BMJ Open

Public risk perception and behaviours towards COVID-19 during the first and second waves in Nigeria: a secondary data analysis

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To cite: Ochu CL, Onoja M, Olatunji D, *et al*. Public risk perception and behaviours towards COVID-19 during the first and second waves in Nigeria: a secondary data analysis. *BMJ Open* 2022;**12**:e058747. doi:10.1136/bmjopen-2021-058747

► Prepublication history and additional supplemental material for this paper are available online. To view these files, please visit the journal online (http://dx.doi.org/10.1136/bmjopen-2021-058747).

Received 28 October 2021
Accepted 01 March 2022

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ABSTRACT

Objectives To describe changes in public risk perception and risky behaviours during the first wave (W1) and second wave (W2) of COVID-19 in Nigeria, associated factors and observed trend of the outbreak.

Design A secondary data analysis of cross-sectional telephone-based surveys conducted during the W1 and W2 of COVID-19 in Nigeria.

Setting Nigeria.

Participants Data from participants randomly selected from all states in Nigeria.

Primary outcome Risk perception for COVID-19 infection categorised as risk perceived and risk not perceived.

Secondary outcome Compliance to public health and social measures (PHSMs) categorised as compliant; non-compliant and indifferent.

Analysis Comparison of frequencies during both waves using χ^2 statistic to test for associations. Univariate and multivariate logistic regression analyses helped estimate the unadjusted and adjusted odds of risk perception of oneself contracting COVID-19. Level of statistical significance was set at $p<0.05$.

Results Triangulated datasets had a total of 6401 respondents, majority (49.5%) aged 25–35 years. Overall, 55.4% and 56.1% perceived themselves to be at risk of COVID-19 infection during the W1 and W2, respectively. A higher proportion of males than females perceived themselves to be at risk during the W1 (60.3% vs 50.3%, $p<0.001$) and the W2 (58.3% vs 52.6%, $p<0.05$). Residing in the south-west was associated with not perceiving oneself at risk of COVID-19 infection (W1—AOdds Ratio (AOR) 0.28; 95% CI 0.20 to 0.40; W2—AOR 0.71; 95% CI 0.52 to 0.97). There was significant increase in non-compliance to PHSMs in the W2 compared with W1. Non-compliance rate was higher among individuals who perceived themselves not to be at risk of getting infected ($p<0.001$).

Conclusion Risk communication and community engagement geared towards increasing risk perception of COVID-19 should be implemented, particularly among the identified population groups. This could increase adherence to PHSMs and potentially reduce the burden of COVID-19 in Nigeria.

Strengths and limitations of this study

- This is a secondary data analysis with triangulation of four datasets of surveys done at different phases of the COVID-19 outbreak in Nigeria.
- Random sampling of participants from all states in Nigeria in original surveys improves representativeness and generalisability of research findings.
- Triangulation of datasets allows validation or otherwise of findings from individual datasets by comparing areas of convergence, divergence or complementarity.
- Extent of data analyses in this study was dependent on the availability and quality of existing data in the datasets.
- Datasets were from cross-sectional studies, hence were unable to provide insights into temporal relationships between outcome and explanatory variables.

INTRODUCTION

The COVID-19 pandemic first detected in Wuhan, China, in December 2019 has severely impacted countries across the world. The rapid spread of the virus, coupled with limited knowledge around its epidemiology and evolving scientific knowledge, affected initial response activities. Predictions assumed that low-to-middle-income countries with health challenges and fragile health systems would more likely be heavily impacted by the virus.[1] Contrary to these expectations, however, many African countries, including Nigeria,

witnessed a different trajectory of the outbreak and so far have outperformed expectations.[2]

Despite this and the seemingly low burden of the disease in Nigeria, the country has grappled with a myriad of public health challenges including widespread public distrust of government institutions and flagrant public disregard for preventive protocols.[3 4] The comparatively lower incidence and case fatality of COVID-19 in Nigeria has been hypothesised to contribute to the low perception of risk and risky behaviour in the country.[5 6] However, there is paucity of evidence on this. Furthermore, the global paucity of knowledge and fast-evolving science around the novel virus meant that public health authorities leading the response to the outbreak had to review strategies and policies rapidly, sometimes recanting what was previously considered standard practice. For instance, at the initial phase of the outbreak, wearing of facemasks was considered inappropriate and even harmful, predisposing the wearer to higher risk of exposure to the virus than the non-wearer.[7 8] This position was later shown to contradict evolving evidence and the recommendation on wearing of facemasks in public places was introduced globally.[9] While evidence-based interventions are commonly understood in scientific communities, COVID-19 policy changes constitute confusion that could fuel distrust and conspiracy theories among the public.

Nigeria has gone through two phases of a rapid surge and decline in COVID-19 cases described as waves, with the second wave (W2) having a higher amplitude than the first wave (W1) due to a higher cumulative incidence (42.0/100 000 vs 30.3/100 000); more cases were also witnessed among females and the younger age group than in the W1.[10] Epicurve of the first two waves is shown in online supplemental file 1.

Risk perception is a key subject area in health and risk communication that affects how people deal with hazards.[11] It can be defined as 'people's subjective judgments about the likelihood of negative occurrences such as injury, illness, disease and death'.[11] Risk perception is a key determinant of health-related behaviours and diverse theoretical models of behavioural change that integrate this concept have been proposed. These include: health belief model, the extended parallel process model, the protection motivation theory and the risk perception attitude framework.[11 12] These theories are largely based on the proposition that willingness to adopt a health protective behaviour is dependent on perceived threat vis-à-vis health benefits and self-efficacy.[11 12]

Public adherence to COVID-19 preventive protocols such as handwashing, physical distancing and wearing of facemask in public settings has been proven to slow down the transmission rate of the virus.[13 14] Compliance to these public health and social measures (PHSMs) could be associated with the level of public risk perception of the virus. In a household survey of 360 respondents in Ibadan, Oyo State, Nigeria, in June 2020, there was a weak but significant correlation (0.239; p<0.001) between perception of risk of contracting COVID-19 and practice of COVID-19 preventive measures.[15] Similarly, in a study across 10 countries in Europe, America and Asia, risk perception had positive correlation with adoption of preventive behaviours against COVID-19.[16] Thus, understanding possible factors that could have triggered and contributed to the W2 in Nigeria will provide evidence to guide public health response for future waves of COVID-19 in the country. For this study, multiple datasets were analysed to describe changes in public risk perception and risky behaviours across the first two COVID-19 waves and ascertain associations of such risky behaviours with the observed trend of COVID-19 outbreak in Nigeria.

METHODOLOGY

A secondary data analysis of cross-sectional study datasets. Four survey datasets were triangulated for this study:

Audience Perception Survey 1 (APS 1): conducted by the Centre for Communication and Social Impact (CCSI) on behalf of the Nigeria Centre for Disease Control (NCDC) around the peak of the W1 of COVID-19 in Nigeria (June 2020). The data were generated through a telephone-based survey of 1535 participants randomly selected from the 36 states and the Federal Capital Territory (FCT) of Nigeria.

APS 2: conducted by the CCSI in November 2020 at the beginning of the W2 of COVID-19 in Nigeria. This was a telephone-based survey of 2244 randomly selected participants across the 36 states and the FCT.

The Partnership for Evidence-Based Response to COVID-19 (PERC 1) survey: conducted by Resolve to Save Lives (RTSL) in June 2020 on behalf of Africa Centers for Disease Control and Prevention (Africa CDC). This was a telephone-based survey of 1304 randomly selected participants from the 36 states and the FCT of Nigeria.

The Partnership for Evidence-Based Response to COVID-19 (PERC 2) survey: conducted by RTSL in December 2020 on behalf of Africa CDC. This telephone-based survey collected data from 1318 randomly selected participants from the 36 states and the FCT. Participation in all the surveys was reported as voluntary following informed consent.

Epidemiologic data from the Surveillance Outbreak Response Management and Analysis System (SORMAS) were used to interpret trend of the outbreak vis-à-vis observed risky behaviours across the first two waves of COVID-19. SORMAS is a digital surveillance tool used for real-time data reporting, analysis and visualisation by NCDC. SORMAS has data for COVID-19 cases in Nigeria since the first case on 27 February 2020 and includes results of laboratory testing by reverse transcriptase PCR only.

Sampling and sample size

Being an analysis of secondary dataset, formal estimation of sample size was not required, thus available data (APS 1, N=1535; APS 2, N=2244; PERC 1, N=1304; PERC 2, N=1318) were used for the study. Variables relevant to

addressing the research questions were extracted from the various datasets. SORMAS (N=802 143) was used only to estimate test positivity rate (TPR) to guide interpretation.

The survey datasets were cleaned and transported from Excel into SPSS V.21 and coded for analyses. Variables from datasets were transformed for standardisation and ease of data analysis (see online supplemental file 2 for details). Age was transformed into categories reflective of common behavioural and social exposures (18–24, 25–35, 36–50, 51–59, 60+ years); marital status into single (including separated/divorced or widowed) or married; highest education completed into no formal education, primary, secondary and tertiary and main source of information into traditional media, non-traditional media and others. States were recategorised into the six geopolitical zones (GPZs) of the country (north-east (NE), north-west (NW), north-central (NC), south-west (SW), south-east (SE) and south-south (SS)) for further analysis; employment status into artisan/daily paid worker, business owner, fully employed, student/corper and unemployed and sex remained male or female. Perception of risk of contracting SARS-CoV-2 was categorised as risk perceived and risk not perceived.

Frequencies with proportions were determined for sociodemographic variables. Bivariate analysis with χ^2 statistic was used to examine associations across both waves, with statistical significance set at p<0.05. Univariate and multivariate logistic regression analyses were done to ascertain the unadjusted and adjusted odds of perception of risk of oneself contracting COVID-19. All variables with significant associations with the outcome variable on univariate analysis were included in the multivariate analysis to identify their independent association after adjustment for other variables. Independent predictors of risk perception for COVID-19 were compared across the two waves. In APS 2, information was elicited on compliance to PHSMs during the lockdown (W1) and during the W2. Risky behaviours were identified as non-compliance to handwashing, physical distancing and wearing of facemasks. Compliance with PHSMs was examined for association with risk perception using bivariate analysis with χ^2 statistic, having the secondary outcome variable categorised as compliant; non-compliant and indifferent (online supplemental file 2). TPR of COVID-19 during each wave was estimated as the proportion of the total number of samples tested during that period that was positive for COVID-19 (W1: from 27 February 2020 to 24 October 2020; W2: from 25 October 2020 to 3 April 2021) .

Patient and public involvement

Stakeholders, including policymakers from relevant ministries, departments and agencies, scientists, civil society groups, private organisations, development partners, the media, politicians and the public, were engaged through a hybrid (virtual and physical) inception meeting. Their opinions were sought on the relevance of the study, the appropriateness of the research questions, the study methodology and their priority areas. Inputs from the stakeholders were integrated into the final study design. A dissemination meeting was also held to announce the results of the study to the stakeholders and receive their feedback and recommendations for translating evidence to policy and practice.

RESULTS

Sociodemographic distribution of respondents

Table 1 describes the sociodemographic characteristics of the respondents to the various surveys whose datasets were used in this study. Aside the APS 2 dataset with mostly male participants (58.8% of total number of records), all surveys included in the analysis had near equal distribution of male and female respondents. Most respondents were within the age group 25–35 years in all datasets, cumulatively accounting for 49.5% of all respondents. While majority of participants in APS 1 and APS 2 had completed tertiary education (75.7% and 50.6%, respectively), a larger proportion of respondents (64.9%) in the PERC survey identified secondary education as the highest level of education completed. Data on marital status were only available for APS 1 and APS 2 datasets with majority being single (55.2% and 53.9%, respectively). Most participants in the APS 2, PERC 1 and PERC 2 were from NW, while APS 1 had majority from NC. Approximately one-fifth of the respondents in the APS 1 and 2 datasets, accounting for 20.7% and 21.2%, respectively, were unemployed. Quantitative data from SORMAS show TPR for COVID-19 of 18.2% (66121/362550) and 20.8% (91644/439593) for W1 and W2, respectively.

Risk perception during W1 and W2 of COVID-19 in Nigeria

While there was no appreciable difference in overall risk perception for COVID-19 between W1 (55.4%) and W2 (56.1%), the overall risk perception remained low during both waves with close to half (44.6% and 43.9%, respectively) of the population not considering themselves at risk of contracting COVID-19. However, differences were observed in risk perception across various sociodemographic variables. Though there seemed to be a general lowering of risk perception across the various age groups in W2, exclusive of those aged 25–35 years, it was not statistically significant. Significant gender differences were observed in risk perception, with a higher proportion of males than females perceiving themselves to be at risk of COVID-19 infection during W1 (60.3% vs 50.3%, p<0.001) and W2 (58.3% vs 52.6%, p=0.01). During W1, being a female was significantly associated with 25% less likelihood (AOR 0.75; 95% CI 0.60 to 0.93) of perceiving oneself to be at risk of COVID-19 than being a male. While this association was also observed during W2, it was not statistically significant (table 2).

Risk perception by GPZ

In W1, while living in any other GPZ was associated with lower risk perception for COVID-19 than living in the

Table 1 Sociodemographic characteristics of the respondents to the various surveys whose datasets were used in this study

	APS 1 (n=1535)		APS 2 (n=2244)		PERC 1 (n=1304)		PERC 2 (n=1318)	
Characteristics	F	%	F	%	F	%	F	%
Sex								
Male	776	50.6	1320	58.8	660	50.6	679	51.5
Female	759	49.4	924	41.2	644	49.4	639	48.5
Age group (years)								
18–24	353	23	496	22.1	242	18.6	212	16.1
25–35	722	47.1	976	43.5	709	54.4	760	57.7
36–50	388	25.3	567	25.3	313	24	291	22.1
51–59	48	3.1	129	5.7	32	2.5	37	2.8
60+	22	1.4	76	3.4	8	0.6	18	1.4
Missing	2	0.1	0	0	0	0	0	0
Marital status								
Single	848	55.2	1209	53.9	–	–	–	–
Married	687	44.8	1035	46.1	–	–	–	–
Highest education completed								
No schooling	43	2.8	103	4.6	21	1.6	50	3.8
Primary school	28	1.8	158	7	85	6.5	75	5.7
Secondary school	302	19.7	847	37.7	843	64.9	400	30.3
Tertiary	1162	75.7	1136	50.6	350	26.9	793	60.2
Employment status								
Artisan/daily paid	131	8.5	231	10.3	–	–	–	–
Business owner	314	20.5	568	25.3	–	–	–	–
Fully employed	465	30.3	595	26.6	–	–	–	–
Student	308	20.0	345	15.3	–	–	–	–
Unemployment	317	20.7	475	21.2	–	–	–	–
Others	–	–	30	1.3	–	–	–	–
Geopolitical zone								
North-east	281	18.3	398	7.7	176	13.5	170	12.9
North-west	213	13.9	427	19	347	26.6	341	25.9
North-central	359	23.4	407	18.1	191	14.6	218	16.5
South-east	146	9.5	346	15.4	148	11.3	147	11.2
South-west	318	20.7	338	15.1	230	17.6	235	17.8
South-south	218	14.2	328	14.6	212	16.3	207	15.7
Religion								
Christian	–	–	1383	61.6	–	–	–	–
Muslim	–	–	859	38.3	–	–	–	–
Others	–	–	2	0.1	–	–	–	–

APS, Audience Perception Survey; PERC, Partnership for Evidence-Based Response to COVID-19.

north-eastern part of the country, this relationship was only significant for those residing in either south-west (AOR 0.28; 95% CI 0.20 to 0.40) or south-south (AOR 0.41; 95% CI 0.28 to 0.60) GPZs (table 2). However, during the W2, the odds of those residing in the north-west to perceive themselves at risk of COVID-19 were fourfolds higher than those residing in the north-east (AOR 4.01; 95% CI 2.89 to 5.57). South-western GPZ residents remained significantly less likely to perceive themselves at risk than those in the north-east during the W2 (AOR 0.71; 95% CI 0.52 to 0.97). Comparison of risk

Table 2 Comparison of unadjusted and adjusted OR of perceiving oneself at risk of COVID-19 infection across the first two waves in Nigeria, 2020

Variable	Unadjusted OR	95% CI	Adjusted OR	95% CI	P value
APS wave 1					
Age years (n=1535)	P=0.19				
18–24	1				
25–35	0.93	0.72 to 1.20	–	–	–
36–50	1.21	0.90 to 1.62	–	–	–
51–59	1.38	0.74 to 2.57	–	–	–
60+	1.45	0.59 to 3.55	–	–	–
Gender (n=1535)	P<0.001				
Male	1		1		
Female	0.67	0.55 to 0.82	0.75	0.60 to 0.93	0.01
Marital status (n=1535)	P=0.002				
Single	1		1		
Married	1.39	1.13 to 1.70	1.53	1.20 to 1.97	0.001
Highest education completed (n=1535)	P<0.001				
No schooling	1		1		
Primary	1.3	0.44 to 3.80	1.35	0.44 to 4.16	0.6
Secondary	0.94	0.47 to 1.89	1.36	0.63 to 2.92	0.43
Tertiary	0.45	0.23 to 0.87	0.71	0.34 to 1.48	0.36
Employment (n=1535)	P=0.004				
Artisan/daily paid worker	1		1		
Business owner	0.47	0.30 to 0.72	0.71	0.45 to 1.14	0.2
Fully employed	0.48	0.32 to 0.72	0.76	0.48 to 1.22	0.25
Student/corper	0.57	0.37 to 0.88	1.14	0.70 to 1.86	0.59
Unemployed	0.59	0.38 to 0.90	1	0.62 to 1.61	0.999
Geopolitical zone (n=1535)	P<0.001				
North-east	1		1		
North-west	0.87	0.59 to 1.27	0.88	0.59 to 1.30	0.51
North-central	0.66	0.47 to 0.91	0.77	0.54 to 1.08	0.13
South-east	0.66	0.43 to 1.00	0.79	0.51 to 1.23	0.3
South-west	0.22	0.16 to 0.32	0.28	0.20 to 0.40	<0.001
South-south	0.37	0.25 to 0.53	0.41	0.28 to 0.60	<0.001
Main source of information (n=1524)	P=0.002				
Traditional media	1		1		
Non-traditional media	0.71	0.58 to 0.87	0.87	0.69 to 1.10	0.23
Others	1.22	0.68 to 2.19	0.95	0.52 to 1.75	0.87
APS wave 2					
Age, years (n=2244)	P=0.156				
18–24	1		–		
25–35	1.21	0.98 to 1.50	–	–	–
36–50	1.26	0.99 to 1.60	–	–	–
51–59	1.51	1.01 to 2.24	–	–	–
60+	0.97	0.60 to 1.58	–	–	–
Gender (n=2244)	P=0.006				
Male	1		1		

Continued

Table 2 Continued

Variable	Unadjusted OR	95% CI	Adjusted OR	95% CI	P value
Female	0.79	0.67 to 0.93	0.85	0.73 to 1.05	0.15
Marital status (n=2244)	P=0.028				
Single	1		1		
Married	1.21	1.02 to 1.43	1.19	0.98 to 1.44	0.09
Highest education completed (n=2244)	P<0.001				
No schooling	1		1		
Primary	1.04	0.63 to 1.70	1.86	1.08 to 3.21	0.03
Secondary	1.11	0.74 to 1.67	1.75	1.10 to 2.79	0.02
Tertiary	1.97	1.31 to 2.95	2.85	1.78 to 4.59	<0.001
Employment (n=2244)	P<0.001				
Artisan/daily paid worker	1		1		
Business owner	1.83	1.34 to 2.50	1.82	1.29 to 2.56	0.001
Fully employed	2.93	2.14 to 4.01	2.37	1.64 to 3.41	<0.001
Student/corper	2.91	2.06 to 4.11	2.80	1.90 to 4.12	<0.001
Unemployed	1.9	1.38 to 2.62	1.86	1.31 to 2.64	<0.001
Others	2.86	1.30 to 6.29	2.39	1.04 to 5.45	0.040
Geopolitical zone (n=2244)	P<0.001				
North-east	1		1		
North-west	4.15	3.05 to 5.64	4.01	2.89 to 5.57	<0.001
North-central	1.12	0.85 to 1.48	0.92	0.69 to 1.22	0.550
South-east	1.11	0.83 to 1.47	0.98	0.73 to 1.32	0.899
South-west	0.88	0.66 to 1.18	0.71	0.52 to 0.97	0.03
South-south	1.15	0.86 to 1.54	1.14	0.84 to 1.55	0.39
Main source of information (n=2244)	P=0.249				
Traditional media	1				
Non-traditional media	1.16	0.968 to 1.389	–	–	–
Others	1.126	0.863 to 1.470	–	–	–

*Significance level is set at p<0.05.
APS, Audience Perception Survey.

perception across states during the two waves is shown in online supplemental file 3.

Risk perception by marital and employment status

The odds of married persons perceiving themselves at risk of COVID-19 infection in W1 was 53% (AOR 1.53; 95% CI 1.20 to 1.97) higher than the single; a similar trend was observed in W2 but it was not statistically significant. Whereas artisans/daily paid workers had the highest proportion with risk perception during the W1 (69.7%), their risk perception became the lowest among all employment categories during W2 (37.7%) (figure 1). Being a business owner (AOR 1.82; 95% CI 1.29 to 2.56), fully employed (AOR 2.37; 95% CI 1.64 to 3.41) or a student/national youth corper (AOR 2.80; 95% CI 1.90 to 4.12) was associated with about 2–3-fold higher odds of risk perception than being a daily paid worker during the W2 (table 2). During W1 however, there was no significant independent association between employment status and risk perception.

Risk perception by educational status

Educational status did not have significant association with risk perception during W1 but became a significant determinant of risk perception during the W2 with any level of education having higher risk perception than no education at all. Those who had completed tertiary level education had the highest odds of risk perception (AOR 2.85; 95% CI 1.78 to 4.59); the odds of being more likely to perceive themselves at risk of contracting COVID-19 was almost three times more than those with no schooling at all. Main source of information was not significantly associated with risk perception in either of the waves. In the study, whereas those with tertiary level education had the lowest rate of risk perception (50.9%) during the W1, this position was reversed during the W2 with their

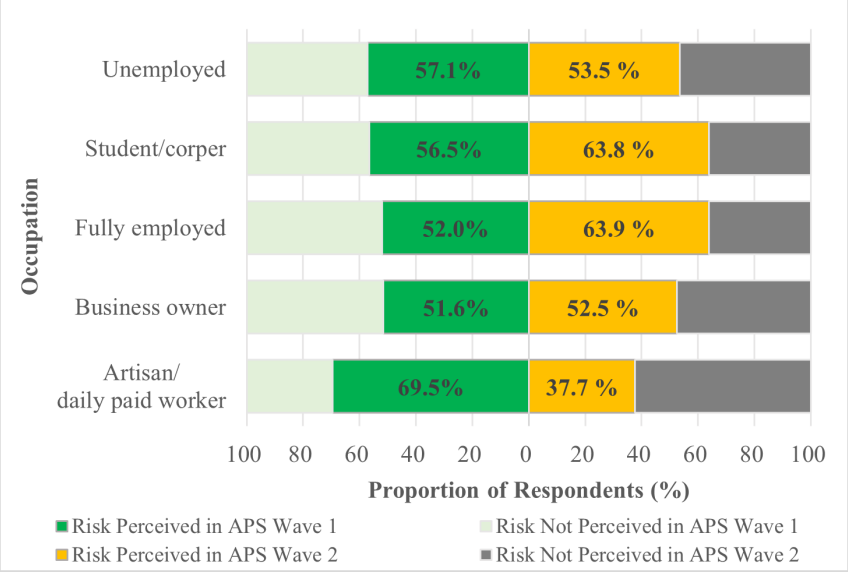

Figure 1 Risk perception by employment status, Nigeria, 2020. Audience Perception Survey.

perception of risk of infection with COVID-19 appreciating by 12.3% to top the list.

Whereas with the APS, a higher proportion of respondents perceived themselves to be at risk of being infected with COVID-19 than those who did not, when asked to grade the level of risk during the PERC surveys, a greater proportion of Nigerians did not perceive themselves to be at substantial risk of contracting COVID-19 in W1 (55.1%) and in W2 (56.1%). In W1, substantial risk perception was highest among those ≥60 years (62.5%) and lowest among the 51–59 years (37.5%) and 36–50 years (38.3%) age categories ($p<0.01$), whereas in W2 there was no significant difference in risk perception across the age groups. Furthermore, in W1, non-substantial risk perception was highest among those with tertiary education (62.6%; $p<0.05$), but there was no significant variation in the level of risk perception across gender or by GPZs.

Changes in risky behaviour across W1 and W2 of COVID-19 in Nigeria

Majority of the respondents affirmed compliance to the PHSMs of handwashing, physical distancing and wearing of facemasks during the first two waves of COVID-19 in Nigeria. However, there was significant increase in risky behaviours in the W2 compared with the first with 13.7% increase in non-compliance to handwashing, 20.2% increase in non-compliance to physical distancing and 15% increase in disregard for wearing of facemasks (figure 2). Not adhering to physical distancing was the most frequent risky behaviour across both waves. Artisan/daily paid workers (18.2%) and the unemployed (12.8%) were the least likely to comply with physical distancing during lockdown in the W1 ($p<0.001$), while student/corper (3.8%) and the fully employed (3.9%) had the least non-compliance rate to physical distancing during same period.

Risk perception versus compliance to COVID-19 PHSMs

Compliance rate to COVID-19 PHSMs was higher among those who perceived themselves to be at risk of COVID-19 infection than among those who did not. This relationship was highly significant across the three PHSMs assessed in the APS W2 study. Of those who did not perceive themselves at risk of COVID-19 infection, 35.1% did not comply with wearing of facemasks, 41.2% were non-compliant to physical distancing and 30.6% did not comply with regular hand washing (table 3).

DISCUSSION

This study compares risk perception and risky behaviours of Nigerians towards COVID-19 during the W1 and W2 and how these parameters may have influenced the observed trend of COVID-19 cases in Nigeria. This is based on the health belief model that motivation to adopt a health behaviour is dependent on perceived risk, perceived benefit, self-efficacy and cue to action.[17] Overall, risk perception towards COVID-19 across both waves remained low suggesting a significant proportion of the study population did not consider themselves at risk of contracting the disease. The 0.7% appreciation in risk perception in W2 is substantially small in comparison with the 13% increase in risk perception observed across the first two waves in South Africa.[18] In our study, despite the slight enhancement in general risk perception, there was significant increase in risky behaviours (range 13.7%–20.2%) in W2 compared with W1, as opposed to a 7.2% increase in protective behaviours in the South African study. One could therefore argue that the differences in risk perception and risky behaviours during both waves could be attributable, in part, to the higher number of COVID-19 counts in South Africa than the figures in Nigeria.[19] However, Abu *et al* in a comparative online

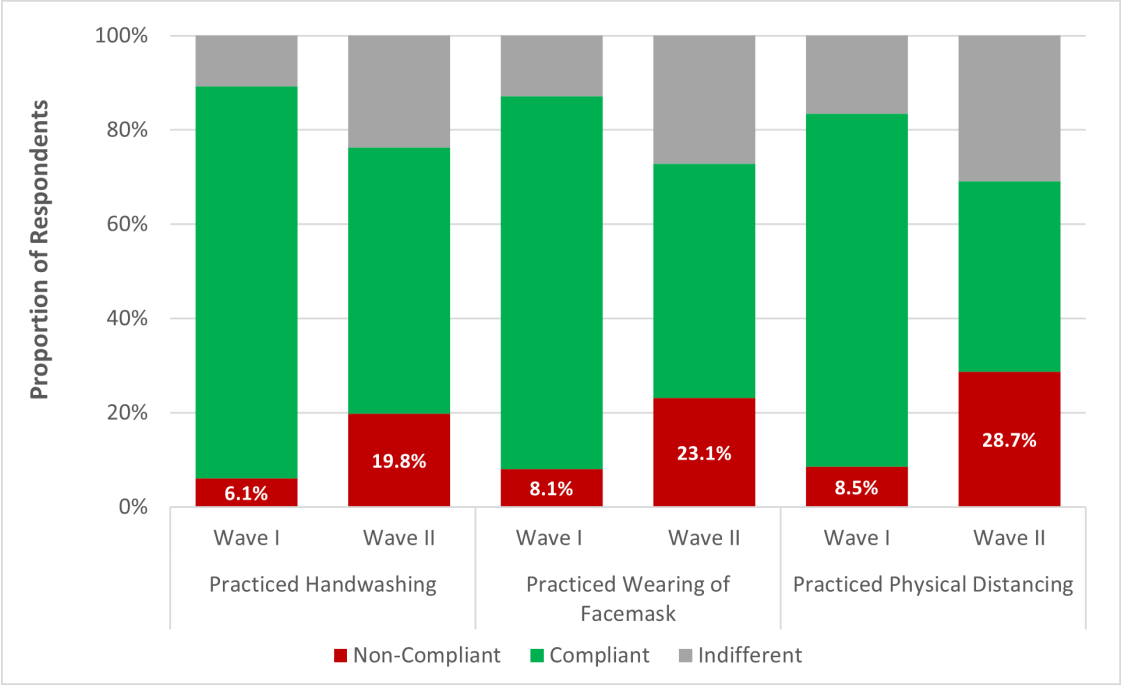

Figure 2 Changes in risky behaviour across the first and second waves of COVID-19 in Nigeria.

cross-sectional survey of risk perception in Africans living in sub-Saharan region (SSA) and those in the diaspora found no significant difference in risk perception between the two groups.[5] A plurality of cognitive, emotional and social factors could have contributed to the observed low-risk perception for COVID-19 in Nigeria: public distrust of government, infodemic, poor community engagement and optimism bias, among many others. A study conducted among Nigerians found that political distrust of the government reduces compliance to COVID-19 safety protocols,[3] a correlation also described by Ning *et al* among Chinese respondents.[20]

In this study, disregard for safety protocol was more prominent for physical distancing than for handwashing and wearing of facemask. This was also the case in a South African study.[18] While lockdown in W1 could have promoted physical distancing with absence of it in W2 limiting adherence, this may not be the sole reason considering that implementation of the measure varied across states in Nigeria. The need for social interactions makes this intervention a difficult one to comply with, especially when the risk perception for the disease as a consequence for non-compliance to physical distancing appears low. In a survey of 40 647 adults aged 50–101 years from 26 countries in Europe, participants were more likely to adhere to social distancing than to wearing of facemasks.[21] This older age population are at a high risk and could be more prone to respiratory difficulties

Table 3 Risk perception versus compliance to COVID-19 preventive behaviours, APS wave 2, Nigeria

Wearing of facemask (n=2244)				
Risk perception	**Compliant**	**Non-compliant**	**Indifferent**	**P value**
Risk not perceived	319 (32.3%)	346 (35.1%)	321 (32.6%)	<0.001
Risk perceived	796 (63.3%)	173 (13.6%)	289 (23.0%)	
Total	1115	519	610	
Physical distancing (n=2244)				
Risk not perceived	255 (25.9%)	406 (41.2%)	325 (33.0%)	<0.001
Risk perceived	652 (51.8%)	238 (18.9%)	368 (29.3%)	
Total	907 (40.4%)	644 (28.7%)	693 (30.9%)	
Handwashing (n=1521)				
Risk not perceived	402 (40.8%)	302 (30.6%)	282 (28.6%)	<0.001
Risk perceived	143 (11.4%)	143 (11.4%)	249 (19.8%)	
Total	545 (35.8%)	445 (29.3%)	531 (34.9%)	

APS, Audience Perception Survey.

that make wearing of facemasks uncomfortable. In this study, perceiving oneself to be at risk of infection with COVID-19 was positively associated with compliance to preventive protocols. The increase in risky behaviours of non-compliance to handwashing, wearing of facemasks and physical distancing during the W2 could have contributed to the higher TPR in W2 (20.8%) compared with W1 (18.2%). Activities geared towards enhancing risk perception for the virus could therefore be an effective strategy for improving adherence to COVID-19 preventive measures and slowing down transmissions.

Apart from persons aged 25–35 years, risk perception for COVID-19 seemed to decline during the W2 across the different age groups, although the association was not statistically significant. Younger persons within the 25–35 year age group are active (constituting 29.1% of the workforce in Nigeria) and may have more access to literary materials, on-the-go media networks and educational resources than the older age groups.[22] A mental health survey of adults in the USA in March 2020 observed an association between older adult age and lower risk perception for getting infected with COVID-19, as was found elsewhere.[23–25] On the contrary, higher perception of susceptibility with increasing age was observed in a study among Ethiopians.[26] Lower severity of COVID-19 in the young, coupled with exposure to infodemics in social media, may challenge the assumption of higher risk perception in persons aged 25–35 years.

Lower risk perception for COVID-19 infection was observed in females than in males in this study and this gender disparity in risk perception was similar across the two waves, although not statistically significant in the W2. This is contrary to the finding of lower risk perception among males in a multinational study in Europe, America and Asia.[16] Utilisation of a pooled model of risk perception in the latter study, alongside contextual differences in educational status and access to public health information among females in the developing world, may be responsible for this disparity. Epidemiologic data from SORMAS show a 62.7% increase (from 23 609 to 38 403) in the absolute number of COVID-19 infections in Nigerian females as against 27.3% increase (from 41 434 to 52 754) in males in the W2 compared with the W1.[27] The higher transmission rate in females may not be unrelated to the lower risk perception observed in this gender category. Lower risk perception is associated with higher risky behaviour and increased chances of being infected with COVID-19, a fact demonstrated also in this study. Targeted interventions to improve risk perception in females such as improving access to information and educational materials could be beneficial in slowing down COVID-19 transmission in Nigeria.

Being married was associated with higher risk perception for contracting COVID-19 than being single. Same observation was made in a study among Ethiopians.[26] Married persons have larger family size with increased tendency to cluster. They also have higher dependency with more family and social responsibilities that could increase their anxiety over COVID-19 infection. Though anecdotal, while the single can easily adhere to a stay-at-home policy, having only themselves to cater for in many instances, the married feel more pressured to go out to fend for their families. Furthermore, the married are more likely to interphase with healthcare facilities in routine clinics and therefore be exposed to credible health information on COVID-19 from healthcare workers.

The role that formal education plays in health information literacy and its attendant risk perception for COVID-19 has been further highlighted by this study. Those with any level of education were more likely to perceive themselves as susceptible to COVID-19 infection than those without formal education. This finding is not surprising given that most information and education materials on COVID-19 are conveyed in literary formats than in audio-visual formats. Furthermore, ability to critically appraise and search the literature for health information is supported by formal education.[26] There is therefore the need for an all-inclusive risk communication strategy that is accessible to and addresses the needs of the uneducated.

Risk perception was highest among artisans/daily paid workers during the W1. This was a period marked by widespread anxiety with infodemic tending more towards creating panic of the new virus than discounting the severity of the pandemic. This group of persons was more prone to being exposed to unverified information, belonging to the low-income usually poorly educated cadre with low access to credible information. It is therefore not surprising that during the W2, there was almost a complete turnaround with this group having the lowest risk perception, a possible reflection of the shift in infodemic towards conspiracy theories. The relatively higher risk perception of the unemployed compared with artisans in this study could be because of the diverse literacy status of the former category. Recent data from the National Bureau of Statistics show that about 2.9 million unemployed Nigerians are graduates and postgraduates.[22] With the impact of educational status on risk perception, it is therefore not surprising that the unemployed in our study had higher risk perception than the artisans. This corroborates the findings in an online survey of risk perception among SSA, though the latter was a multicountry study that could have complex interaction of confounders.[5]

Living in the northern part of Nigeria was associated with a higher risk perception for getting infected with COVID-19 than living in the south. This could be because of the intensity and plurality of healthcare programmes in the north with higher community-level engagement. Due to existing health and security challenges in the north, the region has attracted multiple health, security and other development stakeholders, including non-governmental and civil society organisations that are experts in grassroot engagement. These became critical partners in risk communication in response to the COVID-19 outbreak in Nigeria. Existing structures for the polio eradication programme such as the polio emergency operation

centres were also activated in response to COVID-19. The north which has a chronic history of contending with infectious disease outbreaks could have been more sensitised to the reality of just another outbreak than the south. It is however surprising that the south-west which includes Lagos state, an epicentre of COVID-19 in Nigeria, has had consistently lower risk perception for COVID-19 across the two waves than other GPZs. The study methodology will not allow a temporal causal relationship ascertainment; however, it could be assumed that the low perception of risk in the region might have contributed to the high number of COVID-19 cases in Lagos. Intensifying community engagement and effective risk communication strategies in the southern parts of the country is therefore recommended.

Strengths and limitations

This was a secondary data analysis with triangulation of four datasets collected at different points of the COVID-19 outbreak in Nigeria from randomly selected participants. Randomisation mitigates selection bias and improves generalisability of research findings.[28] Triangulation of datasets from multiple sources allows validation or otherwise of claims from individual datasets by comparing areas of convergence, divergence or complementarity.[29] Cross-sectional studies are unable to provide insights into temporal relationships, hence the establishment of a cause and effect relationship between outcome and explanatory variables in the present study cannot be made. Furthermore, the extent of data analyses in this study was dependent on the availability and quality of existing data in the datasets included in the study. Similar variables in different datasets had different scales of measurement in Likert. To mitigate bias, recategorisation was done using objective criteria to enable fair comparison of datasets. Perceived risk in this study is a single construct based on cognitive assessment of possibility of getting infected with COVID-19 and excludes the emotional domain of worry or anxiety. Assessment of severity of COVID-19 outcomes was not included in the study. Interpretations of research findings therefore are limited to this domain of assessment of perceived risk of infection. The questions eliciting this information in the various datasets were quite specific, mitigating subjectiveness of response.[30]

The primary surveys on which this analysis was based relied on self-report of respondents and are therefore prone to social desirability bias. It is possible that respondents exaggerated their compliance to PHSM. Self-reports are conventionally used in behavioural studies and they remain useful in observing trends of behaviour over time.[31]

CONCLUSION

Risky behaviour regarding COVID-19 was higher during the W2 than during the W1 and this was more prevalent among those without perception of risk of being infected with COVID-19. Gender, marital status, educational status, employment status and GPZ of residence are factors that could influence risk perception for COVID-19 in Nigeria. Implementation of risk communication and community engagement strategy geared towards increasing risk perception for COVID-19 among the identified groups is therefore recommended.

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Acknowledgements Centre for Communication and Social Impact and Partnership for Evidence-Based Response to COVID-19—Prevent Epidemics are acknowledged for sharing their datasets for this study.

Contributors CLO: Conceptualisation, data analysis, initial draft, revisions and approval of final draft. BOO, MO, SOA, DOA, YD, EI and BE: Conceptualisation, data analysis, reviews and approval of final draft. DO, SE, GN, ISU, JOO and KOE: Data analysis, reviews and approval of final draft. OWA, EAA, BF, AA and DAO: Significant reviews and approval of final draft. LD: Figures, tables, reviews and approval of final draft. EI and CI: Supervision, reviews and approval of final draft. CLO as the guarantor accepts full responsibility for the content of this article, has access to the data and controlled the decision to publish.

Funding This work received funding and support of the '#Data4COVID19 Africa Challenge', which is one of the many projects under the 'COVID-19 – Health in Common' initiative launched by France via Agence Française de Développement (AFD) in response to the worldwide public health crisis caused by the COVID-19 pandemic. The challenge was designed and implemented in collaboration with Expertise France and The GovLab. It sought to spur projects that used traditional and non-traditional data in an innovative way to address COVID-19 and its consequences. The opinions expressed and the insights and findings listed herein are solely those of the authors of the challenges and do not necessarily represent a position of AFD, Expertise France or The GovLab will not be liable for the use made of the information presented. More information on the challenge can be found at: https://datachallenge.africa/.

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Competing interests None declared.

Patient and public involvement Patients and/or the public were involved in the design, or conduct, or reporting, or dissemination plans of this research. Refer to the Methods section for further details.

Patient consent for publication Not applicable.

Ethics approval This research was approved by the Health Research Ethics Committee of the Lagos University Teaching Hospital (ADM/DSCST/HREC/APP/4583).

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available from the corresponding author on reasonable request.

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REFERENCES

1 Berhan Y. Will Africa be Devastated by Covid-19 as many predicted? perspective and prospective. *Ethiop J Health Sci* 2020;30:459–67.
2 Ochu CL, Akande OW, Oyebanji O. Fighting a Global War Using a Local Strategy': contextualism in COVID-19 response in Africa. *BMJ Innov* 2021.
3 Ezeibe CC, Ilo C, Ezeibe EN, *et al*. Political distrust and the spread of COVID-19 in Nigeria. *Glob Public Health* 2020;15:1753–66.
4 Nnama-Okechukwu CU, Chukwu NE, Nkechukwu CN. COVID-19 in Nigeria: knowledge and compliance with preventive measures. *Soc Work Public Health* 2020;35:590–602.
5 Abu EK, Oloruntoba R, Osuagwu UL, *et al*. Risk perception of COVID-19 among sub-Sahara Africans: a web-based comparative survey of local and diaspora residents. *BMC Public Health* 2021;21:1562.
6 Iorfa SK, Ottu IFA, Oguntayo R, *et al*. COVID-19 knowledge, risk perception, and precautionary behavior among Nigerians: a moderated mediation approach. *Front Psychol* 2020;11:566773. doi:10.3389/fpsyg.2020.566773
7 Greenhalgh T, Schmid MB, Czypionka T, *et al*. Face masks for the public during the covid-19 crisis. *BMJ* 2020;369:m1435.
8 Howard J. Face masks: WHO stands by recommendation to not wear them if you are not sick or not caring for someone who is sick - CNN, 2020. Available: https://edition.cnn.com/2020/03/30/world/coronavirus-who-masks-recommendation-trnd/index.html [Accessed 25 Sep 2021].
9 Howard J, Huang A, Li Z, *et al*. An evidence review of face masks against COVID-19. *Proc Natl Acad Sci U S A* 2021;118:e2014564118.
10 Akande OW, Elimian KO, Igumbor E, *et al*. Epidemiological comparison of the first and second waves of the COVID-19 pandemic in Nigeria, February 2020-April 2021. *BMJ Glob Health* 2021;6:e007076.
11 Paek H-J, Hove T. Risk perceptions and risk characteristics, 2017. Oxford research encyclopedia of communication. Available: https://oxfordre.com/communication/view/10.1093/acrefore/9780190228613.001.0001/acrefore-9780190228613-e-283 [Accessed 27 Jan 2022].
12 Weston D, Ip A, Amlôt R. Examining the application of behaviour change theories in the context of infectious disease outbreaks and emergency response: a review of reviews. *BMC Public Health* 2020;20:1483.
13 Chiu N-C, Chi H, Tai Y-L, *et al*. Impact of wearing masks, hand hygiene, and social distancing on influenza, enterovirus, and all-cause pneumonia during the coronavirus pandemic: retrospective national epidemiological surveillance study. *J Med Internet Res* 2020;22:e21257.
14 Ayouni I, Maatoug J, Dhouib W, *et al*. Effective public health measures to mitigate the spread of COVID-19: a systematic review. *BMC Public Health* 2021;21:1015.
15 Ilesanmi O, Afolabi A. Perception and practices during the COVID-19 pandemic in an urban community in Nigeria: a cross-sectional study. *PeerJ* 2020;8:e10038.
16 Dryhurst S, Schneider CR, Kerr J, *et al*. Risk perceptions of COVID-19 around the world. *J Risk Res* 2020;23:994–1006.
17 Jones CL, Jensen JD, Scherr CL, *et al*. The health belief model as an explanatory framework in communication research: exploring parallel, serial, and moderated mediation. *Health Commun* 2015;30:566–76.
18 Kollamparambil U, Oyenubi A. Behavioural response to the Covid-19 pandemic in South Africa. *PLoS One* 2021;16:e0250269.
19 Ritchie H, Ortiz-Ospina E, Beltekian D. Coronavirus pandemic (COVID-19), 2020. Our world data. Available: https://ourworldindata.org/covid-vaccinations [Accessed 07 Aug 2021].
20 Ning L, Niu J, Bi X, *et al*. The impacts of knowledge, risk perception, emotion and information on citizens' protective behaviors during the outbreak of COVID-19: a cross-sectional study in China. *BMC Public Health* 2020;20.
21 O'Donovan MR, O'Caoimh R, O'Donovan M. Self-Reported mask wearing, social distancing and COVID-19 among middle-aged and older Europeans. *Eur J Public Health* 2021;31:ckab165.104.
22 National Bureau of Statistics. Labour force statistics, 2020. Available: https://nigerianstat.gov.ng/elibrary?queries[search]=unemployment [Accessed 08 May 2020].
23 Barzilay R, Moore TM, Greenberg DM, *et al*. Resilience, COVID-19-related stress, anxiety and depression during the pandemic in a large population enriched for healthcare providers. *Transl Psychiatry* 2020;10:1–8.
24 Nwachukwu I, Nkire N, Shalaby R, *et al*. COVID-19 pandemic: age-related differences in measures of stress, anxiety and depression in Canada. *Int J Environ Res Public Health* 2020;17:6366.
25 Bruine de Bruin W. Age differences in COVID-19 risk perceptions and mental health: evidence from a national U.S. survey conducted in March 2020. *J Gerontol B Psychol Sci Soc Sci* 2021;76:e24–9.
26 Asnakew Z, Asrese K, Andualem M. Community Risk Perception and Compliance with Preventive Measures for COVID-19 Pandemic in Ethiopia]]&gt. *Risk Manag Healthc Policy* 2020;13:2887–97.
27 Elimian K, Musah A, King C, *et al*. Incidence rate of COVID-19 mortality and its associated factors during the first and second waves in Nigeria: a retrospective cohort study. *SSRN Journal* 2021. doi:10.2139/ssrn.3901784
28 Suresh KP. An overview of randomization techniques: an unbiased assessment of outcome in clinical research. *J Hum Reprod Sci* 2011;4:8–11.
29 Nightingale AJ. Triangulation. In: *International encyclopedia of human geography*. 2nd edn. Oxford: Elsevier, 2020: 477–80. https://www.sciencedirect.com/science/article/pii/B9780081022955104378
30 Wolff K, Larsen S, Øgaard T. How to define and measure risk perceptions. *Ann Tour Res* 2019;79:102759.
31 Durmaz A, İ D, Kabadayi ET. Mitigating the Effects of Social Desirability Bias in Self-Report Surveys: Classical and New Techniques. In: *Applied social science approaches to mixed methods research*. IGI Global, 2020: 85. https://www.igi-global.com/chapter/mitigating-the-effects-of-social-desirability-bias-in-self-report-surveys/www.igi-global.com/chapter/mitigating-the-effects-of-social-desirability-bias-in-self-report-surveys/244122