Disability in North Carolina: Spatial Distributions and Access to Care

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Examination of the spatial patterns of disability rates by North Carolina county reveals regional patterns with eastern and mountain counties having higher levels of disabilities. Income and ethnic measures show the most frequent statistically significant associations with disability rates. Case studies of three counties – Mecklenburg, Chatham, and Halifax – show that residents in the counties with the greatest need for disability services have the poorest geographic access to them. These results have implications for those who make policies concerning the disabled. The paper demonstrates the benefits of collaboration between university students and a North Carolina state agency.

Introduction

Disability is a serious problem in the U.S. Approximately 20% of Americans (around 54 million people) experience an activity limitation due to a physical or mental impairment or health condition. The 1998 and 1999 North Carolina Behavioral Risk Factor Surveillance System indicated that 21% of non-institutionalized adults experience activity limitation as a result of a health condition or perceive that they have a disability (Division of Public Health, State Center for Health Statistics, 2001). To compound the situation, disability is associated with several other problems, including poverty, low educational attainment, and difficulty in obtaining social services. Despite the burden on society of disability, however, it is only recently that geographers have begun to study this problem (Gleeson 1999).

Recent work by geographers and others points toward the idea that disability is a social construction. A person is labeled as disabled when s/he fails to meet societal norms for such activities as employment, schooling, or self-care. Thus, for example, the inability to walk is a serious problem for most people in all times and places, but the inability to drive becomes especially serious in communities where residential areas are distant from services and access to public transportation is limited.

Most people pursue their daily activities in the belief that everyone is physically and mentally fit. This notion, called *ableism*, "refers to ideas, practices, institutions, and social relations that presume able-bodiness, and by so doing, construct persons with disabilities as marginalized, oppressed, and largely invisible 'others'" (Chouinard 1997, p. 380). Being disabled leads to stigmatization and misunderstanding. The disabled are often subject to such psychologically damaging labels as "crippled" or "crazy." The language used to express deviance marks the body and may have a great deal to do with how people see themselves in relation to others (Butler 1990).

This research was conducted as a service-learning project within the context of a university course on the geography of health. It results from collaboration between the North Carolina Office on Disability and Health (NCODH), three undergraduate students and their professor, and a GIS/computer cartography specialist at the university library. Following a request for information from NCODH, the students, in consultation with NCODH staff members,

developed a term project that met both the needs of the state agency and a class requirement to carry out a group research project.

NCODH wanted to examine the prevalence of people with various disabilities across North Carolina, as well as identify factors influencing the distribution of disability. The agency also wanted to know what types of services were offered by state agencies for people with disability, with a particular emphasis on three counties – Mecklenburg, Chatham, and Halifax – that have different population characteristics. These requests were translated for the purpose of this study into two aims with a spatial focus:

(1) Examine the spatial patterns of people with various types of disability at the county level and what factors might be related to these patterns, and
(2) Examine the accessibility of populations in Mecklenburg, Chatham, and Halifax counties to services that cater to the needs of the disabled.

Background

Like many health problems, disability is difficult to define. There are hundreds of different disabilities. Some are present at birth (e.g., hearing impairment); others are the result of occupational hazards (e.g., loss of limbs), aging (e.g., arthritis), or the psychological stresses of life (e.g., mental illness). Disability is often difficult to observe, and requires subjective assessment by both the affected individual and verification by members of the individual's peers. The limited training of physicians in certifying disabilities and the different definitions of disability used by federal (e.g., Social Security, Vocational Rehabilitation) agencies, state and local governments, and the military, lead to a bureaucratic maze that is difficult for people with disabilities to navigate. Furthermore, measuring disability is often beset with problems, including the lack of reliability and validity of instruments, most of which are poorly standardized and produce non-comparable estimates (Elwan 1999). It is important to note that definitional issues underlie some of the difficulties in statistical analyses of disability distributions.

Disability is linked with several other problems. Disabled people (and their families) are more likely than the rest of the population to live in poverty (Elwan 1999). It is difficult to determine whether poverty leads to disability or vice versa. Poor people may become disabled because they face unsafe working conditions or cannot afford to pay for medical care that might mitigate injuries or chronic illnesses. On the other hand, people may become poor because they are disabled, lose their jobs, and have to pay for health care. Many employers are unwilling to hire disabled people, fearing that they will be unproductive or have vocational needs that would disrupt workplace rhythms.

From the preceding discussion, we would expect degree of disability in North Carolina to be related to income level. Disability may also be related to rurality. Twenty-three percent of the non-metropolitan population has disabilities, compared to eighteen percent in metropolitan areas (National Center for the Dissemination of Disability Research 2002). Furthermore, rurality is associated with older populations, lower incomes, less education, and less availability of support services and transportation.

Consideration of rurality leads one to also think about the role of occupation in creating disabilities as many rural jobs such as farming, mining, and logging are among the most physically dangerous (Enders and Seekins 1999). About 2000 farm workers have a finger, arm, or leg amputated every year (North Carolina Dept. of Agriculture & Consumer Services 2001). Certain populations such as migrant farm workers may be especially vulnerable: a North Carolina survey reported that 44.5% of migrant farm worker households had a disabled individual (InterAmerica Research Association 1974).

A possible association is also expected between ethnicity and disability because of the links between ethnicity, poverty, and rurality. Disadvantaged minority groups such as African Americans and Hispanics have higher levels of poverty than European Americans and African Americans are overrepresented in rural areas.

In the US, without comprehensive maintenance programs and other schemes available, disabled people are usually considered to be the responsibility

of their families; publicly funded entitlements are rare, and rehabilitation services are not widely available. The problem of access to benefits for disabled people appears to be especially acute in North Carolina: "The Social Security Administration takes months – and often years – to approve claims it receives for disability benefits" (Krueger 2003).

Additionally, many poor people with disabilities lack appropriate resources to access health care. Insurance companies are often reluctant to pay for specialized care or nontraditional means of health care, such as stress management, chiropractic, and acupuncture. Surveys have shown that, nationwide, up to 46% of persons with disability use public transport regularly, compared with five to six percent of the overall population (Gleeson et al. 1996). Thus, if a needed health facility is not serviced by public transit, it will be inaccessible to many of the disabled. In addition, the disabled are at a disadvantaged in terms of access to or the ability to cope with needed transportation to care.

Measuring geographic access to care has a long tradition in health geography (Joseph and Philips 1984; Ricketts et al. 1994). Traditionally, these measures include the availability of health care personnel, distances traveled to care (Euclidean, road, time), and utilization rates in different geographic areas. Church and Marston (2003), however, argue that traditional methods of measuring accessibility are flawed when applied to people with disabilities because they do not account for the physical and mobility differences between people that might affect travel time, effort, and successful utilization of care.

Studies of disability by geographers can be traced to concerns, starting in the early 1970s, with mental illness and social dependency (e.g., Dear and Taylor 1982; Dear and Wolch 1987). Several scholars working with disability felt that "impairment" should cover a variety of health problems, including chronic illness, but should not be defined in the language of the biomedical model (Gleeson 1999; see also Butler and Bowlby 1997; Dyck 1995). In the last decade, one can discern a new "turn" to disability studies, beginning with Golledge's seminal (1993) article, and picked up by others (e.g., Dorn 1994; Parr 1997; Moss and Dyck 2003). This work provides a valuable theoretical background to this study, which is, in comparison, a more traditional geographic investigation of spatial distributions and geographic accessibility.

Methods

Units of Analysis

For aim (1), examination of spatial patterns of disability in North Carolina, the geographic units of analysis chosen were the 100 counties in the state. Numbers of people with various disabilities in each county are large enough to calculate stable rates for mapping and statistical analysis.

For aim (2), examination of accessibility to disability services, three counties were chosen that were stretched out along the rural-urban continuum and thus had very different characteristics such as population size and percent urban. Mecklenburg is a highly populated and largely urban county (96.24% in 2000), centered on Charlotte, the largest city in the state. Chatham, at the edge of the Research Triangle, is a county that follows a fairly typical pattern of evolving from a rural to a more urban county (19.27% urban in 2000). Many residents commute to work in Raleigh, Durham, and Chapel Hill. Halifax is a relatively remote county, with no metropolitan area nearby; however, it was 42.65% urban in 2000.

It is important for the analysis that follows to profile some salient characteristics of the study counties (Table 1). The relatively low commuting ratio for Chatham County indicates that a substantial proportion of residents work outside the county; many of them, presumably, in Raleigh, Durham, Chapel Hill, or Research Triangle Park. In contrast, the relatively high commuting ratio for Mecklenburg suggests that many people commute to Charlotte from outside the county. Differences in the ethnic composition of county populations are quite striking. Over half of Halifax's population is African American, while only about one-sixth of the residents of Chatham and one-fourth of the residents of Mecklenburg belong to this group. In contrast, almost ten percent of Chatham's population is Hispanic, reflecting the recent wave of immigration into the Triangle Area, whereas only one percent of the Halifax population is Hispanic. Three economic indicators, median housing value, median

household income, and percent below poverty, tell a consistent story. Mecklenburg County is clearly favored in all categories and Halifax the least favored by a large margin. Chatham County lies between the other two in economic indicators, closer to Mecklenburg than to Halifax.

The three counties also differ by age structure (Table 2). Mecklenburg has the largest proportion in the productive age group (16-64) and the smallest proportion of older adults. Chatham has the smallest proportion of children aged 5-15 and the largest proportion of older adults. Halifax has the largest proportion of children, the smallest proportion in the productive age group, and close to the largest proportion of older adults.

Data Collection

Aim (1). Keeping in mind the definitional difficulties noted above, disability in North Carolina was organized into six overlapping categories based on two items in the 2000 census long-form (sampled population). Item 16 was a two-part question that asked about the existence of the following long-lasting conditions: Blindness, deafness, or severe vision or hearing impairment (sensory disability) (2) a condition that substantially limits one or more basic physical activities, such as walking, climbing stairs, reading, lifting, or carrying (physical disability). Item 17 was a four-part question that asked if the individual had a physical, mental, or emotional condition lasting six months or more that made it difficult to perform certain activities. The four activity categories were (1) learning, remembering, or concentrating (mental disability), (2) dressing, bathing, or getting around inside the house (self-care disability), (3) going outside the home alone to shop or visit a doctor's office (go-outside-home disability), and (4) working at a job or business (employment disability). Items (2) and (3) refer to an established category of analysis and service provision, the activities of daily living (see Lawton and Brody 1969 for a list and also http://www/cdc.gov/nchs/datawh/nchsdefs/ADL.htm). They indicate a level of care that can only be provided in a nursing home or with substantial assistance from family members or paid caregivers. Public or private resources to pay for such services are hard to obtain.

Data were collected for sensory, physical, mental, and self-care disability for children 5-15; for all six types of disability for the 16-64 age-group, and for all types except for employment for those over 65. Division into the three age groups was a control for age, a demographic variable that is clearly connected with degree of disability. Rates were calculated by dividing the total count of people with disabilities by type and age group divided by the

Table 1. Demographic, Ethnic, and Economic Characteristics for North Carolina, and Mecklenburg, Chatham, and Halifax counties.

	NC	Chatham	Halifax	Mecklenburg
Population, 2001 est.		51,645	56,703	716,407
Percent Urban, 2000		19.27%	42.65%	96.24%
Commuting Ratio, 2000		0.685	0.922	1.311
Percent White	72.1%	74.9%	42.6%	64.0%
Percent African American	21.6%	17.1%	52.6%	27.9%
Percent Hispanic	4.7%	9.6%	1.0%	6.5%
Persons with a Disability		8,426	15,784	104,224
Median Housing Value	$108,300	$42,851	$26,459	$141,800
Median Household Income	$39,184	$42,851	$26,459	$50,579
Percent Below Poverty	12.3%	9.7%	23.9%	9.2%

total population in that age group. Disabled rates by type and age group were mapped by county, using ArcView (Environmental Systems Research Institute, Inc. 2002).

To examine factors that might be related to the spatial distribution of various types of disability, data on a set of variables that the literature suggested might be associated with disability were collected for counties from the 2000 Census. These included three income measures (per capita income, median household income, and percent below poverty), percent urban, percent in primary activities (farming, fishing, and forestry), and two measures of ethnicity, percent African American, and percent Hispanic. Bivariate and multivariate regressions were performed using these variables and disability rates by disability type and age group (15 regressions in total).

Aim (2). Seven services (Department of Social Services, Independent Living Rehabilitation Program, Vocational Rehabilitation Services, Services for the Deaf and Hard of Hearing, Division of Services for the Blind, Division of Aging, and Mental Health, Developmental Disabilities, and Substance Abuse) were selected as potential sources of care for the disabled. The locations of these facilities across North Carolina were geo-coded by zip-code centroid and placed on maps of the state. Then maps were made showing where these services were located either within the three study counties (Mecklenburg, Chatham, and Halifax) or in surrounding counties (the closest service of a particular type to the case study county centroid was chosen). These maps enabled the examination of access to care for disabled residents of the three counties.

Results

Table 2 shows disability rates for North Carolina and the three case study counties. As expected, rates are low for children aged 5-15, ranging from 14.0 percent to 17.4 percent, but increase to sometimes

Table 2. Percent of population and disability rates by age groups for North Carolina, and Mecklenburg, Chatham, and Halifax counties.

		North Carolina		Mecklenberg		Chatham		Halifax	
Age Group	Disability Type	% of Population	Disability Rate	% of Population	Disability Rate	% of Population	Disability Rate	% of Population	Disability Rate
5-15		15.2		15.4		14.0		17.4	
	Sensory		1.0		1.0		0.8		1.9
	Physical		1.0		0.8		0.4		2.4
	Mental		4.9		4.1		3.9		5.7
	Self-care		0.9		0.9		0.5		1.8
16-64		64.3		68.4		64.1		59.4	
	Sensory		2.5		1.7		2.3		3.8
	Physical		7.1		4.2		5.6		12.1
	Mental		3.7		2.5		2.6		6.9
	Self-care		1.9		1.3		1.4		3.4
	Go-out		6.8		5.8		5.1		11.2
	Employ.		13.3		11.0		11.4		19.2
65+		11.5		8.1		14.7		14.3	
	Sensory		15.4		12.6		13.9		19.4
	Physical		32.3		27.8		27.8		41.2
	Mental		13.2		11.6		10.7		17.3
	Self-care		11.3		9.7		8.9		16.0
	Go-out		22.7		20.3		17.8		30.8

alarming proportions for the productive and older age groups (e.g., 19.2 percent for employment disability in Halifax for those 16-64 and 41.2 percent for physical disability in the same county for those over 65). In North Carolina, almost one-third (32.3 percent) of older adults reported a physical disability, and almost a fourth (22.7 percent) said a disability inhibited their ability to go outside the home. There are clear differences in disability rates among the three selected counties. Mecklenburg rates are consistently lower than or equal to state rates. In contrast, rates for Halifax are always higher than North Carolina rates, often by fifty percent or more. In addition, Halifax rates are always higher than those for the other two case study counties. Chatham's rates are always lower than state rates; they are sometimes higher and sometimes lower than Mecklenburg's rates. Overall, Halifax has a decidedly heavy disability burden.

It is impossible to describe in detail the spatial patterns of the fifteen age group-disability rates by North Carolina County. Very generally, dividing the state into the traditional Eastern (coastal plain and tidewater), Piedmont, and Mountain regions, it was found that (1) the Eastern region, especially the northeast and southeastern counties, had the highest disability rates, (2) Mountain counties had the next highest rates, and (3) the Piedmont region had the

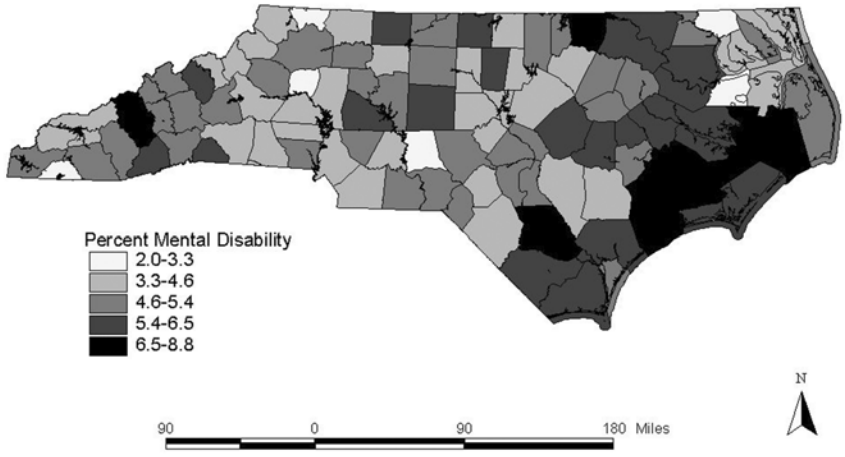

Figure 1. Mental disability rates for age group 5-15 by county in North Carolina (percents)

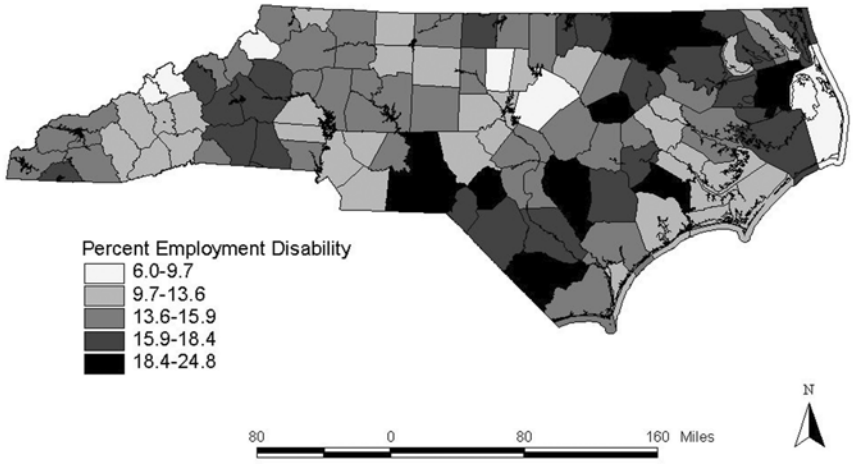

Figure 2. Employment disability rates for age group 16-64 by county in North Carolina (percents)

lowest rates. Figures 1 through 4, which show mental disability rates for children 5-15, employment disability rates for age group 16-64, and sensory and self-care disability rates for those 65 and older, respectively, were chosen as illustrations because they showed some of the stronger patterns, but they generally represent other disability map patterns as well.

Results of regressing the seven predictor variables on disability rates by North Carolina counties are shown in Table 3. For children 5-15, R-squared values were very low and only two independent variables were significantly associated with disability rates. Percent in primary activities was, contrary to expectation, negatively associated with sensory disability ($t = -2.10$, $p = 0.038$). For self-care, percent African-American was positively associated with disability ($t = 2.53$, $p = 0.0129$), in the expected direction.

For the 16-64 age group, all R-squares were 0.44 or more and all were significant at the 0.0001 level. Two economic independent variables, per capita income and median household income, were involved in models for all six disability rates. For mental, going outside, and employment disabilities, percent African-American showed a positive association. The models for older adults also had fairly high R-squared values and, again, all were significant at the 0.0001 level. Income variables dominated as independent variables

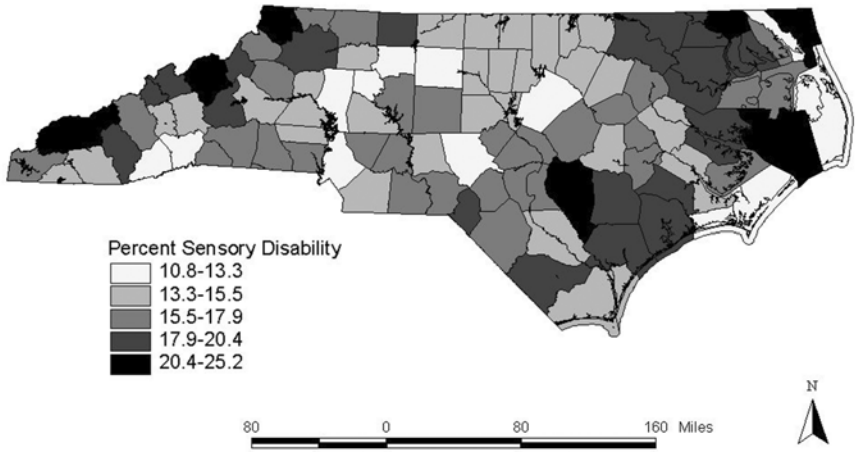

Figure 3. Sensory disability rates for age group 65+ by county in North Carolina (percents)

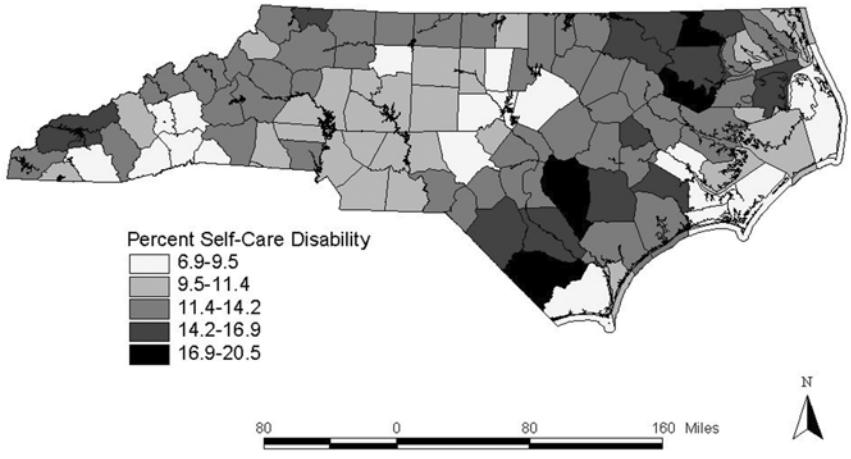

Figure 4. Self-care disability rates for age group 65+ by county in North Carolina (percents)

Table 3. Results of regressions of predictor variables on disability rates by age group for 100 North Carolina counties. **significant at the 0.05 level; **significant at the 0.01 level.*

Age Group	Disability Type	Per Capita Income	Median Household Income	% Below Poverty	% Urban	% Primary Activities	% African American	% Hispanic	Adj. R sq.	P
5-15	Sensory					-2.10*			.03	.0380
	Physical								.13	.0055
	Mental								.04	.1459
	Self-care						2.53*		.05	.0129
16-64	Sensory	-8.87**							.44	.0001
	Physical		-13.32**						.64	.0001
	Mental		-11.09**				2.27*		.62	.0001
	Self-care	-9.97**							.50	.0001
	Go-out	-9.73**					8.04**		.72	.0001
	Employ.	-8.32**					3.13**		.53	.0001
65+	Sensory	-5.10**		2.12*			-3.57**		.47	.0001
	Physical	-10.66**							.53	.0001
	Mental	-7.76**						2.76**	.38	.0001
	Self-care	-4.01**		3.47**					.51	.0001
	Go-out	-7.25**							.34	.0001

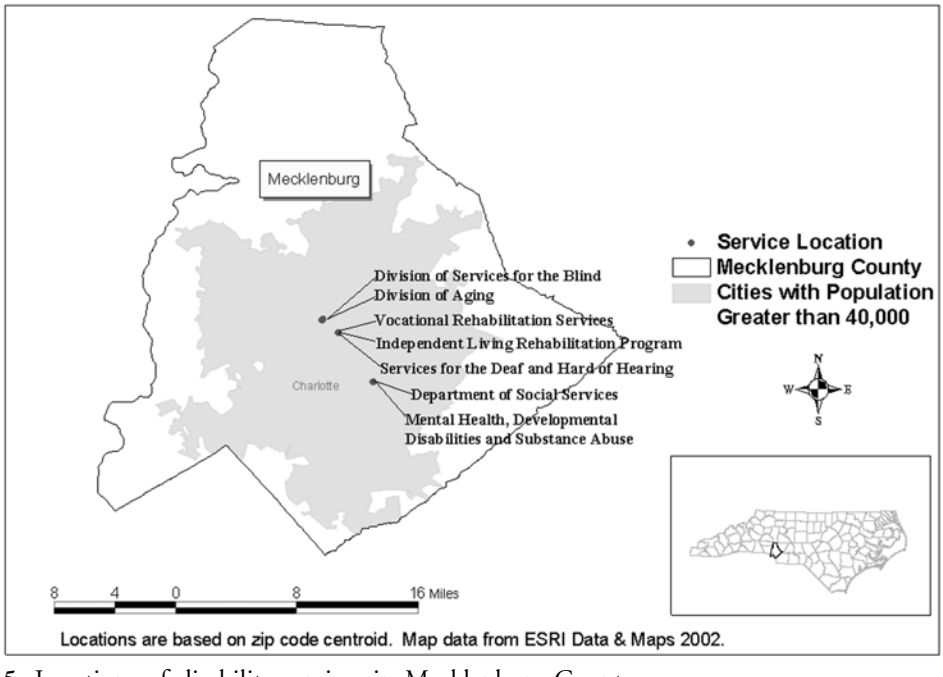

Figure 5. Locations of disability services in Mecklenburg County, NC

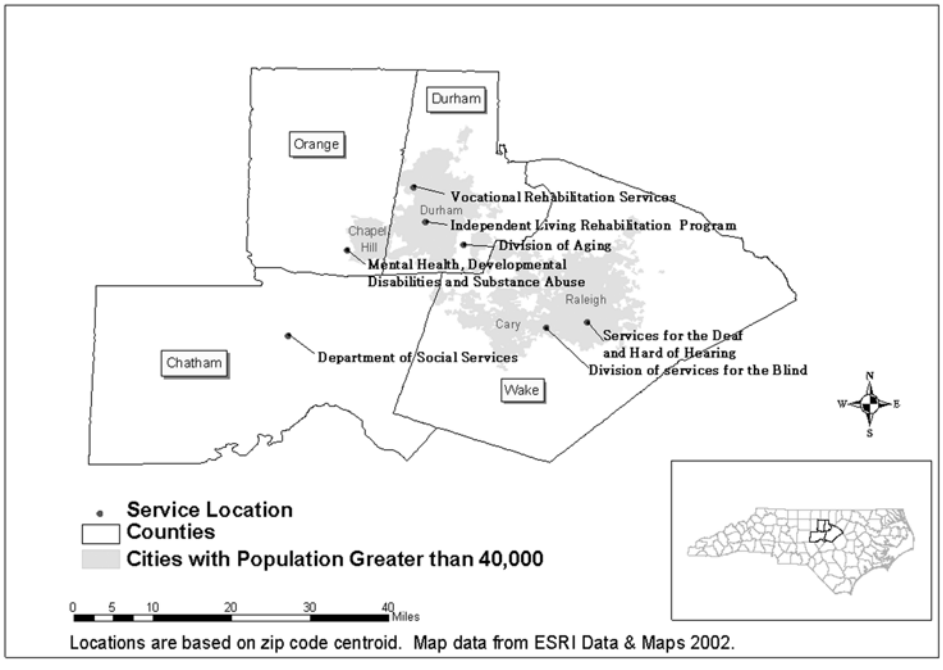

Figure 6. Locations of disability services near Chatham County, NC

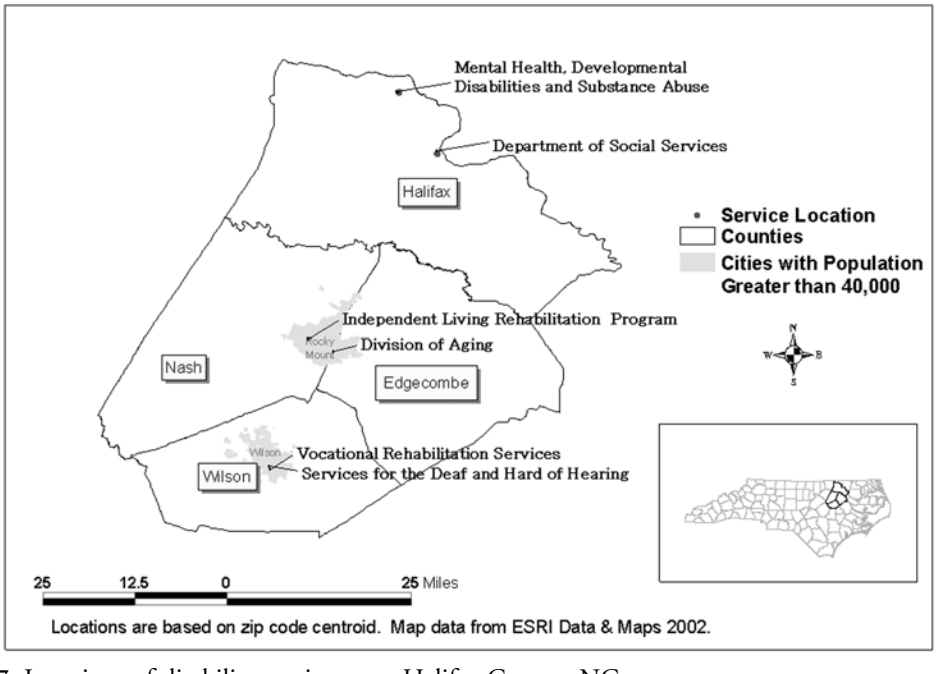

Figure 7. Locations of disability services near Halifax County, NC

associated with disability. For sensory disability, contrary to expectation, percent African-American showed a negative association ($t = -3.57$, $p = 0.0000$), and for mental disability, percent Hispanic showed a positive association ($t = 2.76$, $p = 0.0000$), in line with expectations.

Figures 5 through 7 display disability services in or near the three case study counties. The maps show urban population concentrations of 40,000 or more in order to illustrate the access to care issue more graphically. All seven services are found in Mecklenburg County, located within Charlotte, the state's largest city. Only one of the services is located within Chatham County; for the rest, residents must travel up to 30 miles to one of the major cities in the Research Triangle, Raleigh, Durham, or Chapel Hill. Halifax County has two services; the rest are located in Rocky Mount or Wilson which are, again, up to 30 miles away for some residents. Although it is not known which facilities are accessible by public transportation, one can speculate that many services, especially those farther away from residents, are only accessible by car. It is also interesting to note that Mecklenburg services are most concentrated in the same facilities, whereas those for Chatham County are the most geographically dispersed.

Discussion

Maps of disabilities (Figures 1 through 4) consistently showed the highest rates for the eastern part of the state, the lowest rates for the Piedmont, and rates in between for the mountains. Thus there are regional differences in disability. The disability maps also pinpoint specific counties with relatively high specific disability rates, which is important information for service providers in those counties. Map patterns suggest that negative correlations exist between income and disability and that positive correlations exist between percent African American and disability because disability rates tend to be higher in counties where incomes are lower and percent African American higher. The maps also appear to support the hypothesis that rurality is related to level of disability as counties in both the eastern and mountain regions tend to be more rural.

The connection between higher disability rates and lower incomes discussed in the literature was the most significant result from the regression models (Table 3). For the 16-64 and 65+ age groups, one of the three income variables (usually per capita income) was always positively associated with disability. It is difficult to ascertain cause and effect in the disability-income relationship, however. People with lower incomes have less access to care and thus less opportunity to alleviate a disability; in turn, those with disabilities have less access to the educational and employment opportunities that generate income. Contrary to expectations and also examination of disability rate maps, degree of rurality (measured by percent urban) was not significantly associated with disability. Perhaps the county level of analysis masks within county differences in rurality. Also contrary to expectation, percent in primary activity was not an important independent variable; in fact the only model in which it was significant, sensory disability for children 5-15, it was negative. Again, the county level of analysis may be inappropriate for examination of the role of this variable. Alternatively, accidents from primary activities may not be as important relative to disabilities created by other activities as was thought.

Ethnicity did play a role, as expected, in some models. Percent African-American was important for self-care for children; mental, going outside, and employment for adults 16-64; and sensory for older adults. Many African Americans are both poor and have disabilities. Being African American could be linked to poverty or more severe poverty compared to being non African American or it could be an independent marker of disability risk because of racial discrimination in such areas as housing, employment, medical care, or social services (see LaVeist 1993). Percent Hispanic was positively associated with mental disability for those 65 and older, a noteworthy result for those providing services to this rapidly increasing minority group.

Comparing the disability rates (Table 2) to the maps of access of residents to disability services (Figures 5 through 7) is a clear illustration of the Inverse Care Law, which states that: "The availability of good medical care tends to vary inversely with the need for it in the population served" (Hart 1971, p. 405). Those who have the highest disability rates

appear to have the poorest geographic access to care. This statement needs to be qualified because it is not known where individuals live in relation to facilities. Information about the travel of a sample of individuals to disability care would be needed to confirm the claim. Part of the explanation for the statement could be that state and county services tend to be better in communities such as Charlotte in Mecklenburg County because they possess large enough tax bases or charity organization to support them.

A major component of the access problem is transportation to care. For example, public transportation is more likely to be available in Mecklenburg County, which is the center of a metropolitan area with Charlotte at its center, than it is in Chatham or Halifax. People in the latter two counties must travel substantial distances, either in their own or someone else's car, to reach a care facility. A factor that might play a role here is commuting patterns: contrast Chatham County's outward flows to the Research Triangle with the flows into Mecklenburg County from its surrounding hinterland.

Access to services can of course be a factor in determining rates because some disabilities can be avoided or eliminated by proper care. However, other factors, such as poverty and ethnicity, are also at work in the least well-served counties. Recall that Halifax County has strikingly higher proportions of African Americans and people in poverty, as well as lower median housing values, median household incomes, and proportion in the productive age group than the other two counties. It is well known to geographers that more urban and richer populations often receive better services of many kinds. Some would respond that this is the way that economic and political forces work and little can be done about it. Others would say that more resources, including services and opportunities to overcome poverty, should be delivered to those who need them the most, in order to eliminate the kinds of imbalances revealed by this study.

This study, we feel, represents a unique collaboration between a North Carolina state agency whose concern is the welfare of a substantial portion of the population and a state university where the primary goal is to provide students with the best education possible through course work and an introduction to research methods. It demonstrates that a service-based learning project can be of applied to the "real-world" interests of a state agency such as NCODH that does not have the resources to carry out the necessary research (NCODH received a copy of the class project report and will receive a copy of the published paper). At the same time, the students who carry out the projects learn to deal with all of the problems that arise when practical research is conducted.

Conclusions

Analysis of the spatial patterns of disability and access to care services in North Carolina presents a good illustration of the problems the disabled face. Maps of disability rates and of where people live in relation to care clearly demonstrate the inequalities that exist across space. Areas where disability rates are higher often have lower incomes and sometimes have higher proportions of African Americans and Hispanics. It was also found from an analysis of disability service locations in three case study counties that counties with the highest need tended to have the poorest geographic access to services.

This study adds to the relatively small body of geographic literature on the disabled. The analyses, which were carried out at the county and state levels, can be used by health care policy makers to re-allocate funds, add needed facilities, or re-locate existing services. Further geographic work needs to be done at the level of individuals and the places and spaces they inhabit as they cope with the burden of disabilities.

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