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Validity and Reliability of Typhoid Risk Factors Questionnaire (TRFQ) in Gombe Metropolis, Gombe State, Nigeria

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ABSTRACT

Typhoid poses a significant threat to human health, particularly in Africa and Asia, where the disease continues to be endemic. Typhoid caused approximately 8.4 million disability-adjusted life-years worldwide in 2017, with 116,814 deaths. While vaccinations effectively eradicate the endemic infection, limited resources frequently constrained vaccination strategies. Thus, an understanding of the risks associated with typhoid would aid in implementing targeted interventions. In many states of Nigeria, including Gombe, data on typhoid risk factors are unavailable. This study aimed to develop and validate a questionnaire on typhoid risk factors in the Gombe Metropolis. The questionnaire items were based on previously published questionnaires on typhoid and localized typhoid risk factors. After obtaining ethical approval, the drafted instrument was pilot tested among a small population and checked for readability. The questionnaire's content validity was checked using Fleiss' Multi-rater kappa, while internal consistency and test-retest reliability were checked using Cronbach's alpha and intraclass correlation coefficient (ICC), respectively. The questionnaire validation results revealed that the instruments' readability was easy, content validity with Fleiss' kappa value of 0.623 was good, internal consistency with Cronbach's alpha

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value of 0.720 and McDonald's omega of 0.703, and test-retest reliability with an ICC estimate of 0.736 was good. The questionnaire was valid and reliable for collecting data on typhoid risk factors in Gombe State, Nigeria, to develop targeted health interventions and guide the Government's resource prioritization and allocation decisions for efficient disease control.

Keywords: Questionnaire, reliability, risk, typhoid, validity

INTRODUCTION

Typhoid fever has persisted as a considerable threat to health, especially across African and Asian countries, despite efforts targeting water hygiene improvements. The disease resulted from an infected individual with typhoidal bacteria known as *Salmonella typhi* by consuming either foods or drinkable items that have been contaminated with the bacteria. In 2017, there were reports that around 14,300,000 individuals had an enteric fever, which comprises typhoid and paratyphoid fevers, and approximately one out of every 100 of them had died. Approximations of the 2017 worldwide Disability-Adjusted Life Years (DALYs) resulting from *S. typhi* infections were placed at about 8.4 million with approximately 116,814 mortalities based on information provided by the Institute for Health Metrics and Evaluation (IHME) (Masinaei et al., 2020).

Providing enough healthy water and appropriate sanitation is recommended for *S. typhi* infection deterrence. Control efforts followed closely with safeguarding processing methods and systems of foods and other consumable items, employing fecal interaction safeguards, and efficiently managing disease occurrences. Immunizations have become invaluable as complementarily efficient tactics to curb an endemic infection or disrupt its spread amidst an outbreak. However, in nations with elevated burdens resulting from typhoid fever, communal widespread and scheduled typhoid immunization strategies are usually constrained (Khan et al., 2015).

Because there are many associated behavioral, demographic, socio-cultural, and environmental risk factors for typhoid infection, a comprehensive understanding of *S. typhi* risk factors has become critical. This understanding will guide the planning and implementation of vaccine-involved and non-vaccine prevention and control efforts against the disease. The World Health Organization (WHO) has advocated focusing vaccine-based typhoid control efforts on populations with high typhoid risk. As a result, typhoid conjugate vaccination strategies that target populations with high typhoid risks rather than traditional mass immunization schedules will benefit greatly. In addition, methods that produce isolated risks for distinct populations inside countries are invaluable to control efforts against this disease (Mogasale et al., 2014). Also, it is imperative that planning for efficient utilization of vaccination against typhoid must selectively target locations encompassing

populations with identified increased risks of typhoid fever since many nations especially developing countries of Africa and parts of Asia, have inadequate resources, which leads to them having to cope with control of *S. typhi* infection spread mainly in locations where it is endemic (Lee et al., 2016).

Many states in Nigeria, including Gombe, lack data on typhoid risk factors (Wong et al., 2016). Therefore, the goal of this study is to develop and validate a questionnaire tailored to the Gombe metropolis that can be used to collect behavioral, socio-cultural, and demographic data from laboratory-confirmed typhoid patients to develop a standard instrument for identifying typhoid risk factors in the area and provide data to aid targeted control and prevention efforts against the disease.

MATERIALS AND METHODS

Ethics

This study received ethical approval from the Gombe State Ministry of Health headquarters under the reference number MOH/ADM/S/658/VOL/II/122. In addition, informed consent, confidentiality, anonymous data collection/handling, and ethical research conduct were all adhered to.

Design

Items in the questionnaire were derived from and modified from previously published typhoid investigation questionnaires and forms, including the CRF: Case and control enrolment questionnaire (Jenkins, 2017), Enhanced typhoid and paratyphoid surveillance questionnaire (National Institute for Communicable Diseases, 2016). The questionnaire also included some locally observed variables associated with typhoid risk. The drafted questionnaire, which the Gombe State Ministry of Health had approved was then tested in a pilot study involving twenty typhoid patients at the Gombe State Specialist Hospital to identify vague or unclear questions, possible errors, or any issues with the comprehension of the questions and their options (Blázquez-Sánchez et al., 2020). In addition, the questionnaire's readability was evaluated to determine how simple it is to read and comprehend (Patalay et al., 2018).

Finally, the validation tests of the draft questionnaire were done using standard methods to investigate and analyze the instruments' construct validity (Vova-Chatzi et al., 2020), content validity, i.e., inter-rater agreement (O'Connor et al., 2020), internal consistency (Bäckström et al., 2020) and test-retest reliability (Mansukhani et al., 2019).

Study Population and Sample

The study population was laboratory-confirmed typhoid patients in Gombe State Specialist Hospital in the state's metropolitan area. They included only respondents that gave their

informed consent to participate, and there were no non-citizens involved in the study. This site was chosen among other state-owned and private health facilities based on the following criteria: frequently visited, easily accessible, proximity to more populated areas, and relative availability of diagnostic facilities. The sample size was determined to be 663 at a 95% confidence interval (CI) using CDC's EpiInfo software version 7.2.2.6 (CDC, 2020). The sampling was done using simple random sampling, and only questionnaires that were answered completely and properly were included in the study (n = 663). Sampling was done between 2nd July 2019 to 30th July 2019.

Questionnaire Draft

The questions in the questionnaire draft were closed-ended, and the instrument was self-administered (Namazi et al., 2020). The draft instrument was composed of 71 items which were derived by taking items from similar questionnaires available from literature, removing duplicate items, selecting items that could be related to the study area, and adding locally suspected typhoid risk factors, then placing the items under relevant headings, as described below.

Section A: Demographic information such as town area of residence, age, marital status, gender, and occupation, were derived from the "Suspected/confirmed typhoid fever case investigation form" of the National Institute for Communicable Diseases (National Institute for Communicable Diseases, 2016).

Section B: Socioeconomic status, which includes items such as "number of people in the house, having visitor within past two weeks, having house help, house help preparing food for the home, cockroaches inside the home, houseflies inside the home, typhoid case in the home within past two weeks, having typhoid carrier at home, been vaccinated against typhoid in past two years, type of toilet in residence, and do people defecate openly near your water source," was derived from the "CRF: Enrolment questionnaire for case and control" produced by Jenkins (2017). Only grammatical changes were made to the original items.

Section C: Behavior related items, for example, "Do you eat food from commercial sellers, do you consume iced/frozen drinks, do you eat fruits directly from the seller, do you wash your hands with soap before preparing food, do you wash your hands with soap before eating, do you wash your hands with soap after using the toilet, do you boil water before drinking, what type of animal do you have in your house, and how many times has a doctor treated you for typhoid fever before now," were also sourced from the "CRF: Enrolment questionnaire for case and control" produced by Jenkins (2017) and only grammatical changes were made to the sourced items.

Also included in the draft questionnaire under Section C (Behavior) is locally suspected typhoid risk factors which included drinking water from commercial sellers, eating zogale

(local salad) from commercial sellers, drinking nono (locally fermented milk) from commercial sellers, and drinking kunu (local beverage) from commercial sellers.

Readability Test

After making corrections observed from the pilot test, the readability of the questionnaire was investigated using the Flesch reading ease test and Flesch-Kincaid grade level test to determine how easy it is to read and understand the questionnaire and at what grade level of school a person ought to be able to do that, respectively. These were done using the proofing option in Microsoft Office Word 2016 (Patalay et al., 2018).

Statistical Analysis: Validation Studies

Content Validity. Content validity describes the magnitude to which the questionnaire elements represent the whole theoretical construct the questionnaire is conceived to evaluate. An expert panel comprising two epidemiologists, two public health professionals, two medical microbiologists, and two medical doctors assessed the content validity of each item in the questionnaire on a Likert scale ranging from "not relevant, somewhat relevant, quite relevant, to highly relevant." These responses were then analyzed using Fleiss' Multi-rater kappa to obtain the inter-rater agreement value at 95% CI (O'Connor et al., 2020). The value of kappa was inferred based on the following guide: values ≤ 0 indicate no agreement, 0.01–0.20 indicate none to a slight agreement, 0.21–0.40 as fair agreement, 0.41–0.60 as moderate agreement, 0.61–0.80 as substantial agreement, and 0.81–1.00 as almost perfect agreement (McHugh, 2012). This analysis was done using Statistical Product and Service Solutions (SPSS) version 26 (v26) for Windows.

Construct Validity and Internal Consistency. Construct validity is the magnitude to which the dimensions utilized assess the theory they evaluate (Ginty, 2013). It was investigated using Cronbach's alpha value after an exploratory factor analysis (EFA) with varimax rotation and eigenvalue greater than one extraction criterion to reduce the data's dimensionality. Prior to factor analysis, the Kaiser-Meyer-Olkin (KMO) test of sampling adequacy and Bartlett's test of sphericity were done to ensure the sample was adequate and fit for factor analysis (Vova-Chatzi et al., 2020). The analyses were done using SPSS v26 for Windows.

The McDonald's Omega (ω) coefficient was also calculated and used as another measure of construct validity due to the limitations of Cronbach's alpha, including the assumptions of normality, tau-equivalence, and uncorrelated errors (Crutzen & Peters, 2017). The Omega coefficient was calculated using maximum likelihood (ML) factor analysis with an OMEGA macro for SPSS provided by Hayes and Coutts (2020).

Internal consistency signifies the level to which the questionnaire entries are coherent in measuring the identical construct (Tsang et al., 2017). This was investigated using Cronbach's alpha and McDonald's omega (ML) already described in the previous paragraph. The values of alpha and omega were interpreted using documented guidelines: > 0.9 = Excellent, > 0.8 = Good, > 0.7 = Acceptable, > 0.6 = Questionable, > 0.5 =Poor, < 0.5 = Unacceptable (Taber, 2018). This test was done using SPSS v26 for Windows.

Test-Retest Reliability. Test-retest reliability gauges the stability of the scores of a construct acquired from the same group of individuals on multiple instances (Vilagut, 2014). A group of thirty subjects filled the questionnaire twice with 14 days intervals between sessions. Their responses were analyzed using intraclass correlation coefficient (ICC) with a two-way mixed-effects model, absolute agreement definition, and 95% confidence level using SPSS v26 for Windows. The obtained ICC values were interpreted using published criteria (Abdullah et al., 2019).

RESULTS AND DISCUSSION

Demographic Characteristics of the Respondents

The demographic characteristics of the respondents (Table 1) revealed that they were diverse in terms of their age, gender, occupation, and marital status. The typhoid pathogen *Salmonella typhi* is possibly transmitted through the fecal-oral route by consuming contaminated food or water. Hence, all demographic groups are at risk depending on their

Table 1
Demographic characteristics of respondents (n= 663)

Variable	Category	Frequency	Percentage
Gender	Male	356	53.7
	Female	307	46.3
Age (years)	9 to 17	52	7.8
	18 to 35	418	63.0
	36 to 55	128	19.3
	56 to 65	56	8.5
	66 to 85	9	1.4
Occupation	Student	164	24.7
	Skilled Professional	116	17.5
	Semi-Skilled Professional	352	53.1
	Unskilled Professional	20	3.0
	Not working	11	1.7
Marital Status	Single	283	42.7
	Married	370	55.8
	Divorced	10	1.5

level of hygiene, sanitation, and access to safe food and clean water (Mogasale et al., 2014). These results agree with Lee et al. (2016), who had documented typhoid disease burden among different age groups in low and middle-income countries.

Readability

The readability test results revealed that the draft questionnaire had a Flesch reading ease test value of 79.6 and a Flesch-Kincaid grade level test of 4.5. In contrast, the final validated questionnaire had a Flesch reading ease test value of 70.8 and a Flesch-Kincaid grade level test of 6.0. The results of the questionnaire readability test showed that the questionnaire was "easy to read" based on published guidelines which stated that outcomes of the Flesch reading ease test with values from 60 to 100 are deemed easy to read. In contrast, the Flesch-Kincaid grade level test result implied that the questionnaire could be read and understood by a person between the 4^{th} and 6^{th} grade of school according to documented criteria (Stetson et al., 2011).

Content Validity

The Fleiss' kappa test to evaluate the agreement between the responses of the eight raters regarding the relevance of each questionnaire item as a typhoid risk factor revealed that there was an overall good agreement between the raters, $\kappa = 0.623$, standard error (S.E.) = 0.017, $p < 0.05$, with 95% CI values of 0.622 to 0.624. The level of inter-rater agreement on the rated categories of the individual questionnaire items is shown in Table 2. In addition, the results of the content validity test revealed that the items in the questionnaire are, to a good extent, representative of the total theoretical construct the questionnaire was devised to evaluate, based on the description of content validity and interpretation of Fleiss' Kappa (McHugh, 2012) which implied that a kappa value above 0.60 signifies good agreement amongst raters and confidence ought to be attributed to the outcomes of that study.

Table 2
Values of Fleiss' kappa test for inter-rater agreement

Questionnaire item rating category	Fleiss' kappa value	Standard error (S.E.)	Significance	95% Confidence Interval	
				Lower bound	Upper bound
1	0.475	0.023	$p < 0.05$	0.474	0.477
2	0.330	0.023	$p < 0.05$	0.329	0.332
3	0.688	0.023	$p < 0.05$	0.687	0.690
4	0.687	0.023	$p < 0.05$	0.685	0.688

Construct Validity and Internal Consistency

These were achieved by carrying out exploratory factor analysis (EFA) followed by Cronbach's alpha determination and subsequent determination of McDonald's omega.

Exploratory Factor Analysis

The outcome value of the KMO test for sampling adequacy was 0.799, and that of Bartlett's test of sphericity was $p < 0.01$, after which the EFA outcome (Table 3) was used to assign items to factors that were retained in the draft questionnaire. The EFA model estimates for

Table 3
Items retained in the draft questionnaire after EFA

Items used in the EFA	Factor loadings	Factor solution	Factor s/n	Variance explained
Toilets near a water source	0.824	Toilets/feces near a water source	1	4.855
Animal farms near a water source	0.741			
Humans defecate openly near a water source	0.731			
Crop farms near a water source	0.595			
Open sewage in home	0.345			
Eat commercial salads/*zogale*	0.729	Eat commercial foods/ drinks	2	9.195
Eat food from commercial sellers	0.718			
Drink commercial *kunu*	0.696			
Drink water from commercial sellers	0.660			
Drink commercial cow milk/*nono*	0.609			
Eat fruits directly from the seller	0.366			
Wash hands with soap before eating	0.796	Wash hands with soap before handling food	3	13.009
Wash hands with soap before preparing food	0.719			
Wash hands with soap after using the toilet	0.707			
Wash hands with soap after changing the diaper	0.469			
Type of water used for bathing	0.935	Type of drinking water	4	16.339
Type of water used for brushing teeth	0.881			
Type of drinking water	0.681			
Others in-home vaccinated against typhoid in last two years	0.768	Vaccination against typhoid in your area within last two years	5	19.179
Vaccinated against typhoid in last two years	0.738			
Tiles on the toilet floor	0.777	Have tiles on the kitchen floor	6	21.783
Tiles on the kitchen floor	0.759			
Proximity of water body to the main road	0.648	Collect any food material from river or stream	7	24.373
Collect other food material from a water body	0.582			

Table 3 *(continue)*

Items used in the EFA	Factor loadings	Factor solution	Factor s/n	Variance explained
Fishing in a water body	0.475			
Age group	0.782	Occupation	8	26.928
Marital status	0.729			
Occupation	0.651			
Consume iced or frozen drinks	0.870	Consume iced or frozen products	9	29.139
Use ice blocks or ice cubes	0.635			
Consume imported products within last two weeks	0.357			
Have house help	0.793	Have houseboy or house girl	10	31.292
House help prepare food	0.745			
Work with hands-on a farm	0.793	Work with hands-on a farm	11	33.427
Apply manure/local fertilizer with hands-on farm	0.712			
Attend mass gathering within last two weeks	0.975	Attend any mass gathering in the past two weeks	12	35.468
Consume anything in a mass gathering in the last two weeks	0.573			
Flood in the entire town	0.711	Flood in your area	13	37.417
Flood near home	0.674			
Flood inside home	0.354			
Re-heat kept food before eating	0.597	Re-heat kept food before eating	14	39.346
Keep cooked food in the refrigerator	0.546			
Keep cooked food for later	0.418			
Cockroaches inside home	0.681	Cockroaches inside home	15	41.040
Flies inside home	0.602			
Sharing plate with others at the same time	0.565	Sharing eating utensils with others at the same time	16	44.260
Sharing spoon with others at the same time	0.368			
Eating with bare hands	0.355			
Type of animal in the house	0.419	Type of kitchen in home	17	45.744
Type of kitchen	0.384			
Method of collecting stored drinking water	0.301			
Local Government Area (LGA) you live in	0.559	Area you live in your LGA	18	46.892
Area you live in your LGA	0.475			

goodness of fit include $p < 0.01$, df = 1254, and $\chi^2 = 1747.026$. Other items not included in the EFA but thought to have clinical importance to typhoid risk were retained in the draft questionnaire. These included: boiling water before drinking, other treatment for drinking water, using public toilets, having other typhoid patients in the home within the past two weeks, having a typhoid carrier at home, level of education, and previous typhoid episodes. The draft questionnaire was reduced to a total of 25 items.

Cronbach's Alpha Determination

The Cronbach's alpha test outcome revealed that overall, the alpha value was 0.720 with a mean of 43.76, a variance of 47.573, and a standard deviation of 6.897. To obtain the above alpha value and hence a good construct validity, results of the item-total statistics in the SPSS reliability (validity) test were used to delete draft questionnaire items with higher "Cronbach's alpha value if item deleted" until the remaining items (n = 21) had an overall Cronbach's alpha of 0.720. The deleted items included: type of drinking water (EFA factor 4), occupation (EFA factor 8), flood in your area (EFA factor 13), and area you live in your local government area (EFA factor 18). Also, some questionnaire items with Cronbach's alpha if item deleted value greater than the overall alpha value were retained because removing them would still maintain the overall alpha value within the same interpretive range it was previously. The items subsequently retained in the questionnaire are shown in Table 4.

Table 4
Items retained in the questionnaire after Cronbach's alpha determination

Questionnaire items	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's alpha if item deleted
1) Do you have a houseboy or housegirl?	41.42	43.652	0.268	0.711
2) Do you re-heat kept food before eating?	42.32	46.745	0.034	0.728
3) Do you usually see cockroaches inside your house?	42.21	46.312	0.078	0.725
4) Has anyone had typhoid in your house within the last two weeks?	41.78	44.445	0.201	0.717
5) Has a doctor ever told anyone in your house that he/she is a typhoid carrier?	41.69	42.231	0.403	0.700
6) Has there been typhoid vaccination in the last two years in your area?	41.54	41.916	0.432	0.697
7) Are there any toilets/feces near your water source?	41.36	42.446	0.413	0.699
8) Do you work with your hands on a farm?	41.51	42.259	0.393	0.700
9) Do you collect any food material from any river or stream?	41.29	42.694	0.428	0.699

Table 4 *(continue)*

Questionnaire items	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's alpha if item deleted
10) What is your level of education?	40.98	42.324	0.340	0.705
11) Do you consume food/drinks from commercial sellers?	42.09	44.832	0.177	0.719
12) Do you consume iced/frozen items?	42.11	44.543	0.215	0.716
13) Do you share eating utensils at the same time with others?	42.11	44.957	0.197	0.717
14) Did you attend any mass gatherings within the past two weeks?	41.72	44.369	0.204	0.717
15) Do you wash your hands with soap before handling food?	41.95	43.493	0.292	0.709
16) Do you boil water before drinking?	41.35	41.461	0.548	0.689
17) Do you use public toilets?	41.86	44.674	0.225	0.715
18) Do you have tiles on your kitchen floor?	41.76	43.072	0.289	0.710
19) What type of kitchen do you have?	41.41	44.468	0.189	0.719
20) Do you treat drinking water in any of these other ways?	41.31	42.410	0.418	0.699
21) How many times has a doctor treated you for typhoid fever before now?	41.52	45.513	0.118	0.724

McDonald's Omega Determination

The McDonald's Omega (ω) coefficient value was 0.703. However, it was only obtained after deleting EFA factor 14 (Do you re-heat kept food before eating? α if item deleted = 0.728) and EFA factor 15 (Do you usually see cockroaches inside your house? α if item deleted = 0.725) from the alpha-validated questionnaire which initially produced ω = 0.697. The remaining items in the questionnaire (n = 19) were then subjected to test-retest reliability analysis (Table 5).

The questionnaire's construct validity and internal consistency are acceptable based on the Cronbach's alpha and McDonald's omega values obtained in this study after an EFA. A KMO test for sampling adequacy and Bartlett's test for sphericity revealed that the data obtained using the content validated questionnaire was adequate and fit for factor analysis based on the interpretive criteria previously documented (Vova-Chatzi et al., 2020), which implied that KMO values with 0.50 and above are deemed suitable for factor analysis and that Bartlett's test of sphericity ought to be significant for factor analysis to be suitable to the data. The EFA model with statistically significant goodness of fit reduced the questionnaire items from 70 to 18. It is in line with a published work by Liu et al. (2018), where EFA was used to reduce 65 questions in a questionnaire into nine extracted dimensions. After the EFA, the questionnaire items were summed up to 25 by adding some items not included

in the EFA but are thought to have clinical significance to determining typhoid risk factors in the study area. Some items with factor loadings less than 0.4 were still retained in the questionnaire because it has been shown that a supplementarily moderate score limit of ≤ 0.40 may be utilized to enable differentiation between items of a questionnaire during the initial stages of design and validation (Ugulu, 2013). Subsequently, the Cronbach's alpha and McDonald's omega analyses produced values indicative of good construct validity and internal consistency based on previously documented interpretive criteria, which described alpha and hence omega values greater than 0.70 as acceptable for instrument construct validity internal consistency.

Table 5
Items retained in the questionnaire after McDonald's omega determination

Questionnaire item	Mean	SD	Error variance
1) Do you have a houseboy or housegirl?	1.554	0.710	0.503
2) Has anyone had typhoid in your house within the last two weeks?	1.986	0.880	0.729
3) Has a doctor ever told anyone in your house that he/she is a typhoid carrier?	2.078	0.874	0.629
4) Has there been typhoid vaccination in the last two years in your area?	2.341	0.885	0.710
5) Are there any toilets/feces near your water source?	2.401	0.826	0.526
6) Do you work with your hands on a farm?	2.259	0.886	0.641
7) Do you collect any food material from any river or stream?	1.810	0.866	0.636
8) What is your level of education?	2.781	0.973	0.785
9) Do you consume food/drinks from commercial sellers?	2.457	0.823	0.503
10) Do you consume iced/frozen items?	2.047	0.889	0.751
11) Do you share eating utensils at the same time with others?	1.658	0.767	0.564
12) Did you attend any mass gatherings within the past two weeks?	1.658	0.822	0.642
13) Do you wash your hands with soap before handling food?	2.478	0.767	0.416
14) Do you boil water before drinking?	2.413	0.780	0.331
15) Do you use public toilets?	1.902	0.768	0.560
16) Do you have tiles on your kitchen floor?	2.002	0.948	0.777
17) What type of kitchen do you have?	2.359	0.905	0.774
18) Do you treat drinking water in any of these other ways?	1.243	0.504	0.253
19) How many times has a doctor treated you for typhoid fever before now?	2.243	0.846	0.684

Test-Retest Reliability

The resulting overall ICC value was 0.736 with 95% CI values of 0.533 to 0.878, and $p < 0.01$. The test-retest reliability overall ICC estimate indicated that the questionnaire has good test-retest reliability. The 95% CI values of the ICC estimates indicate that the

reliability of the questionnaire is moderate at the worst-case scenario represented by the lower bound ICC value of 0.533 and very good at the best-case scenario represented by the upper bound ICC value of 0.878. These interpretations were based on documented guidelines which also suggested that confidence intervals of the ICC estimate and not just the overall ICC estimate should be utilized as the elements for evaluating levels of instrument reliability (Koo & Li, 2016).

CONCLUSION

To the best of the authors' knowledge, this questionnaire specific to the Gombe metropolis of Gombe State, Nigeria, is the first of its kind to be designed and validated using standard methods. At the end of the various validation tests, it was established that the questionnaire is easy to read and understand, has moderate reliability, and has good validity. Hence, the instrument can collect data to identify typhoid risk factors in the study area to create targeted health interventions and guide the Government's financial decisions on resource prioritization and efficient allocation to prevent and control the disease.

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