Published in final edited form as:
Arch Phys Med Rehabil. 2011 March ; 92(3): 464–471. doi:10.1016/j.apmr.2010.08.028.

Do Communities Matter After Rehabilitation? The Effect of Socioeconomic and Urban Stratification on Well-Being After Spinal Cord Injury

Amanda L. Botticello, PhD, MPH, **Yuying Chen, MD, PhD**, **Yue Cao, PhD**, and **David S. Tulsky, PhD**
Kessler Foundation Research Center, West Orange, NJ (Botticello, Tulsky); Department of Physical Medicine and Rehabilitation, University of Medicine and Dentistry of New Jersey, Newark, NJ (Botticello, Tulsky); University of Alabama at Birmingham, Birmingham, AL (Chen, Cao); and Department of Physical Medicine and Rehabilitation, University of Michigan, Ann Arbor, MI (Tulsky)

Abstract

Do communities matter after rehabilitation? The effect of socioeconomic and urban stratification on well-being after spinal cord injury.

Objective—To assess the influence of community-level socioeconomic status (SES) and urban composition on well-being after spinal cord injury (SCI) rehabilitation.

Design—Retrospective analysis of cross-sectional survey data.

Setting—Two participating centers in the SCI Model Systems (SCIMS) program.

Participants—Persons (N=1454) with traumatic SCI from New Jersey and Alabama enrolled in the SCIMS database in 2000 to 2009.

Intervention—Not applicable.

Main Outcome Measures—Dichotomous measures of perceived health (ill vs good health), life satisfaction (dissatisfied vs satisfied), and depressive symptoms (presence of a syndrome vs not) to assess well-being.

Results—Multilevel logistic regression was used to model community effects on each indicator of well-being. The likelihood of ill health and dissatisfaction with life in people with SCI, but not depressive symptoms, varied across communities. Community SES was related inversely to the odds of reporting ill health. However, the odds for dissatisfaction were higher in persons with SCI living in high SES and urban communities. Associations between community predictors and dissatisfaction with life were sustained after controlling for individual differences in injury severity, SES, and demographics, whereas individual SES was a stronger predictor of ill health than community SES.

Conclusion—This research suggests that community stratification influences the likelihood for diminished well-being for persons with SCI after rehabilitation. Understanding the contribution of

---

Reprint requests to Amanda L. Botticello, PhD, MPH, Kessler Foundation Research Center, 1199 Pleasant Valley Way, West Orange, NJ 07052, abotticello@kesslerfoundation.org..

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

communities in long-term outcomes after SCI rehabilitation is needed to inform future interventions aimed at preventing disability in this population.

Keywords

Communities; Multilevel modeling; Rehabilitation outcomes; Spinal cord injuries

---

CONSIDERABLE EMPIRICAL evidence has established that a range of health indicators, including perceived health,[1,2] physical disability,[3,4] cognitive impairment,[5] and emotional distress,[6] differ across communities, suggesting that the context in which a person resides, works, and interacts is an important determinant of health. There has been comparatively little investigation of the role that community stratification has in health and well-being for adults with SCI, especially with studies applying multilevel analytic techniques. In general, prior work in SCI has linked perceptions of environmental quality to physical functioning, community reintegration, and quality of life.[7–9] For example, studies have shown that perceptions of greater accessibility[9] and fewer physical barriers[10,11] predict higher functioning. However, this work was limited by the use of subjective individual-level measures of environmental quality. What is less well known is whether the physical, social, and economic characteristics of geographic areas influence the well-being of people with SCI after rehabilitation.

Several recent studies have suggested that communities influence health and well-being for persons with disabilities. For example, researchers have observed a negative relationship between physical activity and neighborhood crime by using Census data and suggested that living in urban areas, which typically have higher crime rates, was detrimental to functioning for persons with SCI.[12] Alternately, other researchers have concluded that living in urban (vs rural) areas benefitted well-being after SCI because urban areas have more options for employment, recreation, transportation, and health care.[13] Of note, a recent study by Corrigan and Bognar[14] (2008) reported a positive association between community poverty and functioning difficulties, activity limitations, and low social participation for persons with traumatic brain injury. This finding confirmed the association observed in the general population between area-level (SES) disadvantage and the likelihood of poor health.[15] Despite these compelling findings, prior research concerning the influence of the environment on the well-being of rehabilitation populations have been limited because community-level characteristics typically are analyzed as individual attributes by using traditional regression techniques. In contrast, a multilevel modeling approach is more appropriate for the analysis of clustered data because individuals are non–randomly distributed across geographic areas.[16,17]

Understanding the role of community characteristics in well-being is of particular importance to the rehabilitation process, which endeavors to maximize community living. The purpose of this study was to investigate the role of community characteristics on well-being after rehabilitation in persons with SCI by using objective measures of community stratification and multilevel analytic techniques. Based on previous research, we posited that long-term well-being after rehabilitation for SCI, specifically, perceived health, life satisfaction, and depressive symptoms, would differ across communities and be influenced in part by differences in community-level SES and urban composition.

METHODS

Sources of Data

This investigation involved secondary analysis of existing data from the SCIMS database and the 2000 US Census. Space limitations preclude an in-depth description of the SCIMS methodology, which are available elsewhere in the literature.[18,19] The database combines clinical information from persons with traumatic SCI treated at 26 selected rehabilitation centers since 1973 with longitudinal follow-up surveys administered 1-year post discharge and then at subsequent 5-year intervals. The clinical portion of the SCIMS database (Form I) consists of medical, functional, and demographic information for consented participants. The follow-up portion of the SCIMS database (Form II) consists of detailed information on health, functioning, and social participation after rehabilitation.

The use of geocoded data with the SCIMS database is a novel approach. To pilot the use of this information, we derived a subsample from 2 SCIMS centers: Alabama and New Jersey. Cases were selected if the participant had current address information, was 18 years or older when injured, and had completed a follow-up assessment between 2000 and 2009. For participants who had completed more than 1 follow-up, only the most recent assessment was selected. This ensured that the address information used for geocoding corresponded with the most recent follow-up data. Investigators at each site obtained Institutional Review Board approval to add data points identifying the state, county, census tract, and block of an address by using FIPS codes published by the federal government for use in linking individual data to aggregate census data. FIPS codes were added to the sample by SCIMS staff at each site. Coding accuracy was verified by means of double data entry and then a random check of 10% of the cases.

Data from the 2000 US Census SF3 was extracted through the National Historical Geographical Information System (http://www.nhgis.org)[20] at the county level. The SF3 contains data collected by the Census long-form questionnaire that is administered concurrently with the decennial census to a sample of U.S. households.[21] Approximately 1 in 6 households was selected to provide detailed information for nativity, education, employment, income, and housing and weighted to represent the total U.S. population. Census data for this study included SES indicators and the proportion of households located within an urban area.

Analytic Sample

The initial study sample included 1826 people (n=1280 from Alabama, n=546 from New Jersey). Address information that could be assigned a geocode was available for 1519 individuals. Cases without geocodes were excluded from further analysis. Data from out-of-state participants (4.3% in Alabama and New Jersey, respectively) were also excluded. These analytic deletions yielded a final sample of 1454 persons with SCI who resided in 79 counties. Comparisons of the analytic sample with excluded participants (n=372) suggested that those in the excluded group were more likely to have low education (χ^2_2=7.20; P=.03), were injured longer (t_{1824}=4.77; P<.001), and were less likely to be dissatisfied with life (χ^2_1=8.15; P=.004).

Measures

Outcome variables—Three self-reported outcomes that encapsulate health and well-being after SCI were selected for analysis: perceived health, life satisfaction, and depressive symptoms. Perceived health is based on the 36-item Short Form Health Survey item that asks individuals to rate their health as poor, fair, good, very good, or excellent.[22] A dichotomous measure was created indicating persons who reported ill health (ie, either poor or fair) versus not. Life satisfaction was assessed by using the 5-item Diener scale; statements are scored using a 7-point Likert-type scale ranging from 1 (strongly disagree) to 7 (strongly agree).[23] Responses were summed and then divided by the number of items, yielding a score that corresponded with the item response metric. These total scores were dichotomized into dissatisfied (ie, based on a score ≤3) versus satisfied with life. Depressive symptoms were assessed by using the 9-item Patient Health Questionnaire, which has good agreement with independent diagnoses made by mental health professionals[24] and is appropriate for use in persons with SCI.[25,26] Using a time frame of the past 2 weeks, individuals reported the frequency with which they had experienced depressive symptoms on a scale of 0 (not at all) to 3 (nearly every day). Summated responses were used to assess the presence of depressive symptoms versus not.

Community-level variables—Community SES was measured by using a summary score created from Census indicators developed by Diez-Roux et al[27] (2001). The distributions of these SES indicators are listed in table 1. Using the log of the median household income, log of the median housing unit value, percentage of households receiving interest income, percentage of adults older than 25 years who completed high school, percentage of adults who completed college, and percentage of employed persons older than 16 years in managerial occupations, each variable was converted to a standardized score and summed to create a final score. A higher score corresponds with a higher SES level. We also used a measure of the percentage of the population within an urban area. An urban area defined by the census is a densely populated area of at least 50,000 people.[28]

Individual-level variables—Measures of injury severity, SES, and demographic characteristics were used to assess individual differences. Injury severity was based on diagnosis at 1-year by using the International Standards for Neurological Classification of SCI.[29] Discharge injury status was used for cases missing diagnostic data at 1 year. Tetraplegia included persons with injury levels C1 to C8, and paraplegia included persons with injury levels at T1 and below. Motor complete (grade A or B) versus incomplete (grade C or D) injury was defined using the American Spinal Injury Association Impairment Scale. A final 4-level categorical variable was used to differentiate individuals with incomplete paraplegia, complete paraplegia, incomplete tetraplegia, and complete tetraplegia. Age at injury and number of years injured were based on dates recorded at injury and follow-up. Two individual SES indicators were based on follow-up data: education level (less than high school, high school graduate, and some college or more) and employment status (worked for pay vs not). Demographic characteristics of sex, race/ethnicity, and marital status (at follow-up) were measured by using standard items in survey data collection.

Statistical Analysis

The goal of this investigation was to assess the influence of community characteristics on well-being for persons with SCI. People are not randomly distributed across communities, but rather share characteristics and experiences with fellow residents and therefore are not independent. We used a multilevel modeling approach to account for this clustering effect, which enables partitioning of the error variance of parameter estimates into between-level (ie, across communities) and within-level (ie, within community) components.[16,17] Two-level hierarchical logit models of each outcome, in which level 1 was the persons with SCI and level 2 was the communities, were estimated using HLM.[30,a] Communities were operationalized by using county-level data. Statistical power for the multilevel model was calculated by using Optimal Design Software.[31,b] Based on estimates of the intraclass correlation coefficient (ρ) from prior multilevel studies[3,4] and estimates of small, medium, and large effect sizes for multilevel research suggested by Raudenbush and Liu,[32] (2000), the analytic sample of 1454 individuals nested in 79 clusters with an average of 16 persons with SCI per cluster has sufficient power (.90) to detect variation across communities and main effects of community-level covariates.

Using an iterative modeling strategy, we estimated an unconditional model (model I) that included only random intercept and τ_{00}, which signifies the amount of variation in each outcome caused by differences between communities. Next, we tested the main effects of the 2 community-level indicators (models II and III, respectively) on risk for each outcome. If the association between the community indicator and the outcome attained significance, the model (model IV) was adjusted for individual-level covariates. All analyses were based on the Bernoulli distribution and used full maximum likelihood estimation, which produced estimates that were robust to non-normality.[16] All univariate descriptive statistics and bivariate tests of site differences were assessed by using chi-square and Student *t* tests, as appropriate, using STATA.[33,c]

RESULTS

Sample Distributions

Distributions of the predictor and outcome variables and bivariate comparisons between the SCIMS sites are listed in table 2. Community SES across the 79 clusters varied widely and differed significantly by site ($t_{77}=-11.8$; $P<.001$), with a lower average level of community SES in Alabama compared with New Jersey. The average community was approximately 40% urban, with New Jersey communities characterized as more urban in comparison to Alabama ($t_{77}=-8.23$; $P<.001$).

Approximately one third of the sample had complete paraplegia and one third had complete tetraplegia. On average, this sample was injured at a young age (33.6y) and had lived with their injuries for a considerable time (10y). This differed by site; the Alabama subsample was younger on average when injured and had a longer duration of injury than the New Jersey sample. Overall, individual SES among the sample was low, with few persons reporting post–secondary education or postinjury employment. Demographically, the total sample was predominantly male non-Hispanic white, and single. Bivariate comparisons by site indicated that the New Jersey subsample had a higher portion of well-educated and employed persons, persons of Hispanic background, and persons with single marital status compared with Alabama. For the outcome variables, more than one third of the sample reported ill health, 40% indicated they were dissatisfied with life, and approximately 1 of every 5 individuals manifested symptoms of depression. Bivariate tests indicated significant site differences, with the Alabama subsample more likely to report ill health ($\chi^2_1=10.4$; $P=.001$) and the New Jersey subsample more likely to report dissatisfaction with life ($\chi^2_1=41.5$; $P<.001$).

Community Effects on Health

As listed in table 3, parallel multilevel analyses of community effects on well-being began with the estimation of gross variation in each outcome (model I). Results for the null (unadjusted) model indicated significant variation in the likelihood of ill health and dissatisfaction with life for persons with SCI across communities and, contrary to expectations, no variation in the likelihood of depressive symptoms. Model II tested the effect of community SES, which had a small significant effect on the likelihood of ill health; that is, a 1-unit increase in community SES decreased the average likelihood of ill health by 4%. The addition of community SES to the model was accompanied by a 33% decrease in the variance component ($\tau_{00}=.12$), suggesting that community-level variation in ill health was explained in part by differences in SES between communities. For life satisfaction, a 1-unit increase in community SES increased the average likelihood for dissatisfaction by 5%, suggesting that the risk for dissatisfaction in persons with SCI increased in more affluent areas. The addition of community SES to the dissatisfaction model decreased the between-community variance component by 50% ($\tau_{00}=.07$), suggesting that a portion of the variation in dissatisfaction was attributable to differences in community SES. Community SES had no effect on the likelihood of depressive symptoms. Model III assessed the contribution of urban composition, which had little to no effect on the likelihood of ill health or depressive symptoms. However, living in a urban area increased the likelihood of dissatisfaction (vs satisfaction) by nearly 3 times.

The adjusted models predicting community-level effects on ill health are listed in table 4. The association between community SES and ill health was sustained after adjusting for injury characteristics (model IIa). Age at injury increased the odds of ill health, controlling for community SES. The effect of community SES also was sustained after adjusting for demographic characteristics (model IIb). The odds of ill health were higher in persons of other ethnic backgrounds compared with non-Hispanic whites, women compared with men, and no longer married compared with married persons. The addition of individual-level SES (model IIc) notably attenuated the association between community SES and ill health, suggesting that individual SES is a more proximal determinant of health status. Individuals with low education were 70% more likely to report ill health compared with highly educated people. Persons who reported working at follow-up were 67% less likely to report ill health.

Table 5 presents adjusted models for dissatisfaction with life. We found that the small but significant relationship between community SES and dissatisfaction was maintained after adjusting for individual injury and demographic characteristics (models IIa, IIb). The odds of dissatisfaction with life for persons with SCI were lower in men than women and married persons than those who were no longer married. Controlling for individual SES (model IIc) did not alter the association between community SES and dissatisfaction. Of the individual SES variables, being employed decreased the odds of dissatisfaction by 67% when variation in community SES was taken into account. Accounting for individual injury characteristics, demographic variables, and individual SES did not alter the main effect for urban composition (models IIIa–IIIb).

DISCUSSION

This study suggests that differences in SES and urban composition of communities contributed to differences in health outcomes for persons with SCI. This conclusion was strengthened by our systematic multilevel modeling approach, which yielded more parsimonious estimates of community effects on individual outcomes. Our analyses also suggested that the relationship between communities and health is neither uniform nor unidirectional. We observed that the risk posed by living in communities of varying quality mattered most for perceived health and dissatisfaction, but not depressive symptoms. This was contrary to our expectations, which were informed by studies of neighborhood effects on health from the general population.[1–6,34,35] The lack of an association for depressive symptoms suggests that trends observed for the general population are not always generalizable to adults with disabilities and that more work is needed to examine the connection between communities and health for persons with SCI.

The direction of the associations between community-level predictors and health outcomes also did not entirely conform to our expectations. Our prediction of an inverse relationship between poor health and high SES was supported, whereas an opposite pattern was observed for dissatisfaction with life. Assuming that greater availability of resources and services in urban areas would serve to promote health for persons with SCI, we also posited that living in a more urbanized community would benefit rehabilitation outcomes. However, we found that the likelihood of dissatisfaction with life was significantly higher on average for persons with SCI living in communities that were characterized as urban. Much of the observed associations were affected by substantial site differences. Although community-level indicators ranged widely within New Jersey and Alabama, the observed community effects also likely are reflective of regional differences in SES and urban composition. Use of multilevel modeling controlled in part for the aggregate differences in social stratification by site, but greater clarity on the nature of these associations would be attained if this analysis was based on a more representative and geographically diverse sample. Expanding sample size and geographic representation in future investigations also would enable the analysis of contingencies between community-level predictors and individual-level indicators of social stratification.

The theory of relative deprivation may partially explain the counterintuitive relationships we observed between community-level SES and risk for dissatisfaction with life. People perceive inequality in socioeconomic advantage by making social comparisons to the people around them, which in turn affects health.[36] Regardless of the overall level of resources, individuals with higher incomes experience higher status in society, whereas persons with relatively less income have lower status and are more likely to experience the stress that accompanies negative social comparisons.[37] This stress in turn may lead to greater dissatisfaction with life. Given that persons with SCI often experience economic strain,[38,39] living in a highly advantaged community could lead to diminished well-being in the long-term for individuals who are less affluent relative to their friends and neighborhoods. Persons living in urban communities may perceive less support than persons with SCI living in less densely populated areas. More work is needed to assess whether differences in interpersonal resources mediate the negative association between urban living (vs suburban or rural) and well-being.

Our findings also showed that analyses of community effects need to be considered in conjunction with individual-level predictors, which have more proximal associations with health. For example, we observed that the relationship between community SES and ill health was not independent of individual SES. Post hoc analyses indicated that employment status explained much of the variability in ill health. However, given that small portion of the sample that was employed postrehabilitation and the overall low rate of employment in persons with SCI, this observation should be interpreted with caution. The observed association between community SES, percent urban, and dissatisfaction with life remains significant in the adjusted models, suggesting that long-term satisfaction with life after SCI is sensitive to the quality of environment over and above individual-level differences.

Study Limitations

Our study was limited by use of a subsample of the SCIMS database from 2 distinct regions that is not fully representative of persons with SCI. This study also was limited by the operationalization of communities because there is considerable heterogeneity within counties for SES and urban composition. Other investigations have used smaller geographic units (eg, Census tracts) to estimate community effects. Use of tract-level data for this investigation would have resulted in sparse data that were unsuited for multilevel modeling. Alternately, assigning tract-level values to individual-level data and using traditional regression techniques result in biased parameter estimates that are susceptible to ecologic fallacy. Although the number of clusters (79) was determined to have sufficient power to investigate the main effects of community-level variables, data sparseness for some individual-level covariates (ie, sex, ethnicity, employment status) limited elaboration of the models in the final multivariate analyses. A larger and more representative sample, both geographically and demographically, would enable assessment of fully elaborated models, as well as cross-level interactions between community SES and individual-level injury, demographic, and socioeconomic characteristics. This study was limited by the analysis of self-reported outcomes, which provide just one dimension of health and functioning after SCI, and the use of selected community-level indicators. Because this investigation used cross-sectional data, we cannot draw conclusions about the direction of the observed relationships between communities and health. We also were limited to geographic information for the most recent residence and follow-up interview. Longitudinal data, as well as information for the occurrence and direction of moves (ie, to relatively more or less affluent communities), would provide more indication of the risk that communities pose to health and is an important direction for future research in this area.

CONCLUSION

Evidence of geographic variation in SCI outcomes suggests that health and well-being are influenced in part by the environment after rehabilitation discharge. As suggested by the World Health Organization, the disabling process needs to be considered in context.[40] For large-scale surveillance efforts like the SCIMS, integrating indicators of community stratification is a useful development in tracking rehabilitation outcomes and monitoring disparities in health and disability. This would enable greater understanding of the risk posed to adults with acquired disabilities from living in poor-quality communities and will contribute to the development and delivery of more effective interventions intended to promote health and prevent disability in people with SCI.

Acknowledgments

We thank Joe McCabe for assistance with data preparation and Trevor Dyson-Hudson, MD, Allen Heinemann, PhD, and Michael DeVivo, PhD for comments on earlier drafts of this work.

Supported by the National Institute on Disability and Rehabilitation Research (grant no. H133N060022) and the National Institutes of Health Eunice Kennedy Shriver National Institute of Child Health and Human Development (grant no. 1K99HD065957-01).

List of Abbreviations

τ_{00}	intercept variance
FIPS	Federal Information Processing
SES	socioeconomic status
SCI	spinal cord injury
SCIMS	Spinal Cord Injury Model Systems
SF3	US Census Summary File 3

References

1. Kim D, Kawachi I. A multilevel analysis of key forms of community- and individual-level social capital as predictors of self-rated health in the United States. J Urban Health. 2006; 83:813–26. [PubMed: 16810567]
2. Krause N. Neighborhood deterioration and self-rated health in later life. Psychol Aging. 1996; 11:342–52. [PubMed: 8795063]
3. Freedman VA, Grafova IB, Schoeni RF, Rogowski J. Neighborhoods and disability in later life. Soc Sci Med. 2008; 66:2253–67. [PubMed: 18329148]
4. Clarke P, George LK. The role of the built environment in the disablement process. Am J Public Health. 2009; 95:1933–9. [PubMed: 16195520]
5. Wight RG, Aneshensel CS, Miller-Martinez D, et al. Urban neighborhood context, educational attainment and cognitive function among older adults. Am J Epidemiol. 2006; 163:1071–8. [PubMed: 16707655]
6. Aneshensel CS, Wight RG, Miller-Martinez D, Botticello AL, Karlamangla AK, Seemen TE. Urban neighborhoods and depressive symptoms among older adults. J Gerontol Psychol Soc Sci. 2007; (62 Suppl 1):S52–9.

7. McKinley WO, Meade MA. Community integration following SCI. NeuroRehabilitation. 2004; 19:79–80.

8. Hampton NZ, Qin-Hilliard DB. Dimensions of quality of life for Chinese adults with spinal cord injury: a qualitative study. Disabil Rehabil. 2009; 26:203–12. [PubMed: 15164954]

9. Richard JS, Bombardier CH, Tate D, et al. Access to the environment and life satisfaction after spinal cord injury. Arch Phys Med Rehabil. 1999; 80:1501–6. [PubMed: 10569447]

10. DeJong G, Branch LG, Corcoran PJ. Independent living outcomes in spinal cord injury: multivariate analysis. Arch Phys Med Rehabil. 1984; 65:66–7. [PubMed: 6696605]

11. Whiteneck GG, Meade MA, Dijkers M, Tate DG, Bushnik T, Forchheimer MB. Environmental factors and their role in participation and life satisfaction after spinal cord injury. Arch Phys Med Rehabil. 2004; 85:1793–803. [PubMed: 15520974]

12. Liang H, Tomey K, Chen D, Savar NL, Rimmer JH, Braunschweig CL. Objective measures of neighborhood environment and self-reported physical activity in spinal cord injured men. Arch Phys Med Rehabil. 2008; 89:1468–73. [PubMed: 18674982]

13. Hagglund KJ, Clay DL, Acuff M. Community reintegration for persons with spinal cord injury living in rural America. Top Spinal Cord Inj Rehabil. 2009; 4:28–40.

14. Corrigan JD, Bognar JA. Neighborhood characteristics and outcomes after traumatic brain injury. Arch Phys Med Rehabil. 2008; 89:912–21. [PubMed: 18452741]

15. Robert SA. Community-level socioeconomic status effects on adult health. J Health Soc Behav. 1998; 39:18–37. [PubMed: 9575702]

16. Raudenbush, SW.; Bryk, AS. Hierarchical linear models: applications and data analysis methods. 2nd ed. Sage; Thousand Oaks: 2002.

17. Diez-Roux AV. Multilevel analysis in public health research. Annu Rev Public Health. 2000; 21:171–92. [PubMed: 10884951]

18. Stover SL, DeVivo MJ, Go BK. History, implementation, and current status of the National Spinal Cord Injury Database. Arch Phys Med Rehabil. 1999; 80:1365–71. [PubMed: 10569429]

19. DeVivo MJ, Go BK, Jackson AB. Overview of the National Spinal Cord Injury Statistical Center Database. J Spinal Cord Med. 2002; 25:335–8. [PubMed: 12482178]

20. Minnesota Population Center. Prerelease. version 0.1. University of Minnesota; Minneapolis: 2004. National Historical Geographic Information System.

21. US Census Bureau. 2000 Census of population and housing, summary tape file 3 (sample data).

22. McHorney CA, Ware JE Jr. Raczek AE. The MOS 36-Item Short-Form Health Survey (SF-36): II. Psychometric and clinical tests of validity in measuring physical and mental health constructs. Med Care. 1993; 31:247–63. [PubMed: 8450681]

23. Diener E, Emmons R, Larsen J, Griffin S. The Satisfaction With Life Scale. J Pers Assess. 1985; 49:71–5. [PubMed: 16367493]

24. Spitzer RL, Kroenke K, Williams JBW. Validation and utility of a self-report version of PRIME-MD. JAMA. 1999; 282:1737–44. [PubMed: 10568646]

25. Bombardier CH, Richards JS, Krause JS, et al. Symptoms of major depression in people with spinal cord injury: implications for screening. Arch Phys Med Rehabil. 2004; 85:1749–56. [PubMed: 15520969]

26. Kalpakjian CZ, Toussaint LL, Albright KJ, et al. Patient Health Questionnaire-9 in spinal cord injury: an examination of factor structure as related to gender. J Spinal Cord Med. 2009; 32:147–56. [PubMed: 19569462]

27. Diez Roux A, Merkin SS, Arnett D, et al. Neighborhood residence and incidence of coronary heart disease. N Engl J Med. 2001; 345:99–106. [PubMed: 11450679]

28. US Census. [Accessed November 14, 2009] Geographic changes for Census 2000 + glossary. 2001. Available at: http://www.census.gov/geo/www/tiger/glossary.html.

29. Marino RJ, Barros T, Biering-Sorenson F, et al. International standards for neurological classification of spinal cord injury. J Spinal Cord Med. 2003; 26:S50–6. [PubMed: 16296564]

30. Raudenbush, SW.; Bryk, AS.; Cheong, YF., et al. Hierarchical linear and non-linear modeling for Windows. version 6.04. Scientific Software International; Lincoln-wood, IL: 2007.

31. Spybrook, J.; Raudenbush, SW.; Congdon, R.; Martinez, A. [Accessed October 2, 2009] Optimal design for longitudinal and multilevel research: documentation for the Optimal Design Software V.2. Available at: http://www. wtgrantfdn.org/resources/overview/research_tools/research_tools.

32. Raudenbush SW, Liu X. Statistical power and optimal design for multisite randomized trials. Psychol Methods. 2000; 5:199–213. [PubMed: 10937329]

33. Stata Corp. Stata Statistical Software: release 10.0. Stata Corp; College Station, TX: 2007.

34. Botticello AL. A multilevel analysis of gender differences in psychological distress over time. J Res Adolesc. 2009; 19(2):217–47.

35. Wight RG, Aneshensel CS, Botticello AL, Sepulveda JE. Ethnic variation in depressive symptoms among adolescents: a multilevel analysis. Soc Sci Med. 2005; 60:2073–84. [PubMed: 15743655]

36. Runciman, WG. Relative deprivation and social justice. Routledge; London: 1966.

37. Pham-Kanter G. Social comparisons and health: can having richer friends and neighbors make you sick? Soc Sci Med. 2009; 69:335–44. [PubMed: 19515477]

38. Greenwood J. Disability dilemmas and rehabilitation tensions: a twentieth century inheritance. Soc Sci Med. 1985; 20:1241–52. [PubMed: 3161190]

39. Woolhander S, Himmelstein DU. Double catastrophe: injury-related bankruptcies. Med Care. 2007; 45:699–701. [PubMed: 17667302]

40. Gray DB, Hendershot GE. The ICIDH-2: developments for a new era of outcomes research. Arch Phys Med Rehabil. 2009; (81 Suppl 2):S10–4.

Suppliers

a. Scientific Software International Inc. 7383 N Lincoln Ave, Ste 100. Lincolnwood, IL: p. 60712-1747.

b. Optimal Design Software. Available at: http://www.wtgrantfoundation.org/resources/overview/research_tools

c. StataCorp. Lakeway Dr; College Station, TX 77845: 4905

Table 1

Distributions of Community Characteristics Measured at the County Level

Community-Level Predictors	Total (N=79)	Alabama (N=62)	New Jersey (N=17)
Median household income ($K)	36.6±14.0	30.5±6.4	58.7±11.8
Median home value ($K)	89.2±52.1	65.5±17.4	175.6±44.9
Households receiving interest income	0.28±0.11	0.23±0.05	0.44±0.08
Percent of adults who completed high school	0.73±0.08	0.70±0.06	0.84±0.06
Percent of adults who completed college	0.17±0.10	0.14±0.06	0.30±0.09
Percent of adults in professional occupations	0.28±0.08	0.24±0.05	0.38±0.07

NOTE. Values listed are mean ± SD.

Table 2

Descriptive Statistics for the Analytic Sample

Variables	Total N=79	Alabama N=62	New Jersey N=17
Community-level predictors			
Community SES score	0.2±5.8 (6.6 to 16.9)	−2.3±3.1 (−6.6 to 9.3)	9.1±4.5[*] (2.7 to 16.9)
Population residing in urban area (%)	0.4±0.3 (0.0 to 1.0)	0.3±0.3 (0.0 to 0.9)	0.9±0.2[*] (0.5 to 1.0)
	N=1454	**N=967**	**N=487**
Individual-level predictors			
Injury severity (%)			
Complete paraplegia	33.7	34.1	32.8
Incomplete paraplegia	18.9	19.0	18.5
Complete tetraplegia	29.9	29.3	31.3
Incomplete tetraplegia	17.5	17.6	17.4
Age at injury (y)	33.6±15.1	31.7±13.7	37.2±16.9[*]
Years injured	10.0±8.9	12.4±9.5	5.2±4.5[*]
Education (%)			
<12y	26.1	32.5	13.6
High school	49.9	47.4	55.0
Some college or more	24.0	20.1	31.4[*]
Employed (vs not; %)	17.1	15.0	21.2[†]
Man (vs woman; %)	80.1	80.7	79.8
Race/ethnicity (%)			
Non-Hispanic white	61.3	62.3	59.3
Black	34.9	37.5	29.8
Hispanic	2.8	0.0	8.2
Other	1.0	0.2	2.7[*]
Marital status (%)			
Single	41.9	36.2	53.2
Married	33.3	34.2	31.6
Divorced/widowed/separated	24.8	29.6	15.2[*]
Outcomes (%)			
Ill health (vs not)	30.3	33.5	24.6[†]
Dissatisfied (vs not)	41.3	34.5	53.4[*]
Depressive disorder (vs none)	22.4	23.6	20.7

NOTE. Values expressed as mean ± SD (range) or %. Bivariate tests of group differences based on chi-square or *t* tests.

[*] *P*<.001

[†] *P*<.01.

Table 3

Multilevel Models Estimating Community Effects on Long-term Rehabilitation Outcomes[‡]

Model	Ill Health[*]	Dissatisfaction With Life[†]	Depressive Disorder[†‡]
Model I: model			
Intercept (γ_{00})	0.45 (0.38–0.54)[§]	0.69 (0.58–0.81)[‖]	0.28 (0.24–0.32)[‖]
Between-community variation (τ_{00})	0.18[§]	0.14[§]	0.00
Model II: community SES effects			
Intercept (γ_{00})	0.48 (0.40–0.58)[‖]	0.62 (0.53–0.72)[‖]	0.28 (0.24–0.32)[‖]
Community SES (γ_{01})	0.96 (0.93–0.99)[¶]	1.05 (1.02–1.08)[§]	1.00 (0.97–1.04)
Between-community variation (τ_{00})	0.12[¶]	0.07[#]	0.00
Model III: percent urban effects			
Intercept (γ_{00})	0.48 (0.39–0.59)[‖]	0.57 (0.48–0.67)[‖]	0.29 (0.24–0.35)[‖]
Urban composition (γ_{01})	0.69 (0.40–1.19)	2.74 (1.74–4.31)[‖]	0.99 (0.59–1.66)
Between-community variation (τ_{00})	0.17[¶]	0.07[#]	0.00

NOTE. Values expressed as odds ratio (confidence interval).

Abbreviations: γ_{00}, random intercept; γ_{01}, risk for each outcome.

[*] Omitted reference group is good health.

[†] Omitted reference group is nodisord with life.

[‡] Omitted reference group is no disorder.

[§] $P<.01$

[‖] $P<.001$

[¶] $P<.05$

[#] $P<.10$.

Table 4

Multilevel Logistic Regressions of Ill Health After SCI

	Ill Health[*]		
Variable	**Model IIa**	**Model IIb**	**Model IIc**
Intercept (γ_{00})	0.47 (0.35–0.62)	0.54 (0.40–0.74)	0.46 (0.33–0.65)
Community-level predictors			
SES (γ_{01})	0.96 (0.93–0.99)[†]	0.97 (0.94–0.99)[†]	0.98 (0.95–1.01)
Individual-level predictors			
Injury characteristics			
Complete paraplegia[‡]	0.87 (0.62–1.23)	NA	NA
Complete tetraplegia[‡]	0.75 (0.51–1.09)	NA	NA
Incomplete tetraplegia[‡]	1.04 (0.68–1.59)	NA	NA
Age at injury	1.02 (1.01–1.03)[§]	NA	NA
Injury duration	1.00 (0.99–1.03)	NA	NA
Demographic characteristics			
Hispanic[//]	NA	1.19 (0.60–2.34)	NA
Black[//]	NA	1.25 (0.95–1.64)	NA
Other ethnicity[//]	NA	4.02 (1.29–12.53)[†]	NA
Man (vs woman)	NA	0.64 (0.46–0.89)[¶]	NA
Single[#]	NA	1.10 (0.77–1.56)	NA
Divorced/widowed/separated[#]	NA	1.49 (1.14–1.95)[¶]	NA
SES characteristics			
Low education[**]	NA	NA	1.70 (1.16–2.48)[¶]
Moderate education[**]	NA	NA	1.08 (0.75–1.55)
Employed (vs not)	NA	NA	0.33 (0.23–0.47)[§]
Between-community variation			
Intercept (τ_{00})	0.12[†]	0.12[†]	0.08

NOTE. Values expressed as odds ratio (95% confidence interval) unless noted otherwise.

Abbreviations: γ_{00}, random intercept; γ_{01}, risk for each outcome; NA, not applicable.

[*] Omitted reference group is good health.

[†] $P<.05$.

[‡] Omitted reference group is incomplete paraplegia.

[§] $P<.001$.

[//] Omitted reference group is non-Hispanic white.

[¶] $P<.01$.

[#] Omitted reference group is married.

[**] Omitted reference group is high education.

Table 5

Multilevel Logistic Regressions of Satisfaction With Life After SCI

	Dissatisfaction With Life[*]					
Variable	**Model IIa**	**Model IIb**	**Model IIc**	**Model IIIa**	**Model IIIb**	**Model IIIc**
Intercept (γ_{00})	0.67 (0.54–0.82)[†]	0.56 (0.40–0.79)[‡]	0.67 (0.52–0.87)[‡]	0.61 (0.49–0.75)[†]	0.54 (0.39–0.75)[†]	0.63 (0.49–0.82)[‡]
Community-level predictors						
SES (γ_{01})	1.04 (0.93–0.99)[‡]	1.05 (1.02–1.08)[‡]	1.06 (1.03–1.09)[†]	NA	NA	NA
Urban (γ_{01})	NA	NA	NA	2.74 (1.73–4.36)[†]	2.61 (1.58–4.32)[†]	3.11 (1.93–5.02)[†]
Individual-level predictors						
Injury characteristics						
Complete paraplegia[§]	1.36 (1.02–1.83)[‖]	NA	NA	1.36 (1.01–1.81)[‖]	NA	NA
Complete tetraplegia[§]	1.29 (0.94–1.77)	NA	NA	1.21 (0.76–1.94)	NA	NA
Incomplete tetraplegia[§]	1.20 (1.76–1.90)	NA	NA	1.21 (0.76–1.94)	NA	NA
Age at injury	1.01 (1.01–1.02)[‡]	NA	NA	1.01 (1.01–1.02)[‡]	NA	NA
Injury duration	0.99 (0.98–1.00)	NA	NA	0.99 (0.98–1.00)	NA	NA
Demographics						
Hispanic[¶]	NA	1.50 (0.86–2.60)	NA	NA	1.32 (0.76–2.29)	NA
Black[¶]	NA	1.18 (0.92–1.52)	NA	NA	1.10 (0.87–1.40)	NA
Other ethnicity[¶]	NA	1.55 (0.77–3.12)	NA	NA	1.46 (0.72–2.94)	NA
Man (vs woman)	NA	0.77 (0.61–0.97)[‖]	NA	NA	0.77 (0.62–0.97)[‖]	NA
Single[#]	NA	1.36 (0.97–1.91)	NA	NA	1.32 (0.93–1.88)	NA
Divorced/widowed/separated[#]	NA	1.55 (1.15–2.09)[‡]	NA	NA	1.52 (1.13–2.04)[‡]	NA
SES characteristics						
Low education[**]	NA	NA	1.24 (0.87–1.78)	NA	NA	1.19 (0.84–1.69)
Moderate education[**]	NA	NA	1.02 (0.81–1.29)	NA	NA	1.01 (0.80–1.27)
Employed (vs not)	NA	NA	0.33 (0.22–0.50)[†]	NA	NA	0.35 (0.23–0.52)[†]
Between-community variation						
Intercept (τ_{00})	0.08[‡]	0.06	0.06	0.07[††]	0.07[††]	0.08[‖]

NOTE. Values expressed as odds ratio (95% confidence interval) unless noted otherwise.

Abbreviations: γ_{00}, random intercept; γ_{01}, risk for each outcome; NA, not applicable.

[*] Omitted reference group is satisfied with life.

[†] $P<.001$

[‡] $P<.01$.

[§] Omitted reference group is incomplete paraplegia.

[‖] $P<.05$.

[¶] Omitted reference group is non-Hispanic white.

[#] Omitted reference group is married.

[**] Omitted reference group is high education.

[††] $P<.10$.