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Research article

Validity and Reliability of the Home Management of Diarrhoea Assessment Scale for Mothers in Nigeria: A Rasch Analysis

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ABSTRACT

In Nigeria, 151,700 children die every year from diarrhoea disease. The use of a valid and reliable tool for eliciting information on what mothers do at home to manage diarrhoea is critical for healthcare providers and researchers. The study aimed to develop and validate the Home Management of Diarrhoea Assessment Scale (HMDAS) using Rasch Analysis among mothers of under-fives in Nigeria. The cross-sectional survey design was employed among 376 mothers in one selected local government area in each of the 6 geopolitical zones of Nigeria recruited using multi-stage sampling technique. Data were collected for 6 months and were subjected to descriptive statistics and Rasch analysis. The HMDAS was developed after in-depth literature review and 3 rounds of input from 5 expert reviewers. fit analysis revealed that 12 items were misfits and were expunged from the tool. The HMDAS was found to be unidimensional with Eigen value of less than 1. Item and person separation index of the HMDAS were 11.1917 and 2.0123 respectively. Item and the person reliability index of the HMDAS were 0.9121 and 0.0820. The HMDAS was concluded to be a reliable and valid tool for data collection. It was recommended that the HMDAS should be utilized in generating data that can be used for designing interventions aimed at stemming the tide of diarrhoea in Nigeria.

Keywords: *Diarrhoea, Home management, Rasch analysis, Reliability scale, Mothers, Under-five children*

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INTRODUCTION

Diarrhoea diseases are responsible for 1 in 9 child deaths globally, making diarrhoea the second leading cause of death among children under the age of five (Centers for Disease Control and Prevention (CDC), 2022). Although a significant proportion of diarrhoeal disease can be prevented through safe drinking water and adequate sanitation and hygiene yet it is a leading cause of malnutrition in children under five years old (WHO, 2021). According to the National Population Commission (NPC, 2018), diarrhoea disease is associated with high under-five mortality rate (U5MR) in Nigeria, a country with U5MR of 128 per 1000. In Nigeria, it is estimated that 151,700 children die in Nigeria every year from diarrhoea disease (Dairo *et al*, 2017).

The WHO (2017) defined diarrhoea as the episode of three or more loose or liquid stools per day or more frequent passage than is normal for the individual. It can also be defined as an increment in the volume, fluidity of stools and increased frequency of defecation with slight changes in consistency (Peter *et al*, 2018). Diarrhoea is among the health challenges that mothers in developing countries like Nigeria may face at home and to which they may attempt to proffer solutions to. It is a disease condition which in the absence of the necessary intervention, the health status of the child deteriorate with time. As a result of its commonality and the morbidity and mortality associated with it, mothers and other significant others at home usually may employ all the necessary resources available at home in order to enhance recovery and bring comfort to the child before and if they will eventually bring the child to the health facility. Factors in addition to availability of resources for managing diarrhoea at home which encourage mothers to employ home remedies for management of under-five diarrhoea include lack or inadequate finances to cover health care cost, barriers of distance and conflict between cultural belief systems and practices of the orthodox health care system among others.

About 88% of diarrhea-associated deaths are caused by consumption of unsafe water, insufficient sanitation, and poor hygiene (WHO, 2022). Diarrhoea is usually a symptom of an infection in the intestinal tract, which can be caused by a variety of bacterial, viral and parasitic organisms. Infection is

accessed through the consumption of contaminated food or drinking-water, or from person to person as a result of poor hygiene. The morbidity and mortality associated with diarrhoea most often arise as a result of the depletion of the body's physiological pool of body fluids and electrolytes. As a consequence, fluid replacement is at the forefront and an evidence-based strategy for managing diarrhoea. This is achieved through the administration of oral rehydration solutions either in the form of prepacked salts that can accessed from pharmaceutical or health facilities; or prepared using calculated quantities of sugar and salt which are readily available at home. Both the former and the latter are to be dissolved in 1 litre of water that is clean and fit for drinking. This is an intervention that can be easily implemented by mothers at home. Mothers are taught during health education in health facilities how to prepare and administer the preparations to their sick children. In addition to rehydration, the WHO (2022) have affirmed that zinc supplements given during an episode of acute diarrhoea reduce the duration and severity of the episode, and giving zinc supplements for 10-14 days lowers the incidence of diarrhoea in the following 2-3 months.

Antibiotic therapy and the use of antiprotozoal agents may be required for managing infective diarrhea. The standard is to give the child both medications only on the doctors prescription. Rice water has also been documented as one of the strategies employed at home in managing diarrhea (Kianmehr, 2016). Other supportive and management measures will depend on the uniqueness and associated factors in the child being managed. Some mothers may bring their child to the health facility for the management of persistent diarrhoea, when there is the presence of blood in stool or if there are signs of dehydration and shock. Provision of adequate nutrition including breast milk depending on the age of the child to combat malnutrition and facilitate healing are necessary for the resolution of diarrhoea.

Home-based oral therapy in the management of diarrhoea has been recognised and advocated by the WHO, UNICEF and the Integrated Management of Childhood Illness to reduce the impact of diarrhoea, particularly on children (WHO, 2018; UNICEF, 2018). These resources are easily accessible, available and simple to use for use at home for managing diarrhoeal conditions and preventing associated complications. In many instances, before caregivers bring a child to a health facility for treatment, there would have been other attempts to manage these problems in the child at home. Studies have affirmed that when children experience illnesses, caregivers mostly mothers, first of all manage them at home before presenting to the health facility (Uzodinma *et al*, 2017; Ahmed *et al*, 2017 & Omole *et al*, 2019). The time that elapses from the beginning of the illnesses to when the child is brought to the health facility is variable.

Scale development and validation have been known to be critical to much of the work in the health, social, and behavioral sciences Boateng *et al* (2018). For conclusions made from researches to be useful, instruments used for their data collection should undergo rigorous reliability and validity checks prior to administration. It is imperative to use a validated instrument which can be useful for population screening and in the assessment of outcome following an episode of diarrhoea and home care. One model that has been found helpful in providing a framework for validating research tools is the Rasch model. Rasch model is based on the item response theory and a mathematical model that provide a framework that ensures that test instruments used in research studies possess the appropriate psychometric properties. Ensuring that a data collection tool conforms to the Rasch model helps to ensure that data generated from such instruments provide results are a true representation of the phenomenon under consideration. While many validation of data collection tools in the past are based on the classical item item theory, Rasch analysis provides an alternative method of questionnaire validations that more comprehensively tests the psychometric properties of a questionnaire (Rusch *et al*, 2017). It examines each item for biases, redundancy, and ambiguity in its wording (Salaffi *et al*. 2013). Rasch analysis gained popularity in the area of education from the early period of its development. It was initially used prominently to evaluate different types of student assessment tests. With time, it has continued to gain relevance and is incorporated into social and health sciences research (De Battisti *et al*, 2010; Brentari *et al*, 2008; Hashim *et al*, (2012); Ishar *et al*, (2016); Dabaghi *et al*, (2020); Afdal *et al*, (2021) & Anselmi, *et al* (2015)). Unlike the classical test theory, Rasch analysis is probabilistic and inferential, and focuses on the pattern of item responses that stipulates the interaction between a person and an item based on a mutual latent trait (Ishar *et al*, 2016).

It is important to develop a valid and reliable measurement scale that is best suited to the local culture, belief and practices for diarrhoea home management among women in Nigeria. Validity and reliability studies are essential to increase the credibility of research tools in order to produce valid data. This helps to collect good-quality data with high comparability and increased credibility that can be generalized to the population. Data generated with tools with good psychometric qualities can be useful for designing health care, decision making and policy formulation by stakeholders. This study is therefore aimed at developing and validating an indicator-based assessment tool for home management of diarrhoea among rural women in Nigeria. The specific aims of the study were to (a) develop; (b) assess item fit, (c) determine the dimensionality; (d) the separation index and ,(e) assess the reliability of the HMDAS.

MATERIALS AND METHODS

Study population and selection: The cross-sectional survey design was employed in the study. The population comprised of mothers caring for at least one under-five child in one selected local government area in each of the 6 geopolitical zones of Nigeria. Multi-stage sampling technique was employed in recruiting the sample of 376 determined using Cochran's formular. Simple random sampling was used to select both one state and local government area (LGA) in each of the six geopolitical zones of Nigeria. Purposive sampling was used to select one health facility with high patronage in each selected local government area while respondents in each of the selected health facilities were conveniently recruited.

Method: Data collection was on the spot in the immunization clinics of the selected health facility and lasted for 6 months. The validated Home management of Diarrhoea Assessment Scale (HMDAS) comprise 2 sections designated sections A and B. Section A was designed to generate data on the socio-demographic characteristics of women while section B covered different aspects of home management of diarrhoea. Items in HMDAS were generated after extensive literature review and 3 rounds of input from 5 expert reviewers in the field of maternal and child health and measurement and evaluation.

Data analysis: Data generated were subjected to descriptive statistics of frequency, percentages, mean and standard deviations and also analyzed using Rasch analysis with the aid of SPSS version 23 and jamovi software version 64.2.

Ethical consideration: Ethical approval with number NHREC/05/01/2008B-FWA00002458-1RB00002323 was obtained from the Health and Research Ethics committee of University of Nigeria Teaching Hospital, Ituku Ozalla, Enugu State. The ethical principles of confidentiality, non-maleficence and informed consent were upheld at all times during the study.

RESULTS

Demographic data: As shown in Table 1, 174 of the respondents representing 46.3% were within the ages 20 - 29 years, 146 representing 38.8% are within the age 30-39 years; the lowest number of respondents are from respondents within the age 60 years and above which contributed only 1 representing 0.3% of the respondents. It could be inferred from the result that age 20 - 29 years and 30 -39 years which is the child-rearing age were well represented in the study. With respect to marital status, 322 representing 85.6% were married and living with their spouse while only 6 respondents representing 1.6% are widowed. It could be seen from the result that the larger percentage of the respondents are married. The table further shows the average income of respondents per month, 106 representing 28.2% earn less than #30,000, while only 10 representing 2.7% received #500,000 per month. In terms of educational attainment, 12 representing 3.2% of the respondents have no formal education while 114 representing 30.3% have secondary education as their highest educational qualification. A greater number of the respondents are igbos by tribe (136; 36.2%) where as only 1 respondent representing 0.3% of the respondents are of the Buji tribe.

Based on the recommendations on acceptable infit and outfit mean square value of 0.6 to 1.4 for survey items, 13 items were identified misfit to the model (items COD2, COD3, TOF6, FOGO5, HLPO6, MIGTHT3, HPCD1, HPCD2, HPCD4, DAC1, DAC2, DAC4, and RFSCHF5). See Table 2. The misfit items were removed from the instrument. After deletion of the misfit items, a test of reliability gave an acceptable reliability index. Seen Table 4 for analysis of reliability of the HMDAS.

Table 1:
Socio-demographic characteristics of study participants recruited from immunization clinics from selected facilities in the 6 geopolitical zones of Nigeria from July to December 2021 (N=376)

		Frequency	Percentage
Mothers Age	Less than 20 years	8	2.1
	20 - 29 years	174	46.3
	30-39 years	146	38.8
	40-49 years	43	11.4
	50-59 years	4	1.1
	60 years Above	1	.3
	Total	**376**	**100**.0
	Mean age and S.D is 31.02 ±6.53		
Marital status	Married and living together	322	85.6
	Divorced/Separated	7	1.9
	Single Parent/Never married	25	6.7
	Married but living in separate place	16	4.3
	Widowed	6	1.6
	Total	**376**	**100**.0
Average income per month	Less than 30,000	106	28.2
	Between 30,000 - <?50,000	88	23.4
	Between 50,001- < ?100,000	81	21.5
	?100, 000- 300,000	49	13.0
	>?300,000 - ?500,000	42	11.2
	>?500,000	10	2.7
	Total	**376**	**100.0**
Educational attainment	No formal education	12	3.2
	Primary education	30	8.0
	Secondary education	114	30.3
	Higher Certificate programme/Diploma	94	25.0
	University First Degree	99	26.3
	University Masters/PhD	27	7.2
	Total	**376**	**100.0**
Occupation	Housewife	79	21.0
	Trader	102	27.1
	Farmer	15	4.0
	Civil Servant	135	35.9
	Student	34	9.0
	Artisan	11	3.0
	Total	**376**	**100.0**
Tribe	Igbo	136	36.2
	Hausa	87	23.1
	Yoruba	50	13.3
	Ijaw	30	8.0
	Idoma	14	3.7
	Fulani	38	10.1
	Buji	1	.3
	Ibibio	17	4.5
	Others	3	.8
	Total	**376**	**100.0**

Table 2:

		Measure	S.E. Measure	Infit	Outfit
Cause of Diarrhoea	Infection or germs	-12.605	0.467	1.141	1.145
	Eating too much food	0.509	0.454	0.440	0.434
	Evil eyes from neighbours, relatives or others	0.430	0.456	1.675	1.676
	Teething	1.206	0.456	0.900	0.945
	Eating bad or contaminated food and water	-6.645	0.457	0.875	0.873
	Eating food that the body does not tolerate	-7.084	0.458	0.972	0.974
Signs of Diarrhoea	The child passes faeces more than 3 times a day	-6.820	0.457	0.913	0.915
	Faeces is watery (sinks into diaper or napkin in babies)	-16.153	0.530	1.001	1.001
	The child has sunken eyes	-15.500	0.498	1.014	1.014
	The child is thirsty and weak	-14.440	0.475	0.959	0.959
	There is a depression on the part of the child's head closer to the face	-14.926	0.483	0.998	0.998
	The child's skin is dry	-13.876	0.470	0.946	0.945
Actions Taken to Stop Diarrhoea	Give the child hard food such as bread and/or raw pap to seal off the intestine	-14.106	0.471	1.010	1.010
	Give oil to the child to neutralize the cause of the diarrhoea	-6.145	0.456	0.881	0.882
	Withhold water from the child to decrease the frequency of passing faeces	-5.950	0.456	0.757	0.756
	Give water and other fluid diet.	-0.518	0.456	0.991	0.990
	Give the child oral rehydration solution (ORS)	-6.549	0.457	0.943	0.941
	Withhold food from the child to keep the stomach empty	-7.213	0.458	1.159	1.157
Type of Fluid	Oral rehydration solution (ORS) from chemist	-5.555	0.457	1.061	1.059
	Oral rehydration solution (ORS) prepared with salt & sugar solution at home	0.245	0.455	0.785	0.772
	Gripe water	-6.508	0.456	0.748	0.750
	Fruit juice and/or other soft drinks	-6.094	0.456	0.803	0.803
	Coconut water	-6.081	0.456	0.788	0.788
	Rice water	1.305	0.456	4.707	4.709
Frequency of Giving ORS	Every 30 minutes	-5.758	0.457	0.897	0.893
	Every 1 hour	-6.681	0.457	1.070	1.068
	After every time the child passes faeces	-6.290	0.456	0.757	0.757
	When the child is thirsty	-6.531	0.457	1.030	1.031
	Whenever the child starts becoming weak	0.331	0.456	2.424	2.403
	Whenever I feel the child needs it	-6.553	0.457	1.029	1.028
How Long A Prepared ORS is Used Before Discarding	Until the child recovers	-6.575	0.457	1.075	1.077
	Until the child finishes it	-5.877	0.456	1.031	1.029
	After 24 hours	-0.477	0.456	1.330	1.329
	3 days	-7.358	0.459	1.310	1.309
	After 1 week but before two weeks	-5.043	0.459	1.303	1.303
	After 2 weeks	-4.811	0.460	1.522	1.520
Medicines Given at Home to Treat Diarrhoea	Flagyl	-4.760	0.461	1.226	1.322
	Zinc tablet	-7.103	0.458	1.160	1.161
	Septrin	0.326	0.456	2.284	2.264
	Antibiotic medicines	0.879	0.456	0.841	0.843
	Paracetamol	-6.282	0.456	0.800	0.799
	worm medicine	-6.309	0.456	0.957	0.956
Hygiene Practice When Child **Is Having Diarrhoea at Home**	Ensure that the child wears nothing	1.127	0.456	3.016	3.019
	Change the child's diaper or napkin after passing faeces at least 3 times	1.214	0.456	5.646	5.651
	Change child's diaper or cloth after each passage of feaces	-6.501	0.456	0.955	0.953
	Wash the child's buttocks after passing faeces	0.520	0.454	0.523	0.515
	Pour talcum powder on the child's buttocks	-7.144	0.458	1.115	1.117
	Give the child a bath after each passage of feaces	-6.274	0.456	0.885	0.888
Day for Visiting Health Facility	Day 1	-6.526	0.457	5.776	5.777
	Day 2	0.683	0.457	5.555	5.549
	Day 3-5	-6.444	0.456	1.114	1.117
	After 1 week but before 2 weeks	0.946	0.456	3.463	3.472
	After 2 weeks but before one month	-5.360	0.457	1.209	1.208
	Not specific but anytime I feel the treatment at home is not helping the child	-5.289	0.458	1.289	1.292
Reason for Seeking Care At Health Faciity	The child is passing faeces non-stop	-15.772	0.509	0.980	0.981
	There is presence of blood in the child's faeces	-14.323	0.473	0.947	0.948
	The child is not responding to all the drugs given to him/her	-14.861	0.481	0.998	0.999
	The child becomes very weak is almost collapsing	-14.606	0.477	0.973	0.973
	The child becomes unconscious	1.247	0.457	1.448	1.450
	The child is no longer able to eat.	-14.353	0.474	0.997	0.997

Table 3:
Dimension analysis of HMDAS

Scale	F1	F2	F3	F4	F5
Eigen value	**0.65**	**0.51**	**0.15**	**0.78**	**0.55**
Proportion Var	**0.12**	**0.08**	**0.07**	**0.06**	**0.06**
Proportion Explained	**0.32**	**0.20**	**0.18**	**0.16**	**0.14**

The Eigen values of HMDAS in all the contrasts were less than 1 indicating that the scale is unidimensional.

Table 4:
Separation index of the HMDAS

Scale	Items	Person
Home Management of Diarrhoea Scale	11.1917	2.0123

The item separation index in the result are classified as high with item and person indices higher than 2 as shown in Table 4.

Table 5: Reliability of the HMDAS

Scale	Items	Person
Home Management of Diarrhoea Scale	0.9121	0.8020

Table 5 presents reliability of the HMDAS. After the removal of the misfit items, the reliability analysis was performed on the fit items. The result shows that the Home Management of Diarrhoea Scale has an item reliability of 0.9121 and person reliability of 0.8020.

DISCUSSION

After subjecting the HMDAS to fit analysis according to the Rasch model, 13 items with misfit indices were unraveled. These unfit items were expunged from the HMDAS. After removal of these items, a test of reliability yielded acceptable indices. This is a confirmation that the final structure of the scale conforms to the tenets of the Rasch model. This method of removal of misfit items was applied in the study by Gómez-Chacón (2021). The Rasch analysis of the HMDAS yielded dimensionalities of eigenvalues less than 1 showing that the scale is unidimensional. This is a desirable attribute because it indicates that the HMDAS measures only one construct. This is in contrast to a situation where an assessment tool measures several such traits which are conceptually incompatible and potentially irrelevant to the key trait (Whittington *et al*, 2022). An acceptable item and person separation index of the HMDAS indicate that all the scale is sensitive enough to distinguish between high and low altitude of mothers on home management of childhood illnesses tool. Separation index values can range from 0 to infinity, and higher values indicate better separation. Item separation indices of 3 or greater are desirable (Linacre *et al*, 2012). In terms of person separation, an index of 1.50 is acceptable, 2.00 is good, and 3.00 is excellent (Duncan *et al*, 2003)

After the removal of the misfit items analysis for the HMDAS revealed that it has an item reliability of 0.9121 and person reliability of 0.8020. Similarly, in reporting the reliability and validity of SuperitemTest Instrument using Rasch analysis, Ridzuan *et al*, (2020) cited an individual reliability index of 0.90 and item reliability was 0.99. With these two reliability indices in their study, they confirmed the reliability of the superitem test instrument which they developed and validated. Thus, the alpha values obtained after reliability testing of the HMDAS is therefore a proof that the scale is reliable for data collection

In conclusion, from the findings and discussions so far, it is concluded that the HMDAS is reliable and valid for collection of data in Nigeria. It therefore possesses the appropriate psychometric properties and should be utilized for the purpose of data collection when assessing mothers/caregivers home management of childhood illnesses among under-five children.

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