

Research article

# An examination of the psychometric properties of the community integration questionnaire (CIQ) in spinal cord injury

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**Objective:** To examine the psychometric properties of the Community Integration Questionnaire (CIQ) in large samples of individuals with spinal cord injury (SCI).

**Design:** Longitudinal 12-month survey study.

**Setting:** Nation-wide, community dwelling.

**Participants:** Adults with SCI: 627 at Time 1, 494 at Time 2.

**Interventions:** Not applicable.

**Outcome measures:** The CIQ is a 15-item measure developed to measure three domains of community integration in individuals with traumatic brain injury: home integration, social integration, and productive activity. SCI consumer input suggested the need for two additional items assessing socializing at home and internet/email activity.

**Results:** Exploratory factor analyses at Time 1 indicated three factors. Time 2 confirmatory factor analysis did not show a good fit of the 3-factor model. CIQ scores were normally distributed and only the Productive subscale demonstrated problems with high (25%) ceiling effects. Internal reliability was acceptable for the Total and Home scales, but low for the Social and Productive activity scales. Validity of the CIQ is suggested by significant differences by sex, age, and wheelchair use.

**Conclusions:** The factor structure of the CIQ was not stable over time. The CIQ may be most useful for assessing home integration, as this is the subscale with the most scale stability and internal reliability. The CIQ may be improved for use in SCI by including items that reflect higher levels of productive functioning, integration across the life span, and home- and internet-based social functioning.

**Keywords:** Spinal cord injury, Community Integration Questionnaire, Factor analysis, Validity, Reliability

## Introduction

‘Community integration’ is an important component of quality of life that can be conceptualized as the fulfillment of an individual’s age-, sex- and culturally-appropriate roles and responsibilities in society.<sup>1</sup> Neurological injury, such as spinal cord injury (SCI), may result in physical and/or cognitive impairments that alter “normal” family, peer, school, or work roles. Community (re)integration, which returns an individual to community living and “normalizes” role functioning and social participation, is a central goal of rehabilitation.

Many measures exist to track specific physical and cognitive functions, but few instruments assess community integration as a multi-dimensional concept. The Craig Handicap Assessment and Reporting Technique (CHART),<sup>2</sup> a 32-item interview-based measure that was designed based on the World Health Organization (WHO) definitions of handicap, impairment, and disability<sup>3,4</sup> is one of the most commonly used measures of integration in those with SCI. Currently, the CHART has more data on psychometric properties in SCI than any other measure of integration.<sup>5</sup> The CHART has shown good-to-excellent test-retest reliability,<sup>2</sup> good known groups (construct) validity,<sup>6</sup> poor-to-good inter-rater reliability,<sup>2</sup> poor-to-adequate

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criterion validity,<sup>7,8</sup> and substantial ceiling effects for those with lower level spinal cord injuries.<sup>9</sup> The CHART is sometimes used as a self-report measure, though the authors caution that valuable information could be lost if not administered as an interview.<sup>10</sup>

Given the limitations of the CHART, there is need for an accessible (e.g. brief, comprehensible) self-report measure of integration that is valid and reliable for use in persons with SCI. The Community Integration Questionnaire (CIQ), a brief and easy to administer self-report tool that was developed for individuals with traumatic brain injury (TBI),<sup>11</sup> addresses three central factors of integration: home competency, social integration, and productive activity. The CIQ score reflects the frequency of and independence in activities within these three domains. In TBI samples, the CIQ has shown good measurement properties (see Methods) and the three-factor structure of the CIQ has been confirmed in a large-scale factor analysis;<sup>12</sup> however, the findings from this study indicated a need to reclassify or eliminate several items.

Several studies have used the CIQ in clinical populations with mobility impairments including SCI,<sup>13,14</sup> multiple sclerosis,<sup>15,16</sup> and cerebral palsy.<sup>17</sup> However, a few psychometric studies of the CIQ in these non-TBI populations exist. The only published psychometric study in SCI supported the construct validity of the CIQ,<sup>8</sup> but was limited by an extremely small sample size ( $n = 28$ ). A larger study in a mixed, sample of subjects with physical disability, including SCI, demonstrated internal consistency and concurrent validity of the CIQ, but the results of a factor analysis indicated a need to reclassify several of the items.<sup>18</sup> Given the paucity of evidence as to the psychometric properties of the CIQ in SCI, efforts to replicate and extend our understanding of this measure in SCI are warranted.

In sum, the CIQ was developed as a self-report measure of multi-dimensional community integration in TBI. There has been no examination of the psychometric properties of the CIQ in SCI with a sufficiently large sample. Furthermore, the factor structure of the CIQ has not been consistent across studies. Research that provides additional empirical information regarding the CIQ and its scales would be of significant value to clinicians or researchers who are considering using a psychometrically tested measure such as the CIQ with persons with SCI. Moreover, it could support measure developers in improving assessment of community integration for persons with SCI.

Given the above considerations, the aim of this study was to examine the psychometric properties of the CIQ in a longitudinal study of a large and diverse sample of

individuals with SCI. Based on previous research,<sup>11,12</sup> we predicted that the CIQ would have three factors reflecting community integration at home, socially, and in productive activities. We expect that the CIQ factors will be stable in this study sample over a 1-year period. We also predicted that the CIQ Total scale and Home subscale would demonstrate better internal reliability than the Social and Productive subscales. We examined whether new items that consumers with SCI indicated were relevant to community integration for people with SCI improved the factor analysis model. Validity was evaluated by differences in CIQ scores by sex (women were expected to have higher Total and Home subscale scores), age (scores were expected to decline with advancing age, but with highest Home and Productive subscale scores in middle age), and wheelchair use (scores were expected to be lower for those who use power wheelchairs or are pushed in a wheelchair by another person compared to those who do not use a wheelchair or push self in a manual wheelchair).

## Methods

### *Participants and procedures*

This is a secondary data analysis of a study examining physical activity and secondary health conditions in individuals with SCI; the primary paper contains additional study information.<sup>19</sup> Participants were self-recruited through nation-wide membership mailings by the National Spinal Cord Injury Association, the Independent Living Research Utilization, and the Edward Hines, Jr. Veterans Administration (VA) Hospital (Hines, IL, USA). Invitations to participate were mailed to approximately 5000 individuals. Eligibility criteria included age  $\geq 18$  years, SCI diagnosis,  $\geq 1$  year post-SCI, United States resident, and fluent in English. Informed consent and Health Insurance Portability and Accountability Act documents, the Time 1 survey, instructions, staff contact information, and a prepaid return envelope were mailed to enrollees. Identical follow-up survey packets were mailed 12 months later (Time 2) to those who returned the first survey. The MedStar Research Institute Institutional Review Board approved all study procedures.

### *Measures*

Survey questions were chosen through an iterative process that incorporated consumer input using internet-based audiocast technology. Listeners with SCI were encouraged to provide feedback on the content and format of the entire survey instrument, including the CIQ, via email. The research team reviewed and

discussed feedback. No changes to original CIQ item wording were suggested. However, two additional items were created based on consumer feedback that the CIQ did not assess having friends visit one's home or social interactions by email/social media.

### Demographics and SCI clinical characteristics

Participants provided demographic information, including age, sex, education, income, marital status, and date of SCI. Participants were asked about SCI duration, arm and leg functioning, the cause of SCI, wheelchair use, and co-morbid conditions.

### Community Integration Questionnaire

The CIQ has 15 items and three subscales. The Home Integration subscale has five items rated on a 3-point scale that assess involvement in household shopping, meal preparation, housework, child care, and planning social arrangements. The Social Integration subscale has one item assessing involvement in home finances, three items assessing monthly frequency of shopping, leisure activities, and visiting friends/relatives, one item asking about having a best friend, and one item about whom one participates in leisure activities with. The Productive subscale consists of four questions that assess frequency of travel outside the home, current work situation, student status, and volunteer activities. The CIQ has a total scale score range of 0–27, with possible ranges of 0–10 for the Home subscale, 0–12 for the Social subscale, and 0–7 for the Productive subscale. In TBI studies, the CIQ has demonstrated good criterion and construct validity,<sup>12,20–22</sup> test–retest reliability,<sup>11,20</sup> inter-rater reliability,<sup>11,23</sup> and full-scale internal reliability.<sup>21,24,25</sup> Internal consistency for the Social and Productive subscales is not consistently supported.

The aforementioned two new CIQ items ask about the frequency of “entertaining friends or relatives inside your home” and “email and internet activities such as shopping, chatting with friends, dating, games, research, etc.” on a 3-point scale (0 = never to 2 =  $\geq 5$  times/month). These items have not been included in earlier psychometric studies.

### Data analysis

#### Factor structure

Prior to examining the factor structure of the CIQ, we calculated the rate of missing values across each CIQ item at both time points. To examine the structure of the items of the CIQ in this sample of adults with SCI, we conducted an exploratory factor analysis (EFA) with Geomin (default) and Varimax (orthogonal) rotations on the Time 1 CIQ data. Because all previous factor analyses have found different item loadings

on the three factors, generation of factors in this sample was exploratory. Scree plot, Kaiser criterion (eigen values  $\geq 1$ ), and item loadings were all considered to determine how many factors to retain. Because the response scale is ordinal, factor analyses were conducted on a polychoric correlation matrix. We used robust weighted least squares to estimate models. Items with loadings  $\leq 0.40$  were considered to be weak, and we dropped these from the scale. To examine the stability of the factor structure in our sample, we conducted a confirmatory factor analysis (CFA) on the Time 2 CIQ data. We first conducted the EFA on the original CIQ and subsequently conducted an EFA on the “expanded set” of CIQ items that included the two new items. Factor analyses were conducted using Mplus Version 7.0 statistical software.<sup>26</sup> Model fit was evaluated with the Bentler's Comparative Fit Index (CFI)<sup>27,28</sup> on which values  $> 0.95$  indicate good fit.<sup>28,29</sup> We also examined the root mean square error of approximation (RMSEA) where values  $< 0.05$  indicate close fit,  $< 0.80$  indicate reasonable fit, and  $> 0.08$  indicate poor fit.<sup>29,30</sup> Finally, we considered the standardized root mean square residual (SRMR), where a value  $< 0.08$  is generally considered a good fit.<sup>29</sup>

### Score distribution and measurement reliability and validity

After establishing the factor structure, we computed CIQ total and subscale scores to represent each factor. We examined the distribution of scores (skew, kurtosis, and ceiling and floor effects) and computed Cronbach's alpha values to estimate the internal reliability ( $\geq 0.70$  indicated acceptable levels of internal reliability<sup>31</sup>) for the total CIQ score and subscales. To assess criterion validity, we conducted univariate general linear models, examining the associations between the CIQ scores and age, sex, and wheelchair use. These analyses were conducted using both Time 1 and Time 2 data.

## Results

### Sample characteristics

A total of 627 adults with SCI completed Time 1 surveys and 494 returned Time 2 surveys. The average number of days between Time 1 and Time 2 was 410.32 (SD = 161.28; median = 374.50 days). Demographic and clinical data for the samples at both time points are presented in Table 1. Compared to those who did not return the follow-up survey, Time 2 respondents were significantly younger (mean age responders = 47.17 (0.61), non-responders = 52.46 (1.17)), had lower levels of leg use (response rates = 64% for full use, 76% for partial use, and 82% for no use), were more likely to

**Table 1 Sample demographics and clinical characteristics at Time 1 and Time 2**

Variable	Time 1 (N = 627)		Time 2 (N = 494)	
	M (SD)	Min–Max	M (SD)	Min–Max
Age (years)	48.28 (13.50)	18–89	47.17 (12.98)	18–84
SCI duration (years)	16.52 (12.67)	1–63	16.15 (11.98)	2–61
	N	%	N	%
Female	228	36.5	193	39.1
Caucasian	558	89.0	436	89.2
Education				
No High school completed	8	1.3	6	1.2
High school completed	147	23.6	116	23.6
Technical school or College	326	52.2	255	51.8
Masters or higher degree	143	22.9	115	23.4
Currently not working	374	59.6	285	58.4
Married/cohabitating	332	53.4	260	53.1
Living in personal home/apartment	622	99.2	491	99.4
Living in a group home/nursing home	5	0.8	3	0.6
Endorsed having a brain injury	48	7.7	41	8.5
SCI etiology				
Vehicular accidents	272	52.0	202	50.6
Falls	91	17.4	59	14.8
Sports accidents	68	13.0	58	14.5
Medical/Surgical	57	10.9	48	12.0
Violence	35	6.7	32	8.0
Complete SCI	234	41.9	192	42.7
Arm use				
Full	360	58.0	289	59.0
Partial	243	38.8	187	38.2
No use	18	2.9	14	2.9
Leg use				
Full	41	6.6	27	5.5
Partial	190	30.5	144	29.3
No use	392	62.9	321	65.2
Wheelchair use				
Does not use wheelchair	90	14.4	64	13.0
Push self in manual wheelchair	327	52.2	257	52.0
Use power wheelchair	192	30.6	159	32.2
Pushed by somebody else in manual wheelchair	18	2.9	14	2.8

Note: SCI, spinal cord injury; M mean; SD standard deviation; N, number.

be female (response rates = 85% of women, 75% of men), and more likely to be working (response rates = 85% of working, 75% of unemployed). All other factors were not significantly different between Time 2 responders and non-responders (all  $P > 0.16$ ).

### Factor analysis

#### Exploratory factor analysis (Time 1)

Rates of missing values across all CIQ items at Time 1 ranged from 0% for the question on travel (CIQ12) to 1.9% (12/627 values) for the question on who plans social events (CIQ5). The average rate of missing data across all CIQ items at Time 1 was 0.69% (4.3/627 values). Only 111 (18%) participants reported having children in the home and the item regarding childcare (CIQ4) was therefore dropped from analyses. For the remaining 14 items, the screen plot showed a clear bend indicating the existence of three factors all of which had Eigen values  $\geq 1.0$ . Although the 3-factor

solution had good data fit statistics (Table 2), examination of the item loadings on the three factors under unrotated, Geomin and Varimax EFA conditions indicated there were problems with items that did not load strongly on any factors (e.g. work, school) and items that cross-loaded on multiple factors (frequency of shopping). Elimination of weak or cross-loading items would have decimated the measure and was not a good solution. Instead, we examined whether adding the two new items suggested by consumers with SCI resulted in an improved, parsimonious, and interpretable factor structure. Addition of both items did improve the loading of other items across the factors, but the internet/email item did not load under any rotation condition. The school item also did not load on any factor under any conditions; this item was highly skewed, with 88% not attending school. Elimination of the school and internet/email items and addition of the suggested new item about

**Table 2 Results of exploratory factor analysis with Varimax (orthogonal) rotation for 3-factor models, for the original scale and expanded scale (i.e. including the new item) at Time 1 and the expanded scale at Time 2**

Fit statistics	Time 1						Time 2		
	Original Scale			Expanded Scale			Expanded Scale		
	RMSEA = 0.046, CI <sup>90</sup> = 0.02–0.05 CFI = 0.99 SRMR = 0.032			RMSEA = 0.048, CI <sup>90</sup> = 0.03–0.06 CFI = 0.98 SRMR = 0.048			RMSEA = 0.050, CI <sup>90</sup> = 0.04–0.06 CFI = 0.98 SRMR = 0.051		
	Home Factor 1	Social Factor 2	Productive Factor 3	Home Factor 1	Social Factor 2	Productive Factor 3	Home Factor 1	Social Factor 2	Productive Factor 3
Who shops for groceries? CIQ1	0.83			0.82			0.80		
Who prepares meals? CIQ2	0.94			0.95			0.94		
Who does housework? CIQ3	0.84			0.83			0.86		
Who cares for children? CIQ4	–	–	–	–	–	–	–	–	–
Who plans social arrangements? CIQ5	0.59			0.60			0.52		
Who looks after finances? CIQ6	0.58			0.57			0.59		
Frequency of shopping CIQ7	0.51		0.58	0.49			0.42	0.64	
Frequency of leisure activities CIQ8			0.84		0.59			0.78	
Frequency of visiting friends or relatives <b>outside</b> your home? CIQ9			0.74		0.65			0.67	
Who do you participate in leisure activities with? CIQ10			0.52		0.52				0.46
Do you have a best friend? CIQ11			0.42		0.42				0.47
Frequency of travel outside of the home? CIQ12		4.22				0.90		0.78	
Work CIQ13	0.23	0.14	0.29			0.58		0.52	
School CIQ14	0.08	0.09	0.14	–	–	–	–	–	–
Volunteer work CIQ15			0.41		0.40			0.35	
<b>New item</b>									
Frequency of entertaining friends or relatives <b>inside</b> your home?	–	–	–		0.54				0.57

Note: Item loadings <0.40 are not depicted in the table unless all loadings for an item were <0.40. A dash (–) indicates an item that either was dropped from analyses due to low frequency (i.e. CIQ4, CIQ14) or was a new item, not previously available. CI<sup>90</sup>, 90% confidence interval; RMSEA, root mean square error of approximation; CFI, Bentler's Comparative Fit Index; SRMR, standardized root mean square residual. Values in bold font indicate that an item loads sufficiently on a given factor.

entertaining inside one's home resulted in the most easily interpretable factor structure.

Data fit indices for the final factor structure, depicted in the middle columns of Table 2 ("Expanded Scale"), suggest acceptable to excellent fit of the model to the data (i.e. CFI > 0.95, RMSEA < 0.05, SRMR < 0.08). This factor structure is largely consistent with that found in the original scale,<sup>11</sup> as can be seen in Table 3. Different item loadings were found for the shopping frequency item (CIQ7), which loaded on the Home rather than Social subscale, and the volunteer work item (CIQ15), which loaded on the Social rather than Productive subscale.

### Confirmatory factor analysis (Time 2)

Rates of missing values across all CIQ items at Time 2 ranged from 0% for the question on work (CIQ13) to

2.43% (12/494 values) for the question on who plans social events (CIQ5). The average rate of missing data across all CIQ items at Time 2 was 0.99% (4.93/494 values). Model fit indices indicate that the 3-factor structure identified at Time 1 was not a good fit to the Time 2 data (RMSEA = 0.091 (90% CI = 0.083–0.099), CFI = 0.89). The original scale structure<sup>11</sup> was also not a good fit to the Time 2 data (RMSEA = 0.102 (90% CI = 0.094–0.110), CFI = 0.85). Given that previously established factor structures were not a good fit to the data, we conducted a *post hoc* EFA on the Time 2 data, following the same iterative approach as described for the Time 1 EFA. The best fitting and most interpretable factor structure in the Time 2 data (Table 2) had three factors and, similar to the Time 1 data, included the new item on entertaining friends in the home. Compared to Time 1, the factor structure at

**Table 3 Comparison of CIQ factor structure across psychometric studies**

Sample	Willer (1993) <i>N</i> = 49 TBI	Sander (1998) <i>N</i> = 312 TBI	Hirsh <i>et al.</i> (2011) <i>N</i> = 751 mixed*	Current study	
				Time 1 <i>N</i> = 627 SCI	Time 2 <i>N</i> = 494 SCI
Who shops for groceries? (CIQ1)	Home	Home	Home	Home	Home
Who prepares meals? (CIQ2)	Home	Home	Home	Home	Home
Who does everyday housework? (CIQ3)	Home	Home	Home	Home	Home
Who cares for children in the home? (CIQ4)	Home	–	–	–	–
Who plans social arrangements? (CIQ5)	Home	Home	Home	Home	Home
Who looks after personal finances? (CIQ6)	Social	<b>Home</b>	<b>Home</b>	<b>Home</b>	<b>Home</b>
Frequency of shopping (CIQ7)	Social		Home/Social	Home	Productive
Frequency of leisure activities (CIQ8)	Social	Social	Social	Social	Productive
Frequency of visiting friends or relatives outside your home? (CIQ9)	Social	Social	Social	Social	Productive
Who do you participate in leisure activities with? (CIQ10)	Social	Social	Social	Social	Social
Do you have a best friend? (CIQ11)	Social	Social	Social	Social	Social
Frequency of travel outside of the home? (CIQ12)	Productive	<b>Social</b>	Productive	Productive	Productive
Work (CIQ13)	Productive	Productive	<b>Social/Productive**</b>	Productive	Productive
School (CIQ14)	Productive	Productive		–	–
Volunteer work (CIQ15)	Productive	Productive		<b>Social</b>	Productive

\*Mixed sample, SCI *n* = 146, multiple sclerosis *n* = 174, limb loss *n* = 158, muscular dystrophy *n* = 273.

\*\*CIQ13–CIQ15 were combined into a single item in this study.

Items that load on different factors compared to previous studies are displayed in bold font.

Time 2 had more points of deviation from the original scale structure<sup>11</sup> (see Table 3 for comparisons).

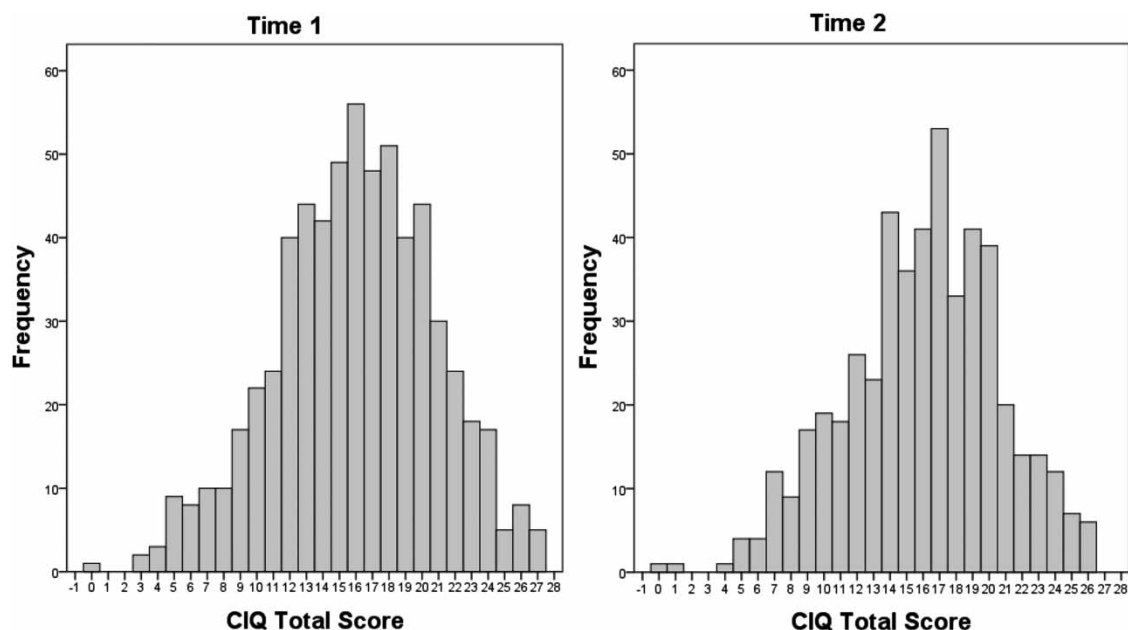
### Distribution characteristics

The CIQ was scored at both time points based on the factor structure established at Time 1. Total CIQ scores were normally distributed at both time points (Fig. 1), and demonstrated low frequencies of ceiling and floor effects (Table 4). The CIQ subscales were

also normally distributed and had low rates of floor and ceiling effects, with the exception of the Productive subscale, which had high rates of ceiling effects.

### Reliability

At both time points, the CIQ Total scale and the Home subscale demonstrated adequate internal reliability (i.e.



**Figure 1** Histograms of CIQ Total scores at Time 1 (*N* = 627) and Time 2 (*N* = 494).

**Table 4** Distribution characteristics for CIQ total and subscales scores at Time 1 (N = 627) and Time 2 (N = 494)

	Time 1				Time 2			
	CIQ total	Home	Social	Productive	CIQ total	Home	Social	Productive
Mean	15.93	6.47	7.25	2.23	15.95	6.53	7.16	2.26
SD	4.82	3.03	2.44	1.27	4.65	3.00	2.40	1.28
Minimum	0	0	0	0	0	0	0	0
Maximum	27	12	12	4	26	12	12	4
# (%) at floor	1 (0.2)	8 (1.3)	4 (0.6)	54 (8.6)	1 (0.2)	6 (1.2)	3 (0.6)	40 (8.1)
# (%) at ceiling	5 (0.8)	40 (6.4)	10 (1.6)	147 (25)	0 (0)	38 (7.7)	10 (2.0)	134 (27.1)
Skew	-0.21	0.15	-0.52	0.05	-0.28	0.16	-0.43	0.40
Kurtosis	-0.14	-0.81	-0.01	-1.01	-0.87	-0.73	-0.01	-1.08

Note: SD, standard deviation.

**Table 5** Internal reliability of the CIQ Total score and subscale scores

	Time 1 Cronbach's alpha (# items)	Time 2 Cronbach's alpha (# items)
Total CIQ	0.75 (14)	0.71 (14)
Home integration	0.81 (6)	0.79 (6)
Social integration	0.63* (6)	0.62* (6)
Productive integration	0.51* (2)	0.50* (2)

Note: \*Poor internal reliability (e.g. <0.70).

$\alpha \geq 70$ ), but poor internal reliability for the Social and Productive subscales (Table 5).

### Validity

Validity of the measure is suggested at both time points by significant differences in community integration by sex, age, and wheelchair use (Table 6). Findings for sex are consistent with previous research<sup>11</sup> and traditional gender stereotypes in the United States, with women showing higher levels of Total and Home integration compared to men. CIQ scores decreased significantly with increasing age, with exception of scores on the Home subscale, where scores were the highest for those aged 40–59 years. CIQ scores differed by wheelchair use, with those who did not use a wheelchair showing the highest Home integration and those who pushed their own manual chairs having the highest Social, Productive, and Total integration scores. Findings were highly consistent between the two time points.

### Discussion

Community (re)integration is a central goal of rehabilitation care following SCI. As such, efforts are needed to ensure that outcome measures assess integration domains that are relevant to the patient, provide valid and reliable measurement of a large range of integration (i.e. from very low to very high levels of integration on

each subdomain), are sensitive to changes in integration level, and are acceptable and accessible for easy and widespread administration. This study is the first to examine the psychometric qualities of the CIQ, a brief self-report measure of community integration, in a large and geographically diverse sample of individuals with SCI.

As predicted, the EFA at Time 1 indicated a three-factor structure that largely mapped onto the original factor structure.<sup>11</sup> However, the model would only converge after we eliminated the school item and added the item suggested by SCI stakeholders relating to entertaining *inside* the home. This suggests that items that assess low-frequency activities for a population (e.g. student status, childcare) do not contribute to accurately assessing community integration. Additionally, for people with SCI and other clinical populations with limited mobility, evaluating social activities that take place inside the home may be essential to adequately measuring social participation. Interestingly, the CFA conducted in the Time 2 data did not verify a three-factor structure; a post hoc EFA using Time 2 data indicated a three-factor model that, with the exception of most of the Home integration items, did not overlap well with factor structures from other samples.

Total CIQ scores at both time points were normally distributed. Low ceiling and floor effects indicate that the CIQ Total score and Home and Social subscales have adequate range to assess community integration along the full spectrum of functioning. However, the Productive subscale had problems with ceiling effects, suggesting that items that assess a higher range of productive functioning (e.g. career advancement) may better assess the full range of productive activity in an SCI population.

The adequate internal consistency for the full-scale CIQ and Home subscale but poor internal consistency for the Social and Productive subscales are consistent with previous findings.<sup>21,24,25</sup> As a group, these findings

**Table 6** General Linear Model (GLM) results comparing CIQ total and subscale scores by sex, age, and wheelchair use at Time 1 (*N* = 627) and Time 2 (*N* = 494)

	CIQ total Mean (SD)	Home Mean (SD)	Social Mean (SD)	Productive Mean (SD)
<i>Time 1</i>				
Sex				
Males	15.32 (4.92)	5.86 (3.01)	7.21 (2.44)	2.19 (1.23)
Females	17.02 (4.46)	7.55 (2.76)	7.35 (2.44)	2.25 (1.29)
<i>F</i> (1, 627) =	18.53, <i>P</i> < 0.001	48.03, <i>P</i> < 0.001	0.47, <i>P</i> = 0.49	0.339, <i>P</i> = 0.56
Age				
18–39 ( <i>n</i> = 158)	17.24 (4.80)	3.96 (2.94)	7.80 (2.12)	2.51 (1.23)
40–59 ( <i>n</i> = 336)	15.90 (4.76)	6.61 (2.99)	7.00 (2.56)	2.29 (1.33)
60–89 ( <i>n</i> = 121)	14.29 (4.61)	2.45 (3.03)	7.13 (2.45)	1.75 (0.95)
<i>F</i> (2, 627) =	13.29, <i>P</i> < 0.001	9.50, <i>P</i> < 0.001	6.03, <i>P</i> = 0.003	13.54, <i>P</i> < 0.001
Wheelchair use				
No use ( <i>n</i> = 90)	16.37 (4.63)	7.30 (2.92)	6.76 (2.74)	2.31 (1.20)
Push self ( <i>n</i> = 327)	17.25 (4.48)	7.21 (2.99)	7.58 (2.26)	2.45 (1.25)
Power chair ( <i>n</i> = 192)	13.86 (4.62)	5.04 (2.50)	6.98 (2.52)	1.89 (1.26)
Pushed by other ( <i>n</i> = 18)	12.06 (4.51)	3.83 (2.57)	6.72 (2.37)	1.50 (0.99)
<i>F</i> (3, 627) =	27.08, <i>P</i> < 0.001	31.48, <i>P</i> < 0.001	4.30, <i>P</i> = 0.02	10.68, <i>P</i> = 0.049
<i>Time 2</i>				
Sex				
Males	15.42 (4.56)	5.89 (2.92)	7.18 (2.36)	2.36 (1.29)
Females	16.90 (4.64)	7.62 (2.80)	7.13 (2.46)	2.15 (1.27)
<i>F</i> (1, 486) =	12.09, <i>P</i> < 0.01	41.84, <i>P</i> < 0.001	0.06, <i>P</i> = 0.82	3.25, <i>P</i> = 0.07
Age				
18–39 ( <i>n</i> = 158)	17.31 (4.74)	7.13 (3.02)	7.60 (2.44)	2.58 (1.24)
40–59 ( <i>n</i> = 336)	16.08 (4.48)	6.71 (2.86)	7.03 (2.41)	2.34 (1.31)
60–89 ( <i>n</i> = 121)	14.38 (4.52)	5.53 (3.10)	7.11 (2.28)	1.80 (1.10)
<i>F</i> (2, 483) =	11.17, <i>P</i> < 0.001	8.62, <i>P</i> < 0.001	2.31, <i>P</i> = 0.10	11.16, <i>P</i> < 0.001
Wheelchair use				
No use ( <i>n</i> = 72)	15.97 (4.11)	6.89 (2.76)	6.79 (2.52)	2.29 (1.24)
Push self ( <i>n</i> = 246)	17.05 (4.56)	7.21 (3.03)	7.39 (2.39)	2.44 (1.30)
Power chair ( <i>n</i> = 153)	14.42 (4.46)	5.38 (2.64)	7.07 (2.31)	2.01 (1.26)
Pushed by other ( <i>n</i> = 17)	14.53 (5.59)	6.11 (3.62)	6.53 (2.58)	1.88 (1.11)
<i>F</i> (3, 487) =	11.29, <i>P</i> < 0.001	13.11, <i>P</i> < 0.001	1.76, <i>P</i> = 0.15	4.20, <i>P</i> < 0.01

Note: *F*, Fischer's Exact Test with (degrees of freedom); SD, standard deviation.

indicate that the CIQ factor structure is not stable across samples or time; the Home subscale seems to be the most consistent subscale (see Table 3). Results indicating that the CIQ scores differed by sex, age, and wheelchair use in expected ways suggest that the CIQ is a valid measure in SCI.

These findings indicate that the CIQ may provide useful information about community integration, but the analyses suggest clear weaknesses in the CIQ in its present form, at least in individuals with SCI. Importantly, the findings also provide important information regarding how the CIQ might be improved. For example, items on the Home subscale reflecting housework, grocery shopping, meal preparation, etc., appear to hold together in both samples, suggesting that the Home integration domain could be assessed reliably in persons with SCI. The CIQ was developed 20 years ago and may provide a dated assessment of social connectedness and activity. In this study, consumers suggested adding an item that assesses internet-based social interactions to the CIQ. Although the

internet/email item did not load on any factor of the CIQ in the current study, the use of social media and internet-based resources have emerged and grown in the past two decades and are associated with health-related quality of life in people with SCI.<sup>32,33</sup> Consequently, these social activities may be important when measuring re-integration into age- and culturally-appropriate roles and responsibilities following SCI.

Findings highlight the limitations of using the CIQ to assess community integration across the life span. Items that relate to childcare are relevant only to those who are at child-bearing/rearing age and school participation may be less relevant to older individuals. In this and previous evaluations of the CIQ, the child care item has been eliminated due to item skew,<sup>12,18</sup> and in this study, the school item was eliminated for the same reason. Shifting demographics around the world indicate dramatic increases in the rate of adults serving as caregiver to elderly relatives.<sup>34</sup> If caregiving is conceptualized as a key aspect of participation, taking care of



spouses, elderly individuals, and children may need to be reflected in a comprehensive community integration measure.

The current study has a number of notable strengths. The large, heterogeneous sample provided adequate power to conduct the psychometric analyses. All previous psychometric studies of the CIQ have used Pearson correlation matrix-based factor analytic procedures, which is not an optimal approach to use with items that have ordinal response options.<sup>35</sup> This study marks the first time that an EFA was conducted using polychoric correlations to determine factor structure, which is the appropriate approach given the categorical CIQ response options.<sup>26,35</sup> Furthermore, the longitudinal study design provided the ability to examine factor structure stability over time.

### Study limitations

Study sample factors, including few participants who were ethnic minority and the fact that participants were self-recruited, and identified through their association with a large disability advocacy organization or VA, may have resulted in a sample that is not representative of the broader population of persons with SCI, which could limit the generalizability of findings. In addition, because the subsample that completed Time 2 data was significantly different from the Time 1 sample on a number of demographic and clinical variables, extra caution in generalizing findings from the Time 2 data to the broader population is warranted. The fact that other measures of participation, social integration, or quality of life were not administered in this study limited our ability to examine some aspects of validity (e.g. construct validity).

### Conclusions

In this study, the CIQ demonstrated a factor structure that was neither stable over time nor consistent with previous findings. The CIQ Home subscale performs the best and may provide a sufficient measure of domestic integration for individuals with SCI. However, for social, vocational, and other types of integration, the CIQ may not provide a reliable or adequately broad measure of integration for individuals with SCI. Further study of the psychometric properties of the CIQ, including examination of the construct validity and sensitivity to change, is necessary to fully determine its usefulness in SCI. Given its poor psychometric performance in terms of factor stability, subscale reliability, and ceiling effects, alterations to the measure may be necessary before its further use in persons with SCI can be recommended. The CIQ may be improved by

adding items that assess higher levels of productive integration, integration across the lifespan, and home- and internet-based social activities.

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**Contributors** There are no non-author contributors.

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**Conflicts of interest** The authors have no conflicts of interest to declare.

**Ethics approval** The MedStar Research Institute Institutional Review Board approved all study procedures prior to the start of data collection.

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