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THE IMPACT OF PERCEIVED ENVIRONMENTAL BARRIERS ON COMMUNITY INTEGRATION IN PERSONS WITH TRAUMATIC BRAIN INJURY

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SUMMARY

Background
Earlier models of disability emphasized the impact of only injury-related factors impeding community integration. However, recent models incorporate the significance of physical and social environment on community integration. This study aimed to identify perceived environmental barriers that impact community integration among an ethnically diverse sample of persons with traumatic brain injury (TBI).

Material/ Methods:
A total of 167 patients with medically documented TBI, consecutively admitted to the Neurosurgery Service at a Level I trauma center, participated in this study. Participants completed assessments in their homes at least 6 months post injury. Environmental barriers were assessed using the Craig Hospital Inventory of Environmental Factors – Short Form (CHIEF-SF). Community integration was evaluated using the Community Integration Measure (CIM) and the Craig Handicap Assessment and Reporting Technique – Short Form (CHART-SF).

Results:
After accounting for injury severity, race and pre-injury productivity, MANCOVA results indicated that service/assistance barriers was significantly associated with decreased community integration. Trends were found for physical/structural and attitudinal/support barriers. Multiple regression analyses revealed that physical/structural barriers were associated with decreased independent participation, belonging, and occupation/productivity outcomes. Service/assistance barriers were associated with both decreased independent participation and mobility. Attitudinal/support barriers were associated with increased community mobility.

Conclusions:
Certain environmental barriers perceived by persons with TBI may negatively impact their reintegration to the community post injury. Identifying such barriers may help develop programs or policies to reduce barriers, while facilitating improved access to health care and other services after injury.

Key words: participation, environment, outcomes assessment (health care), rehabilitation

INTRODUCTION

The negative impact of traumatic brain injury (TBI) on community integration has been well-documented, including decreased independence in daily life (Kersel et al., 2001; Ponsford. Olver, & Curran, 1995; Sander et al., 1999), unemployment and reduced productivity (Kreutzer et al., 2003; van Velzen et al., 2009), decreased participation in leisure activity (Bier et al., 2009; Kersel et al., 2001), and disruption of friendships (Olver, Ponsford, & Curran, 1996; Seibert et al., 2002) and intimate relationships (Gill et al., 2011; Wood et al., 2005). Worse community integration has been noted for African Americans and Hispanics compared to Whites (Arango-Lasprilla et al, 2008; Hart et al., 2005; Rosenthal et al., 1996; Sander et al., 2009; Sherer et al., 2003).

Prediction of community integration has been the topic of several reviews, particularly with regard to productivity outcomes (Nightingale et al., 2007; Reistetter & Abreu, 2005; van Velzen et al., 2009; Willemse-van Son et al., 2007). While demographic and injury characteristics account for a portion of the variance in outcomes, a large portions remains unaccounted for across studies. Environmental factors have been increasingly emphasized as an important contributor to community integration outcomes (Sander et al., 2010; Whiteneck & Dijkers, 2009), and quality of life of the of persons with TBI (Pachalska et al 2012).

In a recent paper, Sander et al. (2011) conducted qualitative interviews to assess perceptions of community integration in 167 persons with TBI, including Whites, African Americans, and Hispanics. The results indicated that almost half of participants mentioned aspects of the environment as being important for their sense of belonging in the community. Environmental factors that were mentioned included quality of relationships amongst people in their community, and safety and organization of the community. A greater percentage of blacks and Hispanics mentioned the environment as an important factor that influences their sense of belonging in the community. This perceived importance of environmental factors for facilitating or obstructing community integration is reflected in the most recent models of disability: the New Paradigm of Disability by the National Institute on Disability and Rehabilitation Research (Pledger, 2003; US Department of Education, 2000), along with the ICF or International Classification of Functioning, Disability and Health (World Health Organization, 2001). These models emphasize that the injury and its resulting impairments are not the only determinants of outcomes. Environmental factors, including physical accessibility, service availability, social attitudes, social support, and government policies can impact participation or community integration.

There is literature available on the environmental impact in persons with TBI in the US. One study examined the relationship between neighborhood characteristics and outcomes in 200 persons with TBI (Corrigan & Bogner, 2008). They assessed the impact of specific environmental factors, including natural environment and human-made changes to environment, support and relationships, services, systems, and policies. The economic and social characteristics of a person's neighborhood contributed to the total variance in the Glasgow Outcome Scale and the Satisfaction With Life Scale. However, individual characteristics (e.g. demographics, pre-morbid, and injury-related factors), functional status, and the individual's perception of environmental influences contributed the greatest amount of variance. Whiteneck et al. (2004) found that persons with TBI reporting greater environmental barriers also reported lower levels of participation and life satisfaction in a sample of 73 persons with TBI at 1 year post injury. While Whiteneck et al. (2004) was the first study to assess perceived environmental factors in a sample of persons with TBI, this is the first study to identify such factors utilizing a racially/ethnically and socio-demographically diverse sample of persons with TBI. This study aims to identify the unique contribution of environmental barriers to community integration in a diverse sample of persons with TBI.

METHODS

Participants

A total of 167 persons with medically documented traumatic brain injury (TBI) agreed to participate in the study. The participants were at least 18 years of age, resided in the community in a private residence at 6 months post injury, and were cognitively able to provide consent and valid answers to assessment instruments. No participants had cognitive impairments that would impede their participation (e.g. aphasia, minimally conscious states), pre-existing neurological disorders (e.g. stroke, progressive dementia), or severe psychiatric disorder (e.g. schizophrenia or other psychotic disorder).

Instruments

CHIEF-SF. Environmental barriers were assessed using the Craig Hospital Inventory of Environmental Factors – Short Form (CHIEF-SF) (Craig Hospital Research Department, 2001; Whiteneck et al., 2004). The CHIEF-SF consists of 12 items, which make up the 5 domains of the original 25-item CHIEF instrument: (1) service/assistance, (2) physical/structural, (3) work/school, (4) attitude/support, and (5) policy. The CHIEF-SF was developed to be a feasible way to assess the frequency, magnitude, and overall impact of perceived environmental barriers, while being sensitive in distinguishing persons with disability from those without disability. It has documented reliability and validity and has been tested with persons with TBI (Whiteneck et al., 2004). Respondents are asked to rate how often they have experienced a particular barrier over the past 12 months. For the current study, the instrument was modified to assess frequency of barriers over the past 6 months (daily; weekly; monthly; less than monthly; never). For responses other than "never" participants are asked to indicate the magnitude of the problem ("big problem" or "little problem"). Scoring is done by multiplying the frequency (0=never to 4=daily) by the magnitude (1=little problem; 2=big problem) to obtain the overall impact score. For the work/school domain, if the respondent was neither working nor in school, the items were not scored and marked "not applicable." As the majority of participants were neither working nor in school post injury, this domain was dropped from the analysis due to insufficient power. Subscale or domain ratio scores were utilized to account for missing items, which may range from 0 to 8.

CIM. Community integration was assessed using the Community Integration Measure (CIM) (McColl et al., 2001). The CIM is a client-centered 10-item instrument based on a theoretical model of community integration, which was developed based on input from participants with TBI. The CIM provides a subjective measurement of a participant's community integration, which is conceptualized by assimilation into the community, support from others, occupation (productivity & leisure activities), and the ability to live independently (McColl et al., 2001). Based on a principal components factor analysis, two factors were identified: belonging and independent participation. Each item is rated from 1 'always disagree' to 5 'always agree'. The two subscales, consisting of 5 items each, are calculated by summing the items. Higher scores indicate a greater sense of belonging in the community and a greater sense of independence in the community, for each respective subscale. The CIM has demonstrated content, discriminant, criterion, and construct validity (McColl et al., 2001). Good reliability has been demonstrated with samples consisting of survivors, college students, and family members (McColl et al., 2001).

CHART-SF. Community integration was also assessed using the Craig Handicap Assessment and Reporting Technique – Short Form (CHART-SF) (Mellick et al., 1999). The 19-item CHART-SF is an abbreviated version of the original 32-item CHART. It was developed to assess community participation after neurological impairments and disabilities (Whiteneck et al., 1992). The instrument consists of 6 subscales: (1) Physical independence; (2) Cognitive independence; (3) Mobility; (4) Occupation/Productivity; (5) Social integration; (6) Economic self-sufficiency. This study only utilized the mobility, occupation/productivity, and social integration subscale scores. The CHART-SF Mobility subscale assesses an individual's ability to move about effectively in his/her surroundings. The Occupation/Productivity subscale assesses an individual's participation in various productive activities, such as employment, schooling, and active homemaking and home maintenance. The Social Integration subscale assesses the individual's participation in social relationships. Each subscale has a maximum score of 100, with higher scores associated with greater levels of community participation. Validity and good reliability has been demonstrated in outcome studies utilizing TBI samples (Cusick et al., 2001).

PROCEDURE

The participants were recruited based on consecutive admission to the Neurosurgery Service at a Level I trauma center in the southern part of the United States. Informed consent and completion of the assessment were done in the participant's home at least 6 months post injury and at least 3 months after completion of comprehensive medical/rehabilitative care. A bilingual (English- and Spanish-speaking) research assistant completed the assessment in the participant's primary language. The sample was ethnically and socio-economically diverse (31.1% White, 34.7% black/African American, and 34.1% Hispanic/Latino). Regarding family income, 49.2% reported a household income of $30,000 or less, while 20.4% had an income of more than $50,000. Of the 167 participants, 73.7% were male and 43.1% had never married. A typical participant was approximately 36 years old, with about 11 years of education, and 76.6% were born in the U.S. The majority (85.6%) selected English as their preferred language. At the time of data collection, 62.3% of the participants had full-time jobs, while 25.1% reported being unemployed (see Table 1).

Statistical Analyses

Statistical analyses were conducted using SPSS version 20.0. The community integration measures (CIM & CHART-SF subscales) were correlated with each other and were used in a multivariate analysis of covariance (MANCOVA). The measures of environmental barriers (CHIEF-SF) were utilized as covariates in the analysis to identify significant associations with the dependent variables collectively. Additionally, five multiple regression analyses were conducted with each of the subscales from the CIM and CHART-SF used as dependent variables. Injury severity (measured by the Glasgow Coma Scale score, GCS; Teasdale & Jennett, 1974), race/ethnicity, and pre-injury productivity (0=non-productive, 1=productive) were controlled for to identify the significant, predictive impact of each perceived environmental barrier on community integration outcomes.

RESULTS

For the MANCOVA of community integration subscale scores, a statistically significant multivariate F value was obtained for three independent variables: GCS [$F(5,148)=2.477$, $p<.05$]; service/assistance barriers [$F(5,148)=3.173$, $p<.01$]; and race [$F(10,298)=2,552$, $p<.01$].

Standard multiple regression analyses were used to identify the extent to which the independent variables from the MANCOVA analysis were predictive of each of the five community integration subscale scores. The eight aforementioned predictors (IVs) accounted for 18.8% of the total variance in CIM Independent Participation subscale scores with a significant model, $F(8,154)=4.443$, $p<.001$ (see Table 2). Racially self-identifying as black was associated with increased participation in comparison to identifying as non-black. More importantly, service/assistance and physical/structural barriers were associated with a lower score on the CIM Independent Participation subscale.

The second regression analysis indicated that the eight IVs accounted for 15.1% of the total variance in CIM Belonging subscale scores with a significant model, $F(8,154)=3.416$, $p<.001$ (see Table 3). Physical/structural barriers were associated with a decreased sense of belonging on the CIM Belonging subscale.

Table 1. Demographic characteristics of participants

Variables	N	%
Gender		
Male	123	73.7
Female	44	26.3
Age ($\bar{X}$=36.26, SD=15.763)		
18-30	76	45.5
31-40	35	21.0
41-50	26	15.5
51-60	17	10.2
61 and above	13	7.8
Education (Years) ($\bar{X}$=11.39, SD=3.108)		
0-12	115	68.9
13-18	52	31.1
Race		
White	52	31.1
Black	58	34.7
Latin/Hispanic	57	34.1
Born in the US		
Yes	128	76.6
No	39	23.4
Language		
English	143	85.6
Spanish	24	14.4
Marital		
Never Married	72	43.1
Married/Common Law	42	25.1
Divorced/Widowed	29	17.4
Separated	15	9.0
Cohabitating	9	5.4

Table 1. Demographic characteristics of participants

Pre-injure employment		
Employed	118	70.7
Irregular jobs	7	4.2
Unemployed	42	25.1
Family Income		
Below $10,000	30	18.0
$10,001-20,000	26	15.6
$20,001-30,000	26	15.6
$30,001-40,000	18	10.8
$40,001-50,000	8	4.8
$50,001-100,000	24	14.4
More than $100,001	10	6.0

Table 2. Multiple regression analysis of the Independent Participation subscale scores from the CIM

Variable	B	SE	t	Sig.
Glasgow Coma Scale (GCS)	0.057	0.081	0.699	.485
Service/Assistance barrier	-0.705	0.226	-3.127	.002*
Physical/Structural barrier	-0.417	0.198	-2.108	.037*
Attitude/Support barrier	0.336	0.217	1.547	.124
Policy barrier	0.101	0.180	0.564	.574
Race1 (1=Blacks; 0=others)	1.523	0.767	1.986	.049*
Race 2 (1=Hispanic; 0=others)	0.243	0.759	0.320	.749
Productive (1=yes; 0=no)	0.099	0.804	0.123	.902

$F(8,154)=4.443$, $p<0.001$; $R^2=0.188$;*$P<0.05$

The third regression analysis indicates that the eight IVs did not show a statistically significant impact on the CHART-SF Social Integration subscale scores, F(8,154)=1.938, p=.058 (see Table 4). Injury severity was associated with a significant increase in CHART-SF Social Integration subscale scores. Specifically, milder injuries were associated with higher Social Integration subscale scores. In addition, persons with TBI self-identifying as black/African American reported decreased social integration in comparison to others. There were no significant associations found between the perceived environmental barriers and the CHART-SF Social Integration subscale scores.

For the CHART-SF Occupation subscale, the regression analysis results indicated that the eight IVs accounted for 19.8% of the variance, F(8,154)=4.758, p<.01 (see Table 5). Injury severity (GCS) and pre-injury productivity were both predictive of greater productivity. Those who were productive prior to injury (i.e. employed, student, homemaker, volunteer) and had a milder injury (higher GSC score) were more likely to have greater productivity. After accounting for these variables, participants with greater perceived physical/structural barriers showed lower productivity on the CHART-SF Occupation subscale.

Table 3. Multiple regression analysis of the Belonging subscale scores from the CIM

Variable	B	SE	t	Sig.
Glasgow Coma Scale (GCS)	-0.041	0.078	-0.529	.598
Service/Assistance barrier	-0.162	0.218	-0.743	.459
Physical/Structural barrier	-0.484	0.191	-2.536	.012*
Attitude/Support barrier	-0.093	0.210	-0.445	.657
Policy barrier	-0.073	0.174	-0.442	.674
Race1 (1=Blacks; 0=others)	0.721	0.741	0.973	.332
Race 2 (1=Hispanic; 0=others)	1.143	0.733	1.559	.121
Productive (1=yes; 0=no)	-0.582	0.777	-0.749	.455

F(8,154)=3.416, p<0.001; R^2=0.151; *P<0.05

Table 4. Multiple regression analysis of the Social Integration subscale scores from the CHART-SF

Variable	B	SE	t	Sig.
Glasgow Coma Scale (GCS)	-0.041	0.078	-0.529	.598
Service/Assistance barrier	-0.162	0.218	-0.743	.459
Physical/Structural barrier	-0.484	0.191	-2.536	.012*
Attitude/Support barrier	-0.093	0.210	-0.445	.657
Policy barrier	-0.073	0.174	-0.442	.674
Race1 (1=Blacks; 0=others)	0.721	0.741	0.973	.332
Race 2 (1=Hispanic; 0=others)	1.143	0.733	1.559	.121
Productive (1=yes; 0=no)	-0.582	0.777	-0.749	.455

F(8,154)=3.416, p<0.001; R^2=0.151; *P<0.05

Table 5. Multiple regression analysis of the Occupation/Productivity subscale scores from the CHART-SF

Variable	B	SE	t	Sig.
Glasgow Coma Scale (GCS)	1.880	0.724	2.597	.010*
Service/Assistance barrier	-3.731	2.020	-1.847	.067
Physical/Structural barrier	-3.596	1.770	-2.032	.044*
Attitude/Support barrier	2.676	1.946	1.375	.171
Policy barrier	1.074	1.608	0.668	.505
Race1 (1=Blacks; 0=others)	-7.095	6.869	-1.033	.303
Race 2 (1=Hispanic; 0=others)	-12.137	6.798	-1.785	.076
Productive (1=yes; 0=no)	24.000	7.199	3.334	.001*

$F(8,154)=4.758$, $p<0.001$; $R^2=0.198$; $*P<0.05$

Table 6. Multiple regression analysis of the Mobility subscale scores from the CHART-SF

Variable	B	SE	t	Sig.
Glasgow Coma Scale (GCS)	0.199	0.318	0.626	.532
Service/Assistance barrier	-2.553	0.887	-2.878	.005*
Physical/Structural barrier	-0.819	0.777	-1.053	.294
Attitude/Support barrier	2.384	0.855	2.790	.006*
Policy barrier	0.449	0.706	0.636	.526
Race1 (1=Blacks; 0=others)	-2.236	3.016	-0.741	.460
Race 2 (1=Hispanic; 0=others)	-3.505	2.985	-1.174	.242
Productive (1=yes; 0=no)	4.491	3.161	1.563	.120

$F(8,154)=2.720$, $p=0.008$; $R^2=0.124$; $*P<0.05$

The results of the final regression analysis showed that the eight IVs accounted for 12.4% of the variance in the Mobility subscale score of the CHART-SF, F(8,154)=2.720, p<.001 (see Table 6). Greater perceived service/assistance barriers were predictive of decreased mobility on the CHART-SF Mobility subscale. In contrast, perceived attitude/support barriers were predictive of increased mobility.

DISCUSSION

The results of the current study indicate that environmental factors can contribute to community integration outcomes, after controlling for injury severity, race/ethnicity, and pre-injury productivity. These findings are consistent with the perceptions of persons with TBI about the importance of environment in facilitating or obstructing community integration (Sander et al., 2011). The findings are also consistent with the broader conceptualization of disability that is emphasized in the NIDRR New Paradigm of Disability and the WHO International Classification of Functioning, Disability, and Health.

In the current study, physical/structural barriers were associated with decreases on an objective measure of community integration, the CHART-SF occupation scale, as well as on a subjective measure of community integration-the CIM. In both cases, more barriers were associated with reduced integration. It makes intuitive sense that persons with TBI who cannot navigate their communities are likely to be less productive. Interestingly, they also feel less productive, and feel a lesser sense of belonging, as indicated by their responses to the CIM scales. The current results also indicate that barriers in the area of service/assistance are associated with decreased community mobility and with a decreased sense of independence for persons with TBI. It is important to remember that the results indicate a relationship, but not cause and effect. It is possible that persons who are less mobile have less access to services and feel less independent. Future studies may clarify this possibility by investigating the relationship between service barriers and mobility for those with physical impairments compared to those without. At any rate, improving access to services for people with TBI, regardless of physical impairment, would appear to be important for improving community integration.

A counterintuitive finding of the current study was that attitudinal barriers were associated with increased community mobility. One possible explanation is that persons with TBI who were more mobile in the community had exposure to a greater number of people, with the potential for encountering more negative attitudes and stigma. Education to reduce the stigma associated with TBI may be beneficial in improving community integration outcomes.

The current findings were somewhat consistent with those of Whiteneck et al. (2004). Both studies found a negative relationship between service/assistance barriers and mobility outcomes, as well as between physical/structural barriers and occupation outcomes; however, Whiteneck and colleagues also found relationships between occupation outcome and the other four CHIEF subscales. Our results may differ for various reasons. We investigated each of the individual environmental barriers' predictive value after controlling for race/ethnicity, injury severity, pre-injury productivity, and the other environmental barriers. Whiteneck et al. investigated the correlational relationship between the perceived environmental barriers and outcomes at 1 year post injury, without controlling for other variables that could impact outcomes. In addition, our sample differed from Whiteneck et al.'s in having a higher percentage of racial/ethnic minorities and in recruitment from a non-rehabilitation sample.

This study has several limitations. First, the sample consisted of persons with TBI who were evaluated at 6 months post-injury and recruited from a level

I county hospital where comprehensive rehabilitation was not provided. Therefore, results may not generalize to individuals who received rehabilitative services and to those evaluated at more long-term post-injury time points. The impact of perceived environmental barriers may differ for individuals at different time points in recovery after TBI, which could not be assessed in this cross-sectional study. In addition, the individuals all received initial care at a single level I county hospital, and the results may be biased based on local community factors. Replicating this study using multiple centers would greatly improve the generalizability of the findings. Lastly, environmental barriers were assessed using only the CHIEF. Future studies could include qualitative assessment as well as additional quantitative measures to more fully characterize the specific environmental facilitators and/or barriers that may impact community integration.

The implication for the clinical rehabilitation community is that clinical interventions provided without consideration of environmental factors may show a more limited impact on outcomes than would otherwise be possible. For example, failing to consider that an individual who is being trained to be proficient in using a wheelchair for mobility lives in a neighborhood that does not have curb cuts or many sidewalks may make some difference with regard to community mobility outcomes, particularly if public transportation or private vehicles are unavailable. Training a client to have the skills necessary to complete a particular job in a work setting may not lead to a successful work placement if the employer or coworker attitudes towards disability or towards those with cognitive impairments have not been addressed. That is, persons with brain injury who may have developed sufficient skills in the relatively barrier-free rehabilitation setting may face a number of environmental issues that hinder participation in their own communities. Conversely, there may be environmental supports present in the community that can facilitate participation. While brain injury rehabilitation often focuses primarily on promoting change in the individual with brain injury, promoting maximal community participation by modifying the person's environment or identifying existing community environmental supports may be the more powerful intervention tactics. This may be particularly true for those with more severe impairments for which limitations in cognitive and behavioral functioning may be more long-lasting.

A comprehensive clinical approach that systematically includes consideration of environmental factors in assessment, intervention, and outcome evaluation would appear most likely to promote efficiency while fostering the greatest possible community integration outcomes. Identification of physical, service, attitudinal, work/school and policy limitations and supports in an individual's community as part of the overall assessment approach in rehabilitation can help the team to streamline interventions and plan for addressing barriers in a prospective manner. Anticipating specific barriers and targeting both individual changes and environmental adaptations to address these barriers can lead to a more efficient approach to service delivery and may promote increased generalizability of strategies, as adaptations for the individual's specific community environment are considered from the start.

CONCLUSION

In conclusion, environmental factors contribute to some objective and subjective aspects of community integration. Environment should be considered in all research investigating predictors of community integration after TBI. Development and evaluation of interventions designed to modify environmental factors is warranted.

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