

REVIEW ARTICLE (META-ANALYSIS)

# Community Integration After Traumatic Brain Injury: A Systematic Review of the Clinical Implications of Measurement and Service Provision for Older Adults



Linda Ritchie, PGCertHSc,<sup>a</sup> Valerie A. Wright-St Clair, PhD,<sup>a</sup> Justin Keogh, PhD,<sup>b,c</sup> Marion Gray, PhD<sup>d</sup>

From the <sup>a</sup>Department of Occupational Science and Therapy, School of Rehabilitation and Occupation Studies, Faculty of Health and Environmental Sciences, Auckland University of Technology, Auckland, New Zealand; <sup>b</sup>Research Centre for Health, Exercise and Sports Sciences, Faculty of Health Sciences and Medicine, Bond University, Robina, QLD, Australia; and <sup>c</sup>Human Potential Centre, Auckland University of Technology, Auckland, New Zealand; and <sup>d</sup>Cluster for Health Improvement, Faculty of Science, Health, Education and Engineering, University of the Sunshine Coast, Sippy Downs, QLD, Australia.

## Abstract

**Objective:** To explore the scope, reliability, and validity of community integration measures for older adults after traumatic brain injury (TBI).

**Data Sources:** A search of peer-reviewed articles in English from 1990 to April 2011 was conducted using the EBSCO Health and Scopus databases. Search terms included were *community integration*, *traumatic brain injury* or *TBI*, *65 plus* or *older adults*, and *assessment*.

**Study Selection:** Forty-three eligible articles were identified, with 11 selected for full review using a standardized critical review method.

**Data Extraction:** Common community integration measures were identified and ranked for relevance and psychometric properties. Of the 43 eligible articles, studies reporting community integration outcomes post-TBI were identified and critically reviewed. Older adults' community integration needs post-TBI from high quality studies were summarized.

**Data Synthesis:** There is a relative lack of evidence pertaining to older adults post-TBI, but indicators are that older adults have poorer outcomes than their younger counterparts. The Community Integration Questionnaire (CIQ) is the most widely used community integration measurement tool used in research for people with TBI. Because of some limitations, many studies have used the CIQ in conjunction with other measures to better quantify and/or monitor changes in community integration.

**Conclusions:** Enhancing integration of older adults after TBI into their community of choice, with particular emphasis on social integration and quality of life, should be a primary rehabilitation goal. However, more research is needed to inform best practice guidelines to meet the needs of this growing TBI population. It is recommended that subjective tools, such as quality of life measures, are used in conjunction with well-established community integration measures, such as the CIQ, during the assessment process.

Archives of Physical Medicine and Rehabilitation 2014;95:163–74

© 2014 by the American Congress of Rehabilitation Medicine

Population proportions and the absolute number of people aged  $\geq 65$  years, referred to in this article as older adults, are continuing to increase in many countries worldwide.<sup>1</sup> Falls and consequent injuries are one of the most costly issues associated with the aging population with at least 30% of people aged  $\geq 65$  years falling each year, a third of which result in serious injury impacting on

function.<sup>2,3</sup> Accidental falls are the primary cause of traumatic brain injury (TBI) for older adults.<sup>4</sup>

The age-adjusted rate of hospitalization for TBI in older adults is 155.9 per 100,000, over double that of the general population (60.6 per 100,000 population). Those  $\geq 75$  years have the highest rates of TBI-related hospitalization and death.<sup>4</sup> Given the aging demographic, the incidence of falls and fall-related TBI and demands on rehabilitation services are expected to rise. Evidence suggests that community integration (CI) should be the primary goal of rehabilitation for people after a TBI<sup>5,6</sup> because CI is an adaptive process of rehabilitation that is multidimensional,

Supported by an Auckland University of Technology Summer Studentship 2009–2012 (grant no. CGH 51/09).

No commercial party having a direct financial interest in the results of the research supporting this article has conferred or will confer a benefit on the authors or on any organization with which the authors are associated.

dynamic, personal, and culturally bound<sup>5,6</sup> and is linked to concepts of handicap and social participation.<sup>5,6</sup> Definitions of CI typically include social, community, and in-home participation and participation in meaningful, productive activities.<sup>6,7</sup>

Reistetter and Abreu<sup>5</sup> investigated methods of measuring CI and CI outcomes for post-TBI populations, though their inquiry pertained to adults  $\geq 19$  years. There is limited literature on identifying and meeting the CI needs of older people who have sustained a TBI. There is evidence to suggest, however, that advancing age is associated with poorer outcomes after TBI.<sup>8</sup> This association could be because of measurement issues, where existing measures fail to adequately assess the CI needs of older adults after TBI, or it could in fact be a true reflection of outcomes after TBI for older people. Therefore, a critical review of the literature was conducted to explore the measures used and older adults' CI needs after TBI.

## Methods

A systematic literature search was conducted using the EBSCO Health and Scopus databases. To further identify older people's needs after TBI, secondary searches for qualitative studies were conducted on ProQuest Social Science Journals, Sociology: A SAGE Full-Text Collection and Expanded Academic ASAP. However, no additional qualitative studies were found. The search terms used were as follows: *community integration, community reintegration, older adult, elderly, geriatric, traumatic brain injury, assessment, measure, and qualitative*. Common synonyms were used, as were common acronyms for measures, and truncation was used where appropriate. Boolean combinations and separate keywords were also used. For example, *community integration AND older adult, or older adult OR elderly*. Supplementary searches were conducted on SCOPUS for the following named measures: the Participant Objective, Participant Subjective (POPS), Satisfaction with Life Scale (SWLS), Dartmouth COOP Functional Health Assessment Charts/WONCA (COOP), RAND Medical Outcomes Study 36-Item Short-Form Health Survey (SF-36), and the Sickness Impact Profile-68. Searches were limited to full-text English language articles published in peer-reviewed

journals from 1990 to April 2011. There was no attempt to retrieve information from unpublished articles to ensure that all studies we reviewed had gone through a rigorous peer-review process. A total of 152 articles was accessed by the first author (L.R.) and reviewed for appropriateness to the research topic. Forty-three published articles met the inclusion criteria.

Studies reporting older adults' needs post-TBI, with participants aged  $\geq 65$  and using CI outcome measures, or studies reporting or reviewing CI assessments, were included. Studies not reporting relevant age-specific findings were excluded. No criteria for methodologic design or TBI severity were specified. Because of the scarcity of studies investigating CI for older adults who had sustained a TBI, imposing further limits on injury severity was avoided. Ethical approval was not required for this literature review.

The first author (L.R.) critically appraised and scored the 43 selected research articles using either the Critical Review Form—Quantitative Studies or the Critical Review Form—Qualitative Studies designed by Law et al<sup>9</sup> (table 1). These tools have been used extensively in rehabilitation research reviews<sup>10,11</sup> to determine and compare methodologic quality. For every question indicative of good methodologic quality, a yes response was scored 1 and a no or not addressed response was scored a 0 (see table 1). A total score was generated for each of the 43 reviewed articles. One previously scored quantitative article was randomly selected and independently rated by the authors to determine scoring accuracy. This revealed a difference of 2 marks among all 4 reviewers. Differences were discussed and an agreement was reached that there should be a blanket penalty for unaddressed responses in studies, regardless of applicability. A second randomly selected quantitative article was then scored. There was a difference of 1 mark among all 4 reviewers for the second study cross-scored. Further discussion led to consensus about the application of the standardized appraisal system. All of the 11 studies were then scored by 1 author (J.K.), and there was total agreement between the first author (L.R.) and the scores of the second reviewer (J.K.) for all 11 studies. Based on a previous review that denoted quantitative studies that scored between 7 and 10 as moderate quality,<sup>12</sup> it was determined that  $\geq 10$  out of 15 ( $>66\%$ ) would be used to define good quality. Similarly,  $\geq 16$  out of 24 was used to define good quality qualitative studies. Eleven

### List of abbreviations:

CHART	Craig Handicap Assessment and Reporting Technique
CI	community integration
CIM	Community Integration Measure
CIQ	Community Integration Questionnaire
COOP	Dartmouth COOP Functional Health Assessment Charts/World Organization of National Colleges, Academies, and Academic Associations of General Practices/Family Physicians
GCS	Glasgow Coma Scale
POPS	Participant Objective, Participant Subjective
SF-36	Medical Outcomes Study 36-Item Short-Form Health Survey
SWLS	Satisfaction with Life Scale
TBI	traumatic brain injury
WHOQOL-BREF	World Health Organisation Quality of Life-Abbreviated 26 items
WHOQOL-DIS	World Health Organization Quality of Life-Disabilities module
WHOQOL-OLD	World Health Organization Quality of Life-Older Adult module

**Table 1** Critical appraisal scoring system

	Maximum Score	Qualitative Research	Maximum Score
Study purpose	1	Study purpose	1
Literature	1	Literature	1
Design	1	Design	3
Sample	2	Sampling	3
Outcome	2	Descriptive clarity	4
Intervention	3	Procedural rigor	1
Results	4	Analytical rigor	2
Conclusions and implications	1	Auditability	2
		Theoretical connections	1
		Trustworthiness	4
		Conclusions and implications	2
Maximum score	15		24

articles (10 quantitative observational studies<sup>8,13-21</sup> and 1 qualitative study<sup>22</sup>) were considered robust enough to report the CI needs of older adults after TBI.

Commonly used measures of older adults' CI post-TBI were identified from the 43 selected articles, and their properties were listed and compared.

The data were then examined for how older adults' CI was operationalized, the outcome measures used post-TBI, and their assessed needs for CI.

## Results

All of the 11 good quality studies included participants who were  $\geq 65$ . Injury severity was defined by Glasgow Coma Scale (GCS) scores. Five of the 11 studies included participants with mild, moderate, and severe TBIs,<sup>15,16,19-21</sup> 2 studies had participants with mild to moderate TBIs only,<sup>14,17</sup> and 2 studies included participants with moderate to severe TBIs only.<sup>8,13</sup> Corrigan et al<sup>18</sup> stated that 64% of the sample had scores within the severe range, but GCS scores were available for only 89% of the total 218 participants. GCS scores were not stated for participants in the only qualitative study,<sup>22</sup> and it was stated that all 80 participants had experienced a TBI and had an inpatient stay in a rehabilitation hospital.

## Measuring CI

Variables used to operationalize CI were diverse, including household integration, social connectedness, social-recreational engagement, driving, employment, and quality of life. Sander et al<sup>23</sup> suggest that CI was traditionally defined by participation in employment or other productive activity, independent living, and social activity. In contrast, when people are asked what CI means to them post-TBI, emerging themes from a number of studies primarily revolved around social connection.<sup>23</sup>

Six assessment tools were identified in the literature reviewed (table 2). These were the Community Integration Questionnaire (CIQ),<sup>7</sup> Craig Handicap Assessment and Reporting Technique (CHART),<sup>24</sup> Community Integration Measure (CIM),<sup>25</sup> Satisfaction With Life Scale (SWLS),<sup>24</sup> World Health Organization-Disability Assessment Schedule 2.0,<sup>26</sup> and the World Health Organization Quality of Life-Older Adult module (WHO-QOL-OLD).<sup>27</sup>

## Community Integration Questionnaire

The CIQ, developed specifically for a post-TBI population, was the most widely used CI outcome measure, appearing in 5 of the 10 high quality quantitative studies.<sup>8,13,14,18,20</sup> It was developed by an expert panel, informed by research evidence. The CIQ has good face validity for measuring CI post-TBI<sup>6,28,29</sup> and shows good predictive validity.<sup>29</sup> Test-retest reliability coefficients for the total score and subscales range from .83 to .97.<sup>30</sup> Interrater reliability based on Pearson correlations are acceptable,<sup>28</sup> and 3 out of 4 studies reported levels that exceed alpha coefficients of .80 for internal consistency.<sup>28,29</sup> The CIQ is considered to have adequate to excellent reliability for use with proxies, with kappa coefficients that ranged from .42 (shopping) to .94 (school).<sup>6,28,29</sup> However, it has shown skewed results for sex, age, and level of education and tends to favor those who engage in many different activities.<sup>6</sup> Social participation generally declines with older age

regardless of health status, and older people living alone tend to participate mainly in activities around the home.<sup>31</sup> Older adults with TBI may have reduced their social life further and spend more time looking after their home environment; therefore, they would expect to score lower on the social integration subscale and higher on the home integration subscale of the CIQ compared with younger people without TBIs. Dalemans et al<sup>29</sup> recommend using the CIQ in concert with similar assessments of impairment, disability, environmental barriers, and demographic descriptors to reflect the true level of CI; as such, these complementary assessments may help to mitigate some of the floor and ceiling effects of the CIQ. It has been suggested that some items of the social integration and productivity subscales be changed, that preinjury assessments be used as a baseline measure, and that separate norms be developed for sex, ethnicity, and marital status.<sup>32</sup> Despite these criticisms, the CIQ remains the outcome measure of choice to measure CI post-TBI, being used in 9 of 10 studies examining the effect of a variety of interventions on CI.<sup>33</sup>

Most studies attempting to measure CI as a construct or to predict CI outcomes post-TBI, use, or advocate using, a battery of tools and/or outcomes to best capture this complex construct.<sup>13,14,16,18,19,25,34-36</sup> Many studies used at least 2 specific CI measures, for example the CIQ along with the CHART.<sup>14,19,25,29,30,34,36-38</sup> Other studies use composite outcome measures. Bell et al<sup>39</sup> measured the effectiveness of a scheduled telephone intervention, offering counseling and education to people with TBI on behavioral outcomes, compared with standard follow-up at 1 year postinjury. The CIQ and the mobility, travel, home management, leisure and recreation, and social integration domains of the Functional Status Examination were included in their composite score of CI. Bell<sup>39</sup> stated the "use of composite outcome measures best capture the varied benefits that might result from this intervention"<sup>39(p854)</sup> and suggest, in response to specific identified problems and interventions, "a composite test increases the power to detect the effect."<sup>39(p853)</sup> However, because of a range of measures being used, varied results were found.

CI may be best evaluated using both objective and subjective measures.<sup>25,30,40</sup> In a post-TBI study comparing regular drivers with nondrivers, Rapport et al<sup>19</sup> found that the largest effects of driving cessation were observed on objective measures (CHART) but no significant differences were found on a subjective measure of CI (CIM), suggesting that "objective indices of community integration can dissociate from subjective feelings about them."<sup>19(p926)</sup> Accordingly, objective measurements may only tell part of the story, and supplementing assessment with subjective CI measures, such as life satisfaction and well-being, is recommended.<sup>25,30,40</sup> The inclusion of subjective CI measurement may also promote cultural relevance because disparity between ethnic or minority groups and white or majority groups has been highlighted.<sup>36,40,41</sup> In their systematic review of 8 articles, Arango-Lasprilla and Kreutzer<sup>41</sup> found marked disparities for people of ethnic minority compared with whites in functional, psychosocial, and neurobehavioral outcomes after TBI. Using the POPS,<sup>17</sup> Mascialino et al<sup>40</sup> found no differences between 2 groups (whites and minorities) in objective participation (except transportation); however, differences were found in subjective participation. Although the POPS was developed in 2004, it does not appear to be widely used. This review located no independent studies reporting its validity and reliability. Similar to the POPS, the Participation Profile: A Measure of Home and Community Participation includes objective and subjective aspects and was developed to reflect the World Health Organization's *International Classification of Functioning, Disability and*

*Health.*<sup>42</sup> However, no relevant data were uncovered in relation with its validity for assessing CI post-TBI for older adults. The ethnic makeup of most study samples is largely unknown, which means the level of cultural bias that may occur within these studies assessing CI in older adults cannot be determined.<sup>23</sup> To address the cultural relevance issue, the World Health Organization Disability Assessment Schedule 2.0 is based on an extensive cross-cultural study spanning 19 countries and was developed primarily to allow cross-cultural comparisons.<sup>26</sup>

### Quality of life and life satisfaction measures

To overcome the gaps when using objective community outcome measures only, numerous studies included quality of life measures or satisfaction scales.<sup>16,18,28-30,35,39,43-46</sup> The SWLS was the most commonly used. However, an additional database search on the SWLS with subjects  $\geq 65$  years revealed no further results. McNaughton et al<sup>47</sup> has recommended using the RAND SF-36 until measures of individual participation and quality of life are developed because it “captures the most relevant information about function for a general, community-based rehabilitation population.”<sup>47(p2187)</sup> Alternatively, the COOP and the Sickness Impact Profile-68 have been used to measure quality of life at hospital discharge and 1 year postdischarge, respectively, for TBI patients.<sup>46</sup> In summary, the RAND SF-36, followed by the COOP, is the most commonly used quality of life measure for older adults. Two of the 11 high quality studies used quality of life measures and 2 used the SWLS<sup>16,18</sup> (table 3).

Developed in the 1990s as generic, cross-cultural, and multidimensional measures of quality of life for use with healthy and unhealthy people, the World Health Organization Quality of Life Assessments, the WHOQOL-100 items and WHOQOL-Abbreviated 26 items (WHOQOL-BREF), may be useful supplementary tools to further understand the link between the perceptions of older individuals with TBI on quality of life and quality of CI. In addition, the WHOQOL-OLD module was developed specifically for older adults and contains facets (sensory abilities; autonomy; past, present, and future activities; death and dying; and intimacy), identified as meaningful for quality of life by older people from 15 different countries, which are not included in the WHOQOL-100 items or the WHOQOL-Abbreviated 26 items. The WHOQOL-BREF implemented in conjunction with the WHOQOL-OLD is considered a reliable and valid cross-cultural method for use with older adults.<sup>48-50</sup> However, Rasch analysis revealed areas for measurement improvement, particularly related to a psychological item (body image) and 2 social items (sexual activity and friends' support).<sup>50</sup> Moreover, the recently developed World Health Organization Quality of Life-Disabilities Module (WHOQOL-DIS), which adds a module to existing World Health Organization Quality of Life Assessment instruments to assess quality of life for people with physical and intellectual disabilities, may be useful for post-TBI populations. The WHOQOL-DIS was developed specifically for implementing with adults with disabilities by using simplified wording, 3-point (instead of 5-point) response scales, and smiley faces as visual cues.<sup>51</sup> Still relatively new, the WHOQOL-DIS reportedly exhibits good face validity,<sup>51</sup> but research testing on its comprehensive validity and/or reliability remains scarce. In general, assessments that are quick to administer, with minimal respondent burden, are recommended for post-TBI populations.<sup>46</sup> This means that questions about complex constructs (eg, CI), which require abstract thinking, should be avoided.<sup>52</sup>

### Considerations of assessment and use of proxies

The use of proxies in assessment is routine with TBI populations, although research suggests discrepancies between persons with TBI or disability and their caregivers or significant others.<sup>22,37,53,54</sup> However, Cusick et al<sup>53</sup> found acceptable levels of agreement between research participants and their proxies, and concluded that the degree of potential bias did not outweigh the benefits of including proxy data. However, agreement between participants and their proxies was poorest when the response required judgment, opinion, firsthand experience of activities outside the home setting, an integral aspect of CI,<sup>37</sup> and perceived satisfaction.<sup>54</sup> Furthermore, older adults are likely to have proxies who are paid caregivers, spouses, or younger family members, and this could be problematic if they are asked about the older adults' perceived satisfaction or meaningful social integration.

### Needs of older people after TBI

After applying the standardized review formation, a total of 11 studies (10 observational and 1 phenomenological) was identified for analysis of older adults' needs after TBI. The evidence suggests that after TBI, older people have poorer CI outcomes than their younger counterparts<sup>8,13,15,16,55</sup> for example, in 1 study, older participants had greater difficulty getting places, shopping, and managing money.<sup>13</sup> Five of the good quality studies found significantly poorer CI outcomes for people who were older.<sup>8,13,15,16,20</sup> In contrast, Rapport et al<sup>14</sup> revealed that age was unrelated to CI outcomes, and Brown et al<sup>17</sup> found that current age was not related to participation when using the POPS measure. Three studies found injury severity to be an indicator of poorer community outcomes,<sup>13,16,20</sup> and 3 show sex to affect CI outcomes post-TBI.<sup>8,13,16</sup> Men were found to have poorer outcomes in 2 of the 11 studies,<sup>8,13</sup> whereas 1 study showed that women had lower levels for CI than men.<sup>16</sup> Incidentally, Wagner et al<sup>20</sup> found that sex did not play a role in CI scores using the CIQ, but women showed greater disability 1 year post-TBI than men on the Disability Rating Scale. Reported outcomes tend to remain relatively stable over time.<sup>8</sup> Problems with CI exist beyond rehabilitative treatment phases<sup>22</sup> and occur when service utilization rates reduce.<sup>16</sup> In qualitative interviews with participants up to 10 years postinjury, Rotondi et al<sup>22</sup> found that participants need periodic reassessment and ongoing intervention for problems such as behavioral control, concentration, memory, judgment, and mobility. Other long-term needs included individual and support group assistance for participants to understand their injuries, treatments and potential consequences, emotional and mental health, and financial and life planning assistance. Such findings point to rehabilitation being needs-based over time rather than being provided for a set time frame.

Older adults are more likely to be unemployed post-TBI<sup>13,15</sup> and are more likely to retire because of their injury.<sup>13,18</sup> Unemployment at the time of injury predicted lower CIQ scores after 1 year.<sup>20</sup> Conversely, employment is an identifiable factor associated with life satisfaction at 2 years after TBI.<sup>18</sup> Social participation and social integration have become a focus of investigation and rehabilitation for post-TBI populations.<sup>17,21</sup> Social integration is second only to depressed mood as an associated factor of life satisfaction at 2 years post-TBI,<sup>18</sup> and older age is associated with poorer social integration outcomes and poorer quality of life post-TBI.<sup>16</sup> Rapport,<sup>14</sup> however, found that age was unrelated to CI



**Table 2** Common CI assessment tools suitable for older adults post-TBI

Characteristics	CIQ	CHART	CIM	SWLS	WHODAS 2.0	WHOQOL-OLD
Designed for	People with impairments and disabilities because of injury, chronic illness, or old age Developed for inclusion in the National Institute on Disability and Rehabilitation Research TBI Model Systems National Database in the U.S.	Developed in late 1980s as an interview or survey to assess extent of handicap among rehabilitation clients living in the community, regardless of years since injury or ongoing involvement with the health care system	Assessment of individuals views of CI post-TBI	Measuring subject well-being	Conducting population surveys for registers and for monitoring individual patient outcomes in clinical practice and clinical trials of treatment effects	Assess quality of life for older people; valid for cross-cultural use
Construct	Being in (returning to) the mainstream of family and community life by 6 areas of role definition: orientation, physical independence, mobility, occupation, social integration, and CI	WHO concept of handicap and physical independence, mobility, occupation, social integration, and economic self-sufficiency Measurement of participation; items were intended as simple, objective, observable, and quantifiable criteria that would represent the degree to which respondents fulfilled roles expected of able-bodied members of society	Subjective, assesses perceived quality of CI and participation (ie, subjective CI) Developed following a literature review and qualitative study, 9 themes related to CI emerged and questions developed to measure these themes	Assesses overall life satisfaction	WHO international classification scheme, the ICF	WHO international classification scheme, the ICF
Items	15-short form	27	10	5	36	24
Domains and scoring	Home environment (5 items) Integration into a social network (6 items) Integration into productive activities (4 items) Scores report performance frequency, with additional weight given on whether or not assistance was obtained; 12 items scored on 3-point scale, 3 items (productive-employment, school, and volunteer activities) are scored on a 6-point scale Provides domain subscale scores and total CIQ scores	Physical independence (3 items) Mobility (9 items) Occupation (7 items) Social integration (6 items) Economic self-sufficiency (2 items) Revised in 1999 to include cognitive independence (5 items) Scores quantify the extent to which individuals fulfill various social roles, which may be summed for a total score Normed with nondisabled population	Participant's level of involvement in tasks associated with home, socializing, and work in additional aspects of integration, such as belonging, acceptance, diffuse relations, and independent living Items reflect client-centered perspectives on a broad range of feelings related to connectedness and belonging (eg, "I feel that I am accepted in this community" and "There are things that I can do in this community for fun in my free time")	5 questions scored on a 7-point Likert scale; life satisfaction can be assessed specific to a particular domain of life (eg, work, family) or globally	Cognitive (6 items) Mobility (5 items) Self-care (4 items) Getting along (5 items) Household (4 items) Work (4 items) Participation (8 items) Items scored on a 3-point Likert scale to accommodate intellectual disabilities	24 x 5-point Likert-scaled items (4 per facet) assigned to six facets: Sensory Abilities, Autonomy, Past, Present and Future Activities, Social Participation, Death and Dying, & Intimacy. The six facet scores or values of the 24 single items can be combined to calculate an overall QOL score for older adults higher scores indicate higher quality of life, time frame for assessment is the past 2wk

Table 2 (continued)

Characteristics	CIQ	CHART	CIM	SWLS	WHODAS 2.0	WHOQOL-OLD
Administrative burden	Low, 15min to administer, no training required	Low, 10–15min to administer, no training required	Declarative statements rated on a 5-point Likert response scale Low, 5min to administer, no training required	Low, takes a few minutes to administer	Fair, can be administered in <20min during interviews and in 5–10min when self-administered or administered by proxy; training manual needed.	ND
Respondent burden	Low, can be completed quickly and easily by most individuals with TBI or by an appropriate, substitute proxy	It has been suggested that respondents may find questions regarding annual income and nonreimbursed medical expenses difficult to answer	Low, self report	Low		ND

Abbreviations: ICF, *International Classification of Functioning, Disability and Health*; ND, no data; WHO, World Health Organization; WHODAS 2.0, World Health Organization Disability Assessment Schedule 2.0.

outcomes. Both the Rapport studies, including adults ≤89 years old<sup>19</sup> and ≤68 years old,<sup>14</sup> indicate that driving status has an independent influence on post-TBI CI, with nondrivers having poorer CI outcomes than drivers even after accounting for injury severity, levels of social support, negative affectivity, and use of alternative transportation.<sup>14,19</sup>

### Discussion

This review reveals the challenging issues facing rehabilitation clinicians on how to best assess community rehabilitation for older adults after TBI. Although the CIQ is currently the standardized measure of choice, there is ongoing work to develop more inclusive, culturally sensitive, and appropriate tools.<sup>17,48-51</sup> Debate continues about the validity of tools that aim to measure a rather abstract and personalized notion, such as CI, because there is always going to be discrepancy between the values of clinicians, researchers, and clients. It seems well established that any measure of CI should include both objective and subjective perspectives.<sup>19,26,30,40</sup> Subjective understanding of CI needs post-TBI is currently achieved by including independent life satisfaction or quality of life scales,<sup>16,18,28,30,35,39,43-46</sup> or by simply asking about the person's experiences and level of satisfaction.<sup>22,56</sup> This type of qualitative inquiry, however, is limited to use with small participant numbers, indicating a remaining need for standardized measures that can be used for assessing large populations. Similarly, the Reistetter and Abreu<sup>5,6</sup> reviews found good evidence for the CIQ and the need to include both objective and subjective measures to evaluate CI, the premiere goal of rehabilitation.

A range of standardized subjective measures, such as the CIM, SWLS, RAND 36-Item Short Form Health Survey, COOP, or Sickness Impact Profile-68, is used to ascertain CI outcomes post-TBI. Particular subjective measures may best be used at different recovery time frames,<sup>46</sup> that is, at discharge or specified time frames postinjury; however, such applications makes it impossible to measure change over time. Composite measures, assembled from various outcome measures, such as the CIQ with the Functional Status Examination, are used, but this method raises concerns for the validity of the composite instrument itself.

Although caregiver proxies are often a good source of information for post-TBI populations,<sup>53</sup> proxies should not be asked to make judgments about the well-being, quality of life, or level of satisfaction that people experience post-TBI.<sup>37,54</sup> Preferably, the person with TBI should be supported to express their own needs using adapted methods, that is, increasing the role of the interviewer to clarify questions and providing assistance with calculating answers.<sup>52</sup>

One post-TBI outcome is clear: older adults are a disadvantaged population,<sup>8,13,15,16,22,55,57</sup> particularly those from minority ethnic groups.<sup>36,40,41,45,58</sup> Age is positively correlated with poorer outcomes and longer recovery periods.<sup>8,13,16,22</sup> In addition, when compared with their younger counterparts, older people are less likely to return to work and engage socially after TBI. The scarcity of CI research conducted solely with older adult populations post-TBI means that their outcomes and needs over time are not well understood.

Along with age, TBI severity has been shown to negatively impact community outcomes. People with severe injuries show more handicap than those with less severe injuries.<sup>16</sup> Evidently, however, people with mild TBI have been found to report more symptoms than those with moderate injuries.<sup>16,57</sup> Only 5 of the 11

**Table 3** Summary of reviewed articles reporting CI outcomes for older adults post-TBI

Authors	Quality Score (out of 15)	Study Aim	Study Design	Participants (TBI severity and age)	Follow-Up Post-TBI	CI Outcome Measures	Results
Willemse-van Son et al <sup>8</sup>	11	To evaluate the course and identify determinants of CI for up to 3y after moderate to severe TBI	Prospective cohort	Moderate to severe TBI N=119 Aged 16–67y; mean, 34y Men to women ratio 3:1	3y	CIQ BI FIM FAM	Time postinjury significantly associated with improved home integration, social integration, productivity, and total CIQ. Total CIQ scores decreased at 3mo, significantly increased at 6 and 12mo, and remained stable at 24 and 36mo. Most did not reach pre-TBI levels. Some CI improvements were transient. Lower CI at 36mo associated with being a man, older age (a major determinant), living with others preinjury, longer hospital stays, lower BI scores, low preinjury CIQ scores.
Colantonio et al <sup>13</sup>	11	To examine the long-term outcomes of rehabilitation patients with moderate to severe TBI	Cohort	Moderate to severe TBI N=306 70% men Aged 23–90y; mean $\pm$ SD, 44 $\pm$ 13y 6.6% retired because of TBI	7–24y (mean $\pm$ SD, 14.2 $\pm$ 4.4y)	CIQ Employment status	Worse self-rated health significantly correlated with being a man, older age, cognitive impairment, higher injury severity score, and IADL functions, except meal preparation. Most limited IADL were getting to places, walking distance, shopping, and managing money. In an older population, 11.1% reported being retired at follow-up, most of them (6.6% of total sample) reported that they had retired because of their TBI.
Rapport et al <sup>14</sup>	10	To examine the relations among driving status, perceptions of barriers to the resumption of driving, and CI outcomes after TBI	Cross sectional	Mild to moderate TBI N=51 Aged 18–68y; mean $\pm$ SD, 39.1 $\pm$ 13.3y	6m–10y (mean $\pm$ SD, 4.3 $\pm$ 3.5y)	CIQ CHART Driving status postinjury	Age unrelated to CI outcomes. Greater integration for drivers vs nondrivers. Drivers and nondrivers differed significantly on CHART occupation, but not on the CIM. Objective CI outcomes related barriers to driving and driving status. Subjective CI related strongly to participants' experiences of barriers to driving but not to reported driving status.
Senathi-Raja et al <sup>15</sup>	11	To examine the association of age with long-term psychosocial outcome after TBI	Case control	Mild to severe TBI: n=112; controls: n=112 TBI aged 26–89y; mean $\pm$ SD, 54.9 $\pm$ 17.5y Controls aged 28–89y; mean $\pm$ SD,	5–22y postinjury	SPRS-form A Employment status	Most CI change to occupational activity, interpersonal relations, and living skills. Age not significantly associated with living skills. Lower scores on occupational activity significantly associated with older age. *Employment predicted by shorter PTA and younger age.

Table 3 (continued)

Authors	Quality Score (out of 15)	Study Aim	Study Design	Participants (TBI severity and age)	Follow-Up Post-TBI	CI Outcome Measures	Results
Whiteneck et al <sup>16</sup>	11	To determine state wide, population-based outcomes of persons hospitalized with TBI at 1y postinjury	Cross-sectional	55.1±17.3y All community dwelling Mild to severe TBI: N=257 (16.2% of sample) Aged 16–96y; mean, 41y; aged ≥65y: 68% men	1y	CHART-short form SWLS	16% showed handicap. Degree of handicap associated with severity of injury, age, and sex. Older age associated with poorer social integration and QOL. 20% identified traveling in the community as a need. Over 4y of follow-up, poor outcomes remained relatively constant, whereas the rate of service utilization reduced dramatically.
Brown et al <sup>17</sup>	10	To describe the development, content, and validity of a new measure of participation, the POPS	Case control	Mild (54%) and moderate TBI (N=454) Aged 21–93y; mean ± SD, 47±15.2 Control (N=121) Aged 20–89y; mean ± SD, 53.7±17.9y	1mo–54y	POPS Flanagan Quality of Life Scale Life 3 BDI BISQ	Current age, injury severity, and years post-TBI onset were not related to PO or to PS total scores. More variance in PS scores than PO scores. Correlation between PO and PS total scores was weak. Subjective scores for both groups (mild and moderate TBI) associated more with other subjective measures than with PO scores.
Corrigan et al <sup>18</sup>	10	To investigate factors associated with life satisfaction at 1 and 2y after injury and identify factors that correlate with changes between the first and second years	Prospective, longitudinal cohort	TBI N=218, 64% severe TBI Aged 15–86y; mean, 33.1y 75% men	Yearly, at 1 and 2y	Employment Social integration (CIQ) Depressed mood SWLS	Change in SWLS from years 1–2 was relatively minimal. Life satisfaction at year 2 most associated with current depressed mood, social integration, and employment, and prior history of substance abuse.
Rapport et al <sup>19</sup>	11	To examine resumption of driving after TBI and its relation with CI	Cross-sectional; survey and cognitive data	Mild-moderate (21%) to severe (77%) TBI: N=261 214 men, 47 women Aged 18–89y; mean ± SD, 44.0±13.6 All had driven before TBI	3mo–15y	CIM CHART-short form	44% resumed driving Nondrivers had sustained more severe injuries and had poorer CI than drivers. Driving status had independent influence on post-TBI CI. Latent effects of driving cessation were observed on objective (CHART) (social mobility, occupation/vocation, social integration).
Wagner et al <sup>20</sup>	10	To investigate the utility of GCS, RTS, ISS, and TRISS alone and in conjunction with	Cohort	Mild to moderate (64%) to severe TBI.	1y	CIQ Employment	Significant associations between CIQ scores at 1y and GCS, RTS, TRISS, and age.



Table 3 (continued)

Authors	Quality Score (out of 15)	Study Aim	Study Design	Participants (TBI severity and age)	Follow-Up Post-TBI	CI Outcome Measures	Results
		injury severity, demographic, and premorbid variables in predicting 1y outcome for individuals hospitalized with TBI		N=120 72.5% men 25.8% were ≥50y of age		data	Minority status, payor status, violent mechanisms of injury, premorbid disability, psychiatric disease, premorbid drug and alcohol use, lower educational level, and premorbid unemployment were predictive of lower CI scores. GCS and RTS of ≤8 and lower TRISS scores were predictive of poorer CI. RTS of ≤8, violent mechanisms of injury, <high school education, and unemployment at time of injury predicted lower CIQ scores at 1y.
Struchen et al <sup>21</sup>	10	To evaluate the contribution of social communication abilities and affective/behavioral functioning to social integration outcomes for persons with TBI	Prospective cohort	N=184 Mild (55%) to moderate (10.6%) to severe (34.4%) TBI Aged 18–91y; mean ± SD, 36.12±15.12y 72.8% men	≥6mo (mean, 7.84mo)	CHART-short form, social integration subscale CIM, social integration subscale	Social communication abilities and affective/behavioral functioning contributed significantly to concurrently measured outcomes for both social integration measures. Combined social communication and affective/behavioral measures explained a significant amount of the variance in both social integration outcomes (11.3% and 16.3%) for CIQ and CHART-short form measures.
Authors	Quality Score (Out of 24)	Study Aim	Study Design	Participants and Conditions	Follow Up	Community Integration Outcome Measures	Results
Rotondi et al <sup>22</sup>	23*	To determine the expressed needs of persons with TBI and their primary family caregivers	Phenomenology	TBI: n=80; primary family caregivers/support persons: n=85 26% of TBI participants age 50–69y, 13% aged 70–89y	Average 5.8y	A semistructured telephone interview based on the critical incident technique	Four phases (1) acute care; (2) inpatient rehabilitation; (3) return home, a 3-4mo transitional period; and (4) life in the community. Themes occurring in phase 4 were understanding injuries, treatments, and consequences; emotional and mental health post-TBI; financial assistance; guidance for the family's emotional and mental health; finding and evaluating providers; periodic reassessment and treatment; community integration; having a support group; and life planning. CI meant being an active and integrated member of society, including public TBI awareness and acceptance.

Abbreviations: BDI, Beck Depression Inventory; BI, Barthel Index; BISQ, Brain Injury Screening Questionnaire; FAM, Functional Assessment Measure; IADL, instrumental activities of daily living; ISS, Injury Severity Score; PTA, posttraumatic amnesia; QOL, quality of life; RTS, Revised Trauma Score; SPRS, Sydney Psychosocial Reintegration Scale; TRISS, Trauma and Injury Severity Score.

\* Maximum quality score for quantitative studies is 15; for qualitative studies it is 24.

studies analyzed in this review included participants with TBIs ranging from mild to severe<sup>15,16,19-21</sup> (see table 2); therefore, comparing age-specific findings of these studies with studies that included participants with only mild to moderate injuries or moderate to severe injuries is problematic. Older adults may have poorer CI outcomes than their younger counterparts because of the severity of their injuries or conceivably because comorbidities common in older age impact on their ability to travel in the community, for example. Furthermore, older adults who are retired are deprived of the range of rehabilitation benefits afforded to those who return to work after injury. Moreover, older adults reporting more problems with social integration than their younger counterparts post-TBI may be representing life stage rather than issues related to their injury status. Although Whiteneck et al<sup>16</sup> investigated CI post-TBI for injury severity and demographic subgroups, detailed data on older adults grouped into injury severity groups, sex, and other variables, such as living arrangements and social supports, are lacking. Moreover, given the varied follow-up periods in this investigation (6mo–54y), it is unclear if the older adults recruited sustained a TBI at a young or older age. This distinction will influence CI outcomes because the nature of interventions afforded to younger patients may be different (eg, focusing on vocational rehabilitation and independent living), and outcomes for those with limited time or difficulties adjusting to injury are likely to be negatively impacted.

These gaps in knowledge may mean that incorrect assumptions underpin current rehabilitation interventions for older people. For example, the notion of retirement or driving cessation post-TBI may be viewed from a life stage approach rather than as a consequence of injury.

Conversely, reduced social integration in older adults post-TBI could be viewed as a consequence of injury, without considering the expected decrease in social engagement commonly experienced in this age group. Research shows that older adults who sustain a TBI are at risk of poorer CI, particularly in areas related to work or productive activities<sup>13,15,18</sup> and social integration.<sup>16</sup> Whether this is a direct result of their injury or a result of age-related changes, older adults stand to benefit from rehabilitation efforts that draw attention to these specific areas of needs.

## Study limitations

Every effort was made to uncover all relevant research on the topic. However, it is possible that some articles were missed given the apparent trend of increasing numbers of recently published CI research and because there was no attempt to retrieve information from unpublished articles. Also, some assessment tools, such as the World Health Organization-Disability Assessment Schedule 2.0, are still in development or are yet to be tested for older adults who have sustained a TBI.

Limitations arise largely because of the scarcity of data on older people post-TBI. Not one of the studies accessed focused solely on the older adult population. In accord, studies were reviewed if they included older adult subjects and reported age-specific findings. Age-related data were commonly reported as measures of central tendency (mean age of participants) and variability (age range and/or SD); for example, Bryant et al<sup>43</sup> reported participant statistics as age ranged from 16 to 71 years (mean  $\pm$  SD, 34.26 $\pm$ 12.82). Some studies aggregated older age categories within a wide age band (eg, 25.8% were  $\geq$ 50y),<sup>20</sup> making it impossible to interpret the data and results for subjects  $\geq$ 65 years. Furthermore, studies that did report

data for older age categories mostly included small numbers of subjects aged  $\geq$ 65 years (ie, only 2% of  $n=204$  were  $\geq$ 65y),<sup>37</sup> meaning that data analysis was limited to descriptive statistics.

The heterogeneity of the data does not allow for accurate comparison across all studies; for example, TBI severity varied across studies. However, this critical review provides a range of objective and subjective insights to the evidence based on older adults' CI outcomes and needs after TBI.

## Conclusions

The aim of this study was to examine the scope, reliability, and validity of CI measures and review the CI needs of older adults after TBI.

TBI secondary to falls is a significant health and social issue for older adults. CI should be a primary rehabilitation goal after TBI; however, the limited evidence base means that health care professionals who offer services to people with TBI have a very limited evidence basis on how to best meet the needs of this growing population. Furthermore, we know very little about how variations in the demographic characteristics may also influence CI because there appears to be no research conducted on how factors such as ethnicity and financial status/income influence CI in older adults. Such research would appear crucial because previous research has highlighted how ethnicity and income may impact on the CI of young to middle-age adults with TBI.<sup>36</sup> Collectively, the findings of this review indicate a call for additional research addressing the CI and social integration needs and improving quality of life of a variety of groups of older adults post-TBI.

Clearly, good quality post-TBI research, including criterion standard intervention studies focused solely on older adults, is needed before evidence-based best practice clinical protocols are determined. Well-conducted randomized controlled studies are needed to determine clinical interventions that address important CI needs and achieve the best possible CI outcomes. Because it is difficult to construct and operationalize the complex nuances and subjective experiences of pre- or post-TBI CI, good quality qualitative research should occur alongside larger-scale quantitative inquiries.

Recent research indicates that the CIQ is a reasonably valid and reliable standardized instrument for measuring older adults' activity engagement after TBI. The introduction of further reliable quality of life measures, validated for use with older adults post-TBI, may ultimately signal an effective way of measuring rehabilitation needs and outcomes, allowing a move away from predefined notions of CI with arbitrary subscale weightings. Regardless, clinicians should also explore post-TBI patients' subjective understandings and experiences of engaging within their communities of interest. Such qualitative explorations should be coupled with quantitative indicators to elicit comprehensive, quality data on patients' CI needs and outcomes. Post-TBI, CI rehabilitation services for older people should be based on real, rather than presumed, needs by using population-specific, valid, and reliable assessment tools, and integrating robust qualitative information.

## Keywords

Aged; Brain injuries; Rehabilitation

## Corresponding author

Valerie Wright-St Clair, PhD, Department of Occupational Science and Therapy, School of Rehabilitation and Occupation

Studies, Faculty of Health and Environmental Sciences, AUT University, Private Bag 92006, Auckland 1142, New Zealand. E-mail address: [vwright@aut.ac.nz](mailto:vwright@aut.ac.nz).

## References

1. Statistics New Zealand. The impact of structural population change (Structural change and the 65+ population articles). Wellington: Statistics New Zealand; 2009.
2. Campbell AJ, Borrie MJ, Spears GF, et al. Circumstances and consequences of falls experienced by a community population 70 years and over during a prospective study. *Age Ageing* 1990;19:136-41.
3. Wagenaar R, Keogh JW, Taylor D. Development of a clinical Multiple-Lunge Test to predict falls in older adults. *Arch Phys Med Rehabil* 2012;93:458-65.
4. Thompson HJ, McCormick WC, Kagan SH. Traumatic brain injury in older adults: epidemiology, outcomes, and future implications. *J Am Geriatr Soc* 2006;54:1590-5.
5. Reistetter TA, Abreu BC. Appraising evidence on community integration following brain injury: a systematic review. *Occup Ther Int* 2005;12:196-217.
6. Salter K, Foley N, Jutai J, Bayley M, Teasell R. Assessment of community integration following traumatic brain injury. *Brain Inj* 2008;22:820-35.
7. Willer B, Ottenbacher KJ, Coad ML. The community integration questionnaire. A comparative examination. *Am J Phys Med Rehabil* 1994;73:103-11.
8. Willemsse-van Son AHP, Ribbers GM, Hop WCJ, Stam HJ. Community integration following moderate to severe traumatic brain injury: a longitudinal investigation. *J Rehabil Med* 2009;41:521-7.
9. Law M, Steinwender S, Leclair L. Occupation, health and well-being. *Can J Occup Ther* 1998;65:81-91.
10. Steel DM, Gray MA. Baby boomers' use and perception of recommended assistive technology: a systematic review. *Disabil Rehabil* 2009;4:129-36.
11. Anaf S, Sheppard LA. Physiotherapy as a clinical service in emergency departments: a narrative review. *Physiotherapy* 2007;93:243-52.
12. Thomas M, Wood L, Selfe J, Peat G. Anterior knee pain in younger adults as a precursor to subsequent patellofemoral osteoarthritis: a systematic review. *BMC Musculoskelet Disord* 2010;11:201.
13. Colantonio A, Ratcliff G, Chase S, et al. Long term outcomes after moderate to severe traumatic brain injury. *Disabil Rehabil* 2004;26:253-61.
14. Rapport LJ, Hanks RA, Bryer RC. Barriers to driving and community integration after traumatic brain injury. *J Head Trauma Rehabil* 2006;21:34-44.
15. Senathi-Raja D, Ponsford J, Schönberger M. Association of age with long-term psychosocial outcome following traumatic brain injury. *J Rehabil Med* 2009;41:666-73.
16. Whiteneck G, Brooks CA, Mellick D, et al. Population-based estimates of outcomes after hospitalization for traumatic brain injury in Colorado. *Arch Phys Med Rehabil* 2004;85(4 Suppl 2): S73-81.
17. Brown M, Dijkers MPJ, Gordon WA, et al. Participation objective, participation subjective: a measure of participation combining outsider and insider perspectives. *J Head Trauma Rehabil* 2004;19:459-81.
18. Corrigan JD, Bogner JA, Mysiw WJ, Clinchot D, Fugate L. Life satisfaction after traumatic brain injury. *J Head Trauma Rehabil* 2001;16:543-55.
19. Rapport LJ, Bryer RC, Hanks RA. Driving and community integration after traumatic brain injury. *Arch Phys Med Rehabil* 2008;89:922-30.
20. Wagner AK, Hammond FM, Sasser HC, Wiercisiewski D, Norton HJ. Use of injury severity variables in determining disability and community integration after traumatic brain injury. *J Trauma* 2000;49:411-9.
21. Struchen MA, Pappadis MR, Sander AM, Burrows CS, Myszkka KA. Examining the contribution of social communication abilities and affective/behavioral functioning to social integration outcomes for adults with traumatic brain injury. *J Head Trauma Rehabil* 2011;26:30-42.
22. Rotondi AJ, Sinkule J, Balzer K, Harris J, Moldovan R. A qualitative needs assessment of persons who have experienced traumatic brain injury and their primary family caregivers. *J Head Trauma Rehabil* 2007;22:14-25.
23. Sander AM, Clark A, Pappadis MR. What is community integration anyway?: defining meaning following traumatic brain injury. *J Head Trauma Rehabil* 2010;25:121-7.
24. Corrigan JD, Smith-Knapp K, Granger CV. Outcomes in the first 5 years after traumatic brain injury. *Arch Phys Med Rehabil* 1998;79:298-305.
25. Winkler D, Unsworth C, Sloan S. Factors that lead to successful community integration following severe traumatic brain injury. *J Head Trauma Rehabil* 2006;21:8-21.
26. Garin O, Ayuso-Mateos J, Almansa J, et al. Validation of the "World Health Organization Disability Assessment Schedule, WHODAS-2" in patients with chronic diseases. *Health Qual Life Outcomes* 2010;8:51.
27. Peel NM, Bartlett HP, Marshall AL. Measuring quality of life in older people: reliability and validity of WHOQOL-OLD. *Australas J Ageing* 2007;26:162-7.
28. Dijkers MP, Whiteneck G, El-Jaroudi R. Measures of social outcomes in disability research. *Arch Phys Med Rehabil* 2000;81(12 Suppl 2): S63-80.
29. Dalemans R, de Witte LP, Lemmens J, van den Heuvel WJ, Wade DT. Measures for rating social participation in people with aphasia: a systematic review. *Clin Rehabil* 2008;22:542-55.
30. Corrigan JD, Bogner J. Latent factors in measures of rehabilitation outcomes after traumatic brain injury. *J Head Trauma Rehabil* 2004;19:445-58.
31. Dahan-Oliel N, Gelinis I, Mazer B. Social participation in the elderly: what does the literature tell us? *Crit Rev Phys Rehabil Med* 2008;20:159-76.
32. Kaplan CP. The community integration questionnaire with new scoring guidelines: concurrent validity and need for appropriate norms. *Brain Inj* 2001;15:725-31.
33. Kim H, Colantonio A. Effectiveness of rehabilitation in enhancing community integration after acute traumatic brain injury: a systematic review. *Am J Occup Ther* 2010;64:709-19.
34. Brown M, Gordon WA, Spielman L. Participation in social and recreational activity in the community by individuals with traumatic brain injury. *Rehabil Psychol* 2003;48:266-74.
35. Huebner RA, Johnson K, Bennett CM, Schneck C. Community participation and quality of life outcomes after adult traumatic brain injury. *Am J Occup Ther* 2003;57:177-85.
36. Sander AM, Pappadis MR, Davis LC, et al. Relationship of race/ethnicity and income to community integration following traumatic brain injury: investigation in a non-rehabilitation trauma sample. *Neurorehabilitation* 2009;24:15-27.
37. Cusick CP, Gerhart KA, Mellick DC. Participant-proxy reliability in traumatic brain injury outcome research. *J Head Trauma Rehabil* 2000;15:739-49.
38. Sady MD, Sander AM, Clark AN, et al. Relationship of preinjury caregiver and family functioning to community integration in adults with traumatic brain injury. *Arch Phys Med Rehabil* 2010;91:1542-50.
39. Bell KR, Temkin NR, Esselman PC, et al. The effect of a scheduled telephone intervention on outcome after moderate to severe traumatic brain injury: a randomized trial. *Arch Phys Med Rehabil* 2005;86:851-6.
40. Mascialino G, Hirshson C, Egan M, et al. Objective and subjective assessment of long-term community integration in minority groups following traumatic brain injury. *Neurorehabilitation* 2009;24:29-36.

41. Arango-Lasprilla JC, Kreutzer JS. Racial and ethnic disparities in functional, psychosocial, and neurobehavioral outcomes after brain injury. *J Head Trauma Rehabil* 2010;25:128-36.
42. World Health Organization. *International Classification of Functioning, Disability and Health*. Geneva: World Health Organization; 2001.
43. Bryant RA, Marosszeky JE, Crooks J, Baguley IJ, Gurka JA. Post-traumatic stress disorder and psychosocial functioning after severe traumatic brain injury. *J Ner Ment Dis* 2001;189:109-13.
44. Griffen JA, Hanks RA, Meachen SJ. The reliability and validity of the community integration measure in persons with traumatic brain injury. *Rehabil Psychol* 2010;55:292-7.
45. Hart T, Whyte J, Polansky M, Kersey-Matusiak G, Fidler-Sheppard R. Community outcomes following traumatic brain injury: impact of race and preinjury status. *J Head Trauma Rehabil* 2005;20:158-72.
46. van Baalen B, Odding E, van Woensel MP, et al. Reliability and sensitivity to change of measurement instruments used in a traumatic brain injury population. *Clin Rehabil* 2006;20:686-700.
47. McNaughton HK, Weatherall M, McPherson KM. Functional measures across neurologic disease states: analysis of factors in common. *Arch Phys Med Rehabil* 2005;86:2184-8.
48. Fleck MP, Chachamovich E, Trentini C. Development and validation of the Portuguese version of the WHOQOL-OLD module. *Rev Saude Publica* 2006;40:785-91.
49. Kalfoss M, Low G, Molzahn A. The suitability of the WHOQOL-BREF for Canadian and Norwegian older adults. *Eur J Ageing* 2008;5:77-89.
50. Liang WM, Chang CH, Yeh YC, et al. Psychometric evaluation of the WHOQOL-BREF in community-dwelling older people in Taiwan using Rasch analysis. *Qual Life Res* 2009;18:605-18.
51. Power M, Quinn K, Schmidt S. Development of the WHOQOL-Old Module. *Qual Life Res* 2005;14:2197-214.
52. Bogner J. Community participation: measurement issues with persons with deficits in executive functioning. *Arch Phys Med Rehabil* 2010;91(9 Suppl):S66-71.
53. Cusick CP, Brooks CA, Whiteneck GG. The use of proxies in community integration research. *Arch Phys Med Rehabil* 2001;82:1018-24.
54. Dawson DR, Markowitz M, Stuss DT. Community integration status 4 years after traumatic brain injury. *J Head Trauma Rehabil* 2005;20:426-35.
55. Truelle JL, Fayol P, Montreuil M, Chevignard M. Community integration after severe traumatic brain injury in adults. *Curr Opin Neurol* 2010;23:688-94.
56. Howes H, Benton D, Edwards S. Women's experience of brain injury: an interpretative phenomenological analysis. *Psychol Health* 2005;20:129-42.
57. Whiteneck GG, Gerhart KA, Cusick CP. Identifying environmental factors that influence the outcomes of people with traumatic brain injury. *J Head Trauma Rehabil* 2004;19:191-204.
58. Saltapidas H, Ponsford J. The influence of cultural background on motivation for and participation in rehabilitation and outcome following traumatic brain injury. *J Head Trauma Rehabil* 2007;22:132-9.