Community Rehabilitation Outcomes Across Cultures Following Traumatic Brain Injury

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Abstract
Objective: *This exploratory study investigates Traumatic Brain Injury (TBI) rehabilitation outcomes among culturally diverse outpatients in community-based rehabilitation who have sustained a Mild to Moderate TBI. The major aims of this study are twofold: firstly, to determine whether community-based rehabilitation outcomes following TBI differ across Māori, Pacific and Pakeha cultures; and secondly, to identify any service delivery needs Pacific people in TBI rehabilitation require that may be distinct from Pakeha.*
Method: *A fixed comparative non-experimental design was utilised where participants were selected using direct control based on their self-identified ethnic group resulting in sub-samples of 11 Māori, 11 Pacific and 11 Pakeha (n=33). Each participant completed the Neurobehavioural Cognitive Status Examination (Cognistat) and the Brain Injury Community Rehabilitation Outcome Scales (BICRO-39 Scales).*
Results: *Results indicate that all participants were at a similar level of overall cognitive functioning but Pacific peoples scored significantly lower than both Māori and Pakeha on two Language subtests and significantly lower than Pakeha on the Memory subtest. Individual handicap increased following TBI and decreased following rehabilitation, with no significant difference across cultures and suggesting good efficacy of rehabilitation.*
Conclusion: *There appears to be universalities in TBI experience and global rehabilitation outcomes that transcends individual cultures. However, there are micro-level cultural variations that have valuable implications when assessing and treating Pacific people in neuro-rehabilitation. Neuropsychologists need to take into account formal education levels and language abilities when working with Pacific people.*
Key words: *cross-cultural, neuropsychology, traumatic brain injury, Pacific, Māori.*

Introduction

Closed Traumatic Brain Injury (TBI) is an "injury to the brain resulting from externally inflicted trauma"[1]. Obtaining an accurate picture of the incidence, prevalence, frequency and patterns of distribution of TBI has been impeded by inconsistency in methods of data collection, classification, recording procedures and lack of uniformity in definition. While there is a lack of reliable TBI incidence and prevalence statistics in New Zealand, it is estimated that the total TBI incidence figure, including those people with TBI who do not seek medical attention, is likely to be in the range of 20,000 to 30,000 cases per year[1]. This phenomenon of brain injury represents a significant public health problem for New Zealand and has been coined in the past as a "silent epidemic".

In 2003, 5% of Accident Rehabilitation and Compensation Insurance Corporation (ACC) claimants for concussion related injury were identified as Pacific people.[1] However, Pacific peoples are almost certainly under-represented in TBI-related claims, given that younger people make the most claims and the Pacific people make up 8% of people aged between 15 to 49 years. Furthermore Pacific people are likely to be vulnerable to TBI due to their high over-representation in factors which amass to strong predictors for TBI, such as motor vehicle accidents (many alcohol-related), falls and sports-related injuries.[2]

The neuropathological effects of TBI are produced by sudden acceleration-deceleration and rotation of the brain within the skull and focal contact between the brain and the skull – the frontal lobes, temporal lobes and brain stem are particularly vulnerable. TBI is associated with a multiplicity of neurophysiological, cognitive, behavioural, and psychosocial sequelae that affect every aspect of a person's life to varying degrees. The enormous array of consequences following TBI involving sensory, motor and autonomic functions is vast and complex. Most of these complications, such as impaired movement, vision,

hearing and tactile sensation are apparent in the first days or months (depending on the severity of the TBI) and tend to improve over time.[3,4] For a small group however, some changes are long-term or permanent, with the most common ones being movement disorders, seizures, headaches, ambient visual fields, and sleep disorders[5].

In most cases however, it is the cognitive and behavioural deficits that are the most common residual impairments in the post-acute period of TBI recovery, making the greatest contribution to the consequences of long-term handicap, and also having the greatest impact on psychosocial functioning.[6] The broad spectrum of cognitive consequences are often categorised into impairments in memory, attention, concentration, language dysfunction, arousal, perception and higher executive functioning (such as problem solving, planning, judgement, insight, motivation information processing and organisation). Cognitive consequences may change in severity and presentation over time and although they can occur singly, they usually occur in combination, lead to a myriad of functional and psychosocial problems. Depression and anxiety are the most frequently reported emotional complications following mild, moderate or severe TBI[5].

The emotional, behavioural, cognitive and physical consequences of TBI lead to debilitating social limitations that affect the TBI victims, their families and wider communities. As the TBI victims attempt to resume their usual daily activities, coping with environmental demands often paves the way for additional psychosocial consequences. These social sequelae generally fall into the interconnected domains of valued social roles (such as maintaining employment), relationships (such as conflict with family and/or spouse and social isolation from friends), and reduced participation in leisure and recreational activities.[7, 8]

Cross-cultural neuropsychological studies in New Zealand are sparse and no local research to date has investigated cross-cultural TBI-rehabilitation. Cultural appropriateness is pertinent in neuropsychological assessment with the overarching concern being that misinterpretations and inaccurate conclusions may be drawn with groups other than those on whom tests have been standardized. New Zealand research has demonstrated that Māori perform differently on some tests than Pakeha, and questions the validity and reliability of these tests with Māori.[9,10,11,12] Moreover, neuropsychological assessment impacts on treatment, influencing rehabilitation recommendations, and compromising subsequent rehabilitation outcomes.

TBI is associated with a multiplicity of neurophysiological, cognitive, behavioural, and psychosocial sequelae that affect every aspect of a person's life to varying degrees.

The rehabilitation of individuals with brain injuries is one of the fastest growing areas in all health care over the last two decades. Advances in management of trauma, emergency medical care and technology have seen a significant reduction in mortality rates and an increase in survival following brain injury. As a result there has been a considerable demand for brain injury rehabilitation services, which has subsequently paved the way for the growth and development of community-based post-acute rehabilitation services. In tandem with the worldwide proliferation of specialist services provided to people who have sustained a brain injury, international research efforts have produced an abundance of studies to increase knowledge of the needs for rehabilitation and to continuously develop effective rehabilitation services for these people. Consistent with overseas, there has been an expansion of head injury rehabilitation services in New Zealand, but local research addressing the areas of appropriate needs and effectiveness of these services is sparse. Moreover, while little is known internationally about the needs of people from minority cultures, there is no New Zealand neuro-rehabilitation research existing to date that addresses cultural diversity. The present study is the first that takes into account the inter-cultural make-up of brain injured individuals in neuro-rehabilitation, unique to New Zealand and the South Pacific.

This exploratory study investigates Traumatic Brain Injury (TBI) rehabilitation outcomes among culturally diverse outpatients in community-based rehabilitation who have sustained a Mild to Moderate TBI. The major aims of this study are twofold: firstly, to determine whether community-based rehabilitation outcomes following TBI differ across Māori, Pacific and Pakeha cultures; and secondly, to identify any service delivery needs Pacific people in TBI rehabilitation require that may be distinct from Pakeha.

Method

This study is a fixed comparative non-experimental design where participants were selected using direct control based on their self-identified ethnic group (i.e., Pakeha, Māori or Pacific). Following Ethics approval by the Auckland Ethics Committee, participants were recruited from Burtons Healthcare, a community-based rehabilitation provider with branches in Auckland, Hamilton, Tauranga and Whangarei.

Participants

The population of interest in this study included male and female adults aged 18 to 65 who self-identified as being able to communicate in English,

self-identified as being of Māori, Pakeha or Pacific Islands ethnicity, and had sustained a TBI diagnosed as mild to moderate. Injury severity was measured according to ACC criteria[13] - i.e. the period of Post Traumatic Amnesia, the standardized Glasgow Coma Scale, and loss of consciousness duration. Inclusion criteria also stipulated that potential participants were no longer than 32 months post-injury, had undergone their first rehabilitation session within 12 months following their injury and that at least six months had elapsed since their first session. These time periods are to ensure they have had sufficient time to complete most spontaneous recovery and benefit from rehabilitation.

Overall there were 33 participants with an ethnic breakdown of 11 Pakeha, 11 Māori and 11 Pacific People. Ethnic breakdown of Pacific people consisted of four Tongan, three Samoan, two Fijian, one Niuean and one Cook Island participants.

Consistent with the epidemiological research on TBI, the sample was predominantly male (76%) with a mean age of 37.5 years (range 18-65). Thirty-three percent of TBI's were caused by Motor Vehcial Accidents (MVAs), 30% assault, 27% falls, and 10% other causes. For the level of severity of TBI, 18% were Mild, 15% were Mild-Moderate, 30% were Moderate, and the remaining 36% were Moderate-Severe. The average education level was 11.5 years and the mean time since injury (to date of interview) was 18.7 months.

Measures

The Brain Injury Community Rehabilitation Outcome 39 Scales (BICRO-39)[14] is a multidimensional quantitative assessment of functioning designed specifically to measure community functioning in areas of activity, social participation, and psychological aspects of functioning. The 39-item questionnaire consists of a Pre-injury Form to give retrospective self-ratings of the participants' functioning prior to their TBI, and a Post-injury Form to give self-ratings of the participants' current functioning. There is no ideal score on the BICRO-39, however "individual level of handicap", magnitude, and size of change over time is determined by comparing pre- and post-injury information. The purpose of including Pre-Injury information is to provide an individualised baseline with which to compare post-injury scores.

The Neurobehavioral Cognitive Status Examination (Cognistat)[15] is a brief measure designed to assess cognitive functioning in the areas of: Language, Constructions, Memory, Calculations and Reasoning. A cognitive status profile of performance on subtests is scored rather than a total composite score. The Cognistat was used as a screening measure to filter out any participants who may be too cognitively impaired to give accurate self-reports, and hence skew the data. It was also used to explore any individual and ethnic group differences across cognitive domains.

Analysis

Multi-variate Analyses of Variance (MANOVAs) were performed to determine whether groupings based on ethnicity differed in test scores. Correlational data were generated to determine the strength and directions of relationships between results on measures as well as with demographic data.

Wilks' Lambda and Tukeys multiple comparison test were used as the test statistics for each MANOVA model and results were considered statistically

Table 1. Cognistat Subscale Mean Scores By Ethnicity & Total Pass Rates

Subscale (cut-off score)	Total (n=33)				Pakeha (n=11)		Māori (n=11)		Pacific (n=11)	
	Mean	(SD)	% Pass Cut-Off	Sig.	Mean	(SD)	Mean	(SD)	Mean	(SD)
Orientation (10)	11.7	(0.6)	97		11.6	(0.9)	11.7	(0.5)	11.9	(0.3)
Attention (6)	6.8	(1.7)	73		7.5	(1.3)	6.6	(2.0)	6.5	(1.7)
Language - Comprehen. (5)	5.9	(0.4)	94		6.0	(0.0)	6.0	(0.0)	5.7	(0.6)
Language - Repetition (10)	11.3	(1.5)	91	***	12.0	(0.0)	11.8	(0.6)	10.1	(2.0)
Language - Naming (6)	7.7	(0.7)	97	***	7.9	(0.3)	8.0	(0.0)	7.1	(0.9)
Constructions (4)	4.4	(1.2)	82		4.4	(0.9)	4.6	(1.2)	4.2	(1.5)
Memory (9)	10.4	(2.0)	85	*	11.5	(0.8)	10.3	(2.0)	9.4	(2.5)
Calculations (3)	3.3	(1.0)	76		3.6	(0.9)	3.4	(0.9)	3.0	(1.0)
Similarities (5)	5.9	(0.9)	94		6.2	(0.6)	5.7	(0.6)	5.8	(1.3)
Judgement (4)	4.5	(1.2)	79		4.6	(1.4)	4.5	(1.2)	4.4	(1.1)

*MANOVA compared ethnic groups: ** p≤ .01, *** p≤ .001, difference across ethnicity*

significant if there was corresponding p-value of less than 0.05, or as otherwise stated.[16]

Results

Cognistat

The total sample profile did not fall into the impaired range on any of the subtests on the Cognistat indicating that all participants were at a similar minimum level of cognitive functioning. This increases comparability of results, and improves the reliability and validity of participants' self-reports in other measures.

A MANOVA was performed on the ten subtests of the Cognistat with Ethnicity as the grouping variable results of which are reported in Table 1. Using Wilks' criteria ($F_{20,42} = 1.894$, $p = .041$) variables with significant ethnic group differences were Language - Repetition ($p=.001$), Language – Naming ($p=.001$), and Memory ($p=.045$). Post Hoc multiple comparisons Tukey's tests indicated that for Language – Repetition and Language – Naming, Pacific people scored significantly lower than both Māori and Pakeha, who did not differ significantly from each other. For Memory, Pakeha scored significantly higher than Pacific People but not Māori, and there were no significant differences between Māori and Pacific.

The association of demographic variables has been shown to confound cognitive screening test results. To adjust for demographic differences across ethnicity, the previously identified potentially confounding variables of Education, Time Since Injury and English as a Second Language (ESL) were added as co-variates to the MANOVA. Results indicate that there were still significant differences across ethnicity having adjusted the results for Time Since Injury ($F(20, 40) = 1.807$, $p = .05$), showing that the differences are not dependent on the duration of time since injury. However, there were no significant differences across ethnicity when adjusting for Education ($F(20, 40) = 1.558$, $p = .115$) and ESL ($F(20, 40) = .711$, $p = .792$), showing that these two variables play a part in the differences shown. No significant correlation was identified between ESL and Education (Spearmans $\rho = .27$, $p < .126$) which suggests that both Education and ESL are equally important factors contributing to the aforementioned significant differences across ethnicity.

BICRO-39

Participants and their Close Others completed the BICRO-39 retrospectively for: 1) Pre-Injury, 2) Intake to treatment, and then for 3) Current functioning. Figure 1 depicts scores for these points in time, where a higher score indicates a greater level of handicap. The total BICRO-39 Pre-Injury mean score for the whole sample was 5.1, the total Intake mean score was 11.4, and total Current mean score was 8.1. The amount of individual level of handicap following TBI was larger than the amount of reduction in individual level of handicap following rehabilitation. Hence while there was significant improvement, participants did not return back to pre-morbid level of functioning on average.

Significance across ethnic differences is shown in Table 2. There were no significant differences found across Pakeha, Māori or Pacific ethnicity for the total outcome scores on the BICRO-39. No significant correlations were found between the BICRO-39 results and demographic data.

Analysis of subscales however identified that the subscale of "Socialising" contributed to significant differences across ethnicity for both Pre-injury ($p = .042$) and Intake ($p = .034$) scores. Post Hoc multiple comparisons Tukey's tests indicated that Pakeha scored significantly higher than both Māori and Pacific people on both occasions.

Figure 1 Brain Injury Community Rehabilitation Outcome – 39 Scales Total Pre-Injury, Intake and Current Scores By Ethnicity.

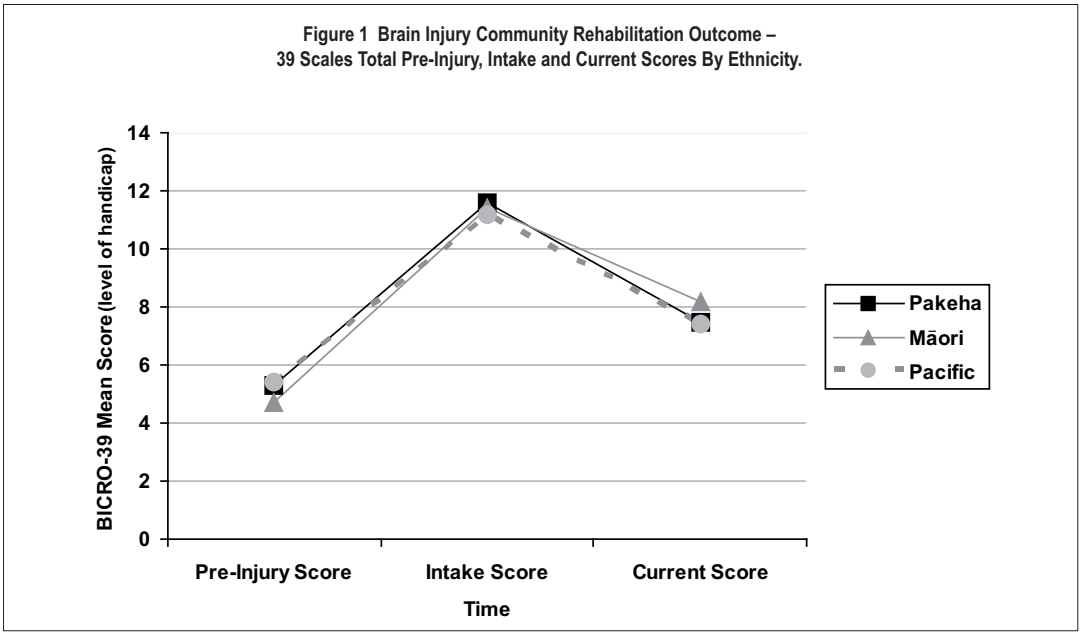

Table 2. Brain Injury Community Rehabilitation Outcome-39 Scales Pre-Injury, Intake and Current Scores By Ethnicity

Scale	Pre-Injury Score								Intake Score								Current Score							
	Total (n=33)		*Pakeha* (n=11)		Māori (n=11)		Pacific (n=11)		Total (n=33)		*Pakeha* (n=11)		Māori (n=11)		Pacific (n=11)		Total (n=33)		*Pakeha* (n=11)		Māori (n=11)		Pacific (n=11)	
	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)
Total	**5.1**	**(1.4)**	**5.3**	**(1.7)**	**4.7**	**(1.0)**	**5.4**	**(1.4)**	**11.4**	**(2.5)**	**11.6**	**(1.8)**	**11.4**	**(3.5)**	**11.2**	**(2.1)**	**8.1**	**(2.0)**	**7.5**	**(1.6)**	**8.2**	**(2.7)**	**8.5**	**(1.7)**
Personal Care	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	2.2	(3.5)	1.1	(2.7)	3.2	(4.7)	2.4	(2.5)	0.2	(0.8)	0	(0.0)	0.6	(1.2)	0.1	(0.3)
Mobility	3.9	(4.5)	1.8 [a]	(2.6)	3.2	(3.7)	6.7	(5.4)	14.7	(9.4)	12.9	(9.4)	13.7	(10.8)	17.6	(7.9)	5.9	(7.0)	3.4	(4)	7.4	(9.7)	6.9	(6.3)
Self-Organisation	2.9	(4.0)	0.8	(1.8)	4.3	(5.4)	3.5	(3.7)	16.3	(7.8)	14.8	(7.7)	18.8	(9.5)	15	(5.7)	9.3	(6.5)	4.8	(3.3)	12.1	(8.1)	11.0	(5)
Contact Partner/Chn	3.9	(3.7)	4.8	(3.3)	4	(4.1)	2.9	(3.7)	3.9	(3.7)	4.7	(2.8)	3.6	(4.4)	3.5	(3.9)	4.6	(3.7)	6.1	(2.8)	3.9	(4.3)	3.9	(3.7)
Contact Parents/Sibs	7.7	(4.6)	7.9	(4.5)	6.6	(4.9)	8.5	(4.6)	7.3	(5.0)	8.2	(6.0)	6.5	(5.0)	7.4	(4.2)	7.2	(4.9)	7.6	(4.9)	5.9	(5.5)	8.3	(4.3)
Socialising	6.7	(4.2)***	10.1	(4.0)	4	(1.9)	6	(4.0)	13.0	(6.6)***	19.2	(6.7)	10	(4.5)	9.7	(3.4)	10.4	(5.2)	12.6	(5.2)	7.8	(4)	10.7	(5.4)
Productive Emplymt	11.7	(3.8)	12.3	(4.4)	11.2	(3.5)	11.6	(3.9)	17.1	(4.2)	17.1	(5.3)	17.2	(3.7)	16.9	(3.6)	14.4	(2.9)	13.8	(3.8)	15.3	(2.4)	14	(2.3)
Psych Well-Being	4.3	(3.0)	4.6	(4.4)	4.3	(2.2)	4.0	(1.6)	16.5	(6.8)	14.6	(5.1)	18.5	(7.4)	16.3	(7.6)	12.3	(5.9)	12.0	(6.7)	12.5	(5.4)	12.5	(6.1)

*MANOVA compared ethnic groups: ** p≤ .01, *** p≤ .001, difference across ethnicity*

Discussion

The BICRO-39 was utilised as the primary outcome measure because it was specifically designed for the multidimensional nature of community-based TBI rehabilitation, measuring functioning in activity, social participation and psychological functioning (i.e., level of handicap). Results showed that average individual level of handicap increased following injury (as might be expected). Following rehabilitation handicap significantly decreased. While participants did not return back to pre-morbid levels of functioning, there was significant improvement, and as demonstrated in previous research, this suggests efficacy of rehabilitation. This evidence, which controls for spontaneous recovery and other potential confounding demographic variables, refutes anecdotal rhetoric which questions the effectiveness of community-based treatment following mild to moderate TBI.

Finding no significant differences across ethnicity for the total rehabilitation outcomes is not aligned with other ethnic minority TBI research. International studies show that ethnic minorities are more likely to have more negative outcomes than the majority race.[17, 18] The results of the present study suggest that Māori and Pacific Peoples can benefit from community-based rehabilitation in New Zealand. This result also contributes to dispelling anecdotal evidence that suggests that Māori and Pacific Peoples have poorer rehabilitation outcomes than Pakeha. Simpson's et al[19] cross-cultural qualitative Australian study reported similar findings and suggested that there is a universal experience of the sequelae of TBI that transcends individual cultures.

On a closer examination of the BICRO-39, Pakeha were significantly more handicapped than both Māori and Pacific Peoples at both Pre-injury and Intake on the Socialising subscale. Because the Socialising subscale focuses on measuring the amount of time spent with extended family and friends, and in traditional Māori and Pacific cultures the individual exists in the context of whanau / aiga potopoto (family / extended family), this result was not unexpected. The change from intake to current social functioning indicates that Pakeha improved significantly more that both Māori and Pacific Peoples. Hence, while Pakeha had increased their amount of time socialising following intake, Māori and Pacific remained constant.

Although they achieved above cut-off levels on the Cognistat, Pacific peoples scored significantly lower than both Māori and Pakeha on two Language subtests and significantly lower than Pakeha on the Memory subtest. Again, confounding demographic variables required statistical scrutinizing and results showed that there was no difference across ethnicity on any of these subtests once years of education and ESL were taken into account. These findings are a first for Pacific people's cognitive performance following TBI.

It has been well documented in the literature that level of education and ESL is associated with neuropsychological performance[3,12,20] and also affects scores on the Cognistat[21]. In their study with a male Māori sample, Ogden and McFarlane-Nathan[12] found that performance on various neuropsychological tests was dependent on Western education. Similarly, Barnfield and Leathem alluded to education and learning to account for their findings of lower neuropsychological performance of Māori subjects. Given that neuropsychological and cognitive tests are based on the Western constructs of intelligence and education it is reasonable to assume that years of formal education and perhaps learning styles contributed to the subscale discrepancies.

However, this does not account for the finding that Māori also had significantly fewer years of education than Pakeha, yet their cognitive profile was comparable to Pakeha. The confounding difference of ESL played a role here with nine of the eleven Pacific people reporting English as their second language and reporting experiencing speech and language difficulties following their injury. Moreover, the Language subtests are obviously heavily reliant on English, and memory tests have been shown as reliant on English as well.[22]

Conclusion

It is evident that Pakeha, Māori and Pacific peoples alike can benefit from community-based rehabilitation following TBI. There appears to be universalities in TBI experience and global rehabilitation outcomes that transcends individual cultures. However, there are micro-level cultural variations that have valuable implications when assessing and treating Pacific people in rehabilitation services for the future.

For Pacific people the impact of language has highlighted the inherent cultural bias in cognitive measures. Of concern to neuropsychological testing as a whole is that the Cognistat reflects standard neuropsychological measures such as the California Verbal Learning Test, Trails A, subtests from the Weschler Memory Scale, and subtests from the Weschler Adult Intelligence Scale. These standard tests are commonly utilized in neuropsychological assessment in New Zealand. Misleading conclusions may occur due to language differences but also because Pacific people have not been included in the population that the instruments are normed on. Consequently, an invalid neuropsychological assessment may give rise to recommendations for a rehabilitation programme that may have minimal effectiveness for a Pacific person. Neuropsychologists

need to take into account the formal education levels and language abilities when dealing with Pacific People, particularly immigrants with English as a second language.

Research is needed to develop and validate the use of neuropsychological and psychometric measures with Pacific people. Measure's would be more effective in New Zealand if they were normed across Māori and Pacific populations. While community-based neuro-rehabilitation has been shown to be effective, future research should also focus on identifying the efficacy of specific interventions within the multi-disciplinary aspects of TBI rehabilitation.

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