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Te Waka Kuaka, Rasch Analysis of a Cultural Assessment Tool in Traumatic Brain Injury in Māori

Hinemoa Elder[1*]

Abstract

Aim: To examine the validity of a new measure, Te Waka Kuaka, in assessing the cultural needs of Māori with traumatic brain injury (TBI).

Method: Māori from around Aotearoa New Zealand were recruited. Three hundred and nineteen people with a history of TBI, their whānau (extended family members), friends, work associates, and interested community members participated. All completed the 46-item measure. Rasch analysis of the data was undertaken.

Results: All four subscales; Wā (time), Wāhi (place), Tangata (people) and Wairua practices (activities that strengthen spiritual connection) were unidimensional. Ten items were deleted because of misfitting the model secondary to statistically significant disordered thresholds, non-uniform Differential Item Functioning (DIF) and local dependence. Five items were re-scored in the fourth subscale resulting in ordered thresholds.

Conclusions: Rasch analysis facilitated a robust validation process of Te Waka Kuaka.

Keywords: Traumatic brain injury; Māori; Rasch analysis; Measurement.

Introduction

Traumatic Brain Injury (TBI) in Māori is a significant health problem. Population data shows that Māori youth are three times more likely to sustain clinically significant TBI compared to non-Māori [1]. A complicating factor in responding to Māori with TBI has been the lack understanding of the cultural importance of injury to the brain and head given the primacy placed on the head in Māori culture. For example, 'he tapu te upoko' is a well-known saying from Te Ao Māori (the Māori world) which means, the head is sacred. This statement clearly indicates the importance of brain injury from a cultural perspective [2].

Recent work has explored these concepts and developed a Māori theory and praxis of TBI [3, 4]. The research found that the concepts of wā (time), wahi (place), tangata (people) and wairua practices (activities that strengthen the unique connection between Māori people and the universe) were central to Māori in navigating recovery. Indeed, how much time is taken, where assessment and treatment takes place, who is present at assessments, and what culturally salient activities are embedded in these assessments and treatment are well understood by practitioners as critical to the engagement of Māori whānau, although formal research in these areas has not been conducted. Practice based evidence also shows that without these factors being implemented Māori whānau disengage from services and therefore

Affiliation:

[1]Te Whatu Ora, Health NZ, Karol Czuba, Hiwai Hauora Raukawa Charitable Trust, Paula Kersten, independent researcher, Alfonso Caracuel, University of Granada, Kathryn M McPherson, AUT University.

***Corresponding author:**
Hinemoa Elder, FRANZCP, PhD, MNZM. Te Whatu Ora, Health NZ.

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do not have access to rehabilitation interventions leading to compromised outcomes. The issue of making time in assessment of Māori has recently been identified as vital to ensuring cultural practices are undertaken and therefore more accurate assessment and recommendations provided [5].

These aspects of comprehensive assessment of Māori may be in tension with clinical imperatives that emphasise efficiencies of time and prioritise brevity of assessment and treatment. While some needs of patients and relatives after a TBI are held trans-culturally, others depend on the specific social and cultural context in which people live. As tools for the assessment of these needs are influenced by culture, measures adapted from other cultures have shown substantial differences between countries, even if they share historical roots and language [6]. Despite some, albeit variable, awareness by health practitioners and researchers of these cultural issues [7, 8] no measures have been developed that might help to conceptualize the magnitude and nature of the cultural needs associated with Māori TBI. Such measures should enable tailored responses to these needs and thereby improve recovery outcomes, improve communication between whānau and clinicians and therefore improve the quality of assessments. The lack of such measures means that Māori cultural needs in the context of TBI lack recognition and attention, or if there is some awareness of these on the part of clinicians the approach is not systematically provided or monitored [9].

Measures used to monitor recovery and needs post-TBI, such as neuropsychological tests, have been developed elsewhere and Māori cultural norms and validation in the Māori community have not been carried out although such work is now underway in the context of the ageing brain [10]. This issue is well recognized as contributing to difficulties in interpreting scores for Māori [11]. Experts in cross-cultural neuropsychology warn that adaptations of tools across cultures has serious drawbacks affecting all stages of the assessment: review of records; interviews; neuropsychological testing; and interpretation of results [12]. Having measures developed by Māori for Māori is therefore a critical issue in ensuring cultural validity. Indeed, there continues to be some debate about what can be measured and how this could occur in a culturally authentic way given the experience of historical measures being used as a means of cultural marginalization of Māori [13]. Developing such measures aligns with the Patient Reported Outcome Measures (PROM) literature that recognizes these measures as a central component to improving multiple facets of care and support, raising the quality of outcomes from illness and injury including in TBI[14, 15]. The need for a dual-purpose tool which serves to assess both cultural needs and also measure outcomes with cultural salience for Māori was apparent from clinical experience, and is frequently requested by Māori whānau seeking tools they felt reflected their realities. The lack of such measures in the literature indicated this was a significant gap to be addressed. This study aimed to examine the internal construct validity using Rasch analysis of a Māori cultural needs post TBI assessment and outcome measure.

Methods

Sample and data collection

A 46-item draft scale has been developed from verbatim quotes taken from transcripts of an earlier phase of the study and refined using a culturally responsive method [16]. Rangahau Kaupapa Maori (Māori research approaches determined and conducted by Māori, with the goal of supporting Māori health advancement) were utilized. The statements used in the first iteration of the tool came from Māori participants in marae wānanga (traditional learning fora). The items were then refined via four focus groups with the final group of participants having experienced TBI. This was to ensure the items were acceptable to those with direct experience, that the items had face validity in addressing the sub-scale areas and were easily understood. The measure was then completed by 319 participants with lived experience of, or interest in TBI from a range of settings in the North Island of Aotearoa New Zealand between June and November 2015. They included attendees at Kura Reo; week-long total immersion Te Reo Māori wānanga (Māori language learning environments) with a range of proficiencies in speaking Te Reo Māori from beginners to experts and face to face clinics of those with experienced of TBI in their whānau (see inclusion criteria below).

People were invited to participate in two ways. First, via Māori health service providers' appointments with the first author. Second, wānanga groups were offered participation and the first author provided a presentation about the project, answered questions, and provided oversight of completion of the tool. Inclusion criteria were Māori with TBI, or non-Māori who were part of Māori whānau (extended families), for example by marriage, whānau members, friends of Māori with TBI, those with work connections with Māori with TBI and Māori community members concerned about TBI. TBI was defined by self-report as either confirmed, possible or unknown. Information was collected about TBI severity by mild, moderate, severe and unknown categories, however given the questionable accuracy of self-report, this data was not included in analysis. The emphasis here was on offering participation to whānau as well as to individuals affected by TBI. This reflects the centrality of whānau as a health and wellbeing construct which is well recognised in Māori scholarship [17] and tikanga (cultural lore) [18]. Indeed, the theoretical basis of this tool proposes that TBI affects the whole whānau and that the whole whānau needs to considered as “the patient” [3]. Participants provided written consent.

The research was approved by the ethics committee of the Health and Disabilities Ethics Committees (14/CEN/17)

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and the first author‟s institution (EC14 034HE). Participants were supervised when completing the draft outcome measure by the first author or a research assistant. These data were then entered into the Rasch analysis software programme, RUMM2030 [19].

Instrument

The instrument resulting from the earlier research [3] contained four subscales and 46 items. The four subscales were labeled Wā (time), Wāhi (place), Tangata (people) and Wairua practices (Wairua is defined here as an aspect of health and wellbeing characterized as a unique connection between Māori people and all aspects of the universe). Participants were invited to score each of the items as strongly agree, agree, disagree, or strongly disagree. While debate continues around whether to include a neutral response option in surveys or assessment tools, the rationale used here aligns with others who have shown absence of a neutral option encourages mental effort to engage with the item and negates the effect of social desirability bias [20]. Other demographic information was collected about each participant as presented in Table 1.

Data analysis

All analyses were carried out on each of the subscales using RUMM2030 [19] to determine the fit of the data to the Rasch model. Rasch analysis is a probabilistic mathematical model that draws on item response theory with the advantage of estimating the item difficulty and the person ability separately, which is not possible using measures based on Classical Test Theory [21]. The 1-parameter logistic function enables each item's difficulty to vary, but assumes all items discriminate equally. Before Rasch analysis is used to transform ordinal observation data into linear measures, Rasch fit statistics are examined to enable assessment of any threats to linearity [22, 23]. Rasch analysis is used to assess the measurement properties of existing measures and to guide the development of new ones [24]. The Rasch model states that the outcome of an encounter between a person and an item is governed by the product of the construct of interest of the person together with the easiness of the item [25]. The person's estimate of cultural needs is derived by dividing the percentage of items that scored highly, by the percentage of items scored in the low range, and then by taking the natural log. Scale items have a variable amount of difficulty. Items which capture difficulty are important because they make the measurement useful in a practical sense, capturing and discriminating high levels of need to be acted upon, and monitored. Likewise, items which capture low, and intermediate levels of need are important in a measure so that both lower and intermediate levels of need can be identified and that changes over time can be monitored and responded to. In the Rasch model, item difficulty is estimated by calculating the odds of success in identifying those who scored highly and those who scored in the low range. Each item within the scale has its own level of difficulty on the trait (item parameter) and every person has his or her own level of "ability/trait". Item parameters are estimated independently from the person parameters and once they are identified they can be placed along the same interval scaled ruler. The item and person performance probabilities determine the interval sizes on the "ruler" of the measure.

Several tests were performed to assess the fit of the subscales to the Rasch model. Fit to the assumptions of the model can have a number of contributing factors which are explained in detail elsewhere [25-28]. It is important to note that 'misfit' should not be taken to mean that the item has no merit or is of no interest, but rather that it does not fit the unidimensional structure of a measure (or in this case domain). If this is the case, collapsing scores or moving an item to a different domain for items that do not fit but add discriminatory information is considered. Table 2 presents a brief overview of the central Rasch analytical concepts and the actions that can be taken in the case of conditions not being met for the transfer from ordinal to linear scores.

Table 1: Demographic characteristics of study participants

	Category	Frequency	Percent of total
Age	0-25	81	25.4
	26-35	78	24.5
	36-50	86	27
	51-76	74	23.2
Gender	Male	118	37
	Female	200	62.7
	Trans	1	0.3
Relationship	Whānau	176	55.2
	Friend	48	15
	Job related	32	10
	Community member	63	19.7
Main Iwi of origin by Maori Electorate	Tāmaki Makaurau/ Te Tai Tokerau	183	57.4
	Hauraki Waikato	47	14.7
	Ikaroa-Rāwhiti	18	5.6
	Te Hauāuru	6	1.9
TBI type	Waiariki	56	17.6
	Te Tai Tonga	1	0.3
	Other	8	2.5
	Confirmed	183	57.4
	Possible	87	27.3
	Unknown	49	15.4

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Table 2: Brief overview of Rasch analysis concepts (adapted from [24])

Concept	Test used	Expected results [24-26,39-41]	Strategies to deal with misfit
Item threshold ordering[A]	Examination of the threshold location and their 95% confidence intervals to determine significance of disordering if observed visually.	Logical progression across the trait being measured	Disordered category responses might have to be collapsed into one
Person fit	Mean fit residuals (SD); range	Mean close to zero and SD close to 1; range -2.5 to 2.5 χ^2 non-significant with a Bonferroni correction	Person(s) might have to be deleted from the dataset[B]
Item fit	Mean fit residuals (SD); range	Mean close to zero and SD close to 1; range -2.5 to 2.5 χ^2 non-significant with a Bonferroni correction	Item might have to be deleted from the subscale
Local dependency[C]	Residual item correlation matrix between all items	Correlations between the residuals >0.20 above the average residual correlation	Locally dependent items to be combined into testlets
Unidimensionality	Principal component analysis (PCA) of the residuals[D]	The 95 % CI of the proportion of significant tests should include 5%	
Reliability index	Person Separation Index	Values of ≥0.70 good for group comparisons (e.g. in research trials); ≥0.85 for individual clinical use.	Not applicable
Overall fit to the Rasch model	Item-trait interaction χ^2	Non-significant with a Bonferroni correction	Not applicable
Targeting of the scale[E]	Logit value; visual inspection of person-item distribution map	Logit value above that of the highest item on the subscale	Not applicable
Differential item functioning (DIF) by person factor (e.g. gender) [F]	ANOVA	Non-significant with a Bonferroni correction	If DIF is uniform, items to be combined into testlets[G] or split by person factor. If DIF is non-uniform items to be deleted.

[A]Thresholds represent points where the probability of scoring either of the two adjacent categories is 50%. If it is not the case, one would observe disordered thresholds where the individual score cannot be reliably interpreted.

[B]Extreme scores (much lower than -2.5, or much higher than 2.5) indicate issues with response pattern which may include: responding according to a socially desired norm, carelessness with responding or low motivation in responding. As such data would not add any meaningful information to the calibration process, it has been suggested to consider excluding extreme persons from the sample (Bond and Fox, 2001; Tennant and Conaghan, 2009).

[C]Local dependency occurs when a person"s response to one item is reflected in their response to another item.

[D]Two subsets of items are identified by PCA: one with positively loading items and one with negatively loading items. Two estimates derived from these subtests are then tested by using an independent t-test. If the result is insignificant at p≤0. 05, the unidimensionality is supported.

[E]Targeting of the scale to the latent trait allows identification of floor and ceiling effects.

[F]DIF occurs when people from different groups (for example, males and females) with equal amounts of the underlying trait do not respond to items in a similar manner.

[G]A testlet is a bundle of items that share a common stimulus[42].

For Rasch analyses, reasonably well targeted samples of 150 are reported to have 99% confidence that the estimated item difficulty is within ± ½ logit of its stable (and n=243 for poorly targeted samples) [29] Our sample of 319 was therefore optimal for the purpose of this analysis.

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Results

This section reports the analysis results of each Te Waka Kuaka subscale separately. There were no missing data in the data set.

Wā (time)

The proposed subscale had 9 initial items all concerned with the broad concept of time. These items were not specifically linked to issues such as time to access treatment or time since injury. Rather, time in this subscale is concerned with what needs to happen first in time, the role of time in facilitating healing, taking time for a range of purposes and flexibility of time schedules. The initial analysis of the Wā subscale showed that there were no items with statistically significantly disordered thresholds and the scale was unidimensional. However, the scale did not fit the Rasch model with a significant (p=0.0005) item-trait interaction chi-square and particularly high mean persons location (2.8; SD=1.5). Twenty-three percent (n=60) of the sample had extreme scores and so were deleted from the analysis, the remainder of n=259 provided a robust sample to analyse.

Deletion of the subgroup improved the mean persons location (2.3; SD=1.2) but did not result in an improvement in item-trait interaction. Further examination of the items revealed three (items 3, 5 and 9) misfitting the model. Item 3, "whakawhanaungatanga (the process of making connections with others) at the beginning sets the scene for the journey" functioned differently according to iwi (tribe), with the "other" group being an outlier. Also, the item did not fit the Rasch model with item fit residual of -2.825, and chi-square probability of 0.006. Importantly, the item seemed to identify issues already captured by items 1 (Starting the process of wairua healing is the first thing that needs to happen for our whānau), 2 (The journey of wairua healing is enhanced with time), and 8 (whakawhanaungatanga time builds, to keep hope and dreams alive). Hence, it was deleted from this subscale. Item 5, "It is important that kaimahi (health workers) are flexible in their schedules of work", had a high fit residual (2.722; p=0.0006) indicating the item does not fit the scale. It was also deleted from the subscale. Lastly, Item 9, "Whānau unity and strength builds healing" showed local dependency problems with item 3 "whakawhanaungatanga at the beginning sets the scene for healing". It also displayed non-uniform DIF for relationship (see Table 1). A number of possible solutions described in Table 3 were tested, however, only deletion of the item led to solving the local dependence with item 3.

These modifications improved the fit of the Wā subscale and provided the final solution (see Table 3). The resulting 6- item scale was unidimensional, and the item-trait interaction was non-significant (p= 0.1237). The reliability of the subscale is relatively low (PSI=0.56). The targeting of the subscale Wā was skewed, suggesting people on average scored towards the upper end of the scale (Figure1).

Table 3: Rasch analysis summary statistics

Analysis*		Item Fit residual[1]		Person Fit residual[1]		Chi Square interaction			PSI			Tests of Unidimensionali ty 95% CI [%]	
		Mean	SD	Mean	SD	Value	DF	p	With extr ms	No extrms	alpha	Lower bound	Higher bound
Wā	First	- 0.703	1.755	-0.676	1.836	44.6	18	0.0005	0.689	0.681	0.858	2	7.3
	Final	-	1.042	-0.645	1.74	17.7	12	0.1237	0.56	0.53	0.721	-0.3	5
Wahi	First	-	2.953	-0.352	1.15	173	40	0	0.77	0.743	0.853	1.4	6.2
	Final	-	1.232	-0.421	1	27.1	24	0.2976	0.77	0.739	0.851	3.3	8
Tanga ta	First	-	1.556	-0.587	1.71	107	60	0.0002	0.79	0.759	0.841	3.3	8
	Final	-	1.289	-0.48	1.36	52.1	27	0.0026	0.73	0.718	0.862	-0.5	4.3
Wairu a	First	-	1.598	-0.565	1.56	102.5	48	0.0000	0.78	0.787	0.898	4.8	9.6
	Final	-	1.249	-0.482	1.37	54.4	27	0.0013	0.73	0.718	0.862	-0.2	4.8

Abbreviations: PSI – Person Separation Index; extrms – extremes; alpha – Cronbach"s alpha. „First" refers to the analysis results of the raw ordinal data; „final" refers to the analysis results of the Rasch-transformed data.

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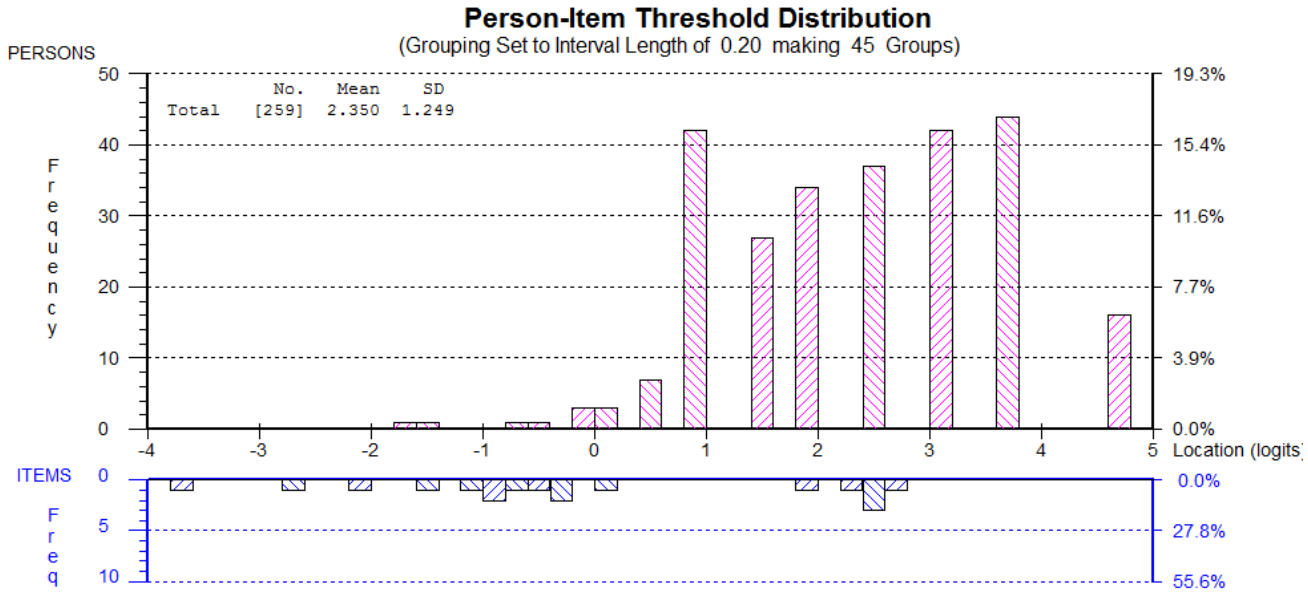

Figure 1: Wā (time)

Wāhi (place)

The proposed Wāhi subscale included 10 items concerned with aspects to do with places, such as those of cultural significance as well as clinics and hospitals. The initial examination of the Wāhi subscale found that the item-trait interaction chi-square was highly significant ($p<0.00001$) and the scale was not unidimensional. None of the items showed disordered response category thresholds. Further analysis of DIF and fit statistics revealed four items that required specific attention: items 10, 11, 16 and 17. Items 10, "The use of pepeha within treatment would support the healing", and item 17, "Whānau from home are an essential link with home", had uniform DIF by TBI severity. These items were combined into a testlet with item 13, "Whakaairo (carvings) teach important lessons that help with healing", which had showed non-significant DIF in an opposite direction. This resulted in these opposing directional DIF cancelling each other out. Item 11, "Being inside buildings like hospitals does not help me", had a very high fit residual of 7.785 ($p<0.00001$), demonstrating it did not fit the subscale. This item was therefore removed. Item 16, "Gathering, preparing and eating food from home is an important part of healing", showed uniform DIF by location and TBI. This item was combined into a testlet with item 19 as this item visually showed to have DIF in the opposite direction (non-significant), "being on the marae is a good place to start to feel strong again", and therefore these DIF in opposite directions cancelled each other out.

These modifications improved the subscales fit to Rasch model and provided the final solution (Table 3). The final subscale had 9 items and was unidimensional, the item-trait interaction was non-significant, and no DIF was observed. The reliability of subscale Wāhi was good (PSI=0.78) and the targeting acceptable (Figure 2).

Tangata (people)

This subscale is concerned with people involved with the person with TBI and their whānau and had a total of 15 statements. The initial analysis of the Tangata subscale showed that the scale was unidimensional and none of the items had statistically significant disordering of response categories thresholds. However, the scale did not fit the Rasch model with statistically significant item-trait interaction chi-square ($p=0.0002$). Further examination revealed three pairs of items with high residual correlations. Item 22, "Within whānau there are a lot of resources", was locally dependent (residual correlation = 0.25) on item 23, "within the whānau is the rongoā" (rongoā is the Māori word for medicine). From a theoretical point of view, these two items consider two very similar concepts. However, item 23 is focused more specifically on the healing process, whereas item 22 (Within whānau there are a lot of resources) is much less specific as to what sort of resources might be available, when and for what purpose. Furthermore, item 23 showed a better spread on the latent trait of interest (3.8 versus 2.8 logits). Therefore, item 22 was deleted from this subscale. Item 26, "Māori have a different point of view from Pākehā (non-Māori of European ancestry)", was locally dependent upon item 27 (0.405) "Māori cultural needs are different from Pākehā". Theoretically, cultural needs secondary to the culturally determined injury to wairua are critical to the functioning of this tool, in order to best understand how whānau conceptualise these needs. While asking about similar issues item 27 more specifically asks about cultural needs, whereas item 26 refers only to a different point of view. Hence, the decision was made to delete item 26. Item 28, "When health workers relate to the culture of the whānau outcomes are improved", was locally dependent (residual correlation = 0.444) on item 29, "When

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health workers support whānau to address wairua outcomes are improved". Item 29 was deemed to be theoretically more important, because it more directly measures the issue of wairua which is central to the theory of the cultural aspect of injury. Therefore, item 28 was deleted from the subscale.

Deletion of these three items improved fit of data to the model and provided the final solution (Table 3). The item-trait interaction chi-square was non-significant, the scale was unidimensional and no DIF was observed. The reliability of the subscale Tangata was good (PSI=0.740) and the targeting was acceptable (Figure 3).

Wairua practices

'Wairua practices' is a phrase used to describe activities that strengthen wairua. Wairua is an area of hauora (health and wellbeing) that conveys the unique connection between Māori and all aspects of the universe. While wairua is mentioned in other subscales, wairua is the primary focus of this subscale. This subscale consisted of 12 items. The initial analysis of the Wairua subscale found that the scale was unidimensional, but it did not fit the Rasch model ($p<0.0001$). Moreover, there was one misfitting item, one item showed nonuniform DIF, two items were locally dependent, and

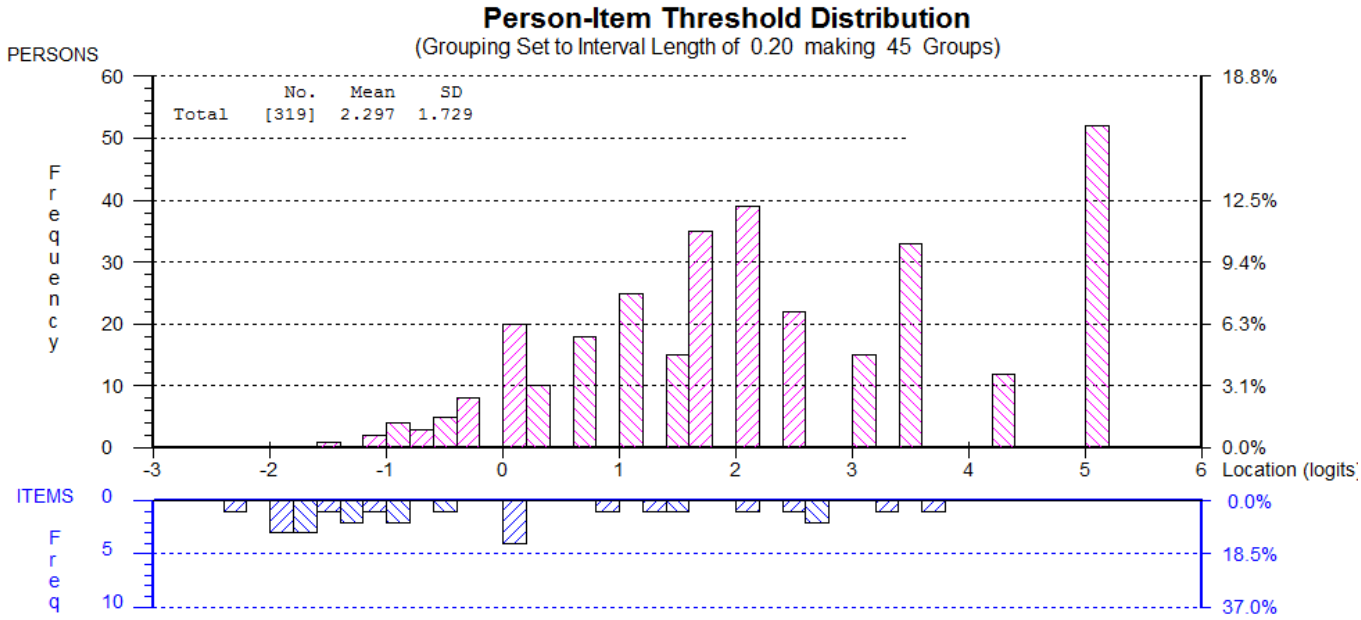

Figure 2: Wāhi (place)

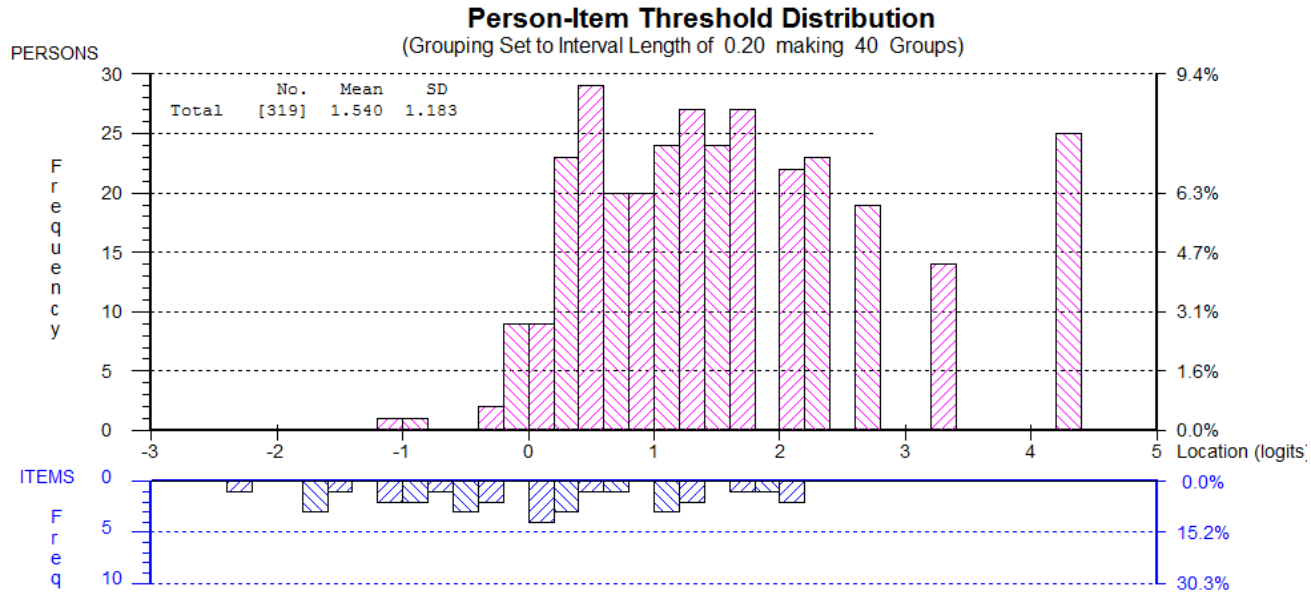

Figure 3: Tangata (people)

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a number of items had statistically significantly disordered response category thresholds. Item 35, "Practices that strengthen wairua are as important as clinical interventions", was found to be misfitting with chi-square p=0.00014. The item was deleted and fit to the model improved. Examination of item 46, "Use of Te Reo Māori means wairua is being strengthened", identified non-uniform DIF by location and statistically significant disordering of response category thresholds. The decision was made to delete this item and this improved fit to the model. Items 43, "Romiromi (type of massage) can be a powerful healing tool", and 42, "Mirimiri (type of massage) can be a powerful healing tool", were found to be locally dependent (residual correlation = 0.638). Because these types of massage are very similar and mirimiri (massage) is more commonly known, item 42 was retained and item 43 was deleted. Five items 36, 38, 39, 44 and 45 showed statistically significant disordered thresholds. The lower two response categories ("strongly disagree" and "disagree") of these items were collapsed into one category. This modification further improved fit of data to the model and provided the final solution for the Wairua subscale. The scale fit the model with non-significant item-trait interaction and was unidimensional. The reliability of the scale was good (PSI=0.733) and the targeting was acceptable (Figure 4). Scoring was modified accordingly.

Item Difficulty

Table 4 presents the relative difficulty of each item of the Te Waka Kuaka subscales. The easier the item, the higher the expected scores are for people with high levels of investigated construct.

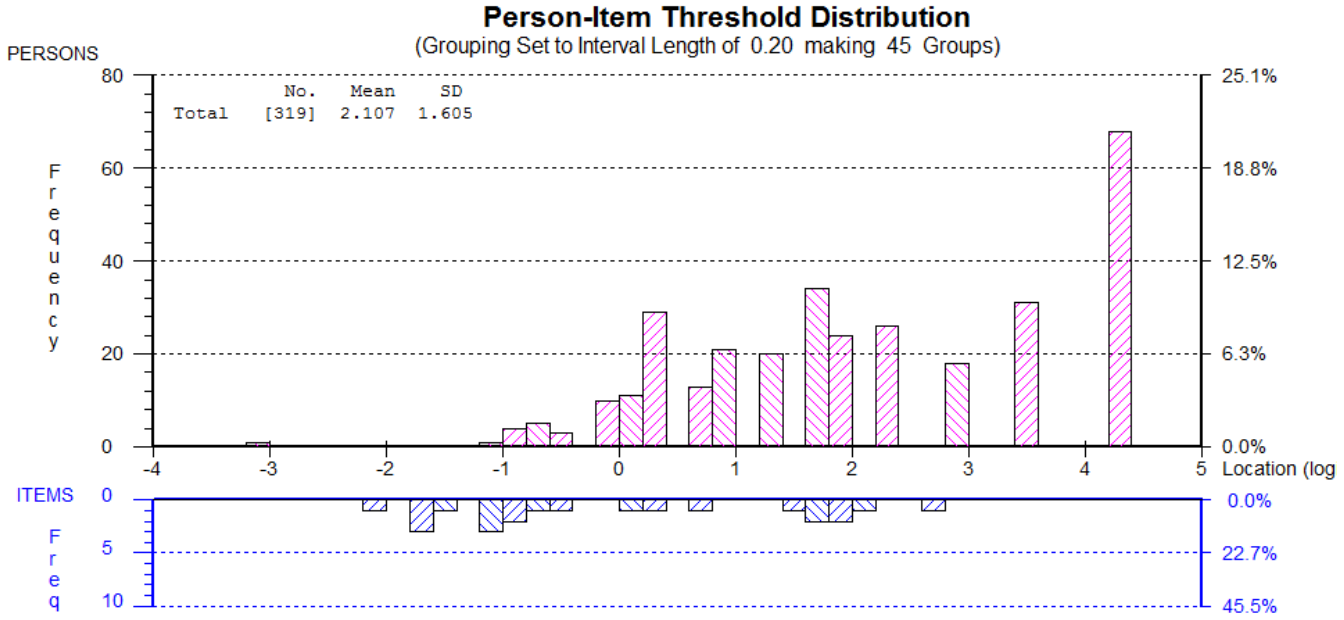

Figure 4: Wairua practices (activities that strengthen spiritual connection)

Table 4: Item Difficulty.

Item Difficulty	Wā		Wāhi		Tangata		Wairua	
Less	Item	Location (logits)	Item	Location (logits)	Item	Location (logits)	Item	Location (logits)
	Q8	-0.753	Q18	-0.583	Q34	-0.56	Q38	-0.882
	Q2	-0.165	Q15	-0.394	Q27	-0.28	Q36	-0.468
	Q7	0.03	*Q16&19	-0.312	Q30	-0.271	Q40	-0.292
	Q6	0.137	*Q10&13 &17	0.265	Q31	-0.15	Q42	-0.246
	Q4	0.277	Q12	0.4	Q33	-0.005	Q39	0.469
	Q1	0.474	Q14	0.623	Q29	0.015	Q44	0.549
					Q23	0.06	Q41	0.559
					Q21	0.067	Q45	0.581
					Q32	0.233		
					Q24	0.35		
More					Q25	0.541		

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Discussion

This study presents Rasch analysis of a new measure, Te Waka Kuaka, for use in Māori cultural needs assessment following traumatic brain injury. Given the over representation of Māori with TBI [1] alongside Māori beliefs about the sacred quality of the head, „he tapu te upoko", [18] such a scale is much needed. This investigation was done to examine the validity of Te Waka Kuaka. Our analysis identified ten items that did not fit the Rasch model and they were deleted. The resulting four subscales fit the Rasch model and were unidimensional. Very few measures developed to assess Māori specific aspects of health exist. One that has been used in mental health and addictions is called "Hua Oranga" [30]. The Hua Oranga operationalises a well know framework called "Te Whare Tapa Whā" (the four walled house). However, this framework does not have an underpinning theory. It proposes four constructs, whānau (extended family), wairua (spirituality), hinengaro (mind) and tinana (body) and whilst some analyses of the psychometric properties of this measure have occurred we are not aware of any previous measure of hauora being developed using Rasch analysis [8, 31]. In addition, the Hua Oranga measure explores a construct of general hauora, rather than four subscales based on a theory of brain injury.

From a clinical perspective, analysis of several of the items were of interest:

- Item 3 highlighted that there were a range of groups for whom the item functioned differently, by iwi (tribal group) and with the "other" group being an outlier. One interpretation of this is that the small non-Māori "other" group had a different understanding of whakawhaunaungatanga. This is not unexpected given the concept is Māori-specific. Also, it is possible that differing iwi (tribal) groups conceptualise this activity in different ways. This finding added to a richer understanding of whanaungatanga itself.
- Item 11, "being inside buildings like hospitals does not help me", was a statement that came from the preliminary research. While this statement may have assisted in considerations about the location of rehabilitation processes, the item did not have explicit theoretical salience regarding the wairua aspects of the injury. These were considered better assessed by item 19 "being on marae is a good place to start to feel strong again".
- The negative frame of the statement ("does not help me") was thought to contribute to a different perception of the item by participants, compared to the positively framed items. The lower PSI (0.56) of the Wā subscale indicates that most of the participants scored those items highly. Given the heterogenicity of the participants as identified by the wide range of iwi (tribal) affiliations represented, arising from different parts of Aotearoa, New Zealand and in having a range of competencies in Te Reo Māori this indicates the importance of the concept of time and the likelihood that these items will be highly endorsed. The finding is of clinical importance. Recognition of responses to items in this subscale, especially those most strongly endorsed can directly inform priorities in subsequent management plans.
- The spread of difficulty in the items of Te Waka Kuaka is relatively narrow, between -1 and 1 (see Table 4). Including deleted items did not affect the spread. Similarly, it is possible that because the methodology of deriving the items was culturally conservative, in other words, developed on marae (traditional meeting houses), albeit urban, rural and remote, that the items do not address Māori cultural needs that are either very easy and or very difficult to endorse. Given the positive skew in this sample, further testing could be undertaken with people who are less in touch with their Māori cultural identity. We hypothesise that sample would score more towards the lower end of the Te Waka Kuaka subscales.
- A potential limitation of the study is that the wider sample of possible participants is unknown so no response rate can be calculated. However, given the large sample size the analysis itself remains robust.

Dissemination of the findings of the analysis with research partners, namely health and education providers in the Māori community, has led to widespread requests for use of Te Waka Kuaka in settings outside of TBI rehabilitation. This is an unexpected development. One approach being considered is to develop a further study protocol to collect this data. Analysis would then enable better understanding of the scope of the tool"s application. Clinical implications of the use of the tool are significant. By being able to identify the immediate needs of the whānau clearly and quickly, the whānau themselves and the health worker can focus on addressing those needs without delay. How these needs change can be easily reviewed, and this can in turn guide further tailoring of supports. Given the theoretical importance of addressing the cultural aspect of the TBI, the injury to wairua, ensuring these cultural needs across the four subscales are thoroughly monitored and responded to be vital. In this way, healing the cultural injury is likely to improve the recovery process, as well as outcomes for whānau.

Conclusion

Te Waka Kuaka is a new measurement scale that has been in development. This paper reports the Rasch analysis phase. Our findings show that the revised subscales are unidimensional and fit the Rasch model and that Te Waka Kuaka can now enable valid and accurate measurement of Māori cultural needs following TBI. Future research examining the responsiveness of Te Waka Kuaka would be a useful addition to better understanding applicability of this measure and its wider application.

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Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper. Subsequent to the funding of this study McPherson became Chief Executive of Health Research Council of NZ.

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