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Wright Map Analysis to Determine Nurses and Midwives' Knowledge of Treatment of Primary Postpartum Haemorrhage in Nigeria

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Abstract: Background: The traditional presentation of results of cognitive test and surveys using simple percentages or average score obscures topics failed or mastered by test takers. However, the Rasch technique revolutionises the presentation of a test result by connecting respondent latent knowledge (or ability) with the test items using Wright maps. **Aim**: To assess nurses and midwives' knowledge of managing primary postpartum haemorrhage using a Wright map **Methods**: A twelve-item dichotomous (YES/NO) computer-based test developed from the recently updated WHO's treatment bundle was presented to the respondents for fifteen minutes. A nine-member panel reviewed the test to ensure clarity and relevance to Nigeria's public maternity setting. All the respondents were nurses and midwives with previous experience of responding to primary postpartum haemorrhage. Ethical approval was provided by the University of Huddersfield and the nurses' association. After eight weeks of data collection, both descriptive and inferential analyses were conducted using a Wright map. **Results**: The 180 responses analysed on a Wright map showed that the lowest, average and highest measures to be 476.3 logits, 495.9 logits and 521.7 logits respectively. Also, 178 (98%) respondents incorrectly answered the question on the source of treatment evidence but correctly answered that uterine atony is the main cause of postpartum haemorrhage. However, all the respondents who scored below average (495.6 logits) incorrectly answered the question on oxytocin as the best uterotonic. **Conclusions**: Wright map analysis confirms the problem of the inadequate knowledge of maternity staff as a major barrier to the effective treatment of maternal bleeding. A significant difference was found in the knowledge of the treatment among the three levels of maternity settings, implying the need for effective educational intervention strategies.

Keywords: primary postpartum haemorrhage; knowledge; cognitive assessment; maternity; Wright map; Rasch techniques; measurement

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1. What Is Known Before

1. Incompetence and low knowledge are associated with ineffective treatment of primary postpartum haemorrhage in Nigeria.
2. Using group means and simple percentages to present clinicians' knowledge of best practice failed to outline the topics failed and mastered.
3. Conventional analysis failed to engage with useful advancement in modern statistical methods.

2. What This Study Adds

1. Using Wright map analysis in objective measurement theory confirms that delays to the timely recognition of primary postpartum haemorrhage may be due to deficient knowledge regarding the monitoring and blood loss estimation among nurses and midwives.
2. Evidence of a statistically significant difference in the knowledge of managing primary postpartum haemorrhage across the different levels of maternity settings.
3. Evidence that inadequate knowledge of best practices persists among maternity clinicians despite ongoing multifaceted interventions to improve maternal health outcomes in Nigeria.

Background: The purpose of this study is to present Wright map analysis of Nigerian nurses' and midwives' knowledge of the evidence-based management of primary postpartum haemorrhage (PPH). In low-resource settings like Nigeria, significant maternal death and other complications are caused by PPH despite various interventions [1–3]. Although perinatal blood loss is difficult to measure, PPH is recognised as loss of 500 mL or more of blood from the reproductive tract within 24 h of vaginal delivery or caesarean operation [4]. The associated severe complications for patients include hypovolaemic shock, which occurs when the body loses a significant amount of blood, leading to decreased blood flow to vital organs such as the brain, heart and kidneys [3,5]. If this condition is not effectively and promptly treated, other complications may result including anaemia, fatigue and weakness and Sheehan's syndrome (a rare type of pituitary gland damage) [2,4]. Additionally, women who survive severe PPH may experience long-term health challenges such as chronic fatigue, psychological trauma and reduced fertility [3,6,7].

The profound adverse effects of PPH in Nigeria have been reflected in the World Health Organisation's and other partners' sustainable development goals [8]. The World Health Organisation (WHO) estimates that severe bleeding from PPH is responsible for about 25% of maternal deaths globally [9]. In Nigeria, the prevalence of PPH varies widely, with some studies reporting rates as high as 16.8% in certain healthcare facilities [10]. PPH severely impacts the human, economic, psychological and social wellbeing of public life in Nigeria [11,12]. The high incidence and poor-quality treatment place a substantial burden on healthcare systems, leading to increased healthcare costs and resource allocation challenges [13]. Furthermore, the loss of mothers has a ripple effect on families and communities, reducing the chances of child survival rates and overall community health [14,15].

In response, PPH interventions encompass multifaceted efforts including staff development training, improved management and team-working, clinical surveillance reporting and research investments [4,5]. Also, nurses and midwives have constituted a good proportion of the clinicians included in past studies on clinicians' knowledge, clinical skills and contextual circumstances of care in Nigerian hospitals [16–20]. Nonetheless, many difficulties such as clinicians' inadequate knowledge of best practice and institutional barriers in terms of poor administration and lack of medical resources hinder the efforts to address PPH treatment in Nigeria [1,2,4]. For instance, lack of prompt recognition and response to PPH cases is a prominent barrier commonly cited in clinical practice [21]. Delays in identifying and managing severe PPH often result from the inadequate training of healthcare providers, insufficient resources and poor infrastructure [12,22]. Furthermore, ineffective PPH management has been associated with a lack of emphasis on preventive measures, such as active management of the third stage of labour and the use of uterotonic drugs, which are crucial in reducing the incidence of PPH [1,2]. However, multifaceted interventions, including training healthcare workers and improving access to essential medications, are found to significantly reduce the incidence and severity of PPH [4]. Yet,

these interventions have not been consistently implemented across all regions of Nigeria, leading to disparities in maternal health outcomes.

Meanwhile, studies from Nigeria have consistently investigated clinicians' baseline knowledge of PPH treatment using high stake tests and recommended better training and educational interventions [2,16]. For example, a retrospective analysis of PPH cases in Ile-Ife (Nigeria) emphasised that the lack of knowledge and skills among healthcare providers was a major barrier to effective PPH management [13]. The study recommended regular training and capacity-building initiatives to enhance clinicians' ability to manage PPH effectively [12]. Also, a ten-year review at a university teaching hospital in Sagamu (Nigeria) revealed that timely and appropriate interventions, such as the use of uterotonics and surgical techniques, were more effectively implemented by clinicians with advanced training and knowledge [23]. Moreover, a quasi-experimental study in Nigerian referral hospitals showed that multifaceted interventions, including clinician training, significantly reduced the incidence of PPH [16]. Another study found there was a 68% reduction in PPH cases in hospitals where clinicians received comprehensive training compared to control hospitals [24]. In summary, although presenting the means and simple percentages of clinicians' knowledge assessment oversimplifies the problem, the persisting efforts reiterate the importance of introducing Rasch techniques of cognitive tests in this area of study.

Notwithstanding the increasing interest in assessing clinicians' knowledge, the results of the assessment of clinicians' knowledge and competence are frequently presented using conventional simple percentages and average scores [22,25,26], thus hindering objective interpretations of test takers' abilities and effective educational interventions. Several limitations dominate the traditional presentations of test takers results using the mean of the group or simple percentages because the statistical methods fail to show the items mastered or failed by the group or individuals [27]. The traditional methods of analysing tests do not delineate items on a test (or survey) on the varying linear continuum of difficulty that is proposed in modern analysis [28]. The implications include inaccurate representation of a test-taker's knowledge and misinterpretations of the test results for individuals and groups.

To address these shortcomings, incorporating Wright map analysis into cognitive assessment is gaining recognition by providing a more detailed and accurate picture of test-taker performance [27]. Spurred by the richness of statistical diagrams, a Wright map, also known as a person–item map, is a visual tool used in Rasch analysis to display the relationship between the difficulty of the test or survey items and the abilities (knowledge, attitude or competence) of the test takers [29]. This method provides a clear and intuitive way to understand how well a test measures the intended construct by aligning item difficulty and person ability on a single continuum called the logit scale [28]. Wright maps offer a more nuanced view by showing the distribution of item difficulties and person abilities, thus highlighting specific areas where test takers excel or struggle [27]. For example, in a test of clinicians' knowledge of PPH management, a Wright map can show that certain items are consistently difficult for clinicians, indicating potential gaps in the curriculum or teaching methods of that particular item. Correspondingly, educators may target specific areas for improvement, rather than relying on overall test scores that often obscure the details required for effective interventions. Wright maps can also offer useful insights for assessing patient-reported outcomes and other latent traits. For example, if a study measures the impact of chronic pain on daily functioning, a Wright map can illustrate which aspects of daily life are most affected by pain and which patients are struggling the most. This approach not only enhances the validity of the assessment but also supports more personalised and effective educational and clinical interventions. Using a probability equation, Wright maps in Rasch analysis provide a visual representation of both item

difficulty and person ability on the same logit (interval) scale [30]. This allows for a more nuanced understanding of test performance, showing not just whether a test-taker got an item right or wrong, but how their ability compares to the difficulty of the items [31]. This analysis is pivotal in identifying specific areas where a test-taker may need improvement, rather than providing a single, undifferentiated score. Therefore, the objective of this study is to analyse nurses and midwives' knowledge of PPH treatment using a Wright map. Correspondingly, a simplified framework of Rasch measurement techniques [27] will be applied in the current study to identify good understanding and gaps in the knowledge of respondents on managing PPH.

3. Methods

Study design: A cross-sectional design was engaged to explore the null hypothesis that there is no significant difference in the knowledge of PPH treatment among nurses and midwives across the three levels of public maternity settings in Nigeria. The main goal is to apply the Wright map analysis provided in Rasch techniques to determine the gaps in the knowledge of the PPH treatment of test takers so that effective learning interventions can be implemented.

Setting: The study focused on nurses and midwives from maternity settings across the public maternity settings in Ondo state southwestern Nigeria. Nigeria operates tripartite levels of healthcare, involving the primary, secondary and tertiary healthcare facilities. Although the three levels of care are interlinked through a referral system, only the secondary and tertiary facilities provide advanced PPH treatment in terms of the available resources and multidisciplinary teamwork.

Participants sampling: A cross-sectional sample of nurses and midwives in the study areas formed the sample population. An official of the nurses' association stated there were about 500 qualified nurses on the register, but the record had not been audited for more than five years for retirement, redundancy or relocation. To be eligible, a respondent must have spent at least one year in employment as a qualified nurse in a public maternity setting and attended to PPH patients. The sample size for this study $(N = 42)$ was estimated based on the following parameters: 80% power, alpha value of 0.05, the null hypothesis of $p_0 = 0.00$, the alternate hypothesis (p_1) value of 0.20 and 20% attrition rate.

$$n = \frac{\left(z_{\frac{\alpha}{2}} + z_{\beta}\right)^2 \times p_1(1 - p_1)}{(p_1 - p_0)^2}$$

Sample recruitment: After ethical approval was provided, a qualtrix link inviting volunteer test takers was sent to the official social media (closed membership) page of the nurses' association. The link contained information about informed consent, and data collection lasted for eight weeks. Respondents were not required to fill in any other form, because attempting and submitting the test implied a sufficient level of consent or voluntary participation.

Data collection/Bias avoidance: The data collection tool is a closed-ended high-stake test (Table 1) developed using the WHO's first responder (conservative) PPH treatment guideline [32].

Table 1. Knowledge test for first responder to PPH event.

Items	Yes	No
1. When PPH occurs, calling for help is a matter of choice by the nurse		
2. Estimating the amount of blood loss is the best method to diagnose PPH		
3. Antibiotics administration is not recommended anywhere in treating PPH		
4. I know that the vital signs of a PPH patient are to be monitored on an hourly basis		
5. All PPH patients should be given a Statum dose of 500 mls of isotonic crystalloids within 30 minutes		
6. The most common cause of PPH is an atonic uterus		
7. A PPH protocol is produced from expert opinion		
8. Treating PPH should never be in phases		
9. Treating PPH based on professional experiences is better than following a protocol		
10. Tranexamic acid is not recommended in treating PPH		
11. Rectal misoprostol is better than oxytocin injection in treating PPH		
12. Circular massage of the uterus is a first line PPH treatment		

The knowledge and awareness scale has twelve dichotomous (Yes/No) response categories with a correct answer scored with one point and an incorrect response scored as zero. The focus of the test is on conservative management, early detection through accurate assessment of postpartum blood loss and first responder interventions such as escalations or timely referral, immediate actions to manage PPH, uterine massage and administration of uterotonic drugs. For face validity, the draft was reviewed by a nine-member panel consisting of a professor of obstetrics, a consultant obstetrician, two senior lecturers in Nursing and Midwifery, the Head of Nursing Services, a senior nursing officer, two nursing officers and a PhD midwifery student in Nigeria. A copy of the draft test and assessment framework was emailed to each of the members of the panel privately. To ensure anonymity, the members were blinded from one another while the completed assessment framework was sent back individually by email to the researcher. The reviewers agreed to the theoretical relevance, clarity, simplicity, timeliness and general outlook of the test. Additionally, building on applying the Rasch technique to the test design [28,30,33], psychometric assessment was conducted on the test items, with an item reliability score (Kr-21) of 0.99 and an item separation index of 17.15. Acceptable infit and outfit mean square (MNSQ) values for a dichotomous scale are often between 0.2 and 1.2 [34], this condition is satisfied with the lowest infit MNSQ value being 0.97 (Q12) and the highest outfit MNSQ value being 1.17 (Q3). Also, all the twelve items of the scale have negative correlations ranging from −0.20 (Q4 and Q9) to −0.11 (Q1 and Q7), which implies good local independence of the scale. Respondents completed demographic information on years of experience, levels of education, place of work and other personal demographic information.

4. Data Analysis

Data analysis was conducted with the Rasch dichotomous model using Winsteps version 5.0.0.0 and IBM SPSS version 26.0. Foremost, descriptive analysis of respondents' demographic information involved frequencies and simple percentages for categorical and nominal data and means for continuous measures. Secondly, a Wright map analysis was constructed for inferential statistics of the test results following the steps (Figure 1) described in objective measurement theory [27,29]. The initial phase included screening the data for unsolicited inclusions from respondents (such as inputting words where

alphanumeric data are expected) for elimination (data reduction). Following this, the justification for a Wright map includes the robust theoretical background of Wright map analysis and mathematically sound solutions to contextual problems such as missing data, guessing and other errors of measurement. Subsequently, the test results were exported from SPSS to Winsteps version 5.0.0.0 for Wright map analysis (modelling/measuring). Through the combined functions of Winsteps 5.0.0.0 and SPSS 26.0, hypothesis testing and context-informed explanations were provided simultaneously. An ANCOVA test (at 95% CI, adjusted for test takers' age) of the null hypothesis was conducted to examine the difference of means among the three groups representing the maternity settings.

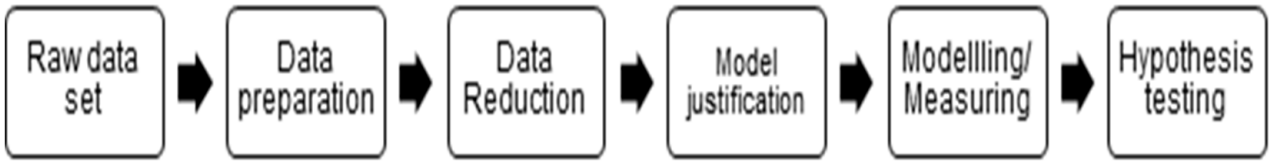

Figure 1. Six steps involved in analysing survey or test data.

Ethical consideration: On 8 October 2020, the School Research Ethics and Integrity Committee of the University of Huddersfield approved this study with the reference: OMOLADE (PhD)—SREIC PGR Panel Application—SREIC/2020/088—Outcome. The conduct of the study adhered to all ethical requirements including voluntary participation, autonomy, data protection, confidentiality and respect of personal virtual space.

5. Results

After analysing 180 completed responses, the summarised results of the demographics, Wright map and ANCOVA analysis of the data are presented in Table 2, Figure 2 and Table 3.

Table 2. Respondents' demographic information.

Demographics		Frequency	Valid Percent
Gender	Male	20	11
	Female	159	87.8
	Prefer not to say	2	1.1
	Total	181	100.0
	Missing	0	
	Total	181	
Place of work	Primary Healthcare Centres	36	19.9
	General Hospitals	96	53
	Teaching Hospitals	49	27.1
	Valid Total	181	100.0
	Missing	0	
	Total	181	

Table 2. *Cont.*

Demographics		Frequency	Valid Percent
Grade level	Assistant/Chief Nursing Officer	33	21.0
	Principal Nursing Officer	28	13.2
	Senior Nursing Officer	59	14.4
	Nursing Officer 1 and 2	60	51.4
	Missing	0	0
	Total	180	100
Qualifications	Master's degree and above	19	1.9
	Nursing degree	98	32.9
	Post basic nursing cert	12	14.3
	RN and RM	37	28.9
	RN Only	8	28.9
	RM Only	6	14.7
	Missing	0	0
	Total	180	100
Availability of PPH Protocol in the hospital	Yes	107	59.4
	No	73	40.6
	Missing	0	0
	Total	180	100
Respondents' Age (Years)	Mean	36.2	S.D = 8.4
Years of practice	Mean	10.2	S.D = 6.9

Table 3. ANCOVA table for the hospitals.

Source	F	*p*-Value
Corrected Model	2.1	0.110
Age (years)	0.3	0.620
Place of work	3.2	**0.04**

Adjusted for the uneven distribution of respondents' age (years), the knowledge and awareness of PPH treatment (KA measure) is statistically significant (at the 5% significance level) for nurses at the various levels of Nigeria's public hospitals, F (3.2, 153.2), $p = 0.04$.

Based on 180 completed responses, females dominated the nursing and midwifery profession; hence, 159 (87.8%) of the respondents were females and only 20 (11%) were males; 2 (1.1%) did not disclose their gender. The three levels of Nigeria's healthcare systems were fairly represented, as almost half of sample (96; 53%) constituted nurses from general hospitals, whereas 49 (27.1%) of the professionals were from teaching hospitals and 36 (19.9%) were from primary healthcare centres.

The Wright map above (Figure 2), shows respondents, measures and items after a linear transformation of the raw scores from the scale using Rasch modelling. While the raw scores would normally range from 0 to 12, a linearly transformed equivalent on the Wright map (0 to 1000 logits) has measures expressed between 460 logits (lowest measure) and 530 logits (highest measure) on the Rasch scale. A logit is the unit of Rasch measure and the raw scores (0 to 12) equivalent is traceable on the Test Characteristic Curve (TCC). The Test taker population is coded as "person" with a # tag representing a block of five test

takers and a "." Sign the equivalent of 1 to 4 respondents. The Wright map is represented as (- - - -) dash lines to show a linear transformation of the ordinal category scores into an interval (Rasch) measure suitable for an objective estimation of respondents' knowledge and parametric statistics. The upper end of the map is labelled "more" on the respondents' axis and "rare" on the item axis. The lower section of the scale is marked "less" on the respondents' side and "frequent" on the item side. This label indicates that respondents with higher knowledge will cluster on the "more" side of the scale and only a few items are expected on the axis since it requires a higher level of knowledge to attain more measures. In contrast, respondents with less knowledge will cluster towards the bottom, where there may be less difficult items (questions). Items on the questionnaire are numbered from Q1 to Q12 with compressed identification labels; Q7 is the most difficult, Q3 is about average and Q9 is the easiest on the map. The + calibration sign marks every 10 logits point and M (close to the mid-point) indicates the mean knowledge and awareness measure of the respondents (M = 495.9 logits). An interesting finding in this study is that person reliability is poor (0.15), indicating that majority of the respondents might be unsure of their answers to the questions.

From the Wright map (Figure 2), the lowest and highest measures for a total (N) of 180 completed answers are 476.3 logits and 521.7 logits, respectively, while the mean measure is 495.9 logits. About eight respondents possessed remarkably high knowledge and awareness of the best treatment of PPH, as shown in the above figure. Similarly, four respondents had the lowest knowledge; however, even those possessing a low level of knowledge could answer three questions correctly (Q9, Q6 and Q12). Respondents located near the mean score (Mean = 495.98 logits) of the population are expected to correctly answer Q10, Q3 and other questions on the lower part of the scale. However, Q8 is difficult for respondents with average knowledge, as the item is not clearly within their grade. There is less likelihood that a respondent with average knowledge will answer Q4 correctly; questions Q2 and Q7 are even harder for these people. The map shows that below the average measure, about 100 respondents know that the treatment of PPH should be in phases, atonic uterus is the main cause of PPH, uterine massage is a first-line treatment, followed by fluid administration, use of tranexamic acid, use of the PPH protocol and not experience and the administration of antibiotics. Yet, only about 80 respondents knew that in PPH treatment oxytocin is better than misoprostol administration, that patients should be on continuous monitoring and not hourly, that estimating blood loss is not the best diagnostic method and that the PPH protocol is not from expert opinion but research evidence. Overall, Q9, Q6, Q12, Q5, Q11 and Q1 were easier for most of the respondents than Q10 and Q3. Q8 requires knowledge higher than the mean knowledge measure for this sample, while Q4, Q2 and Q7 were not likely to be correctly answered by any respondent with average knowledge of PPH treatment. The most difficult question for this sample population is Q7, which is on the best monitoring method for a PPH patient. Also, more than 90% of the respondents did not know that blood loss estimation (Q2) is not a reliable indicator for commencing treatment, nor were they aware that the PPH protocol is from research evidence and not based on expert opinion (Q7).

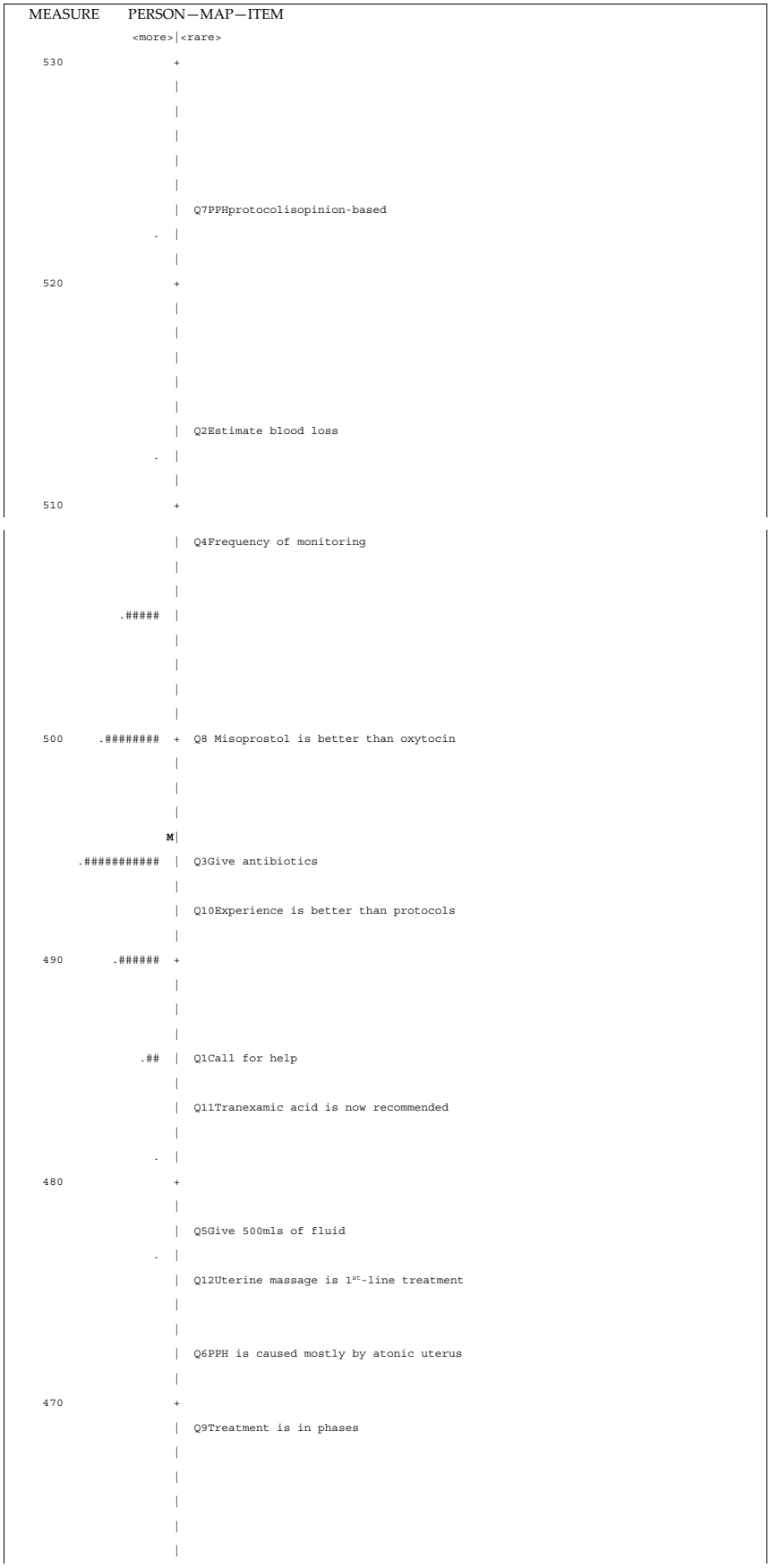

Figure 2. *Cont*.

Figure 2. Wright map analysis.

Hypothesis test: ANCOVA (adjusted for test taker's age) of the knowledge measures of the respondents from the three hospital settings was conducted. Across the three levels of Nigerian public hospitals, the mean nurses' knowledge and awareness of the best treatment of PPH (mean = 493.6 logits, SD = 6.9) is lowest for primary healthcare centres (n = 36), moderate (mean = 496.2 logits, SD = 6.7) for general/state hospitals (n = 95) and highest for teaching hospitals (n = 49, mean = 497.4 logits, SD = 7.0). There was no evidence of heterogeneity of variances as a p-value from Levene's test > 0.05 (p = 0.625). Hence, the ANCOVA table below (Table 3) summarises the result for the hypothesis test.

The null hypothesis was rejected because a statistically significant difference was found among the groups (p = 0.04; 95% CI). On the Wright map, the statistically significant difference among the groups lies in the higher likelihood of staff at the general and teaching hospitals to correctly answer Q3 (antibiotics administration), whereas nurses from the primary healthcare centres are less likely to correctly answer this question.

6. Discussion

The purpose of this study is to present a Wright map analysis of nurses' and midwives' knowledge of PPH treatment in Nigeria. Central to this goal is to inform cognitive tests or surveys with the revolutionary tools in Rasch objective techniques so that educators may have deeper insights into test results and, in response, implement more effective teaching methods. The discussion of the findings below is contextualised within previous studies and the implications for the education and training of maternity staff.

The Wright map analysis revealed a wide distribution of knowledge measures among the 180 respondents, ranging from 476.3 to 521.7 logits, with a mean of 495.9 logits. While a subset of respondents (n $\approx$ 8) demonstrated high knowledge, even those with lower scores managed to correctly answer certain foundational items (Q9, Q6, Q12). This suggests that while the basic principles of PPH management are generally well-understood, critical aspects—such as the effectiveness of oxytocin over misoprostol, the need for continuous patient monitoring and the evidence-based origin of PPH protocols—present the most difficulty. The findings on inadequate knowledge of best practice in monitoring PPH patients, oxytocin and blood loss estimation agree with other studies that engaged the traditional analysis [5,16,22]. The variations in knowledge levels between healthcare settings shows a need for standardisation in nursing education and professional development. Nurses in primary healthcare centres exhibited the lowest knowledge scores, indicating an urgent need for capacity-building initiatives in these settings. While nurses in teaching hospitals demonstrated relatively higher awareness, gaps remain in their ability to apply evidence-based guidelines effectively. Similarly, the difficulty in answering Q8, Q4, Q2 and Q7 correctly implies that educational interventions should prioritise evidence-based decision making and reinforce the clinical application of research findings. Also, the items mostly failed by respondents indicate that existing training frameworks may not adequately emphasise critical aspects of PPH management. In response, integrating simulation-based learning and continuous professional development programs can help bridge these knowledge gaps [35].

Meanwhile, low quality treatment of PPH has been associated with delayed recognition and commencement of treatment resulting from clinicians' inadequate

knowledge [2,13,21]. The findings here indicate critical gaps in nurses' knowledge of postpartum haemorrhage (PPH) treatment, with implications for patient safety and clinical decision making. Deficient knowledge in key areas of PPH management poses a significant risk to patient safety. For instance, 90% (N = 180) nurses are unaware that blood loss estimation is not a reliable indicator for initiating treatment, which may lead to delays in intervention. Similarly, the lack of understanding regarding the importance of continuous monitoring over hourly assessments could result in suboptimal patient outcomes.

In the same vein, inadequate knowledge about use of oxytocin raises significant concern, because oxytocin is recognised internationally as the best uterotonic for treating PPH [4]. Notwithstanding, a counter argument is that clinicians in Nigeria routinely administer misoprostol and oxytocin to prevent PPH due to multiple challenges such as lack of guidelines on uterotonic administration, inadequate storage for oxytocin, substandard oxytocin and clinicians' individual experiences [25,26] This deviation, therefore, shows the influence of maternity context on PPH treatment thus accounting for variations from reasonable adjustment using clinical judgment.

Furthermore, the analysis using ANCOVA (adjusted for age) across hospital settings revealed a gradation in knowledge levels. Nurses from primary healthcare centres (mean = 493.6 logits) lagged behind their counterparts from general/state hospitals (mean = 496.2 logits) and teaching hospitals (mean = 497.4 logits). The Wright map analysis underscores the variation in knowledge levels, particularly in primary healthcare centres, where nurses exhibited the lowest mean scores. This variation could influence the quality of PPH management, potentially increasing the risk of adverse maternal outcomes. However, the disparities in knowledge may be attributed to variations in training quality, resource availability and exposure to evidence-based practices across different healthcare settings. In Nigeria, the primary healthcare settings only provide basic maternity services but are expected to recognise excessive bleeding and refer patients to either secondary or tertiary hospitals. Future studies engaging qualitative or mixed methods approaches may deepen the understanding of the subjective and contextual nuances of PPH management in these settings.

Overall, these results highlight the urgent need for tailored educational interventions, particularly in lower-level facilities, to bridge knowledge gaps in PPH management. Strengthening continuous professional development programs and integrating up-to-date research findings into clinical protocols could substantially improve maternal outcomes, reinforcing the pivotal role of targeted training in enhancing PPH care across Nigeria. Correspondingly, efforts to improve clinicians' knowledge and skills and simulation-based education for maternity clinicians have been recently suggested by WHO in a plan to eliminate PPH-related death by 2030 [35].

Finally, there are limitations to this study even though the best statistical methods were used to analyse and present the results. The first is the reduction of the knowledge of PPH treatment to 12 Yes/No questions, which may not capture all the key factors feeding into the multifaceted dimensions of maternity settings. The second is the small population size of the test takers (N = 180), hence regional or national surveys covering the three levels of maternity settings in Nigeria are desirable. In conclusion, our results contribute to ongoing efforts to address the problem of ineffective PPH treatment in Nigeria by advancing modern statistical analysis into the field of maternity care and educational interventions. Consequently, we recommend that researchers and educators engage with Wright map analysis and other Rasch techniques for analysing the results of tests or surveys to ensure a comprehensive understanding of the variable measures for more effective training curricula and teaching methods.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Data can be made available with application to the University of Huddersfield.

Conflicts of Interest: The authors declare no conflict of interest.

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