

Supplementary Files – Figures, Tables, and Files

Title: Epidemiology of Yellow Fever in Nigeria: Analysis of Climatic, Ecological, Socio-demographic, and Clinical Factors Associated with Viral Positivity Among Suspected Cases Using National Surveillance Data, 2017-2023.

Journal: Journal of Epidemiology and Global Health

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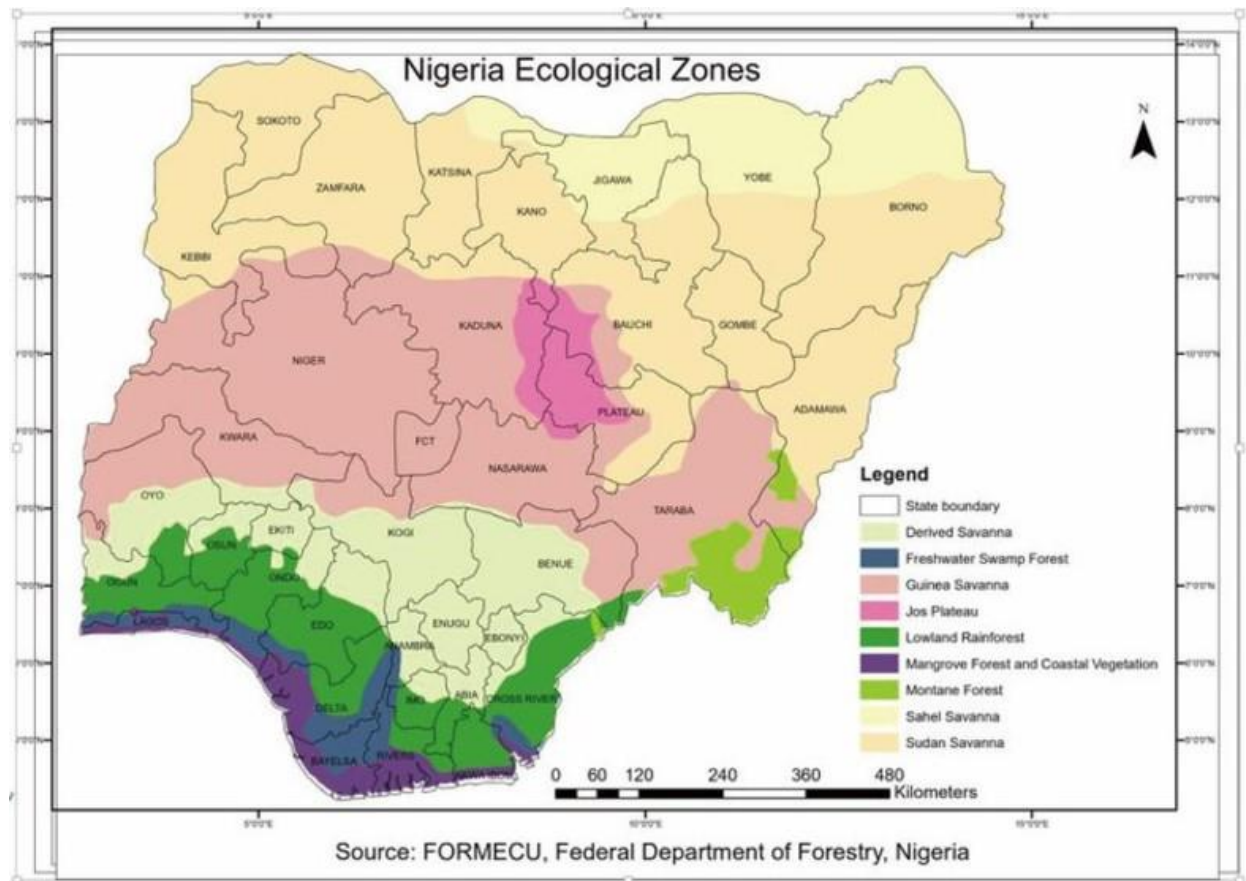
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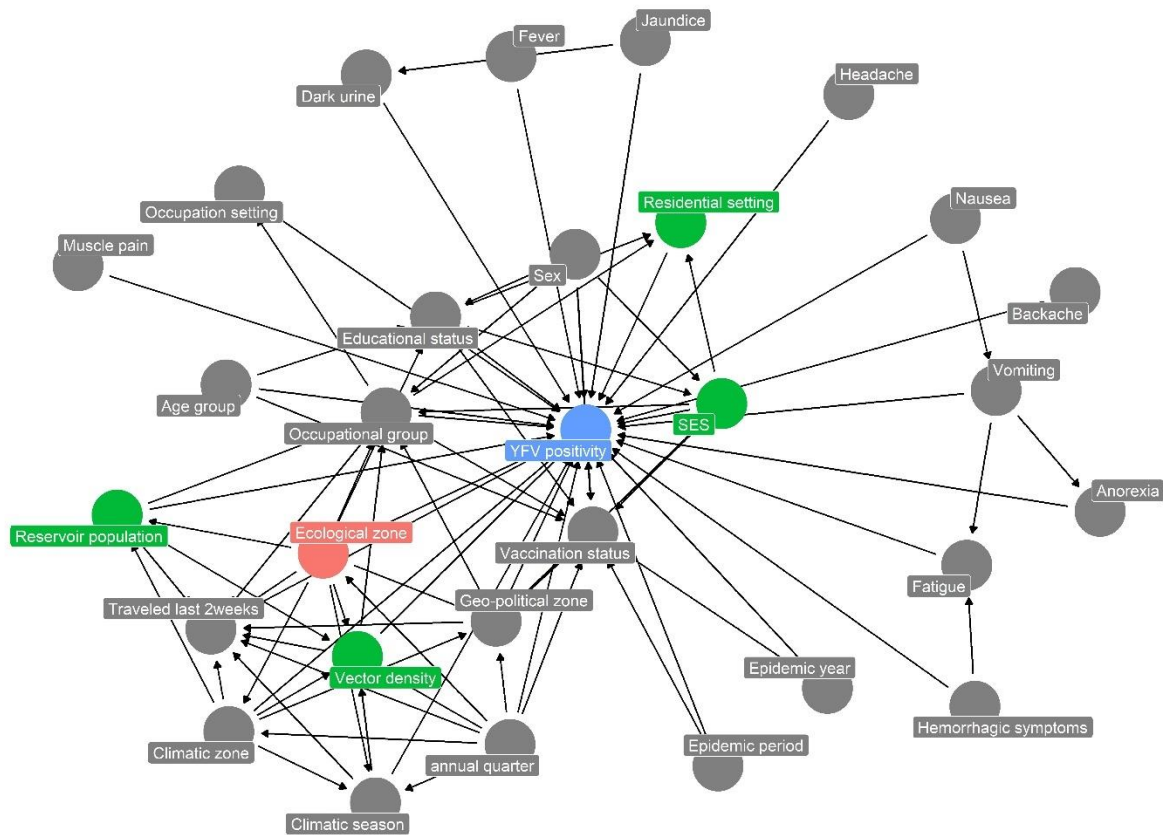
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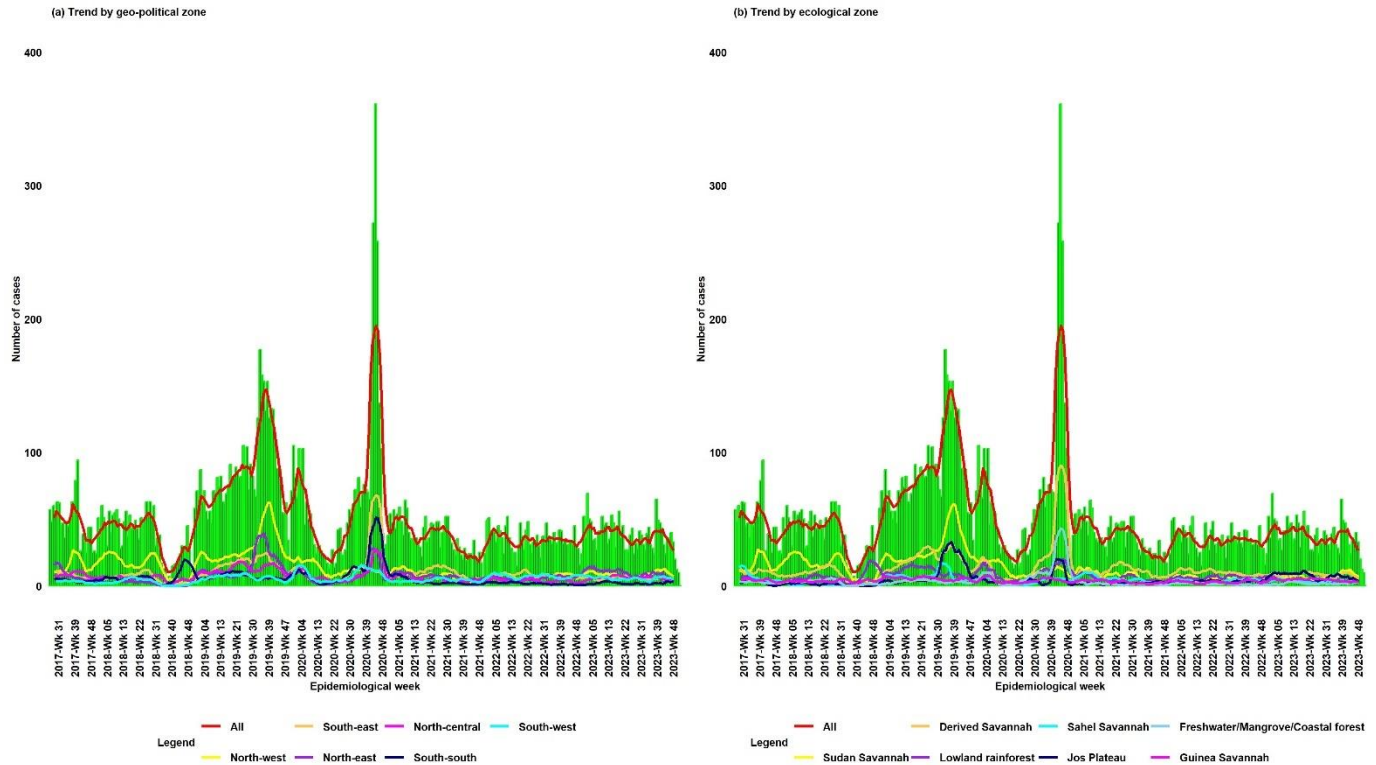
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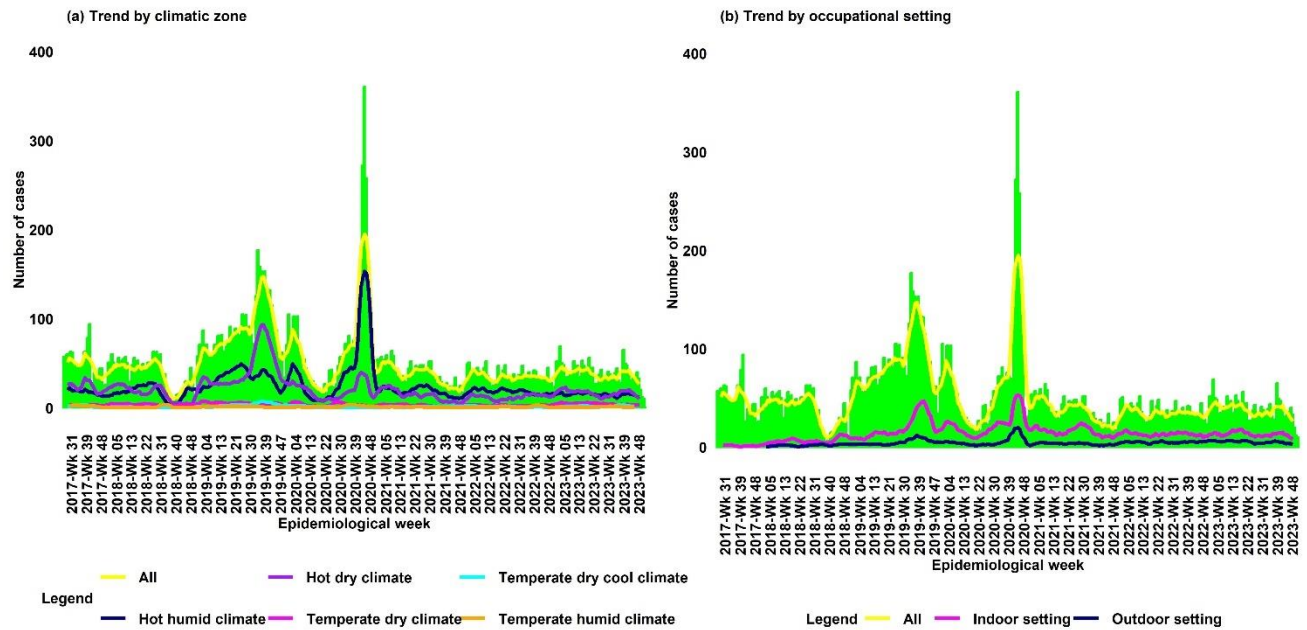
S1. Fig Map of Nigeria showing the distribution of the ecological zones. The ecological zones in Nigeria are shown with different colours. Forests span over nine ecological zones. Reprinted with permission of Dr. Moses M. Ama (Director of Forestry/National Coordinator, Nigeria REDD+ Programme) under CC BY license.



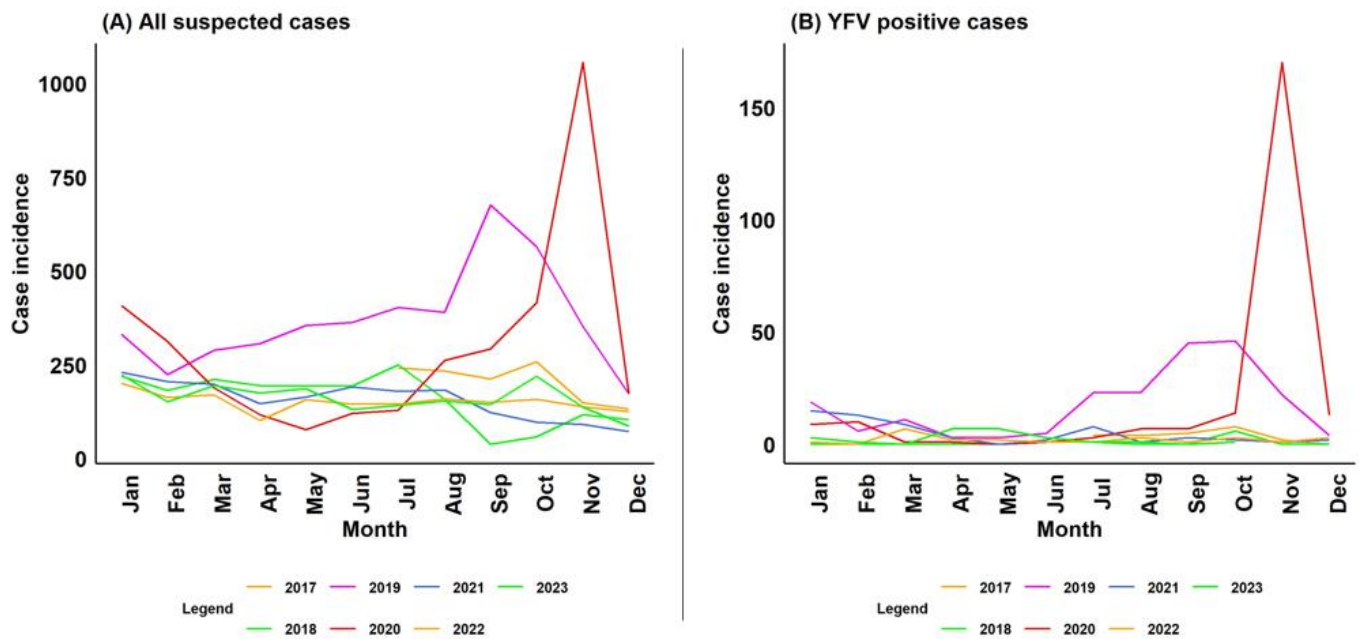
S2 Fig. Directed acyclic graph (DAG) illustrating the relation between variables used in building the binary logistic regression model. Variables colored blue indicate the outcome (dependent) variable, ink indicates the main exposure variable, dark grey indicates observed covariates (independent) variables, and light green indicates unobservable (latent) variables. The DAG was generated in dagitty.com and refined in R Studio. The DAG identified the annual quarter as the main biasing factor to be adjusted for.



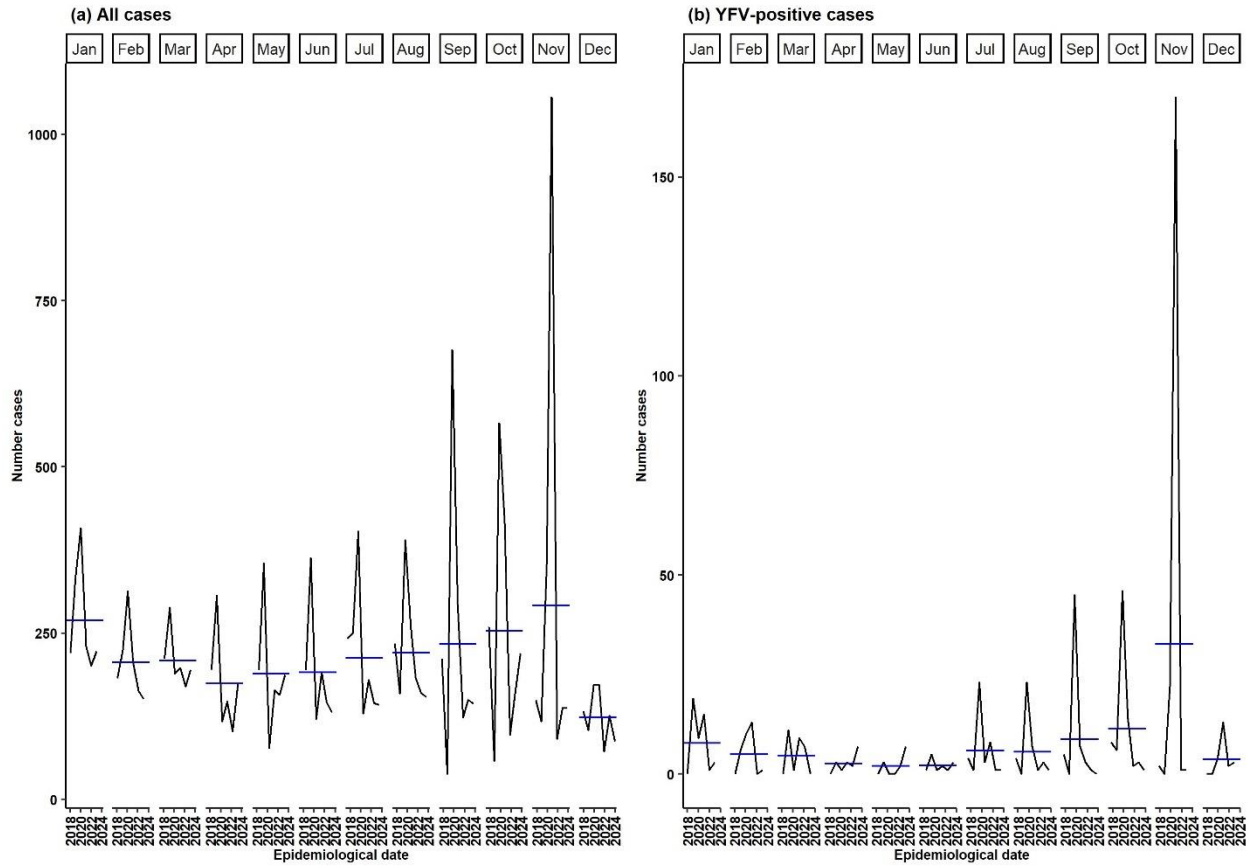
S3 Fig. Trends of incidence of reported YF cases in Nigeria, 2017-2023. Lines indicate weekly mean incidence. In: (a) cases were disaggregated by geo-political zone; and (b) cases were disaggregated by ecological zone. The light green histogram background is the epidemic curve of all reported cases.



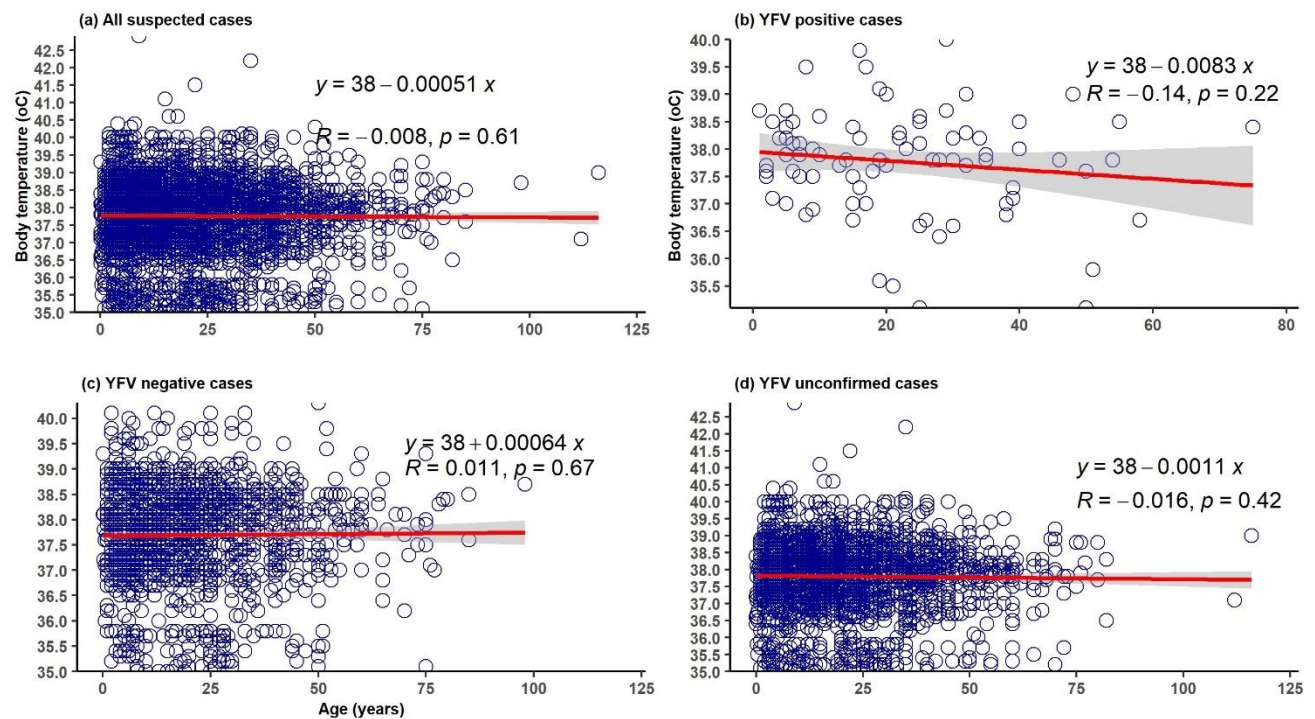
S4. Fig Trends of incidence of reported YF cases in Nigeria, 2017-2023. Lines indicate weekly mean incidence. In: (a) cases were disaggregated by climatic zone; and (b) cases were disaggregated by occupational setting. The light green histogram background is the epidemic curve of all reported cases.



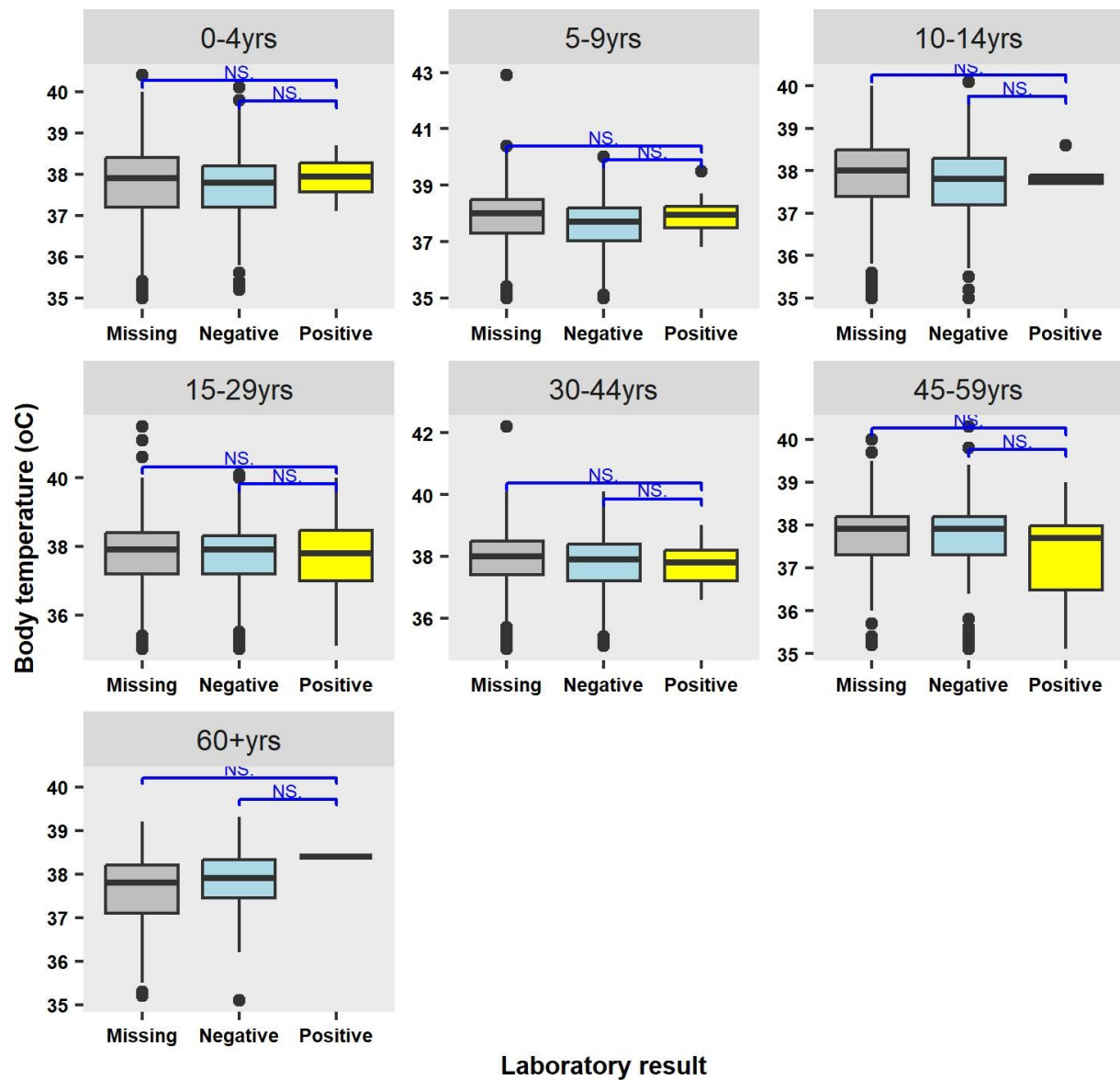
S5. Fig Seasonality plot of reported Yellow fever cases in Nigeria, 2017-2023. (a) all suspected cases (b) YFV confirmed cases. Cases were aggregated by month in a yearly line plot over the entire period.



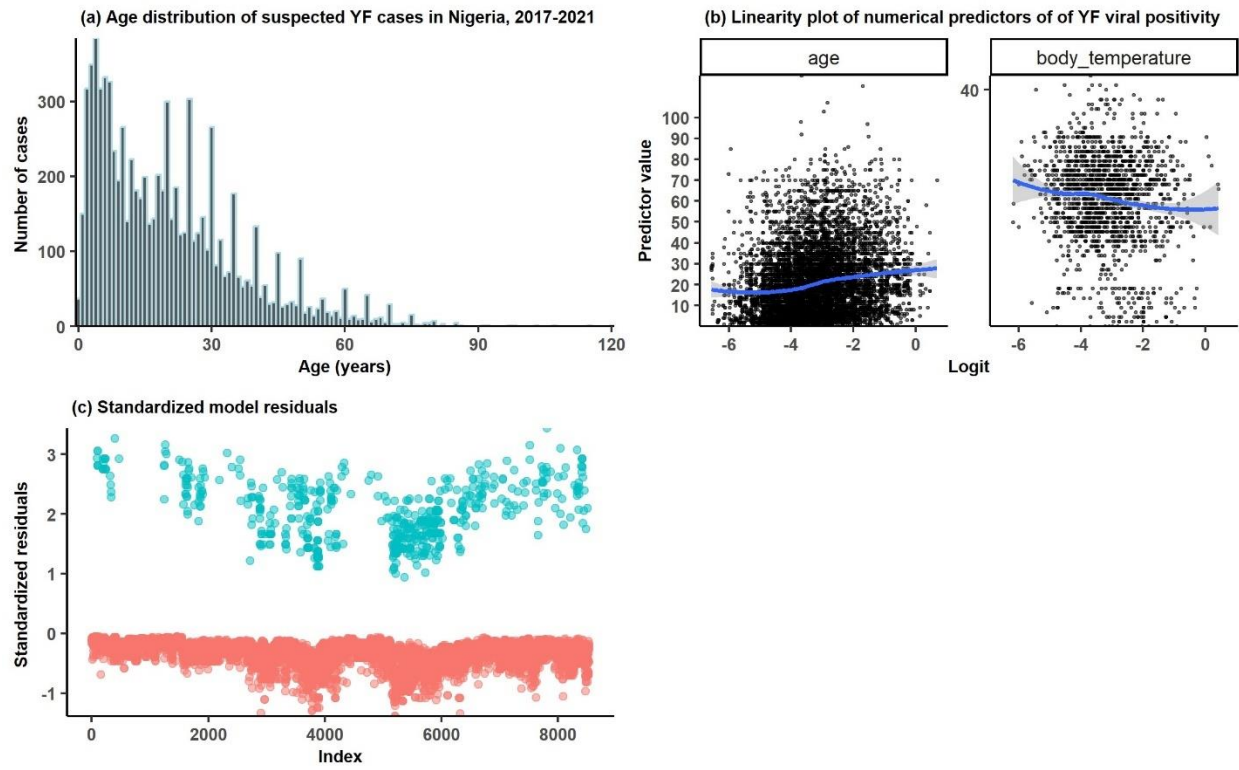
S6. Fig Seasonality plot of reported Yellow fever cases in Nigeria, 2017-2023 disaggregated by month of onset. (a) all suspected cases, (b) YFV confirmed cases. The blue horizontal line indicates the mean number of cases.



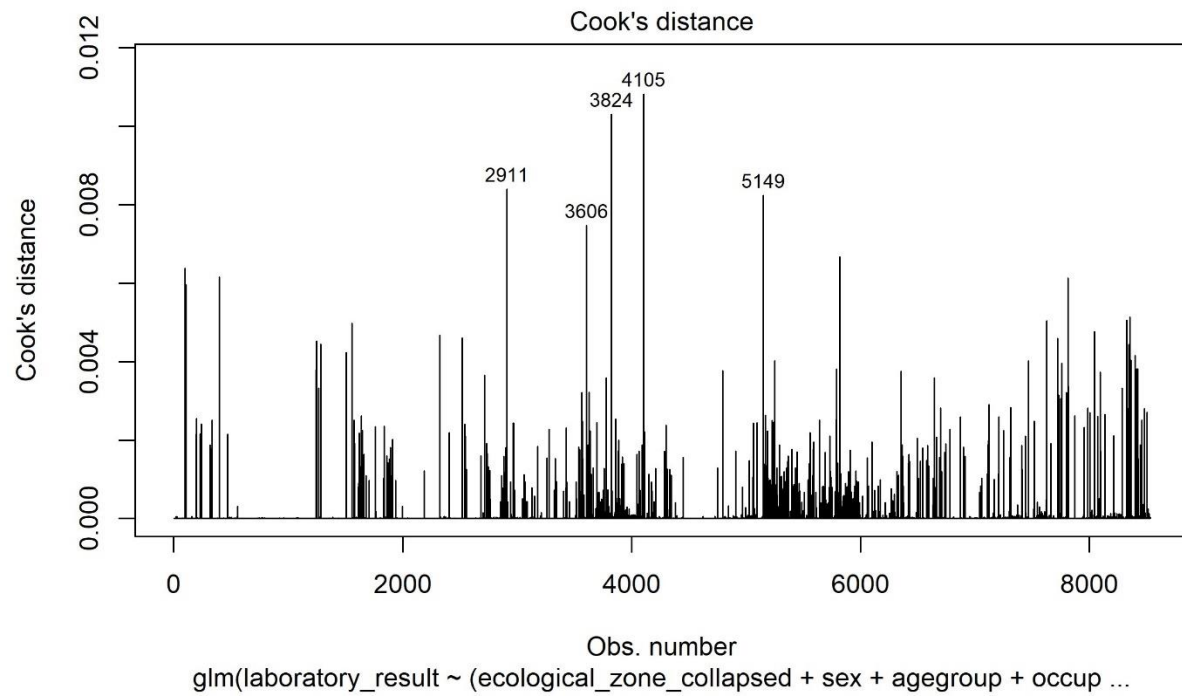
S7. Fig Correlation between measured body temperature at time of case detection and age among cases of YF in Nigeria 2017-2023. (A) All reported cases, (B) YFV positive cases, (C) YFV negative cases, and (D) Unconfirmed cases.



S8. Fig Comparison of measured body temperature at time of case detection by age group among reported cases of YF in Nigeria, 2017-2023. The boxplots are disaggregated by YFV test status. The yellow boxes indicate YFV-positive cases, light blue represents YFV-negative cases, and the grey boxes represent cases with missing laboratory results (unconfirmed cases). Each panel represents an age group (0-4, 5-9, 10-14, 15-29, 30-44, 45-54, and 60+ years). NS = non significant.



S7. Fig Plots of model assumptions evaluation of the predictors of YFD in Nigeria, 2017-2023. (A) Age distribution of the cases using a histogram, (B) Linearity plot of the numerical predictors of YFD, and (C) Standardized model residuals.



S8. Fig Cook's distance plot of final logistic regression model of the predictors of YF viral positivity in Nigeria, 2017-2023. Cook's distance values of the topmost five potential influential values in the final logistic regression model are visualized, the value of which were less than three.

Supplementary tables

S1 Table. Ecological, climatic, seasonal, socio-demographic, and clinical factors associated with YF viral positivity among suspected cases in Nigeria, 2017-2023.

Characteristic	n(%)		Univariate crude odds ratio			
	No YFV, N = 7,947 ¹	YFV present, N = 585 ¹	N	OR ²	95% CI ²	X ² p-value
Geographical and climatic characteristics						
Ecological zone			8,532			
Sahel/Sudan Savannah	2,431(31%)	64(11%)		1.00	Ref	
Jos Plateau	581(7.3%)	123(21%)		8.04	5.89, 11.1	<0.001
Derived/Guinea Savannah	2,799(35%)	246(42%)		3.34	2.54, 4.45	<0.001
Freshwater swamp/Lowland rainforest	2,136(27%)	152(26%)		2.70	2.02, 3.66	<0.001
Climatic zone			8,532			
Temperate cool/dry/humid	862(11%)	30(5.1%)		1.00	Ref	
Hot dry/humid	7,085(89%)	555(95%)		2.25	1.58, 3.34	<0.001
Geo-political zone			8,532			
North-west	1,818(23%)	43(7.4%)		1.00	Ref	
North-central	1,146(14%)	80(14%)		2.95	2.03, 4.34	<0.001
North-east	1,102(14%)	136(23%)		5.22	3.71, 7.49	<0.001
South-east	1,507(19%)	170(29%)		4.77	3.42, 6.79	<0.001
South-south	1,006(13%)	107(18%)		4.50	3.15, 6.52	<0.001
South-west	1,368(17%)	49(8.4%)		1.51	1.00, 2.30	0.050
Time-oriented characteristics						
Climatic season			8,532			
Rainy season	4,409(55%)	262(45%)		1.00	Ref	
Dry season	3,538(45%)	323(55%)		1.54	1.30, 1.82	<0.001
Epidemic year			8,532			
2017	1,818(23%)	43(7.4%)		1.00	Ref	
2018	1,146(14%)	80(14%)		2.95	2.03, 4.34	<0.001
2019	1,102(14%)	136(23%)		5.22	3.71, 7.49	<0.001
2020	1,507(19%)	170(29%)		4.77	3.42, 6.79	<0.001
2021	1,006(13%)	107(18%)		4.50	3.15, 6.52	<0.001
2022	1,368(17%)	49(8.4%)		1.51	1.00, 2.30	0.050
2023	1,818(23%)	43(7.4%)		2.95	2.03, 4.34	<0.001
Annual quarter			8,532			
First quarter	2,497(31%)	105(18%)		1.87	1.30, 2.72	<0.001
Second quarter	1,819(23%)	41(7.0%)		1.00	Ref	
Third quarter	2,002(25%)	141(24%)		3.12	2.22, 4.50	<0.001
Fourth quarter	1,629(20%)	298(51%)		8.12	5.89, 11.5	<0.001
Epidemic period			8,532			
Before COVID-19 pandemic	3,930(49%)	241(41%)		1.00	Ref	
During COVID-19 pandemic	4,017(51%)	344(59%)		1.40	1.18, 1.66	<0.001
Socio-demographic characteristics						
Sex			8,532			
Female	3,663(46%)	217(37%)		1.00	Ref	
male	4,260(54%)	363(62%)		1.44	1.21, 1.71	<0.001
Unknown	24(0.3%)	5(0.9%)		3.52	1.18, 8.59	0.011
Age group			8,532			
<15 years	2,243(28%)	107(18%)		1.00	Ref	
>=15 years	5,391(68%)	455(78%)		1.77	1.43, 2.21	<0.001
Unknown	313(3.9%)	23(3.9%)		1.54	0.95, 2.41	0.069
Educational status			8,532			
Educated	1,449(18%)	120(21%)		1.00	Ref	
Uneducated	6,498(82%)	465(79%)		0.86	0.70, 1.07	0.20
Occupational group			8,532			
Home/office worker	3,215(40%)	189(32%)		1.00	Ref	
Unemployed	3,222(41%)	247(42%)		1.30	1.07, 1.59	0.008
Student	851(11%)	82(14%)		1.64	1.25, 2.14	<0.001
Butcher/hunter/farmer	376(4.7%)	48(8.2%)		2.17	1.54, 3.01	<0.001
Artisan/trader	257(3.2%)	18(3.1%)		1.19	0.70, 1.91	0.50
Healthcare worker	26(0.3%)	1(0.2%)		0.65	0.04, 3.10	0.70
Occupation setting			8,532			

	n(%)		Univariate crude odds ratio			
Characteristic	No YFV, N = 7,947 ¹	YFV present, N = 585 ¹	N	OR ²	95% CI ²	X2 p-value
Indoor	1,583(20%)	107(18%)		1.00	Ref	
Outdoor	889(11%)	123(21%)		2.05	1.56, 2.69	<0.001
Unknown	5,475(69%)	355(61%)		0.96	0.77, 1.20	0.70
Traveled within last 2 weeks			8,532			
No	7,865(99%)	554(95%)		1.00	Ref	
Yes	82(1.0%)	31(5.3%)		5.37	3.47, 8.10	<0.001
Clinical characteristics						
Vaccination status			8,532			
Vaccinated	1,257(16%)	73(12%)		1.00	Ref	
Unvaccinated	1,103(14%)	38(6.5%)		0.59	0.39, 0.88	0.011
Unknown	5,587(70%)	474(81%)		1.46	1.14, 1.90	0.003
Anorexia			8,532			
No	7,588(95%)	565(97%)		1.00	Ref	
Yes	359(4.5%)	20(3.4%)		0.75	0.46, 1.15	0.20
Backache			8,532			
No	7,809(98%)	579(99%)		1.00	Ref	
Yes	138(1.7%)	6(1.0%)		0.59	0.23, 1.22	0.2
Dark urine			8,532			
No	7,493(94%)	557(95%)		1.00	Ref	
Yes	454(5.7%)	28(4.8%)		0.83	0.55, 1.20	0.30
Fatigue			8,532			
No	7,188(90%)	502(86%)		1.00	Ref	
Yes	759(9.6%)	83(14%)		1.57	1.22, 1.99	<0.001
Fever			8,532			
No	3,092(39%)	162(28%)		1.00	Ref	
Yes	4,855(61%)	423(72%)		1.66	1.38, 2.01	<0.001
Headache			8,532			
No	6,820(86%)	495(85%)		1.00	Ref	
Yes	1,127(14%)	90(15%)		1.10	0.87, 1.38	0.40
Jaundice			8,532			
No	5,807(73%)	406(69%)		1.00	Ref	
Yes	2,140(27%)	179(31%)		1.20	1.0, 1.43	0.054
Muscle pain			8,532			
No	7,646(96%)	563(96%)		1.00	Ref	
Yes	301(3.8%)	22(3.8%)		0.99	0.62, 1.51	>0.90
Nausea			8,532			
No	7,710(97%)	575(98%)		1.00	Ref	
Yes	237(3.0%)	10(1.7%)		0.57	0.28, 1.01	0.080
Hemorrhagic symptoms			8,532			
No	7,927(100%)	579(99%)		1.00	Ref	
Yes	20(0.3%)	6(1.0%)		4.11	1.50, 9.69	0.003
Vomiting			8,532			
No	7,642(96%)	537(92%)		1.00	Ref	
Yes	305(3.8%)	48(8.2%)		2.24	1.61, 3.04	<0.001

¹n(%)

²OR = Odds Ratio, CI = Confidence Interval

S2 Table. Comparison of multivariable logistic regression model estimates of full model with interaction terms and full model containing primary variables only

	Model with variables and interaction terms)			Model with primary variables only		
Characteristic	aOR ¹	95% CI ¹	p-value	aOR ¹	95% CI ¹	p-value
Geographical and climatic characteristics						
Ecological zone						
Sahel/Sudan Savannah	1.00	Ref	<0.001	1.00	Ref	<0.001
Jos Plateau	5.32	3.33, 8.78	<0.001	5.36	3.36, 8.86	
Derived/Guinea Savannah	3.37	1.61, 7.10		3.37	1.60, 7.10	
Freshwater swamp/Lowland rainforest	2.20	0.94, 5.17		2.20	0.94, 5.17	
Climatic season						
Rainy season	1.00	Ref	0.10	1.00	Ref	0.130
Dry season	1.24	0.91, 1.70	0.2	1.27	0.94, 1.74	
Climatic zone						
Temperate cool/dry/humid	1.00	Ref	<0.001	1.00	Ref	<0.001
Hot dry/humid	3.24	2.05, 5.30	<0.001	3.36	2.13, 5.49	
Geo-political zone						
North-west	1.00	Ref	0.073	1.00	Ref	0.079
North-central	1.11	0.50, 2.49		1.15	0.52, 2.58	
North-east	1.13	0.66, 1.89		1.14	0.67, 1.91	
South-east	1.15	0.51, 2.61		1.17	0.51, 2.65	
South-south	1.24	0.49, 3.15		1.26	0.50, 3.20	
South-west	0.44	0.18, 1.08		0.45	0.19, 1.10	
Time-oriented characteristics						
Epidemic year						
2017	1.00	Ref	<0.001	1.00	Ref	<0.001
2018	0.81	0.33, 1.80		0.80	0.33, 1.78	
2019	3.92	2.40, 6.63		3.85	2.36, 6.51	
2020	2.92	1.85, 4.81		2.89	1.83, 4.75	
2021	3.63	2.12, 6.40		3.71	2.17, 6.52	
2022	2.93	1.51, 5.70		2.95	1.53, 5.71	
2023	3.42	1.73, 6.74		3.48	1.77, 6.84	
Annual quarter	1.00	Ref	<0.001	1.00	Ref	<0.001
First quarter	1.62	1.01, 2.64		1.60	1.00, 2.61	
Second quarter		Ref		1.00	Ref	
Third quarter	3.26	2.28, 4.77		3.29	2.29, 4.80	
Fourth quarter	5.37	3.57, 8.16		5.40	3.60, 8.21	
Socio-demographic characteristics						
Sex						
Female	1.00	Ref	0.001	1.00	Ref	0.001
Male	1.44	1.19, 1.74	<0.001	1.43	1.18, 1.72	<0.001
Unknown	3.48	1.03, 9.83		3.63	1.09, 10.1	
Age group						
<15 years	1.00	Ref	0.036	1.00	Ref	0.036
>=15 years	1.27	0.96, 1.68	0.091	1.28	0.97, 1.69	0.081
Unknown	0.93	0.53, 1.58		0.96	0.55, 1.64	
Educational status						
Educated	1.00	Ref	0.60	1.00	Ref	0.90
Uneducated	0.78	0.34, 1.80		0.98	0.69, 1.39	
Occupational group						
Home/office worker	1.00	Ref	0.10	1.00	Ref	0.008
Unemployed	1.47	0.75, 2.92	0.3	1.15	0.86, 1.55	
Student	1.32	0.52, 3.39	0.6	1.87	1.13, 3.21	
Butcher/hunter/farmer	0.36	0.08, 1.30	0.2	0.66	0.41, 1.07	
Artisan/trader	0.62	0.17, 2.04	0.5	0.43	0.22, 0.79	
Healthcare worker	9.90	0.38, 129	0.10	1.69	0.09, 9.65	
Occupational setting						
Indoor	1.00	Ref	<0.001	1.00	Ref	<0.001
Outdoor	3.23	1.85, 5.79	<0.001	3.32	1.92, 5.88	<0.001
Unknown	1.45	0.87, 2.50	0.2	1.53	0.93, 2.59	0.10
Traveled within last 2 weeks						
No	1.00	Ref	0.023	1.00	Ref	0.021
Yes	1.99	1.19, 3.28	0.008	1.93	1.16, 3.14	0.009
Clinical characteristics						

	Model with variables and interaction terms)			Model with primary variables only		
Characteristic	aOR ¹	95% CI ¹	p-value	aOR ¹	95% CI ¹	p-value
Vaccination status						
Vaccinated	1.00	Ref	0.70	1.00	Ref	
Unvaccinated	0.79	0.23, 2.62	0.7	0.77	0.49, 1.19	0.20
Unknown	1.03	0.43, 2.59	>0.9	1.30	0.98, 1.75	0.077
Anorexia						
No	1.00	Ref	0.069	1.00	Ref	0.076
Yes	0.59	0.33, 1.02		0.60	0.33, 1.03	
Backache						
No	1.00	Ref	0.20	1.00	Ref	0.20
Yes	0.55	0.20, 1.26		0.55	0.20, 1.25	
Dark urine						
No	1.00	Ref	0.20	1.00	Ref	0.20
Yes	1.38	0.84, 2.18		1.36	0.84, 2.14	
Fatigue						
No	1.00	Ref	0.10	1.12	Ref	0.075
Yes	1.34	0.95, 1.87		1.36	0.97, 1.90	
Fever						
No	1.00	Ref	0.70	1.00	Ref	0.80
Yes	0.96	0.74, 1.25		0.97	0.75, 1.26	
Headache						
No	1.00	Ref	0.90	1.00	Ref	0.90
Yes	1.00	0.73, 1.37		0.99	0.72, 1.34	
Jaundice						
No	1.00	Ref	0.052	1.00	Ref	0.061
Yes	1.30	1.00, 1.69		1.29	0.99, 1.67	
Muscle pain						
No	1.00	Ref	0.80	1.00	Ref	0.40
Yes	1.26	0.06, 8.06		1.25	0.72, 2.12	
Nausea						
No	1.00	Ref	0.069	1.00	Ref	0.073
Yes	0.49	0.22, 1.01		0.50	0.23, 1.02	
Hemorrhagic symptoms						
No	1.00	Ref	0.20	1.00	Ref	0.20
Yes	1.90	0.62, 5.28		1.95	0.64, 5.37	
Vomiting						
No	1.00	Ref	0.70	1.00	Ref	0.011
Yes	0.62	0.03, 3.98		1.68	1.12, 2.51	
Interaction terms						
Occupational group * vaccination status						
Unemployed * Unvaccinated	1.20	0.34, 4.20	0.8			
Student * Unvaccinated	1.61	0.39, 6.64	0.5			
Butcher/hunter/farmer * Unvaccinated	2.16	0.45, 13.0	0.4			
Artisan/trader* Unvaccinated	0.00	0.00, 0.00	>0.9			
Healthcare worker* Unvaccinated	0.00		>0.9			
Unemployed * Unknown	0.76	0.38, 1.49	0.4			
Student * Unknown	1.49	0.55, 4.01	0.4			
Butcher/hunter/farmer * Unknown	1.92	0.52, 9.55	0.4			
Artisan/trader * Unknown	0.71	0.18, 2.95	0.6			
Healthcare worker * Unknown	No data					
Educational status * Vaccination status						
Uneducated * Unvaccinated	0.78	0.23, 2.67	0.7			
Uneducated * Unvaccinated	1.40	0.56, 3.44	0.5			
Fever* Muscle pain	0.93	0.13, 19.6	>0.9			
Fever * Vomiting	2.81	0.42, 58.4	0.4			
Muscle pain*Vomiting*	No data					
Fever* Muscle pain * Vomiting	No data					
Model characteristics						
Observations			8481			8481
R² Tjur			0.126			0.124
AIC			3630.374			3611.855
log-Likelihood			-1753.187			-1759.927
Hosmer-Lemeshow Goodness-of-fit	X-squared = 9.8662, df = 8, p-value = 0.275			X-squared = 16.115, df = 8, p-value = 0.041		

S3 Table. Output of manual backward elimination of statistically insignificant covariates

	Full model included interaction terms			Full model included all primary variables only							
	Variable dropped										
	Fever*m uscle pain*v omiting	Education*v ac cination status	Occupation group*v ac cination status	Backa che	Dar k ur in e	Educati onal status	Fati gue	Fev er	Head ache	Musc le pain	Geo- politi cal zone
Predictors	aOR	aOR	aOR	aOR	aO R	aOR	aOR	aO R	aOR	aOR	aOR
Ecological zone: Jos Plateau	5.35 ***	5.37 ***	5.36 ***	5.40 ***	5.38 ***	5.39 ***	5.44 ***	5.44 ***	5.90 ***	5.42 ***	5.92 ***
Ecological zone: Derived/Guine a Savannah	3.34 **	3.32 **	3.37 **	3.34 **	3.39 **	3.33 **	3.31 **	3.30 **	3.32** *	3.32* *	3.32* **
Ecological zone: Freshwater swamp/Lowla nd rainforest	2.18	2.14	2.20	2.18	2.21	2.20	2.12	2.12	2.05 ***	2.11	2.05 ***
Sex: male	1.43 ***	1.43 ***	1.43 ***	1.42 ***	1.43 ***	1.42 ***	1.42 ***	1.42 ***	1.44 ***	1.42 ***	1.45 ***
Sex: unknown	3.51 *	3.59 *	3.63 *	3.62 *	3.62 *	3.61 *	3.61 *	3.61 *	3.21 *	3.61 *	3.22 *
Age group: >=15 years	1.26	1.26	1.28	1.28	1.27	1.28	1.28	1.28	1.31 *	1.28	1.31
Age group: Unknown	0.92	0.92	0.96	0.96	0.96	0.96	0.96	0.96	0.99	0.96	0.99
Educational status: Uneducated	0.78	0.96	0.98	0.97	0.97						
Occupational group: Unemployed	1.47	1.41	1.15	1.15	1.15	1.15	1.16	1.16	1.15	1.15	1.15
Occupational group: Student	1.33	1.54	1.87 *	1.83 *	1.83 *	1.86 *	1.87 *	1.87 *	1.81 *	1.85 *	1.81 *
Occupational group: Butcher/hunter /farmer	0.36	0.40	0.66	0.68	0.68	0.68	0.69	0.69	0.73	0.69	0.73
Occupational group: Artisan/trader	0.62	0.72	0.43 **	0.44 **	0.44 **	0.44 **	0.45 *	0.45 **	0.43 **	0.45 *	0.43 **

Occupational group: Healthcare worker	9.84	11.83	1.69	1.57	1.75	1.59	1.59	1.58	1.55	1.56	1.50
Occupational setting: Outdoor	3.27 ***	3.25 ***	3.32 ***	3.20 ***	3.22 ***	3.19 ***	3.19 ***	3.19 ***	3.09 ***	3.17 ***	3.10 ***
Occupation setting: Unknown	1.47	1.47	1.53	1.47	1.49	1.46	1.44	1.44	1.40	1.44	1.41
Traveled within last 2 weeks	1.91 *	1.91 *	1.93 **	1.90 *	1.93 **	1.91 *	1.88 *	1.89 *	1.87 *	1.88 *	1.88 *
Vaccination status: Unvaccinated	0.74	0.66	0.76	0.75	0.75	0.75	0.78	0.78	0.80	0.78	0.79
Vaccination status: Unknown	1.03	1.37	1.30	1.29	1.28	1.29	1.31	1.31	1.36 *	1.30	1.35 *
Epidemic year: 2018	0.81	0.80	0.80	0.80	0.80	0.80	0.81	0.81	0.82	0.80	0.82
Epidemic year: 2019	3.87 ***	3.84 ***	3.85 ***	3.85 ***	3.86 ***	3.85 ***	3.85 ***	3.81 ***	3.74 ***	3.81 ***	3.73 ***
Epidemic year: 2020	2.90 ***	2.89 ***	2.89 ***	2.87 ***	2.87 ***	2.87 ***	2.88 ***	2.86 ***	2.83 ***	2.87 ***	2.82 ***
Epidemic year: 2021	3.61 ***	3.57 ***	3.71 ***	3.68 ***	3.69 ***	3.68 ***	3.66 ***	3.64 ***	3.52 ***	3.64 ***	3.52 ***
Epidemic year: 2022	2.90 **	2.89 **	2.95 **	2.87 **	2.95 **	2.88 **	2.96 **	2.94 ***	2.06 *	2.95 ***	2.04 *
Epidemic year: 2023	3.38 ***	3.38 ***	3.48 ***	3.42 ***	3.45 ***	3.43 ***	3.37 ***	3.35 ***	2.50 **	3.33 ***	2.49 **
Annual quarter: First	1.61	1.59	1.60	1.61	1.62 *	1.61	1.60	1.60	1.45	1.61	1.46
Annual quarter: Third	3.27 ***	3.26 ***	3.29 ***	3.25 ***	3.25 ***	3.25 ***	3.26 ***	3.26 ***	3.12 ***	3.26 ***	3.12 ***
Annual quarter: Fourth	5.36 ***	5.33 ***	5.40 ***	5.36 ***	5.37 ***	5.36 ***	5.40 ***	5.40 ***	5.10 ***	5.41 ***	5.10 ***
Climatic season: Dry	1.26	1.27	1.27	1.27	1.26	1.27	1.28	1.28	1.39 *	1.27	1.39 *
Climatic zone: Hot, dry/humid	3.29 ***	3.33 ***	3.36 ***	3.38 ***	3.35 ***	3.37 ***	3.34 ***	3.34 ***	3.15 ***	3.34 ***	3.15 ***
Geo-political zone: North-central	1.12	1.13	1.15	1.14	1.12	1.14	1.14	1.14		1.14	

[illegible]

Unemployed * Unknown status	0.76	0.80									
Student * Unknown status	1.50	1.19									
Butcher/hunter /farmer * Unknown status	1.95	1.72									
Artisan/trader * Unknown status	0.72	0.57									
Healthcare worker * Unknown status	No data	No data									
Educational status and Vaccination status											
Uneducated * Unvaccinated	0.81										
Uneducated * Unknown status	1.40										
Model characteristics											
Observations	8481	8481	8481	8481	8481	8481	8481	8481	8481	8481	8481
R² Tjur	0.126	0.126	0.124	0.124	0.124	0.124	0.123	0.123	0.118	0.123	0.118
AIC	3623.8	3621.3	3611.9	3611.4	3611.5	3609.5	3610.6	3608.8	3634.9	3607.697	3636.8
log-Likelihood	-1753.9	-1754.6	-1759.9	-1761.7	-1760.7	-1761.7	-1763.3	-1763.4	-1782.5	-1763.8	-1782.4
LRT p-value	0.844	0.821	0.637	0.167	0.307	0.141	0.227	0.227	<0.001	0.249	<0.001
* p<0.05 ** p<0.01 *** p<0.001											

S4 Table. Assessment of independence of predictors.

4 Table: Assessment of independence of predictors.												
Predictor dropped												
	Sex	Age group	Occupational group	Travelled with last 2 weeks	Vaccination status	Epidemic year	Annual quarter	Climatic zone	Ecological zone	Anorexia	Jaundice	Vomiting
Predictors	aOR											
Geographical and climatic characteristics												
Ecological zone: Jos Plateau	5.62 ***	5.57 ***	5.43 ***	5.59 ***	5.78 ***	5.65 ***	7.04 ***	4.42 ***		5.45 ***	5.46 ***	5.37 ***
Ecological zone: Derived/Guinea Savannah	3.34 **	3.36 **	3.29 **	3.43 **	3.79 ***	3.02 **	3.10 **	3.01 ***		3.31 **	3.28 **	3.26 **
Ecological zone: Freshwater swamp/Lowland rainforest	2.07	2.18	2.13	2.16	2.47 *	1.79	1.62	1.92		2.16	2.04	2.03
Climatic zone: Hot, dry/humid	3.37 ***	3.34 ***	3.45 ***	3.42 ***	3.50 ***	3.35 ***	3.88 ***		2.65 ***	3.36 ***	3.30 ***	3.23 ***
Climatic season: Dry	1.27	1.29	1.27	1.30	1.31	1.26	1.38 ***	1.30	1.25	1.28	1.29	1.31
Geo-political zone: North-central	1.10	1.11	1.21	1.15	1.06	1.28	1.40	0.74	3.50 ***	1.14	1.11	1.14
Geo-political zone: North-east	1.09	1.11	1.14	1.11	1.12	1.41	1.42	1.22	3.05 ***	1.11	1.12	1.11
Geo-political zone: South-east	1.11	1.16	1.25	1.14	1.06	1.40	1.51	1.32	3.53 ***	1.18	1.15	1.21
Geo-political zone: South-south	1.36	1.31	1.37	1.29	1.18	1.70	2.12	1.48	2.68 ***	1.30	1.35	1.45
Geo-political zone: South-west	0.46	0.46	0.49	0.46	0.42	0.59	0.67	0.53	1.12	0.46	0.47	0.47
Time-oriented characteristics												
Epidemic year: 2018	0.80	0.80	0.82	0.82	0.74		0.33 **	0.78	0.87	0.80	0.80	0.81
Epidemic year: 2019	3.73 ***	3.70 ***	3.96 ***	3.83 ***	3.65 ***		2.07 **	3.74 ***	4.24 ***	3.79 ***	3.78 ***	3.83 ***
Epidemic year: 2020	2.85 ***	2.84 ***	2.93 ***	2.99 ***	2.84 ***		2.09 **	2.91 ***	3.02 ***	2.86 ***	2.99 ***	2.92 ***
Epidemic year: 2021	3.52 ***	3.58 ***	3.60 ***	3.68 ***	3.34 ***		1.61	3.59 ***	3.53 ***	3.66 ***	3.83 ***	3.58 ***
Epidemic year: 2022	2.85 **	2.76 **	2.91 **	2.95 ***	2.75 **		1.54	2.94 ***	3.15 ***	2.98 ***	3.15 ***	2.88 **
Epidemic year: 2023	3.19 ***	3.14 ***	3.39 ***	3.34 ***	3.20 ***		1.25	3.32 ***	4.43 ***	3.39 ***	3.66 ***	3.29 ***
Annual quarter: First	1.63 *	1.59	1.63 *	1.57	1.57	1.63 *		1.56	1.62 *	1.60	1.58	1.57
Annual quarter: Third	3.25 ***	3.22 ***	3.25 ***	3.27 ***	3.27 ***	3.01 ***		3.23 ***	3.50 ***	3.25 ***	3.21 ***	3.27 ***
Annual quarter: fourth	5.37 ***	5.33 ***	5.61 ***	5.43 ***	5.39 ***	4.98 ***		5.53 ***	6.11 ***	5.41 ***	5.38 ***	5.40 ***
Socio-demographic characteristics												
Sex: Male		1.42 ***	1.45 ***	1.42 ***	1.42 ***	1.40 ***	1.40 ***	1.42 ***	1.47 ***	1.42 ***	1.43 ***	1.41 ***
Sex: Unknown		3.43 *	3.69 *	3.83 *	3.46 *	3.17 *	2.57	3.82 *	4.17 **	3.62 *	3.48 *	3.60 *
Age group: Male	1.26		1.37 **	1.28	1.30	1.31	1.28	1.29	1.31	1.28	1.27	1.27
Age group: Unknown	0.97		1.08	0.95	0.93	1.23	1.16	0.98	0.89	0.96	0.94	0.95
Occupational group: Unemployed	1.14	1.30 *		1.16	1.15	1.22	1.19	1.18	1.19	1.15	1.16	1.17
Occupational group: Student	2.05 **	1.92 **		1.89 *	1.91 *	1.89 *	2.11 **	1.94 **	1.69 *	1.89 *	1.83 *	1.88 *

Occupational group: Butcher/hunter/f armer	0.72	0.71		0.74	0.64	0.65	0.59 *	0.71	0.68	0.69	0.72	0.69
Occupational group: Artisan/trader	0.45 **	0.47 *		0.47 *	0.45 **	0.43 **	0.42 **	0.43 **	0.42 **	0.44 **	0.47 *	0.45 **
Occupational group: Healthcare worker	1.70	1.61		1.57	1.37	1.58	1.47	1.72	1.59	1.63	1.50	1.48
Occupational setting: Outdoor	3.45 ***	3.39 ***	1.45 *	3.11 ***	3.38 ***	3.42 ***	3.74 ***	3.42 ***	3.06 ***	3.19 ***	2.96 ***	3.14 ***
Occupational setting: Unknown	1.56	1.38	0.97	1.40	1.57	1.20	1.39	1.47	1.31	1.46	1.31	1.41
Traveled withing last two weeks: Yes	1.91 **	1.91 *	1.82 *		1.92 **	1.94 **	2.33 ***	2.05 **	2.15 **	1.84 *	1.77 *	1.97 **
Clinical characteristics												
Vaccination status: Unvaccinated	0.78	0.80	0.77	0.77		0.65	0.81	0.77	0.71	0.77	0.79	0.78
Vaccination status: Unknown	1.30	1.35 *	1.31	1.31		1.14	1.41 *	1.38 *	1.32	1.31	1.26	1.32
Anorexia: yes	0.67	0.66	0.63	0.68	0.64	0.67	0.63	0.63	0.67		0.69	0.71
Headache: Yes	1.01	1.04	1.00	1.03	1.03	1.05	1.07	1.02	0.98	1.00	1.09	1.08
Jaundice: Yes	1.35 *	1.35 *	1.29 *	1.30 *	1.28 *	1.39 **	1.36 *	1.32 *	1.38 **	1.32 *		1.41 **
Muscle pain: Yes	1.29	1.32	1.26	1.29	1.26	1.29	1.27	1.33	1.30	1.25	1.37	1.30
Nausea: Yes	0.51	0.51	0.51	0.51	0.53	0.51	0.47 *	0.48	0.51	0.44 *	0.52	0.60
Hemorrhagic symptoms: Yes	1.84	1.77	1.75	1.77	1.74	1.81	2.17	1.86	2.05	1.68	1.74	1.97
Vomiting: Yes	1.76 **	1.79 **	1.81 **	1.84 **	1.81 **	1.80 **	2.00 ***	1.68 **	1.77 **	1.73 **	1.92 **	
Model characteristics												
Observations	8481	8481	8481	8481	8481	8532	8481	8481	8481	8481	8481	8481
R ² Tjur	0.119	0.123	0.119	0.122	0.122	0.114	0.098	0.116	0.107	0.12 3	0.122	0.121
AIC	3621.5 44	3609. 230	3613. 856	3612. 830	3614.25 8	3660.6 60	3743. 238	3636. 255	3666.382	3609 .101	3612.2 85	3614. 818
log-Likelihood	- 1771.7 72	- 1765. 615	- 1770. 928	- 1766. 415	- 1768.12 9	- 1795.3 30	- 1833. 619	- 1778. 128	- 1795.191	- 1764 .551	- 1766.1 43	- 1767. 409
LRT p-value	<0.00 1	0.052	<0.00 1	0.009	0.005	<0.001	<0.00 1	<0.00 1	<0.001	0.06 1	0.012	0.004
* <i>p</i> <0.05 ** <i>p</i> <0.01 *** <i>p</i> <0.001												

S5 Table. Univariate table of ecological, climatic, socio-demographic, and clinical factors associated with YFV positivity among suspected YF cases in Nigeria, 2017-2023 stratified by vaccination status.

	Vaccinated cases				Unvaccinated cases				Unknown status				Combined unvaccinated and unknown cases			
Characteristic	N	OR ¹	95% CI ¹	p-value	N	OR ¹	95% CI ¹	p-value	N	OR ¹	95% CI ¹	p-value	N	OR ¹	95% CI ¹	p-value
Geographical and climatic characteristics																
Ecological zone	1,330				1,141				6,061				7,202			
Sahel/Sudan Savannah		1.00	Ref			1.00	Ref			1.00	Ref			1.00	Ref	
Jos Plateau		7.45	2.21, 33.9	0.003		21.2	5.03, 144	<0.001		7.49	5.37, 10.5	<0.001		8.37	6.06, 11.7	<0.001
Derived/Guinea Savannah		2.43	0.82, 10.4	0.20		22.7	6.67, 142	<0.001		2.91	2.17, 3.94	<0.001		3.64	2.75, 4.90	<0.001
Freshwater swamp/Lowland rainforest	1,330	5.50	1.97, 22.9	0.005		8.76	1.87, 61.6	0.010		2.01	1.46, 2.80	<0.001		2.46	1.79, 3.39	<0.001
Climatic zone	1,330				1,141				6,061				7,202			
Temperate cool/dry/humid		1.00	Ref			1.00	Ref			1.00	Ref			1.00	Ref	
Hot dry/humid		1.25	0.63, 2.87	0.60		1.32	0.52, 4.46	0.60		2.74	1.75, 4.59	<0.001		2.58	1.71, 4.10	<0.001
Climatic season	1,330				1,141				6,061				7,202			
Rainy season		1.00	Ref			1.00	Ref			1.00	Ref			1.00	Ref	
Dry season		1.49	0.93, 2.40	0.10		1.17	0.60, 2.24	0.60		1.51	1.25, 1.83	<0.001		1.53	1.27, 1.83	<0.001
Time-oriented characteristics																
Epidemic year	1,330		No data		1,141				6,061				7,202			
2017						1.78	0.30, 33.8	0.60		3.22	2.09, 5.20	<0.001		3.12	2.05, 4.98	<0.001
2018						1.33	0.25, 24.6	0.80		4.60	3.01, 7.40	<0.001		4.07	2.69, 6.47	<0.001
2019						0.51	0.08, 10.0	0.50		2.38	1.41, 4.12	0.001		1.69	1.02, 2.87	0.044
2020						1.50	0.21, 29.9	0.70		1.77	0.89, 3.43	0.10		1.71	0.91, 3.17	0.091
2021						7.76	1.32, 148	0.060		2.09	1.01, 4.16	0.040		2.90	1.57, 5.33	<0.001
2022						1.78	0.30, 33.8	0.6		3.22	2.09, 5.20	<0.001		3.12	2.05, 4.98	<0.001
2023						1.33	0.25, 24.6	0.8		4.60	3.01, 7.40	<0.001		4.07	2.69, 6.47	<0.001
Annual quarter	1,330				1,141				6,061				7,202			
First quarter		2.72	1.37, 5.87	0.006		0.45	0.16, 1.18	0.12		2.30	1.40, 3.95	0.002		1.64	1.08, 2.54	0.023
Second quarter		1.00	Ref			1.00	Ref			1.00	Ref			1.00	Ref	
Third quarter		2.38	1.11, 5.40	0.030		0.68	0.25, 1.70	0.40		4.98	3.12, 8.39	<0.001		3.46	2.35, 5.26	<0.001
Fourth quarter		1.69	0.68, 4.19	0.20		3.51	1.55, 8.04	0.003		12.9	8.29, 21.4	<0.001		9.92	6.91, 14.8	<0.001
Epidemic period	1,330				1,141				6,061				7,202			
Before COVID-19 pandemic		1.00	Ref			1.00	Ref			1.00	Ref			1.00	Ref	
During COVID-19 pandemic		0.83	0.52, 1.34	0.50		1.57	0.77, 3.56	0.20		1.65	1.37, 2.00	<0.001		1.52	1.26, 1.82	<0.001
Socio-demographic characteristics																
Sex	1,330				1,141				6,061				7,202			
Female		1.00	Ref			1.00	Ref			1.00	Ref			1.00	Ref	
Male		1.09	0.68, 1.75	0.70		1.91	0.95, 4.08	0.078		1.47	1.22, 1.79	<0.001		1.50	1.24, 1.81	<0.001
Unknown		0.00		>0.90		91.5	8.19, 2,058	<0.001		2.12	0.50, 6.22	0.20		3.79	1.26, 9.37	0.008
Age group	1,330				1,141				6,061				7,202			
<15 years		1.00	Ref			1.00	Ref			1.00	Ref			1.00	Ref	
>=15 years		1.50	0.89, 2.65	0.14		1.13	0.56, 2.47	0.80		1.86	1.46, 2.41	<0.001		1.79	1.42, 2.29	<0.001
Unknown		1.73	0.62, 4.24	0.30		3.58	0.19, 22.0	0.20		1.36	0.75, 2.31	0.30		1.50	0.85, 2.49	0.14
Educational status	1,330				1,141				6,061				7,202			

	Vaccinated cases				Unvaccinated cases				Unknown status				Combined unvaccinated and unknown cases			
Characteristic	N	OR ¹	95% CI ¹	P-value	N	OR ¹	95% CI ¹	p-value	N	OR ¹	95% CI ¹	p-value	N	OR ¹	95% CI ¹	p-value
Educated		1.00	Ref			1.00	Ref			1.00	Ref			1.00	Ref	
Uneducated		0.87	0.54, 1.44	0.60		0.46	0.24, 0.90	0.021		0.76	0.59, 0.99	0.037		0.81	0.65, 1.03	0.084
Occupational group	1,330				1,141				6,061				7,202			
Home/office worker		1.00	Ref			1.00	Ref			1.00	Ref			1.00	Ref	
Unemployed		1.66	0.92, 3.01	0.093		1.52	0.56, 4.02	0.40		1.17	0.94, 1.45	0.20		1.25	1.02, 1.54	0.033
Student		1.34	0.69, 2.56	0.40		3.31	1.31, 8.46	0.011		1.92	1.38, 2.64	<0.001		1.87	1.38, 2.52	<0.001
Butcher/hunter/farmer		1.08	0.25, 3.23	>0.90		4.08	1.65, 10.3	0.002		2.80	1.85, 4.13	<0.001		2.34	1.63, 3.29	<0.001
Artisan/trader		1.80	0.59, 4.57	0.30		0.00		>0.90		1.26	0.67, 2.19	0.40		1.09	0.58, 1.88	0.80
Healthcare worker		7.56	0.37, 61.8	0.085		0.00	0	>0.90		0.00		>0.90		0.00		>0.90
Occupational setting	1,330			1,141	1,141	No data			6,061				7,202			
Indoor		1.00	Ref			1.00	Ref			1.00	Ref			1.00	Ref	
Outdoor		1.40	0.68, 2.79	0.30		1.77	0.82, 3.79	0.14		1.98	1.43, 2.76	<0.001		2.09	1.55, 2.83	<0.001
Unknown		1.19	0.70, 2.05	0.50		0.62	0.27, 1.39	0.30		0.71	0.54, 0.93	0.013		0.88	0.69, 1.13	0.30
Traveled outside within last 2 weeks	1,330				1,141				6,061				7,202			
No		1.00	Ref			1.00	Ref			1.00	Ref			1.00	Ref	
Yes		2.17	0.12, 12.0	0.50		4.66	0.71, 17.7	0.048		5.69	3.55, 8.90	<0.001		5.56	3.56, 8.50	<0.001
Clinical characteristics																
Anorexia	1,330				1,141				6,061				7,202			
No		1.00	Ref			1.00	Ref			1.00	Ref			1.00	Ref	
Yes		0.99	0.34, 2.29	>0.90		1.21	0.41, 2.89	0.70		0.79	0.39, 1.43	0.50		0.71	0.40, 1.16	0.20
Backache	1,330				1,141				6,061				7,202			
No		1.00	Ref			1.00	Ref			1.00	Ref			1.00	Ref	
Yes		0.52	0.03, 2.45	0.50		1.34	0.21, 4.58	0.70		0.58	0.14, 1.56	0.40		0.62	0.22, 1.37	0.30
Dark urine	1,330				1,141				6,061				7,202			
No		1.00	Ref			1.00	Ref			1.00	Ref			1.00	Ref	
Yes		1.3	0.63, 2.54	0.40		0.65	0.19, 1.67	0.40		1.09	0.60, 1.83	0.80		0.73	0.43, 1.14	0.20
Fatigue	1,330				1,141				6,061				7,202			
No		1.00	Ref			1.00	Ref			1.00	Ref			1.00	Ref	
Yes		0.84	0.37, 1.69	0.70		1.97	0.97, 3.85	0.052		2.13	1.58, 2.82	<0.001		1.75	1.34, 2.25	<0.001
Fever	1,330				1,141				6,061				7,202			
No		1.00	Ref			1.00	Ref			1.00	Ref			1.00	Ref	
Yes		0.67	0.39, 1.23	0.20		2.45	1.13, 6.11	0.034		1.95	1.59, 2.40	<0.001		1.91	1.57, 2.33	<0.001
Headache	1,330				1,141				6,061				7,202			
No		1.00	Ref			1.00	Ref			1.00	Ref			1.00	Ref	
Yes		0.89	0.46, 1.60	0.70		1.60	0.81, 3.07	0.20		1.35	1.01, 1.77	0.038		1.17	0.90, 1.49	0.20
Jaundice	1,330				1,141				6,061				7,202			
No		1.00	Ref			1.00	Ref			1.00	Ref			1.00	Ref	
Yes		0.91	0.56, 1.46	0.70		1.20	0.63, 2.38	0.60		1.71	1.38, 2.12	<0.001		1.31	1.07, 1.60	0.007
Muscle pain	1,330				1,141				6,061				7,202			
No		1.00	Ref			1.00	Ref			1.00	Ref			1.00	Ref	
Yes		1.73	0.65, 3.84	0.20		0.74	0.18, 2.11	0.60		1.23	0.66, 2.12	0.50		0.87	0.50, 1.41	0.60
Nausea	1,330				1,141				6,061				7,202			
No		1.00	Ref			1.00	Ref			1.00	Ref			1.00	Ref	
Yes		0.37	0.02, 1.71	0.30		0.78	0.13, 2.64	0.70		0.69	0.29, 1.39	0.40		0.61	0.29, 1.13	0.15
Hemorrhagic symptoms	1,330				1,141				6,061				7,202			

	Vaccinated cases				Unvaccinated cases				Unknown status				Combined unvaccinated and unknown cases			
Characteristic	N	OR ¹	95% CI ¹	P-value	N	OR ¹	95% CI ¹	p-value	N	OR ¹	95% CI ¹	p-value	N	OR ¹	95% CI ¹	p-value
No		1.00	Ref			1.00	Ref			1.00	Ref			1.00	Ref	
Yes		8.72	0.40, 92.0	0.079		15.3	2.07, 80.9	0.002		2.54	0.58, 7.80	0.14		3.66	1.20, 9.20	0.011
Vomiting	1,330				1,141				6,061				7,202			
No		1.00	Ref			1.00	Ref			1.00	Ref			1.00	Ref	
Yes		1.82	0.68, 4.05	0.2		3.36	1.40, 7.25	0.003		2.54	1.71, 3.67	<0.001		2.34	1.64, 3.25	<0.001

¹OR = Odds Ratio, CI = Confidence Interval

Evaluation of model assumptions

In evaluating the assumptions of our final logistic regression model, we:

- Our dependent (outcome) variable was purely binary, having only two possible levels: 'YFV present' and 'YFV not present'
- Assessed the normality of the distribution of our datasets by plotting a histogram of the cases by age in years (**S7 a Figure**). Our dataset exhibited right skewness and thus failing to meet the requirement for normality.
- The only two continuous variables in our dataset were 'age' and 'measured body temperature'. These variables were used to generate two categorical variables ('age group, and 'fever'). Our analysis revealed that YFV viral positivity was somewhat linearly correlated with 'age' and 'measured body temperature' (**Figure S7 b**).
- We confirmed the nonexistence of the influence of outliers or extreme values in our final model output by first estimating and visualizing the Cook's distance values (**S8 Figure**). To check whether the data contains potential influential observations, the standardized residual errors of the model were inspected. Here we labelled the top five largest values. The plot of the standardized model residuals is shown in Figure S5 C. Many of our data points were found to have absolute standardized residuals of three or less.
- All of our predictor variables in the final binary logistic regression model had a variance inflation factor of less than five, confirming evidence of no multicollinearity.