding non-binary/others

NK/NO = Not known / no answer

Supplemental Table 2. Cancer awareness measures by sociodemographic factors.

	Total sample (N)	CAM-total ‡ % correct (IQR)		CAM ‡ % correct (IQR)		CAM-MYCS ‡ % correct (IQR)	
Overall	1494	47.8 (39.1-60.9)		63.6 (45.5-81.8)		41.7 (16.7-58.3)	
Age							
<25 (ref*)	243	56.5 (43.5-65.2)		63.6 (54.5-81.8)		50.0 (25.0-66.7)	
25-34	657	47.8 (39.1-60.9)	†	63.6 (45.5-81.8)		33.3 (16.7-58.3)	†
35-44	402	47.8 (39.1-60.9)	†	63.6 (45.5-81.8)		41.7 (16.7-58.3)	†
45+	192	45.7 (34.8-52.2)	†	63.6 (36.4-81.8)	†	33.3 (8.3-50.0)	†
Sex							
Female (ref*)	263	47.8 (39.1-56.5)		63.6 (54.5-81.8)		25.0 (8.3-50.0)	
Male	1198	52.2 (39.1-60.9)	†	63.6 (45.5-81.8)		41.7 (16.7-58.3)	†
Non binary	19	52.2 (39.1-65.2)		54.5 (36.4-81.8)	†	41.7 (16.7-66.7)	
Education							
Less than college (ref*)	670	47.8 (34.8-56.5)		54.5 (45.5-72.7)		33.3 (8.3-50.0)	
College or more	818	52.2 (39.1-65.2)	†	72.7 (54.5-81.8)	†	41.7 (16.7-58.3)	†
Region							
Europe (ref*)	1311	47.8 (39.1-60.9)		63.6 (45.5-81.8)		41.7 (16.7-58.3)	
Others	173	47.8 (39.1-58.7)	†	63.6 (45.5-81.8)		33.3 (16.7-58.3)	
Medical occupation							
No (ref*)	1289	47.8 (39.1-60.9)		63.6 (45.5-81.8)		41.7 (16.7-58.3)	
Yes	186	52.2 (43.5-69.6)	†	72.7 (54.5-90.9)	†	33.3 (8.3-58.3)	
BMI							
<25 (ref*)	814	52.2 (39.1-65.2)		63.6 (54.5-81.8)		41.7 (16.7-58.3)	
25-29.9	449	47.8 (34.8-60.9)		63.6 (45.5-81.8)		33.3 (16.7-58.3)	
30+	158	47.8 (39.1-60.9)		54.5 (45.5-72.7)	†	41.7 (16.7-58.3)	†
Alcohol							
No (ref*)	1003	47.8 (39.1-60.9)		63.6 (45.5-81.8)		41.7 (16.7-58.3)	
Yes	436	47.8 (39.1-60.9)		63.6 (45.5-72.7)		41.7 (16.7-58.3)	
Smoking							
Never (ref*)	895	52.2 (39.1-65.2)		63.6 (54.5-81.8)		41.7 (16.7-58.3)	
Ever	527	47.8 (34.8-60.9)	†	63.6 (45.5-81.8)		33.3 (8.3-58.3)	†
Past history of cancer							
No (ref*)	1406	47.8 (39.1-60.9)		63.6 (45.5-81.8)		41.7 (16.7-58.3)	
Yes	64	47.8 (34.8-59.8)		63.6 (45.5-81.8)		33.3 (8.3-58.3)	
Source							
Cancer blog (ref*)	62	43.5 (34.8-47.8)		72.7 (54.5-81.8)		16.7 (0.0-35.4)	
4Chan, Hispachan, Reddit, and others	263	52.2 (39.1-65.2)	†	63.6 (45.5-81.8)		41.7 (16.7-66.7)	†
ForoCoches	1169	47.8 (39.1-60.9)		63.6 (45.5-81.8)		41.7 (16.7-58.3)	

‡ Refers to the median percentage of correct responses for the 11 CAM, 12 CAM-MYCS, and 23 total CAM items. * ref= reference category in multivariable analysis. † Categories associated with independent variables in the multivariable regression analyses. Models were adjusted for COVID-19 vaccination, conspiracy beliefs, preferences for type of medicine, age, sex, education level, region, medical occupation, BMI, alcohol intake, smoking, past history of cancer, and source of the survey.
BMI: Body Mass Index; CAM: Cancer Awareness Measure; CAM-MYCS: Cancer Awareness Measure- MYthical Causes Scale; CAM-total: aggregated cancer awareness measures; IQR: interquartile range.

Supplemental Table 3. Endorsement of cancer causes by risk factors.

Item evaluated	Risk factor	Total sample (N)	Endorsement N (%)	OR (95%-CI)	*P*-value
Being over 70 years old	**Age**				
	Overall	*1494*	866 (58.0)		
	<25	243	173 (71.2)	Reference	
	25-34	657	376 (57.2)	0.53 (0.37-0.75)	<0.001
	35-44	402	223 (55.5)	0.51 (0.35-0.74)	<0.001
	45+	192	94 (49.0)	0.46 (0.29-0.72)	0.001
					P-trend=0.003
Being overweight (BMI over 25)	**BMI**				
	Overall	*1494*	1066 (71.4)		
	<25	814	606 (74.4)	Reference	
	25-29.9	449	310 (69.0)	0.82 (0.63-1.07)	0.144
	30+	158	101 (63.9)	0.64 (0.44-0.93)	0.021
					P-trend=0.015
Smoking any cigarettes at all	**Smoking**				
	Overall	*1494*	1455 (97.4)		
	Never	895	873 (97.5)	Reference	
	Ever	527	513 (97.3)	1.06 (0.47-2.35)	0.893
Passive smoking	**Smoking**				
	Overall	*1494*	1271 (85.1)		
	Never	895	788 (88.0)	Reference	
	Ever	527	427 (81.0)	0.60 (0.43-0.84)	0.003
Drinking >1 unit of alcohol/day	**Alcohol**				
	Overall	*1494*	964 (64.5)		
	No	1003	676 (67.4)	Reference	
	Yes	436	257 (58.9)	0.77 (0.60-0.99)	0.039

Models were adjusted for COVID-19 vaccination, conspiracy beliefs, preferences for type of medicine, age, sex, education level, region, medical occupation, BMI, alcohol intake, smoking, past history of cancer, and source of the survey.
BMI: Body Mass Index, OR: Odds Ratio, CI: Confidence Interval.

Supplemental Table 4. Agreement with the statement '*It seems like everything causes cancer*' by sociodemographic and cancer risk factors.

| | Agreement with the statement '*It seems like everything causes cancer*' | | | | |
| | Strongly disagree, disagree, or not sure | | Agree or strongly agree | | |
	N (%)		N (%)	OR (95%-CI)	*P*-value
Age					
<25	124	(51.0%)	119 (49.0%)	Reference	
25-34	334	(50.8%)	323 (49.2%)	0.91 (0.66-1.26)	0.579
35-44	236	(58.7%)	166 (41.3%)	0.65 (0.45-0.93)	0.017
45+	127	(66.1%)	65 (33.9%)	0.48 (0.30-0.74)	0.001
				P-trend<0.001	
Sex					
Female	137	(52.1%)	126 (47.9%)	Reference	
Male	666	(55.6%)	532 (44.4%)	0.60 (0.44-0.81)	0.001
Non binary	10	(52.6%)	9 (47.4%)	0.72 (0.26-2.00)	0.524
Region					
Europe	718	(54.8%)	593 (45.2%)	Reference	
Others	95	(54.9%)	78 (45.1%)	1.56 (1.00-2.45)	0.052
Education					
Less than college	353	(52.7%)	317 (47.3%)	Reference	
College or more	465	(56.8%)	353 (43.2%)	0.87 (0.06-1.68)	0.216
Medical occupation					
No	696	(54.0%)	593 (46.0%)	Reference	
Yes	116	(62.4%)	70 (37.6%)	0.73 (0.52-1.03)	0.070
BMI					
<25	450	(55.3%)	364 (44.7%)	Reference	
25-29.9	240	(53.5%)	209 (46.5%)	1.14 (0.89-1.46)	0.295
30+	88	(55.7%)	70 (44.3%)	1.08 (0.75-1.55)	0.696
				P-trend=0.655	
Alcohol					
No	575	(57.3%)	428 (42.7%)	Reference	
Yes	212	(48.6%)	224 (51.4%)	1.56 (1.22-1.98)	<0.001
Smoking					
Never	497	(55.5%)	398 (44.5%)	Reference	
Ever	280	(53.1%)	247 (46.9%)	1.07 (0.85-1.36)	0.565
Past history of cancer					
No	770	(54.8%)	636 (45.2%)	Reference	
Yes	41	(64.1%)	23 (35.9%)	0.92 (0.53-1.59)	0.757
Source					
Cancer blog	48	(77.4%)	14 (22.6%)	Reference	
Hispachan, 4Chan, Reddit, and others	157	(59.7%)	106 (40.3%)	1.98 (0.96-4.08)	0.064
ForoCoches	616	(52.7%)	553 (47.3%)	3.68 (1.79-7.56)	<0.001

Models were adjusted for COVID-19 vaccination, conspiracy beliefs, preferences for type of medicine, age, sex, education level, region, medical occupation, BMI, alcohol intake, smoking, past history of cancer, and source of the survey.
BMI: Body Mass Index, OR: Odds Ratio, CI: Confidence Interval.

Supplemental Table 5. Cancer screening knowledge based on sociodemographic factors, conspiracy beliefs, and health characteristics.

	Total sample (N)	Established Breast % correct (95% CI)	Colorectal % correct (95% CI)	Cervical % correct (95% CI)	Non-established Lung % correct (95% CI)	Ovary % correct (95% CI)	Prostate % correct (95% CI)
Overall	1445	86.9 (85.1-88.6)	69.3 (66.9-71.7)	50.0 (47.4-52.6)	73.6 (71.2-75.8)	66.0 (63.5-68.5)	27.9 (25.6-30.3)
COVID-19 vaccination							
1 dose or more (ref*)	1241	88.0 (86.1-89.8)	69.9 (67.2-72.4)	50.4 (47.6-53.3)	73.8 (71.3-76.2)	66.3 (63.6-68.9)	27.6 (25.1-30.1)
Unvaccinated	204	80.4 (74.3-85.6)	66.2 (59.2-72.6)	47.5 (40.5-54.6)	72.1 (65.4-78.1)	64.2 (57.2-70.8)	29.9 (23.7-36.7)
Believes in flat earth or shapeshifting lizards							
No (ref*)	1375	87.3 (85.5-89.1)	70.3 (67.8-72.7)	50.5 (47.9-53.2)	73.6 (71.2-75.9)	65.8 (63.2-68.3)	27.2 (24.9-29.6)
Yes	62	79.0 (66.8-88.3)	51.6 (38.6-64.5) †	41.9 (29.5-55.2)	72.6 (59.8-83.1)	69.4 (56.3-80.4)	37.1 (25.2-50.3)
Preferences on type of medicine							
Conventional or unsure (ref*)	1321	87.6 (85.7-89.3)	70.1 (67.5-72.6)	50.6 (47.8-53.3)	73.8 (71.3-76.2)	66.2 (63.5-68.7)	26.9 (24.6-29.4)
Alternative	110	80.0 (71.3-87.0)	60.0 (50.2-69.2)	43.6 (34.2-53.4)	69.1 (59.6-77.6)	64.5 (54.9-73.4)	37.3 (28.2-47.0)
Age							
<25 (ref*)	237	80.6 (75.0-85.4)	60.8 (54.2-67.0)	40.1 (33.8-46.6)	65.8 (59.4-71.8)	64.1 (57.7-70.2)	26.2 (20.7-32.2)
25-34	634	89.0 (86.3-91.3) †	68.8 (65.0-72.4)	52.2 (48.2-56.2) †	73.2 (69.6-76.6) †	62.8 (58.9-66.6)	27.4 (24.0-31.1)
35-44	387	88.9 (85.3-91.8)	71.6 (66.8-76.0)	55.0 (49.9-60.1) †	74.2 (69.5-78.5) †	66.7 (61.7-71.3)	26.4 (22.0-31.0)
45+	187	84.0 (77.9-88.9)	77.5 (70.9-83.3) †	44.9 (37.7-52.3)	83.4 (77.3-88.4) †	78.1 (71.5-83.8) †	34.8 (28.0-42.1) †
Sex							
Female (ref*)	253	87.4 (82.6-91.2)	71.5 (65.6-77.0)	68.0 (61.9-73.7)	82.6 (77.4-87.1)	69.6 (63.5-75.2)	40.3 (34.2-46.6)
Male	1160	87.2 (85.1-89.0)	69.3 (66.6-72.0)	46.3 (43.4-49.2) †	71.6 (68.9-74.2) †	65.4 (62.6-68.2)	25.1 (22.6-27.7) †
Non binary	19	78.9 (54.4-93.9)	52.6 (28.9-75.6)	42.1 (20.3-66.5) †	63.2 (38.4-83.7)	52.6 (28.9-75.6)	31.6 (12.6-56.6)
Education							
Less than college (ref*)	642	84.3 (81.2-87.0)	65.7 (61.9-69.4)	43.9 (40.0-47.9)	70.4 (66.7-73.9)	63.9 (60.0-67.6)	30.1 (26.5-33.8)
College or more	797	89.2 (86.8-91.3)	72.3 (69.0-75.4)	55.1 (51.6-58.6) †	75.9 (72.8-78.8)	67.8 (64.4-71.0)	26.0 (23.0-29.2) †
Region							
Europe (ref*)	1269	88.2 (86.3-89.9)	71.6 (69.1-74.1)	50.4 (47.6-53.1)	74.1 (71.6-76.5)	66.0 (63.4-68.6)	26.4 (24.0-28.9)
Others	169	77.5 (70.5-83.6)	53.3 (45.4-61.0) †	47.9 (40.2-55.7)	71.6 (64.2-78.3) †	66.9 (59.2-73.9)	39.1 (31.7-46.8)
Medical occupation							
No (ref*)	1248	86.1 (84.0-87.9)	68.1 (65.4-70.7)	47.4 (44.6-50.2)	72.8 (70.3-75.3)	65.3 (62.6-67.9)	26.9 (24.5-29.5)
Yes	179	92.7 (87.9-96.1) †	77.7 (70.8-83.5) †	68.7 (61.4-75.4) †	78.2 (71.4-84.0)	69.8 (62.5-76.5)	35.2 (28.2-42.7)
BMI							
<25 (ref*)	814	86.6 (84.1-88.9)	68.2 (64.9-71.4)	49.9 (46.4-53.4)	73.8 (70.7-76.8)	66.5 (63.1-69.7)	29.0 (25.9-32.2)
25-29.9	449	86.6 (83.1-89.6)	69.0 (64.5-73.3)	49.0 (44.3-53.7)	75.7 (71.5-79.6)	67.7 (63.2-72.0)	26.9 (22.9-31.3)
30+	158	88.0 (81.9-92.6)	76.6 (69.2-82.9)	54.4 (46.3-62.4)	65.8 (57.9-73.2) †	58.2 (50.1-66.0) †	24.1 (17.6-31.5)
Alcohol							
No (ref*)	1003	87.0 (84.8-89.1)	67.9 (64.9-70.8)	50.6 (47.5-53.8)	73.8 (70.9-76.5)	66.3 (63.3-69.2)	27.6 (24.9-30.5)
Yes	436	86.9 (83.4-89.9)	72.9 (68.5-77.1)	49.1 (44.3-53.9)	72.7 (68.3-76.8)	65.1 (60.5-69.6)	28.4 (24.2-32.9)
Smoking							
Never (ref*)	895	86.4 (83.9-88.5)	68.7 (65.6-71.7)	50.3 (47.0-53.6)	75.1 (72.1-77.9)	67.3 (64.1-70.3)	28.2 (25.2-31.2)
Ever	527	88.0 (85.0-90.7)	70.4 (66.3-74.3)	50.5 (46.1-54.8)	71.0 (66.9-74.8)	63.2 (58.9-67.3)	27.3 (23.6-31.3)
Past history of cancer							
No (ref*)	1366	87.0 (85.1-88.8)	69.0 (66.5-71.5)	50.0 (47.3-52.7)	74.1 (71.7-76.4)	66.3 (63.7-68.8)	27.8 (25.5-30.3)
Yes	63	84.1 (72.7-92.1)	74.6 (62.1-84.7)	49.2 (36.4-62.1)	69.8 (57.0-80.8) †	63.5 (50.4-75.3)	31.7 (20.6-44.7)
Source							
Cancer blog (ref*)	60	86.7 (75.4-94.1)	66.7 (53.3-78.3)	56.7 (43.2-69.4)	75.0 (62.1-85.3)	65.0 (51.6-76.9)	43.3 (30.6-56.8)
4Chan, Hispachan, Reddit, and others	254	79.5 (74.0-84.3)	57.1 (50.8-63.3)	47.6 (41.4-54.0)	77.6 (71.9-82.5) †	72.8 (66.9-78.2) †	37.4 (31.4-43.7)
ForoCoches	1131	88.6 (86.6-90.4)	72.2 (69.5-74.8) †	50.2 (47.3-53.2)	72.6 (69.9-75.2)	64.5 (61.7-67.3)	24.9 (22.4-27.6)

* Reference category in multivariable analyses. † Categories associated with independent variables in the multivariable regression analyses. Models were adjusted for COVID-19 vaccination, conspiracy beliefs, preferences for type of medicine, age, sex, education level, region, medical occupation, BMI, alcohol intake, smoking, past history *†*, and source of the survey. BMI: Body Mass Index. CI: Confidence Interval.

Supplemental Table 6. Weighted analyses conducted using representative population data on age, sex, and education among the respondents residing in Spain.

	Adjusted %	CAM-total *% correct (IQR)*	CAM *% correct (IQR)*	CAM-MYCS *% correct (IQR)*
Overall	100.0	47.8 (34.8-56.5)	63.6 (45.5-81.8)	33.3 (8.3-50.0)
COVID-19 vaccination				
1 dose or more (ref*)	87.5	47.8 (34.8-60.9)	63.6 (45.5-81.8)	33.3 (8.3-58.3)
Unvaccinated	12.5	43.5 (34.8-47.8)	54.5 (45.5-81.8)	25.0 (8.3-50.0)
Believes in flat earth or shapeshifting lizards				
No (ref*)	91.4	47.8 (34.8-60.9)	63.6 (45.5-81.8)	33.3 (8.3-50.0)
Yes	2.8	47.8 (39.1-47.8)	45.5 (45.5-72.7) †	41.7 (8.3-50.0)
Preferences on type of medicine				
Conventional or unsure (ref*)	94.1	47.8 (34.8-60.9)	63.6 (45.5-81.8)	33.3 (8.3-50.0)
Alternative	4.8	43.5 (34.8-47.8)	54.5 (36.4-72.7)	25.0 (8.3-50.0)
Medical occupation				
No (ref*)	85.4	43.5 (34.8-56.5)	63.6 (45.5-72.7)	33.3 (8.3-50.0)
Yes	14.0	52.2 (34.8-65.2)	72.7 (54.5-90.9)	33.3 (8.3-50.0)
BMI				
<25 (ref*)	49.3	47.8 (39.1-60.9)	63.6 (45.5-81.8)	33.3 (8.3-50.0)
25-29.9	30.4	43.5 (34.8-56.5)	63.6 (45.5-81.8)	25.0 (8.3-50.0)
30+	13.2	47.8 (34.8-52.2)	54.5 (36.4-72.7)	33.3 (8.3-50.0)
Alcohol				
No (ref*)	70.2	47.8 (34.8-56.5)	63.6 (45.5-81.8)	25.0 (8.3-50.0)
Yes	24.2	43.5 (39.1-60.9)	63.6 (45.5-72.7)	41.7 (16.7-58.3)
Smoking				
Never (ref*)	49.0	47.8 (39.1-60.9)	63.6 (45.5-81.8)	33.3 (8.3-58.3)
Ever	45.0	43.5 (34.8-52.2)	63.6 (45.5-72.7)	25.0 (8.3-50.0)
Past history of cancer				
No (ref*)	95.9	47.8 (34.8-60.9)	63.6 (45.5-81.8)	33.3 (8.3-50.0)
Yes	3.0	43.5 (34.8-52.2)	54.5 (45.5-81.8)	25.0 (8.3-50.0)

* Reference category in multivariable analyses. † Categories associated with independent variables in the multivariable regression analyses. Models were adjusted for COVID-19 vaccination, conspiracy beliefs, preferences for type of medicine, age, sex, education level, medical occupation, BMI, alcohol intake, smoking, and past history of cancer. Percentages are not added to the total because of missing values. CAM: Cancer Awareness Measure, CAM-MYCS: Cancer Awareness Measure-MYthical Causes Scale, CAM-total: aggregated cancer awareness measures. BMI: Body Mass Index; IQR: Interquartile Range.