RESEARCH ARTICLE

Behavior, social and economic impact of COVID-19 responses among healthcare professionals: Development and validation of COVID-19 Responses Impact Questionnaire (COVRiQ)

Nelson Chidinma Okpua MSc[1,2] | Rohayu Hami DrPH[2] |
Chidinma Oswald Edeogu PhD[3] | Noor Mastura Mohd Mujar PhD[2]

[1]Department of Nursing Science, Faculty of Health Sciences and Technology, Ebonyi State University, Abakaliki, Nigeria

[2]Department of Community Health, Advanced Medical and Dental Institute, Universiti Sains Malaysia, Penang, Malaysia

[3]Department of Medical Biochemistry, Faculty of basic medical sciences, Ebonyi State University, Abakaliki, Nigeria

Correspondence
Noor Mastura Mohd Mujar, Department of Community Health, Advanced Medical and Dental Institute, Universiti Sains Malaysia, Penang, Malaysia.
Email: masturamujar@usm.my

Abstract

As the world goes through the fourth wave and the continued emergence of new COVID-19 variants, the general and work-related risks of healthcare professionals are expected to rise. This has the capacity to adversely affect productivity and efficiency in the healthcare delivery system, particularly in this era of global shortage of trained healthcare professionals. We aimed to develop and validate a new instrument known as the COVID-19 Responses Impact Questionnaire (COVRiQ) to evaluate the impact of the pandemic on the healthcare professionals managing the COVID-19 pandemic. This methodological study involved three steps: the formulation of the COVRiQ draft, content and face validation, and construct validity. A total of 61 questions were drafted with 3-point Likert scale answers. From the list, 39 were rated valid by a panel of experts and subsequently tested on 301 participants. The results were analyzed and validated using exploratory factor analysis on SPSS. Components were extracted and questions with low factor loading were removed. The internal consistency was measured with Cronbach's alpha. Following analysis, three components were extracted and named as behavioral, social, and economic impacts. In general, 29 items were deleted leaving 32 out of 61 questions retained as the final validated COVRiQ. Internal consistency showed high reliability with Cronbach's alpha of 0.91. Participants scored a total cumulative mean of 118.74 marks. A subanalysis by occupation showed that medical assistants scored the lowest in the group with a score of 22.3% whereas medical specialists scored the highest at 77.7%. Higher score indicates higher impact of COVID-19 responses among healthcare professionals. The new COVRiQ consisting of 32 items demonstrated to be user friendly with good psychometric properties and valid for assessing the impacts of COVID-19 responses among healthcare professionals.

KEYWORDS
coronavirus, COVID-19 infection, COVID-19 responses, healthcare professional, impact, questionnaire, reliability, SARS-CoV-2, validity

Key points

- Healthcare professionals (HCP) play important roles in the prevention of the spread of COVID-19 virus and treatment of infected persons during the pandemic. This role puts HCPs at increased risks for adverse social, behavioral, and economic impacts.
- This study developed a new, valid, and reliable instrument to comprehensively assess the impacts of the responses of the pandemic on the frontline healthcare providers in the Nigerian population.
- This tool will be useful to HCPs, researchers, and educators in assessing the impacts of the pandemic, as well as the outcomes of interventions aimed toward reducing the impacts of COVID-19 pandemic on frontline healthcare providers.

1 | INTRODUCTION

The outbreak of COVID-19 appears to be the worst pandemic the world has experienced in recent decades. Of the seven known coronaviruses that affect human (MERS-CoV, SARS-CoV, SARS-CoV-2 HCoV-229E, OC43, NL63, and HKU1), SARS-CoV-2 has been reported as highly infectious with the tendencies to mutate into a new variant (Acharya et al., 2020; Lai et al., 2020). This characteristic poses a threat to the global control of the virus. For instance, following the first reported outbreak of COVID-19 in December 2019, the virus has spread to more than 200 countries (World Health Organization [WHO], 2021). Besides, surveys have implicated the newly emerging variants to be mainly responsible for the fourth wave of the pandemic currently faced by most countries (Kalanidhi et al., 2021). Global statistics show that over 215 million people have been infected and more than 4.8 million have died from COVID-19 related complications (WHO, 2021). Healthcare providers constitute more than 10% of these cases of infections and deaths. Experts suggest that healthcare professionals may be at increased risk because of their peculiar roles during the pandemic (Tan et al., 2020; Wang et al., 2020). Epidemiologist had predicted that the adverse impacts would be higher in low-income countries because of poor health infrastructure. However, with the current global statistics, such assumptions may be difficult to establish as more cases of infections and deaths have been reported in developed countries than other regions (WHO, 2021).

The paucity of stratified data to establish the variation or otherwise of the impacts of the pandemic on frontline healthcare providers across regions remains a challenge. Although the impacts of COVID-19 pandemic seem universal, experts appear to agree that frontline healthcare providers are more vulnerable to adverse impacts during the pandemic (Okpua et al., 2021; Khattab et al., 2020). This further poses a threat to healthcare service delivery and may likely worsen the global shortage of trained healthcare providers if the pandemic persists (Chersich et al., 2020). Furthermore, surveys have demonstrated that the pandemic has caused a more than proportionate rise in the population seeking healthcare services and may no doubt put pressure on the healthcare providers and services (Dai et al., 2020; Osterrieder et al., 2021).

Earlier studies that evaluated the effect of psychological instability and pressures on the healthcare providers during the SARS outbreak demonstrated an increased likelihood for medical errors and poor public health decisions among healthcare providers (Chiwaridzo et al., 2017). Similarly, reports from previous pandemics such as Ebola, SARS, and Influenza A virus (subtype H1N1) revealed that the preventive health measures enforced by governments, such as social distancing, movement restriction, reduced recreational and social activities, use of nose masks among others, had long lasting and significant impacts on the socioeconomic and behavioral lifestyles of the people (Kalanidhi et al., 2021; Kisely et al., 2020). These suggest the need to understand the impacts of these lifestyle changes on healthcare providers for a better public healthcare outcome.

Having a valid and reliable instrument would be essential in the assessment of these changes. The paucity of instruments that could wholistically assess the diversity and level of social, economic, and behavioral changes among frontline healthcare providers in response to COVID-19 pandemic remains a serious shortcoming in the strategies for COVID-19 prevention. Previous tools that assessed the impacts of the pandemic either narrowed its scope to psychological impacts on the general population (Greenfield et al., 2020; Kalanidhi et al., 2021), or sampled healthcare providers from other regions who shared different sociocultural backgrounds from Nigeria (Talaee et al., 2022; Zhong et al., 2021). This paper aims to develop and validate a questionnaire to assess the behavioral, social and economic impacts of COVID-19 responses among frontline healthcare providers in Nigeria.

2 | MATERIALS AND METHODS

A methodological research design was used to develop, validate, and psychometrically evaluate the new questionnaire, COVID-19 Responses Impact Questionnaire (COVRiQ), which systematically followed three steps:

1. Development of COVRiQ draft
2. Content and face validation
3. Construct validity

2.1 | Development of COVRiQ draft

The questionnaire items were generated through a systematic literature search conducted on four electronic databases: Google scholar, Medline, Science Direct, and PubMed, using the following key words and phrases: "(COVID-19 OR Coronavirus 2019 OR Pandemic OR SARS-CoV-2)" AND "(Scale OR Questionnaire OR Tool OR Instrument" AND "Social" AND "Behavioral" AND "Economic)" AND "Impacts." Meanwhile, 58 questions were formulated and developed from a review of COVID-19 literature (Xiao et al., 2020), existing COVID-19 assessment scales (Ahorsu et al., 2020; de Sá-Caputo et al., 2020; Talaee et al., 2022), and Malaysia COVID-19 management guidelines. A total of 10 nurses in the COVID-19 treatment center at Alex Ekwueme Federal University Teaching Hospital Abakaliki contributed three additional questions to the draft bringing the total to 61. The questions addressed various aspects of the impact of COVID-19 management response among healthcare professionals, and were scored using a 3-point Likert scale

2.2 | Content and face validation

The developed questionnaire was further sent to an expert panel consisting of 12 healthcare professionals for content judgment. The experts included nurses, doctors, medical laboratory scientists, and ward assistants recruited as follows; seven from academia, comprising lecturers from Departments of Nursing, Community Medicine, and Medical Laboratory Sciences from Ebonyi State University, Abakaliki, Nigeria; University of Manchester City (United Kingdom); University of Putra (Malaysia); and Yale University (United States) respectively. The rest of the experts were senior clinical healthcare workers in Nigeria, most of whom were heads of units or departments in their respective hospitals. Content validity was conducted to explain the degree to which questions in the instrument sufficiently or comprehensively represent the concepts being measured (Waltz et al., 2010; Zamanzadeh et al., 2015).

In addition, the experts were requested to critically review the domain and its items before providing score on each item. The experts were also encouraged to provide written comment to improve the relevance of items to the targeted domains. The comments were used to refine the domains and its items. Each item was then rated for relevance on a scale of 1 to 4, and calculated to establish the Items Content Validity Index (I-CVI), followed by Scale-Content Validity Index (S-CVI/Ave) in order to estimate the average I-CVIs of the developed instrument (Sousa & Rojjanasrirat, 2011). Experts were assumed to be in agreement when they independently give the same score to items. The I-CVI was computed as the number of content valid experts giving a rating of either 3 (quite relevant) or 4 (highly relevant), divided by the total number of experts (Polit et al., 2007). Items with an I-CVI of at least 0.80 (80%) were accepted or retained, those with I-CVI = 0.75 to 0.79 were amended, and items with I-CVI <0.75 were removed from the instrument (Davis, 1992). In addition, the S-CVI/Ave was computed as the average I-CVIs for all the items in the questionnaire, and the total/Universal Agreement was estimated by dividing the number of items that achieved the I-CVI of 1.00 by the total number of items to be validated in the questionnaire. An S-CVI/Ave ≥0.80 was taken as a threshold for the instrument to be content valid (Yusoff, 2019; Zahiruddin et al., 2018) and the score for this instrument was 0.91. Out of the 61 items generated, 17 were eliminated leaving 44 questions that were selected as the COVRiQ prototype for face validity test. The content validation index for this study was presented in Table 1.

Face validity or a pilot study was conducted on 6 nurses and 4 doctors from University of Nigeria Teaching Hospital (UNTH) Enugu to assess the clarity and comprehension of the items and determine how meaningful the items were in assessing the desired concepts among the target participants (Peirce et al., 2016). The participants were given time for an open-ended discussion of the items. Of the 44 items for face validity test in this phase, 5 items were recommended as capable of eliciting social or cultural biases and were eliminated leaving 39 items that were used as the COVRiQ prototype for construct validity assessment. Detailed steps in the development of the questionnaire are summarized in Figure 1.

2.3 | Construct validity

Psychometric properties testing of the COVRiQ prototype was done with 301 healthcare professionals at the UNTH Enugu from May 8 to August 17, 2021. The sample size was calculated using the lower limit of five respondents per variable to be analyzed in line with the rule of thumb. There was a total of 39 questions rated valid in the COVRiQ draft used for this validation study and required ($39 \times 5 = 195 + 20\%$ dropout) respondents. Based on the experts consensus that the larger the sample size, the more reliable the results (Kyriazos, 2018; Riley et al., 2020), a much higher sample size of 301 was used. Participants were recruited via purposive sampling method by selecting various professionals including nurses, medical laboratory scientists, doctors, and ward assistants. Exclusion criteria were those who were not from the aforementioned health specialties or staff of UNTH Enugu. The method of administration of COVRiQ was face to face survey and online Google Forms on smartphone devices.

2.4 | Data analysis

Exploratory factor analysis (EFA) was performed to analyze and validate the COVRiQ questionnaire. The EFA was conducted for component extraction using principal component analysis (PCA) method. The internal consistency was measured using Cronbach's alpha (α), the sampling adequacy was tested using Kaiser-Meyer-Olkin measure (KMO), and data suitability for PCA was tested using Bartlett's test of sphericity (Vaske et al., 2017). The KMO value >0.5 and a significant Bartlett's test ($p \leq 0.05$) were taken as indication of sample adequacy (Ghani et al., 2016; Kaiser, 1974; Kline, 2011). Eigen value threshold of 1 was used as a determinant of the number of factors in the factor loading and items with factor loading of more than plus

TABLE 1 Experts' content validity result: items rated 3 or 4 ($n = 12$)

Items no.	Items	No of experts in agreement	I-CVI
Q1	Worried about personal and family safety	12	1.00
Q2	Often have troubles sleeping during COVID-19 pandemic	9	0.92
Q3	Often feels depressed or moody during the pandemic	12	0.83
Q4	Prefers to be alone or avoids everyone during the pandemic	12	0.92
Q4	Feels the workplace occupational risk has increased following COVID-19 outbreak	6	1.00
Q5	Wears complete personal protective equipment at workplace all the time	12	0.83
Q6	Higher workplace stress during the pandemic than before the outbreak	10	1.00
Q7	Became less satisfied with the job during the pandemic	12	0.83
Q8	Feels like quitting the present job if provided with alternative due to COVID-19 risk	9	0.92
Effects of COVID-19 on social interactions during the pandemic:			
Q9	Cut down social engagements during COVID-19 pandemic	12	0.83
Q10	Reduced time for personal rest and exercise	12	1.00
Q11	Reduced confidence in using public facilities such as hospitals, transports, school, markets, etc	12	0.92
Q12	Poor interest in traveling and social gatherings e.g. cultural festivals, marriage and birthday ceremonies	8	0.92
Q13	Reduced freedom to choose shifts or when to work and the number of hours per week due to inadequate trained personnel during COVID-19 pandemic	12	0.92
Q14	Reduced implementation of personal development plans such as certificate courses or trainings due to lockdowns and workplace engagements	12	1.00
Q15	Avoids direct contacts with everyone, including loved ones; play mates and partners	12	0.83
Q16	Reduced communication and supports	9	1.00
Q17	Spent more time in internet reading and watching health related news on media	12	0.92
Q18	Institutional supports were inadequate during COVID-19 pandemic	12	1.00
	Experiences during COVID-19 pandemic:		
Q19	Decreased monthly income	12	1.00
Q20	Decreased monthly savings	12	0.83
Q21	Increased monthly expenditure or bills	10	1.00
Q22	Delayed payment of your salary/allowances	12	1.00
Q23	Have less access to extra fund for emergencies during COVID-19 pandemic than before the outbreak	12	1.00
Pattern of expenditure:			
Q24	Transportation	12	0.92
Q25	Food/feeding	12	1.00
Q26	Medical and personal protective equipment	9	0.92
Q27	Rent and utilities	12	0.92
Q28	More worried about financial situation during the pandemic than before the outbreak	12	1.00
Q29	Often caught up with lack of money for routine bills during COVID-19 pandemic than before the outbreak	10	0.50
Q30	Feels earnings are low compared to workload and risks during COVID-19 pandemic	12	0.83

TABLE 1   (Continued)

Items no.	Items	No of experts in agreement	I-CVI
Q31	Wishes to do extra work for more money to meet up with bills during the pandemic	12	0.92
		S-CVI/Ave	0.91
		S-CVI/UA	0.97

Note: Proportion of items rated relevant by 12 experts = 0.91 (91%).

Note: Scale-Level Content Validity Index (S-CVI/Ave) is computed as the average Item Content Validity Index (I-CVI) for all the items in the questionnaire. Total/Universal Agreement (UA) is the number of items that achieved the I-CVI of 1.00 divided by the total number of items to be validated in the questionnaire. I-CVI was computed as the number of content valid experts giving a rating of either 3 (quite relevant) or 4 (highly relevant), divided by the total number of experts (Polit et al., 2007). Items with at least I-CVI of 0.80 (80%) were accepted or retained, those with I-CVI = 0.75 to 0.79 were amended, whereas items with I-CVI less than 0.75 were removed from the instrument (Davis, 1992).

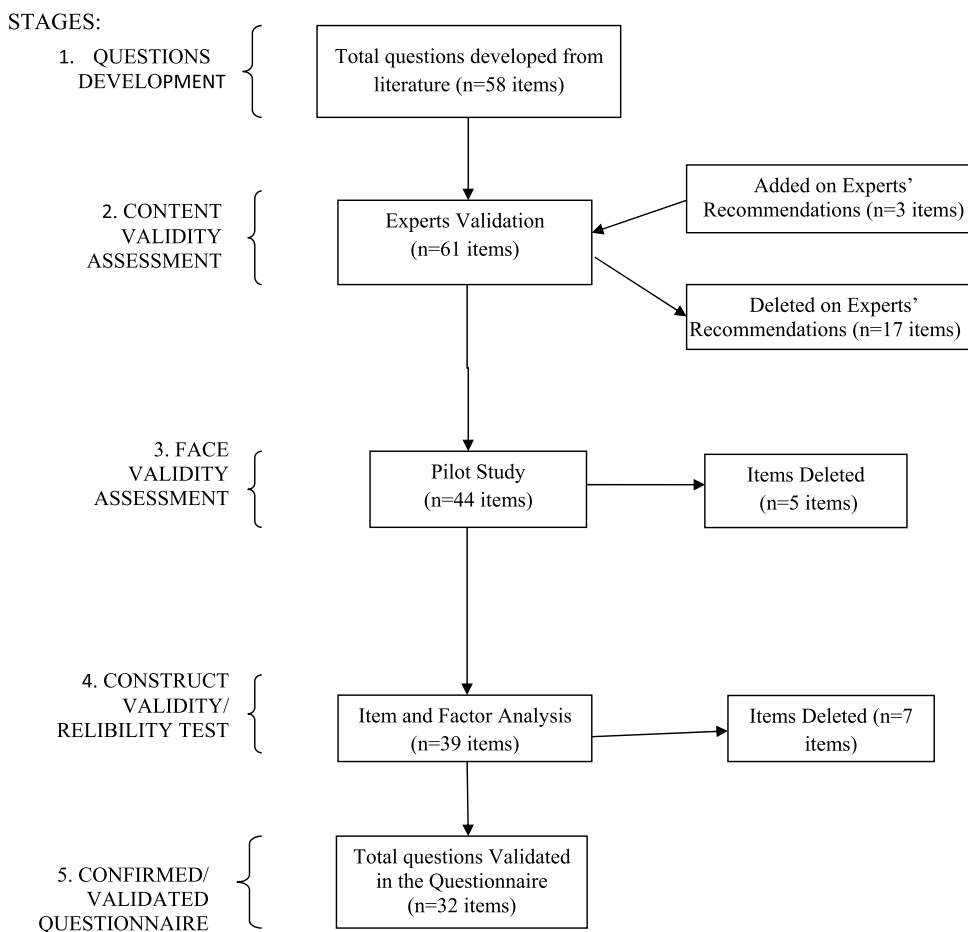**FIGURE 1**   Questionnaire development flow chart

Figure 1: Questionnaire Development Flow Chart

or minus 0.3 were accepted using IBM SPSS statistics 25.0 software (Jones et al., 2015). An acceptable range of item difficulty index of −3 to 3, and item discrimination index of 0.25 or above were adopted (Arifin & Yusoff, 2017; Yang & Kao, 2014). Item fit was assessed using chi-square goodness-of-fit and unidimensionality was estimated through modified parallel analysis (Hajizadeh & Asghari, 2011; Fan et al., 2018). Questions with low factor loading were dropped. Reliability analysis with Cronbach's alpha was calculated before and after questions were removed.

2.5 | Ethical approvals

This study was approved by the Human Research Ethics Committee (JEPeM) of Universiti Sains Malaysia (USM/ JEPeM/20090491) and the Human Research Ethics Committee of the University Teaching Hospital (UNTH) Ituku Ozalla, Enugu Nigeria (UNTH/ NHREC/2020/12/261). Content experts submitted a signed informed consent form indicating their willingness to voluntarily participate before their participation.

TABLE 2 Sociodemographic characteristics of respondents (n = 301)

Variable	Mean (SD)	Frequency	Percentage (%)
Age (years)	34.28 (SD = 13.78)		
Gender			
Male		91	30.2
Female		210	69.8
Religion			
Muslim		6	2.0
Christian		264	87.7
Others		31	10.3
Marital status			
Single		133	44.2
Married		139	46.2
Others		29	9.6
Highest level of education			
Primary/secondary school		59	19.6
Diploma		4	1.3
Bachelors' degree		237	78.7
Others		1	0.3
Specialty			
Doctors		114	37.9
Nurses		106	35.2
Medical lab scientists		14	4.7
Ward assistants		67	22.3
COVID-19 care experience (months)			
<3 months		84	27.9
≥3–6 months		121	40.2
≥6 months		96	31.9
Working hours per week			
40 h below/week		92	30.6
41–60 h/week		117	38.9
61 h above/week		92	30.6
Duty structure			
Shift duties		100	100.0
Office hours		0	0.0
Monthly income (Nigerian Naira)			
N50,000 below		148	49.2
N51 000–N100 000		79	26.2
N101 000–N150 000		33	11.0
N151 000 above		41	13.6

TABLE 2 (Continued)

Variable	Mean (SD)	Frequency	Percentage (%)
No of dependents			
None		131	43.5
1–2 persons		1	0.3
3–4 persons		79	26.2
5–6 persons		30	10.0
7 persons above		60	19.9
Means of transportation			
Walking		69	22.9
Taxi		7	2.3
Car		114	37.9
Bus		48	15.9
Motorcycle		63	20.9
Distance from home to workplace (km)			
Below 1 km		108	35.9
1–3 km		114	37.9
4–6 km		50	16.6
7 km above		29	9.9
Body mass index			
Below 18.5		0	0.0
18.5–24.9		162	53.8
25.0–29.9		78	25.9
30.0 above		61	20.3

3 | RESULTS

The validation study was carried out using 301 participants with the mean age of 34.28 (SD = 13.78) years ranging from 19 to 53 years old. There were more females (69.8%) compared to males, with a higher number of doctors (37.9%) and nurses (35.2%) compared to other healthcare professionals. Majority were degree holders (78.7%) with 19.6% having at least a secondary school education. Another important characteristic of the respondents was their working experience in COVID-19 care, which was considerably high with 72.2% having at least 3 months of experience. The sociodemographic characteristics and details of the respondents were presented in Table 2

The results show that both the item difficulty index and item discrimination index were within the acceptable range of values, −3 to + 3 and 0.9 to 2.3 respectively (Table 3). However, seven items were further removed from the item response theory (IRT) analysis due to their low performance. The item goodness-of-fit assessment demonstrated that all items except two passed the fitness test ($p < 0.05$)

Furthermore, in respect of EFA for the behavioral domain, the KMO measure of sampling adequacy was 0.76 and the significance of Bartlett's test of sphericity was <0.001, suggesting that EFA could be used (Goni et al., 2020). Parallel analysis for the behavioral subdomain

TABLE 3 Results of the PCA analysis ($n = 301$)

Items	b	a	λ	χ^2 (df = 8)	p value
Q1. Worried about personal and family safety	0.72	1.56	0.67	182.10	<0.001
Q2. Often had troubles sleeping during COVID-19 pandemic	0.55	2.85	0.89	170.57	<0.001
Q3. Often feels depressed or moody during the pandemic	−0.41	3.50	0.9	100.55	<0.001
Q4. Prefers to be alone or avoids everyone during the pandemic	0.24	2.32	0.82	88.76	<0.001
Q5. Feels the workplace occupational risk has increased following COVID-19 outbreak	0.64	6.26	0.88	22.80	0.142
Q6. Wears complete personal protective equipment at workplace all the time	0.43	2.34	0.80	50.84	<0.001
Q7. Higher workplace stress during the pandemic than before the outbreak	−1.10	3.39	0.88	24.34	0.002
Q8. Became less satisfied with the job during the pandemic	1.02	1.29	0.60	60.85	<0.001
Q9. Feels like quitting the present job if provided with alternative due to COVID-19 risk	−0.14	3.08	0.87	75.46	0.05
Effects of COVID-19 on social interactions during the pandemic:					
Q10. Cut down social engagements during COVID-19 pandemic	0.40	4.32	0.93	21.16	0.007
Q11. Reduced time for personal rest and exercise	0.74	2.66	0.77	192.12	0.004
Q12. Reduced confidence in using public facilities such as hospitals, transports, school, markets, etc	0.56	2.75	0.98	160.57	0.001
Q13. Poor interest in traveling and social gatherings e.g. cultural festivals, marriage & birthday ceremonies	0.47	3.70	0.89	101.55	<0.002
Q14. Reduced freedom to choose shifts or when to work and the number of hours per week due to inadequate trained personnel during COVID-19 pandemic	0.28	3.34	0.86	88.76	0.001
Q15. Reduced implementation of personal development plans such as certificate courses or trainings due to lockdowns and workplace engagements	0.63	6.29	0.78	32.80	0.018
Q16. Avoids direct contacts with everyone, including loved ones; play mates and partners	0.53	2.54	0.98	61.84	<0.001
Q17. Reduced communication and supports	−1.17	3.29	0.68	34.14	0.001
Q18. Spent more time in internet reading and watching health related news on media	1.02	2.49	0.69	72.86	<0.001
Q19. Institutional supports were inadequate during COVID-19 pandemic	−0.24	3.18	0.85	75.46	0.015
Experiences during COVID-19 pandemic:					
Q20. Decreased monthly income	0.48	5.42	0.91	34.16	0.004
Q21. Decreased monthly savings	0.55	2.85	0.89	170.57	0.001
Q22. Increased monthly expenditure or bills	−0.41	3.50	0.9	100.55	0.005
Q23. Delayed payment of your salary/allowances	0.24	2.32	0.82	88.76	0.001
Q24. Have less access to extra fund for emergencies during COVID-19 pandemic than before the outbreak	0.64	6.26	0.88	22.80	0.000
Pattern of expenditure					
Q25. Transportation	0.43	2.34	0.80	50.84	0.005
Q26. Food/feeding	−1.10	3.39	0.88	24.34	0.001
Q27. Medicals and personal protective equipment	1.02	1.29	0.60	60.85	<0.001
Q28. Rent and utilities	−0.14	3.08	0.87	75.46	0.014
Q29. More worried about financial situation during the pandemic than before the outbreak	0.40	4.32	0.93	21.16	0.006

(Continues)

TABLE 3 (Continued)

Items	b	a	λ	χ^2 (df = 8)	p value
Q30. Often caught up with lack of money for routine bills during COVID-19 pandemic than before the outbreak	0.72	1.56	0.67	182.10	0.011
Q31. Feels earnings are low compared to workload and risks during COVID-19 pandemic	0.55	2.85	0.89	170.57	<0.002
Q32. Wishes to do extra work for more money to meet up with bills during the pandemic	−0.41	3.50	0.9	100.55	<0.001

Abbreviations: a, discrimination; b, difficulty; df, degree of freedom; χ^2, chi-square; PCA, principal component analysis; λ, standardized items factor loading with p values <0.05.

TABLE 4 Results of the exploratory factor analysis (EFA)

Domains	Items	Factor loading	Reliability (Cronbach's alpha)
Behavioral	COVID-19 related anxiety		0.89
	Q1. Worried about personal and family safety	0.527	
	Q2. Often have troubles sleeping during COVID-19 pandemic	0.769	
	Q3. Often feels depressed or moody during the pandemic	0.741	
	Q4. Prefers to be alone or avoids everyone during the pandemic	0.869	
	Workplace risks prevention		0.76
	Q5. Feels the workplace occupational risk has increased following COVID-19 outbreak	0.641	
	Q6. Wears complete PPE at workplace all the time	0.71	
	Q7. Higher workplace stress during the pandemic than before the outbreak	0.791	
	Q8. Became less satisfied with the job during the pandemic	0.769	
	Q9. Feels like quitting the present job if provided with alternative due to COVID-19 risk	0.662	
Social	Family social interaction		0.90
	Effects of COVID-19 on social interactions during the pandemic:		
	Q10. Cut down social engagements during COVID-19 pandemic	0.917	
	Q11. Reduced time for personal rest and exercise	0.769	
	Health information seeking		0.68
	Q12. Reduced freedom to choose shifts or when to work and the number of hours per week due to inadequate trained personnel during COVID-19 pandemic	0.878	
	Q13. Reduced implementation of personal development plans such as certificate courses or trainings due to lockdowns and workplace engagements	0.769	
	Q14. Avoids direct contacts with everyone, including loved ones; play mates and partners	0.556	
	Q15. Reduced communication and supports	0.671	
	Q16. Spent more time in internet reading and watching health related news on media	0.483	
	Q17. Institutional supports were inadequate during COVID-19 pandemic	0.679	
	Q18. Reduced confidence in using public facilities such as hospitals, transports, school, markets, etc	0.742	

TABLE 4 (Continued)

Domains	Items	Factor loading	Reliability (Cronbach's alpha)
Economic	Change in income and expenditure		0.72
	Experiences during COVID-19 pandemic	0.912	
	Q19. Decreased monthly income		
	Q20. Decreased monthly savings	0.632	
	Q21. Increased monthly expenditure or bills	0.671	
	Q22. Delayed payment of your salary/allowances	0.843	
	Q23. Have less access to extra fund for emergencies during COVID-19 pandemic than before the outbreak	0.761	
	Pattern of expenditure		
	Q24. Transportation	0.767	0.84
	Q25. Financial Pressure	0.971	
	Q26. Food/feeding	0.843	
	Q27. Medicals and personal protective equipment	0.793	
	Q28. Rent and utilities	0.536	
	Q29. More worried about financial situation during the pandemic than before the outbreak	0.628	
	Q30. Often caught up with lack of money for routine bills during COVID-19 pandemic than before the outbreak	0.634	
	Q31. Feels earnings are low compared to workload and risks during COVID-19 pandemic	0.636	
	Q32. Wishes to do extra work for more money to meet up with bills during the pandemic	0.664	

was suggestive of a four-factor model. However, EFA was conducted by fixing the number of factors to two for EFA to proceed based on the criterion that the Eigen value was >1. The resultant factors were further rotated in line with the Oblimin method to generate more meaningful factors (Jones et al., 2015; Kline, 2011). All the pooled items demonstrated acceptable factor loadings greater than 0.4 in the behavioral domain with the exception of three items, which were removed. The closeness of all the commonalities to one another further indicated the validity of the two-factor model. The two subdomains of behavioral impacts are COVID-19 related anxiety (four items), and workplace risk prevention (five items) as shown in Table 4. The list of questions and their mean marks are represented in Tables 3 and 4

On the domain of social impacts, there was a factorable data matrix and a KMO value of 0.86 and the significance of Bartlett's test of sphericity ($p = 0.001$) indicated that the criteria to conduct EFA were met. The number of factors were fixed to two in order to continue the EFA as suggested by the result of parallel analysis. All the items in the social impact domain showed factor loadings >0.4 and were retained in the questionnaire except three items, which were removed following cross loading. The two factored subdomains are family social interaction (three items) and health information seeking behavior (seven items) as shown in Table 3. Similarly, a KMO value of 0.78 and the significance of Bartlett's test of sphericity ($p = 0.005$) was evidence to conduct EFA for the economic impacts domain. Also, for the EFA to continue, the number of factors was

fixed to two as suggested by the parallel analysis. All the items in the social impact domain showed factor loadings >0.3 and were retained in the questionnaire except two items, which were removed due to cross loading. The two factored subdomains are change in income and expenditure (eight items) and financial pressure (five items) as shown in Table 3.

The questionnaire showed the Cronbach's alpha coefficients of 0.97, 0.76, and 0.84 for the domains of behavioral, social, and economic impacts respectively. For the behavioral impacts domain, the two factors – COVID-19 related anxiety and workplace risks prevention – had acceptable internal consistency of 0.89 and 0.76 respectively. Similarly, the two subdomains of social impacts (family social interaction and health information seeking behavior) also showed acceptable Cronbach's alpha values of 0.90 and 0.68 respectively. In addition, the Cronbach's alpha values for the subdomains of economic impacts were 0.72 and 0.84.

Overall, a draft questionnaire consisting of 32 items in three domains was developed. The domains included behavioral impacts (9 items), social impacts (10 items), and economic impacts (13 items). The item difficulty index and item discrimination index were within the acceptable range of values -3 to $+3$ and 0.9 to 2.3 respectively (Table 3). Item goodness-of-fit assessment demonstrated that all items except two passed the fitness test ($p < 0.05$). In addition, the Cronbach's alpha coefficients for the domains demonstrated acceptable internal consistency ($\alpha = 0.91$).

4 | DISCUSSION

As the world goes through the fourth wave of the pandemic and the emerging variants of COVID-19, significant changes are expected in socioeconomic and behavioral health (Ho et al., 2021; Pham et al., 2021). Health belief model may play a vital role in bringing about these important lifestyle changes (Jones et al., 2015). This study developed a new questionnaire for the assessment of behavioral, social. and economic impacts of COVID-19 response on healthcare professionals. This tool consists of 32 items in three domains that comprehensively assessed the impacts of the pandemic.

Since the beginning of the pandemic, this is the first attempt to develop a validated instrument to wholistically assess the impact of COVID-19 responses on healthcare providers in the Nigerian population. Previous tools that assessed the impacts of the pandemic either narrowed their scopes to psychological impacts on the general population (Kalanidhi et al., 2021), or sampled healthcare providers from other regions who shared different sociocultural background from Nigeria (Talaee et al., 2022; Zhong et al., 2021). Nigeria as a low income country is threatened by various infrastructural inadequacies. With the outbreak of the COVID-19 pandemic, these threats became compounded, particularly in the era of shortage of healthcare workers and equipment. These may have the capacity to adversely affect the quality of healthcare services and public safety. Earlier studies that assessed the psychosocial and behavioral impacts of the SARS outbreak on the frontline healthcare providers reported poor public health decisions and increased likelihood for medical errors (Chiwaridzo et al., 2017). Similarly, reports from previous pandemics such as Ebola, SARS, and Influenza A virus (subtype H1N1) revealed that the preventive health measures enforced by the governments had long-lasting and significant impacts on the socioeconomic and behavioral lifestyles of the people (Kalanidhi et al., 2021; Kisely et al., 2020). This underscores the need for the general well-being of healthcare providers to be monitored during the pandemic.

Interestingly, this study found that the new instrument is valid and reliable for measuring the behavioral, social. and economic impacts of COVID-19 responses on healthcare providers in Nigeria. Both the EFA and IRT results indicated a good structure for this new questionnaire and acceptable item difficulty and discrimination indexes. Earlier studies support the results of this findings. Ghani et al. (2016) and Yang and Kao (2014) reported that the ideal range of item discrimination index could span from minus infinity to plus infinity. The item difficulty index and item discrimination index in this study ranged from -3 to $+3$ and 0.9 to 2.3 respectively. These suggest that the items were simple and easy for respondents to understand. Nevertheless, this study also found that the factor loadings for the items in the instrument were range of values greater than 0.3, indicating that there may be close relationships between the factors and items.

Furthermore, the Cronbach's alpha coefficient was 0.91. This suggests that the instrument is reliable in measuring the constructs of interest (Kalanidhi et al., 2021). Results from previous studies also support this finding. Earlier study that assessed the validity and reliability of general health questionnaire on Chinese healthcare workers during COVID-19 found the Cronbach's alpha coefficient as 0.892 (Zhong et al., 2021). Similarly, a study that validated the fear of COVID-19 scale (Ahorsu et al., 2020) and two other separate studies that respectively evaluated the validities and reliabilities of the tools for assessment of physical and psychological impacts of COVID-19 (de Sá-Caputo et al., 2020) and stress and burnout in healthcare workers during COVID-19 pandemic (Talaee et al., 2022) reported a similar range of Cronbach's alpha coefficients of 0.80 to 0.89. However, the variation in the Cronbach's alpha values when compared to the findings of this study may be explained by the differences in the sample sizes.

The content validity and Cronbach's alpha coefficient assessment methods have been widely used by researchers to test for the validity and reliability of research instruments. According to Davis (1992) and Polit et al. (2007), for an instrument to be reliable, it must achieve at least a Cronbach's alpha coefficient of 0.6 or above. However, researchers have argued that sample size influences the values of both S-CVI/Ave and the correlation coefficients (Muller et al., 2020; Yusoff, 2019). For instance, a study has demonstrated that the greater the number of the members of expert panel, the lower their chances of agreement (Jones et al., 2015). This implies that the cutoff value for S-CVI/Ave would generally decrease when the number of content experts are increased.

As a new research tool, COVRiQ has good face validity, content validity, construct validity, and internal consistency. In addition, the questionnaire was demonstrated to be simple and user friendly and takes approximately 15 min to complete. It will be very helpful in assessing the changes in the socioeconomic and behavioral domains of frontline healthcare providers in Nigeria during COVID-19 pandemic and other similar future outbreaks. In addition, this tool may also be useful to healthcare professionals, researchers, and educators to assess the outcomes of interventions aimed toward reducing the impacts of COVID-19 pandemic on healthcare providers.

In conclusion, this study demonstrates that COVRiQ is valid and reliable for assessing the behavioral, social, and economic impacts of COVID-19 responses among healthcare providers who are 18 years and above. It is simple, user friendly, and consists of 32 items in three domains: behavioral, social, and economic impacts. Nonetheless, the inability to determine the predictive validity of the instrument could be considered as a limitation in this study. Also, the validity and reliability of the instrument were assessed using exploratory factor analysis. Future study should conduct a confirmatory factor analysis on the validity of this tool.

CONFLICT OF INTEREST

The authors declare that they have no competing interests.

DATA AVAILABILITY STATEMENT

Data is available on reasonable request

AUTHORS' CONTRIBUTION

Research design: Noor Mastura Mohd Mujar, Rohayu Hami

Data collection: Chidinma Oswald Edeogu, Nelson Chidinma Okpua

Data analysis: Chidinma Oswald Edeogu, Rohayu Hami

Manuscript writing: Nelson Chidinma Okpua, Noor Mastura Mohd Mujar,

All authors read and approved that the paper be published.

REFERENCES

Acharya, K. P., Acharya, N., Phuyal, S., Upadhyaya, M., & Steven, L. (2020). One-health approach: A best possible way to control rabies. *One Health*, *2020*, 100161.

Ahorsu, D. K., Lin, C. Y., Imani, V., Saffari, M., Griffiths, M. D., & Pakpour, A. H. (2020). The fear of COVID-19 scale: Development and initial validation. *International Journal of Mental Health and Addiction*, *20*, 1–9. https://doi.org/10.1007/s11469-020-00270-8

Arifin, W. N., & Yusoff, M. S. B. (2017). Item response theory for medical educationists. *Journal of Medical Education*, *9*(3), 69–81.

Chersich, M. F., Gray, G., Fairlie, L., Eichbaum, Q., Mayhew, S., Allwood, B., English, R., Scorgie, F., Luchters, S., Simpson, G., & Haghighi, M. M. (2020). COVID-19 in Africa: Care and protection for frontline healthcare workers. *Globalization and Health*, *16*, 1–6.

Chiwaridzo, M., Chikasha, T. N., Naidoo, N., Dambi, J. M., Tadyanemhandu, C., Munambah, N., & Chizanga, P. T. (2017). Content validity and test-retest reliability of a low back pain questionnaire in Zimbabwean adolescents. *Archives of Physiotherapy*, *7*(3), 3.

Dai, Y., Hu, G., Xiong, H., Qiu, H., & Yuan, X. (2020). Psychological impact of the coronavirus disease 2019 (COVID-19) outbreak on healthcare workers in China. *MedRxiv*, *3*(3), 1–22.

Davis, L. L. (1992). Instrument review: Getting the most from a panel of experts. *Applied Nursing Research*, *5*(4), 194–197.

de Sá-Caputo, D. d. C., Sonza, A., Bachur, J. A., & Bernardo-Filho, M. (2020). Development, validation and reliability of a questionnaire to evaluate changes on the level of physical exercises and psychological impact due to COVID-19 pandemic social distancing. *Acta Biomed*, *91*(3), 1–9.

Fan, Y., Zhang, S., Li, Y., Zhang, T., Liu, W., & Jiang, H. (2018). Development and psychometric testing of the knowledge, attitudes and practices (KAP) questionnaire among student tuberculosis (TB) patients (STBP-KAPQ) in China. *BMC Infectious Diseases*, *18*(1), 213 PMID: 29739363.

Ghani, A., Th, T., Arifin, W., & Chew, K. (2016). Development and psychometric evaluation of flood disaster management questionnaire-(Flooddmq-Bm): Exploratory factor analysis and item response theory analysis. *International Journal of Public Health and Clinical Sciences*, *3*(3), 59–70.

Goni, M. D., Naing, N. N., Hasan, H., Wan-Arfah, N., Deris, Z. Z., Arifin, N. W., Hussin, M. T. A. R., Abdulrahman, S. A., Baaba, A. A., & Arshad, R. M. (2020). Development and validation of knowledge, attitude and practice questionnaire for prevention of respiratory tract infections among Malaysian Hajj pilgrims. *BMC Public Health*, *20*, 189.

Greenfield, J., Sears, M., Nagrani, R., Mazzaferro, G., Widyastuti, A., & Austin, C. C. (2020). Common data models and full Spectrum epidemiology: Epi-STACK architecture for COVID-19 epidemiology datasets. *Data Sharing in Epidemiology*, *2020*, 65.

Hajizadeh, E., & Asghari, M. (2011). *Statistical methods and analyses in health and biosciences a research methodological approach* (Vol. 395). Jahade Daneshgahi Publications.

Ho, R. C., Tran, B. X., & McIntyre, R. S. (2021). The impact of COVID-19 pandemic on global mental health: From the general public to healthcare workers. *Annals of the Academy of Medicine, Singapore*, *50*(3), 198–199.

Jones, C. L., Jensen, J. D., Scherr, C. L., Brown, N. R., Christy, K., & Weaver, J. (2015). The health belief model as an explanatory framework in communication research: Exploring parallel, serial, and moderated mediation. *Health Communication*, *30*(6), 566–576.

Kaiser, H. F. (1974). An index of factorial simplicity. *Psychometrika*, *39*(1), 31–36.

Kalanidhi, K. B., Ranjan, P., Sarkar, S., Kaur, T., Upadhyay, A. D., Singh, A., Sahu, A., Khan, M., Prasad, B. V., Baitha, U., & Kumar, A. (2021). Development and validation of a questionnaire to assess socio-behavioural impact of COVID-19 on the general population. *Diabetes & metabolic syndrome. Clinical Research & Reviews*, *15*(2), 601–603.

Khattab, M. F., Kannan, T. M. A., Morsi, A., Al-Sabbagh, Q., Hadidi, F., Al-Sabbagh, M. Q., Taha, M., Bourghli, A., & Obeid, I. (2020). The short-term impact of COVID-19 pandemic on spine surgeons: A cross-sectional global study. *European Spine Journal*, *29*(8), 1806–1812.

Kisely, S., Warren, N., McMahon, L., Dalais, C., Henry, I., & Siskind, D. (2020). Occurrence, prevention, and management of the psychological effects of emerging virus outbreaks on healthcare workers: Rapid review and meta-analysis. *BMJ (Clinical Research Ed.)*, *369*, m1642.

Kline, R. (2011). *Principles and practice of structural equation modeling* (3rd ed.). NY Guilford Press.

Kyriazos, T. A. (2018). Applied psychometrics: Sample size and sample power considerations in factor analysis (EFA, CFA) and SEM in general. *Psychology*, *9*(08), 2207–2230.

Lai, X., Wang, M., Qin, C., Tan, L., Ran, L., Chen, D., Zhang, H., Shang, K., Xia, C., Wang, S., Xu, S., & Wang, W. (2020). Coronavirus disease 2019 (COVID-2019) infection among health care workers and implications for prevention measures in a tertiary Hospital in Wuhan, China. *JAMA Network Open*, *3*(5), e209666.

Muller, A. E., Hafstad, E. V., Himmels, J. P. W., Smedslund, G., Flottorp, S., Stensland, S. Ø., Stroobants, S., Van de Velde, S., & Vist, G. E. (2020). The mental health impact of the covid-19 pandemic on healthcare workers, and interventions to help them: A rapid systematic review. In *Psychiatry research* (Vol. 293). Elsevier Ireland Ltd. https://doi.org/10.1016/j.psychres.2020.113441

Okpua, C. N., Edeogu, C. O., Hami, R., & Mujar, N. (2021). Impacts of COVID-19 pandemic on frontline healthcare workers in Africa and Asian countries: A systematic review. *Malaysian Journal of Medicine and Health Sciences*, *17*(SUPP 9), 118–130.

Osterrieder, A., Cuman, G., Pan-Ngum, W., Cheah, P. K., Peerawaranun, P., Cheah, P., Silan, M., Orazem, M., Perkovic, K., Groselj, U., & Schneiders, M. (2021). Economic and social impacts of COVID-19 and public health measures: Results from an anonymous online survey in Thailand, Malaysia, the UK, Italy and Slovenia. *BMJ Open*, *11*(7), e046863.

Peirce, D., Brown, J., Corkish, V., Lane, M., & Wilson, S. J. (2016). Instrument validation process: A case study using the paediatric pain knowledge and attitudes questionnaire. *Journal of Clinical Nursing*, *11*(12), 1566–1575.

Pham, Q. T., Le, X., Phan, T. C., Nguyen, Q. N., Ta, N., Nguyen, A. N., Nguyen, T. T., Nguyen, Q. T., Le, H. T., Luong, A. M., Koh, D., Hoang, M. T., Pham, H. Q., Vu, L. G., Nguyen, T. H., Tran, B. X., Latkin, C. A., Ho, C., & Ho, R. (2021). Impacts of COVID-19 on the life and work of healthcare workers during the nationwide partial lockdown in Vietnam. *Frontiers in Psychology*, *12*, 563193. https://doi.org/10.3389/fpsyg.2021.563193

Polit, D. F., Beck, C. T., & Owen, S. V. (2007). Is the CVI an acceptable indicator of content validity? Appraisal and recommendations. *Research in Nursing & Health*, *4*(30), 459–467.

Riley, R. D., Ensor, J., Snell, K. I., Harrel, L. F., Martin, G. P., Reitsma, J. B., Moons, K. G., Collins, G., & van Smeden, M. (2020). Calculating the sample size required for developing a clinical prediction model. *BMJ*, *18*(368), m441.

Sousa, V., & Rojjanasrirat, W. (2011). Translation, adaptation and validation of instruments or scales for use in cross-cultural health care research: A clear and user-friendly guideline. *Journal of Evaluation in Clinical Practice*, 17(2), 268–274.

Talaee, N., Varahram, M., Jamaati, H., Salimi, A., Attarchi, M., Kazempour Dizaji, M., Sadr, M., Hassani, S., Farzanegan, B., Monjazebi, F., & Seyedmehdi, S. M. (2022). Stress and burnout in health care workers during COVID-19 pandemic: Validation of a questionnaire. *Journal of Public Health (Germany)*, 30(3), 531–536.

Tan, B. Y. Q., Chew, N. W. S., Lee, G. K. H., Jing, M., Goh, Y., Yeo, L. L. L., Zhang, K., Chin, H. K., Ahmad, A., Khan, F. A., Shanmugam, G. N., Chan, B. P. L., Sunny, S., Chandra, B., Ong, J. J. Y., Paliwal, P. R., Wong, L. Y. H., Sagayanathan, R., Chen, J. T., ... Sharma, V. K. (2020). Psychological impact of the COVID-19 pandemic on health care workers in Singapore. *Annals of Internal Medicine*, 173(4), 317–320.

Vaske, J., Beaman, J., & Sponarski, C. C. (2017). Rethinking internal consistency in Cronbach's alpha. *Leisure Sciences*, 39(2), 163–173.

Waltz, C. F., Strickland, O. L., & Lenz, E. (2010). *Measurement in nursing and health research*. Springer Publishing Company.

Wang, L. Q., Zhang, M., Liu, G. M., Nan, S. Y., Li, T., Xu, L., Xue, Y., Zhang, M., Wang, L., Qu, Y. D., & Liu, F. (2020). Psychological impact of coronavirus disease (2019) (COVID-19) epidemic on medical staff in different posts in China: A multicenter study. *Journal of Psychiatric Research*, 129(2020), 198–205.

World Health Organization. (2021). *WHO coronavirus disease (COVID-19) dashboard. World health organization 2020*. WHO. https://covid19.who.int/?gclid=Cj0KCQjwreT8BRDTARIsAJLl0KLNpFtGSQYio6A7Kes7wuL9W_B8unrRYLCARO4N6uxv3TtEgNBP9P4aAnZtEALw_wcB (Accessed March 12, 2022).

Xiao, X., Zhu, X., Fu, S., Hu, Y., Li, X., & Xiao, J. (2020). Psychological impact of healthcare workers in China during COVID-19 pneumonia epidemic: A multi-center cross-sectional survey investigation. *Journal of Affective Disorders*, 274, 405–410.

Yang, F. M., & Kao, S. T. (2014). Item response theory for measurement validity. *Shanghai Archives of Psychiatry*, 26(3), 171–177.

Yusoff, M. S. B. (2019). ABC of response process validation and face validity index calculation. *Education in Medicine Journal*, 11(2), 49–61.

Zahiruddin, W., Arifin, W., Mohd-Nazri, S., Sukeri, S., Zwaha, I., & Bakar, R. (2018). Development and validation of a new knowledge, attitude, belief and practice questionnaire on leptospirosis in Malaysia. *BMC Public Health*, 18(1), 331.

Zamanzadeh, V., Ghahramanian, A. M., Rassouli, A., Abbaszadeh, H., Alavi-Majd, H., & Nikanfar, A. R. (2015). Design and implementation content validity study: Development of an instrument for measuring patient-centered communication. *Journal of Caring Sciences*, 4(2), 165–178.

Zhong, X., Jin, X., Yan, L., Yang, L., Long, H., Wang, J., Wang, H., Liu, Y., Pu, J., Xie, P., & Ji, P. (2021). Reliability and validity of general health questionnaire-12 in Chinese dental healthcare workers during the COVID-19 pandemic. *Frontiers in Psychiatry*, 2021, 2420.