DOI: 10.1111/j.1475-6773.2008.00877.x
RESEARCH ARTICLE

Access and Utilization

Is Neighborhood Access to Health Care Provision Associated with Individual-Level Utilization and Satisfaction?

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Objective. To explore whether travel time access to the nearest general practitioner (GP) surgery (which is equivalent to U.S. primary care physician [PCP] office) and pharmacy predicts individual-level health service utilization and satisfaction.

Data Sources. GP and pharmacy addresses were obtained from the New Zealand Ministry of Health in 2003 and merged with a geographic boundaries data set. Travel times derived from these data were appended to the 2002/03 New Zealand Health Survey (N= 12,529).

Study Design. Multilevel logistic regression was used to model the relationship between travel time access and five health service outcomes: GP consultation, blood pressure test, cholesterol test, visit to pharmacy, and satisfaction with latest GP consultation.

Data Collection/Extraction. Travel times between each census meshblock centroid and the nearest GP and pharmacy were calculated using Geographical Information System.

Principal Findings. When travel times were long, blood pressure tests were less likely in urban areas (odds ratio [OR] 0.75 [0.59–0.97]), GP consultations were less likely in rural centers (OR 0.42 [0.22–0.78]) and pharmacy visits were less likely in highly rural areas (OR 0.36 [0.13–0.99]). There was some evidence of lower utilization in rural areas.

Conclusions. Locational access to GP surgeries and pharmacies appears to sometimes be associated with health service use but not satisfaction.

Key Words. Neighborhoods, accessibility, health inequalities, health services, Geographical Information Systems

Strong and growing inequalities in health between different social groups (Goesling and Firebaugh 2004; Olsen and Dahl 2007) and between geographical areas (Mackenbach et al. 2003; Rodwin and Neuberg 2005) have been noted in most OECD countries. There is overwhelming evidence that health is disproportionately poorer among more disadvantaged social groups and geographical areas. Our study focuses on New Zealand, which is no exception to these trends (Blakely et al. 2005a, b; Pearce and Dorling 2006; Pearce et al. 2006), although there has been a recent suggestion that socioeconomic and ethnic health inequalities at least may have peaked from the late 1990s to early 2000s (Blakely et al. 2007). There are numerous explanations for area inequalities in health. Some studies focus on the characteristics of the people living in an area, whereas others focus on the context or features of the area itself (Pickett and Pearl 2001). Neighborhood access to health care services might explain some of the geographic inequalities in health through health care utilization.

The effectiveness of health care utilization to improve health outcomes (Silverstein et al. 2002; Barnett, Pearce, and Howes 2006; Barnett et al. 2006) and to reduce mortality (Macinko, Starfield, and Shi 2007) has been established. Primary care is a vital component of the health care system, and increased utilization of primary care is associated with reduced hospital admissions (Parchman and Culler 1999).

Access to various components of the health care system has been found to reduce area inequalities in health (Korda et al. 2007). Access issues include travel time to health care, opening hours (for doctors and nurses, provision of Sunday, and evening services), extent of choice of doctor in terms of gender for example, quality and cost of care (Hyndman and Holman 2001; Exworthy et al. 2006). Barriers that can be particularly difficult for those already experiencing socioeconomic inequalities can include necessary skills and immigration status for gaining access to the system; achieving access once it is permitted; interactions with reception staff as well as doctors and system quirks (Sobo, Seid, and Gelhard 2006). A recent review suggested that unequal access to health care might explain up to 15 percent of socioeconomic differences in health and mortality (Exworthy et al. 2006).

The relationship between locational access to health services and area inequalities has received considerable attention. In particular, many researchers have examined whether people living in more socially deprived neighborhoods (and hence with a greater need for health services) have poorer provision of health care services, an example of the "inverse care law" (Hart

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1971). However, there is considerable international evidence that access to primary care is at least as good if not better in deprived areas (Mansfield et al. 1999; Hyndman and Holman 2001; Lovett et al. 2002; Jordan, Roderick, and Martin 2004; Adams and White 2005; Hanratty, Zhang, and Whitehead 2007; Pearce et al. 2007b), although there are some notable exceptions in countries with severe urban poverty (Alwitt and Donley 1997; Dokmeci and Ozus 2004; Guagliardo et al. 2004). Nonetheless, there is evidence that even if health services are present they are often underused in more deprived areas, despite the greater levels of need (Barnett, Pearce, and Howes 2006; Barnett et al. 2006) and by those who cannot afford insurance where the health care system is not universal such as in the United States (Kennedy and Morgan 2006).

Locational or geographic proximity is a function of distance or travel time and is one important aspect of health service accessibility. Health service utilization generally appears to decrease as distance or travel time access to health services increases (Pierce, Williamson, and Cruse 1998; Hippisley-Cox and Pringle 2000; LaVela et al. 2004; Seidel et al. 2004). Locational access is of most significance for the utilization of secondary (Pierce, Williamson, and Cruse 1998; Hippisley-Cox and Pringle 2000; Arcury et al. 2005; Polsky et al. 2006) and preventative (Clements et al. 1998; Hyndman and Holman 2000; Iredale et al. 2005) health services, and matters most for groups who find accessing services more difficult due to the nature of their medical condition or sociodemographic situation (Allard, Tolman, and Rosen 2003; Schmitt, Phibbs, and Piette 2003; LaVela et al. 2004; McCarthy and Blow 2004).

Turning to primary health services, the general practitioner (GP), or primary care physician (PCP) in the United States, is the gate keeper to a wide range of health care provision such as preventative tests and secondary care (Shaw and Hegedus 2005). However, the relationship between geographic access to GP surgeries (which are equivalent to U.S. PCP offices) and GP consultation is less clear than for secondary and preventative services. In one study, in rural counties of North Carolina in the United States, GP visits were only related to geographical access when they were made for chronic disease management or preventative measures, but not for acute problems (Arcury et al. 2005). Nevertheless U.S. areas with a shortage of GPs (defined as the number of GPs per population) have been found to have more preventable hospital admissions (Parchman and Culler 1999). British studies have found that GP visits are responsive to proximity when access is measured in time (Field and Briggs 2001; Haynes, Lovett, and Sunnenberg 2003) but not distance (Field and Briggs 2001). Thus further research is needed to clarify the relationship between GP access and use, how it varies in different countries and settings, and for different forms of preventative care.

Pharmacies are another significant component of primary health care provision. For example, in the United Kingdom, pharmacies now offer enhanced services such as independent prescribing, monitoring, and smoking cessation services; they are easily accessible, require no appointment, and are often open longer hours than GP surgeries (Royal Pharmaceutical Society of Great Britain 2007). Pharmacies may assume an even greater role in countries such as New Zealand where there are cost barriers associated with GP consultations (Barnett 2001). There has been little research investigating access to pharmacies as a predictor of use.

Access to GP surgeries is better in urban than rural areas (Mansfield et al. 1999; Lovett et al. 2002; Rosenthal, Zaslavsky, and Newhouse 2005; Iezzoni et al. 2006; Pearce et al. in press). In New Zealand, a tenth of the population, living in rural areas are more than 30 minutes from their nearest GP surgery (Brabyn and Barnett 2004). Women living in rural New Zealand are less likely to visit a doctor and receive prescriptions than urban women (Ministry of Health 2007). Rural areas in New Zealand report problems maintaining GP and pharmacy services. Specific problems encountered with respect to GP services include funding and recruiting GPs and locums, onerous rosters, poor communication between rural primary care and urban specialist care, fewer opportunities for training courses for medical staff, less investigative tests of patients, and high costs in terms of time and petrol incurred for GP visits (Canterbury District Health Board 2006; Fraser 2006). Recruitment of rural pharmacists and pharmacist locums is often difficult; rural pharmacies have closed and it has been argued that current legislation makes the opening of new pharmacies difficult (Canterbury District Health Board 2006). Thus urban–rural status is an important issue for a study of primary health care access, utilization, and satisfaction.

Most previous studies of health care access and utilization have been located in the United Kingdom and North America and have focused on a single type of health care in one urban or rural area. There has been little work on pharmacies. In this New Zealand wide study, we examine the influence of neighborhood access on the utilization of GPs, preventative tests and pharmacies, and satisfaction with health care provision.

METHODS

Geocoded data on the location of all GP surgeries and pharmacies across New Zealand were obtained for 2003 from the New Zealand Ministry of Health.

There were a total of 1,383 GP surgery locations and 1,170 pharmacies. Geographical access to GPs and pharmacies was calculated separately for all 38,350 census meshblocks (average population 100), or what we refer to as "neighborhoods." Each neighborhood was represented by its population-weighted centroid and the travel time taken to the nearest GP surgery and pharmacy along the road network was calculated using the network functionality in a Geographical Information System (GIS). Use of GIS allowed the calculations to be adjusted for variations in speed limits, type of road surface, sinuosity, and differences in the topography across the network. Further details of the GIS methods are documented elsewhere (Pearce, Witten, and Bartie 2006).

The 2002/2003 New Zealand Health Survey (NZHS) is a national survey of the health status of 12,529 adults aged 15+ (target population 2.6 million) asking a range of questions including health service use (Ministry of Health 2004). For each respondent, five dichotomous outcome variables were developed (Table 1). The four outcomes related to health care utilization were GP consultation in the last year, blood pressure test in the last year, cholesterol test in the last year, and pharmacist visit in the last year. The fifth outcome related to satisfaction: very satisfied with latest GP consultation compared with satisfied, dissatisfied, and very dissatisfied was also included. The neighborhood travel time measures were divided into quartiles (for confidentiality reasons) and appended to each respondent in the NZHS. GP surgery travel time access quartiles were used for the four GP-related outcomes and pharmacy travel time access quartiles were used for the pharmacy outcome.

Table 1: Utilization and Satisfaction Outcomes

Outcome	*Nationally Representative Estimate (95% CI) (Ministry of Health 2004)*	*Notes*
Utilization		
GP consultation	80.8% (79.8–81.8)	*Seen a doctor for own health in last 12 months*
Blood pressure	52.0% (50.7–53.3)	*Blood pressure test in the last 12 months*
Cholesterol	25.1% (24.2–26.0)	*Cholesterol test in the last 12 months*
Visited pharmacist	86.2% (85.2–87.1)	*Been to pharmacy/chemist for health product/advice in last 12 months*
Very satisfied	48.4% (46.9–49.9)	*Satisfaction with last GP consultation*

Only includes people who have been to a GP within the last year. There were too few dissatisfied respondents to adequately compare satisfied with dissatisfied.

GP, general practitioner.

Two-level logistic regression models with a random intercept were fitted in *MLWin* version 2.0 using second-order PQL estimation methods. Level one was the individual and level two was the meshblock. Variables were added in two stages. First, we included design variables to account for the sample design and oversampling of ethnic minorities: ethnic composition of the neighborhood, number of respondents in the neighborhood, number of adults in the household, and respondent ethnicity (Maori, Pacific, Asian, or Other). In addition, sex, age (15–24, 25–44, 45–64, and 65+), and individual-level socioeconomic variables were included in all models. The socioeconomic variables included education (none, school, and postschool), social class (professional/managerial, other nonmanual, skilled manual, semi and unskilled manual), benefits (recipient during the last year or not), and household income (<\$25k, \$25–50k, >\$50k). Two potential confounders at the neighborhood level were added in the second stage: area deprivation measured using the 2001 New Zealand Deprivation Index (NZDep 2001) (Salmond and Crampton 2002) divided into quintiles and urban–rural designations using the 2001 Urban Area Classification (main urban area [population >30,000], secondary urban area [population 10,000–29,999], minor urban area [population 1,000–9,999], rural center [population 300–999], and highly rural [population <300]) (Department of Statistics 1992).

Additional analyses were undertaken when we found collinearity between the urban–rural area type variable and the access quartiles. This is not surprising given that the median travel time to the nearest GP surgery is 2 minutes in main urban areas but about 15 minutes in rural areas (pharmacy times are similar to GP) (Pearce et al. in press). Furthermore, urban and rural meshblocks also differ in size (urban meshblocks have an average land area of approximately 7,000 km^2 whereas rural meshblocks have an average land area of 261,000 km^2) and density (urban meshblocks average density is about 450 people per km^2 whereas rural meshblocks only 2 people per km^2). Consequently we first created models for urban areas only and secondly developed a cross-classified variable encompassing urban–rural and travel time access, which supplanted urban–rural and travel time access quartiles in the models. The composite variable enabled the inclusion of urban as well as rural areas thereby still utilizing a key strength of our data set, its pan New Zealand nature. All five urban–rural strata were included in the composite variable and access was measured by collapsing the two poorer access quartiles into below the median travel time (poor access) and collapsing the two higher access quartiles into above the median travel time (good access). The median travel time to the nearest GP surgery was 2.5 minutes and to the nearest pharmacy was 2.6 minutes (see Table 2). Thus the new variable comprised 10 categories. We would have preferred to continue to use quartiles because four categories provide more detail on the nature of the relationship (e.g., if is it linear, concave, or convex, or if there is a threshold) but it was necessary to collapse categories at this point to achieve sufficient cell sizes.

RESULTS

Odds ratios (ORs) and 95 percent confidence intervals for the travel time access quartiles (GP surgeries or pharmacies) were calculated for each out-

Table 2: OR and 95% Confidence Intervals of Travel Time Access Quartiles (Minutes) for all Area Types and Urban Areas Only

	All Area Types		*Urban Areas Only*	
Travel Time Access Quartiles (Minutes)	*Design and Individual-Level Covariates*	*Area-Level Covariates*	*Design and Individual-Level Covariates*	*Area-Level Covariates*
GP consultation				
Best (<1.4)	1	1	1	1
Better (1.4–2.5)	1.02 (0.88–1.19)	1.02 (0.88–1.19)	1.04 (0.90–1.20)	1.05 (0.91–1.21)
Worse (2.5–5.9)	0.90 (0.78–1.04)	0.94 (0.80–1.09)	0.94 (0.81–1.08)	0.96 (0.83–1.12)
Worst (5.9+)	0.74 (0.63–0.87)	0.83 (0.67–1.03)	0.82 (0.62–1.07)	0.85 (0.65–1.13)
Blood pressure test				
Best (<1.4)	1	1	1	1
Better (1.4–2.5)	0.95 (0.84–1.09)	0.97 (0.85–1.10)	0.95 (0.83–1.08)	0.96 (0.85–1.09)
Worse (2.5–5.9)	0.89 (0.78–1.02)	0.93 (0.82–1.07)	0.89 (0.78–1.02)	0.92 (0.81–1.06)
Worst (5.9+)	0.76 (0.66–0.88)	0.84 (0.69–1.02)	0.71 (0.56–0.90)	0.75 (0.59–0.97)
Cholesterol test				
Best (<1.4)	1	1	1	1
Better (1.4–2.5)	1.02 (0.88–1.17)	1.03 (0.89–1.18)	1.00 (0.87–1.15)	1.02 (0.88–1.17)
Worse (2.5–5.9)	0.98 (0.85–1.12)	1.02 (0.89–1.18)	0.96 (0.83–1.11)	0.99 (0.86–1.15)
Worst (5.9+)	0.88 (0.75–1.04)	1.09 (0.88–1.34)	0.84 (0.64–1.10)	0.90 (0.68–1.19)
Visited pharmacy*				
Best (<1.6)	1	1	1	1
Better (1.6–2.6)	0.92 (0.76–1.13)	0.92 (0.75–1.13)	0.90 (0.75–1.07)	0.90 (0.76–1.08)
Worse (2.6–6.4)	0.97 (0.79–1.18)	0.98 (0.80–1.20)	0.93 (0.78–1.11)	0.94 (0.79–1.12)
Worst (6.4+)	0.58 (0.46–0.72)	0.73 (0.53–1.00)	0.99 (0.69–1.44)	0.99 (0.68–1.44)
Very satisfied				
Best (<1.4)	1	1	1	1
Better (1.4–2.5)	1.02 (0.88–1.18)	1.00 (0.87–1.16)	1.01 (0.88–1.16)	1.00 (0.87–1.16)
Worse (2.5–5.9)	1.07 (0.92–1.23)	1.03 (0.88–1.19)	1.07 (0.92–1.24)	1.04 (0.90–1.21)
Worst (5.9+)	1.10 (0.93–1.30)	1.10 (0.88–1.36)	1.04 (0.79–1.36)	0.98 (0.75–1.30)

*"Visited pharmacy" models use travel time to pharmacy quartiles instead of travel time to GP.
GP, general practitioner; OR, odds ratio.

come first for all of New Zealand and second for urban areas only (Table 2). The results for all New Zealand neighborhoods (Table 2, left) suggested that after taking into account design and individual-level covariates there was a relationship between travel time access and GP consultations. Respondents living in neighborhoods with worst travel time access were less likely to have had a GP consultation in the last year (OR 0.74 [0.63–0.87]) compared with respondents living in the quartile of neighborhoods with the best travel time access. Further, travel time access was also related to lower utilization for the other measures: ORs were similar for blood pressure tests (OR 0.76 [0.66–0.88]) and further from the null hypothesis for pharmacy utilization (0.58 [0.46–0.72]). Coefficients were in the same direction for cholesterol tests but were of less magnitude (OR 0.88 [0.75–1.04]). There was no relationship between travel time access to the nearest GP surgery and satisfaction. After inclusion of the neighborhood deprivation and area type measures, coefficients were closer to the null and no longer statistically significant except for visiting pharmacy where the upper confidence interval bound was 1.00.

Collinearity was apparent between the travel time access and degree of rurality, so we repeated the analysis excluding rural areas from the models (Table 2, right). If travel time access is a predictor of utilization and satisfaction unconfounded by rurality, differences between coefficients should be maintained in urban areas alone. Urban respondents with worst travel time access to GP surgeries were less likely to have blood pressure tests (OR 0.75 [0.59–0.97]), compared to those with best travel time access, even after taking account individual and area characteristics. It is worth noting that coefficients were in the same direction for GP consultations and cholesterol tests. However, magnitudes were very small and there were fewer urban neighborhoods in the worst access travel time quartile, which led to large confidence intervals for this quartile. Urban only models showed little relationship between travel time access and use of pharmacies and satisfaction with GP consultations.

A two-stage analysis was undertaken with the composite urban–rural and median travel time access variable (Table 3). In the first stage all categories were compared with main urban areas that had good travel time access (faster than the median). Compared with respondents with good travel time access in main urban areas, respondents with poor travel time access (slower than the median) were less likely to undergo GP consultations in secondary urban areas (OR 0.74 [0.55–1.00]), rural centers (OR 0.66 [0.51–0.86]), and highly rural areas (OR 0.73 [0.61–0.86]); blood pressure tests in secondary urban (OR 0.67 [0.51–0.87]) and highly rural areas (OR 0.79 [0.67–0.92]), and perhaps rural centers (OR 0.79 [0.61–1.03]); cholesterol tests in secondary urban areas (OR

Table 3: OR and 95% Confidence Intervals of Composite Urban–Rural Travel Time Access Variable with Baseline, Demographic, Individual SES, and Area Deprivation

	Urban–Rural Strata				
Travel Time Access	*Main Urban*	*Secondary Urban*	*Minor Urban*	*Rural Center*	*Highly Rural*
Compared with good travel time access in main urban areas					
Blood pressure tests					
Good	1	1.14 (0.80–1.64)	0.90 (0.74–1.11)	1.58 (0.87–2.86)	0.57 (0.31–1.07)
Poor	0.96 (0.83–1.10)	0.74 (0.55–1.00)	0.82 (0.61–1.10)	0.66 (0.51–0.86)	0.73 (0.61–0.86)
GP consultations					
Good	1	0.86 (0.65–1.15)	0.99 (0.82–1.19)	0.79 (0.49–1.28)	0.68 (0.37–1.23)
Poor	0.94 (0.83–1.07)	0.67 (0.51–0.87)	0.88 (0.67–1.16)	0.79 (0.61–1.03)	0.79 (0.67–0.92)
Cholesterol tests					
Good	1	0.77 (0.57–1.04)	1.20 (0.99–1.47)	0.51 (0.29–0.89)	0.20 (0.07–0.54)
Poor	1.00 (0.87–1.14)	0.69 (0.52–0.93)	1.01 (0.76–1.35)	0.92 (0.69–1.23)	0.86 (0.73–1.03)
Visited pharmacy*					
Good	1	0.75 (0.49–1.15)	0.94 (0.71–1.24)	0.34 (0.14–0.86)	1.56 (0.57–4.28)
Poor	1.00 (0.83–1.22)	1.17 (0.77–1.77)	0.76 (0.55–1.05)	0.48 (0.35–0.66)	0.56 (0.45–0.70)
Very satisfied with GP					
Good	1	0.91 (0.67–1.24)	0.83 (0.68–1.02)	0.54 (0.32–0.92)	1.33 (0.66–2.68)
Poor	0.97 (0.84–1.11)	1.10 (0.82–1.48)	1.09 (0.80–1.48)	0.83 (0.61–1.11)	1.03 (0.86–1.23)
Compared with good travel time access in same urban–rural strata					
GP consultations					
Good	1	1	1	1	1
Poor	0.96 (0.83–1.10)	0.65 (0.41–1.01)	0.91 (0.66–1.26)	0.42 (0.22–0.78)	1.27 (0.68–2.38)
Blood pressure tests					
Good	1	1	1	1	1
Poor	0.94 (0.83–1.07)	0.78 (0.53–1.13)	0.89 (0.66–1.21)	1.00 (0.59–1.69)	1.16 (0.64–2.12)
Cholesterol tests					
Good	1	1	1	1	1
Poor	1.00 (0.87–1.14)	0.90 (0.60–1.35)	0.84 (0.61–1.16)	1.81 (0.99–3.32)	4.30 (1.59–11.65)
Visited pharmacy*					
Good	1	1	1	1	1
Poor	1.00 (0.83–1.22)	1.55 (0.88–2.74)	0.81 (0.55–1.18)	1.41 (0.55–3.63)	0.36 (0.13–0.99)
Very satisfied with GP					
Good	1	1	1	1	1
Poor	0.97 (0.84–1.11)	1.21 (0.81–1.81)	1.31 (0.93–1.84)	1.53 (0.85–2.76)	0.77 (0.38–1.56)

*"Visited pharmacy" models use travel time to pharmacy quartiles instead of travel time to GP.
SES, socioeconomic status; GP, general practitioner; OR, odds ratio.

0.69 [0.52–0.93]), and possibly highly rural areas (OR 0.86 [0.73–1.03]); and finally pharmacy visits in rural centers (OR 0.48 [0.35–0.66]), highly rural areas (OR 0.56 [0.45–0.70]), and probably minor urban areas (OR 0.76 [0.55–1.05]).

There were three instances of lower utilization for areas with good travel time access compared with main urban areas with good travel time access. These were cholesterol tests in rural centers (OR 0.51 [0.29–0.89]) and highly rural areas (OR 0.20 [0.07–0.54]), and pharmacy visits in rural centers (OR 0.34 [0.14–0.86]). There were no instances with nonoverlapping confidence intervals where utilization was more likely than the reference group although this was almost the case for cholesterol tests in minor urban areas with good access (OR 1.20 [0.99–1.47]). In summary, compared to main urban neighborhoods with good travel time access, utilization often appears to be lower in secondary urban and in rural areas with poor travel time access. Cholesterol tests and pharmacy visits in rural centers were also less likely in rural centers with good travel time access.

Compared with main urban areas with good travel time access, respondents were less likely to be very satisfied with their GP in rural centers (OR 0.54 [0.32–0.92]) and perhaps minor urban areas (OR 0.83 [0.68–1.02]) with good travel time access.

However, this first stage analysis did not tell us whether, for example, those in secondary urban areas with poor access were less likely to consult a GP than those in secondary urban areas with good access. Thus in the second stage good travel time access was compared with poor travel time access within each urban and rural strata. We thus rotated the reference category to good access for each of the five urban–rural categories in five separate models. We recorded results for the corresponding poor access category for each model. Cell sizes were small for rural centers with good travel time access (the minimum cell size was 48), which increases the size of confidence intervals. In minor and particularly main urban areas there were minimal differences in utilization and satisfaction between those with good and poor travel time access. In secondary urban areas there was a third lower OR of GP consultations in areas of poor travel time access, however, confidence intervals slightly overlapped (OR 0.65 [0.41–1.01]). GP consultations were less likely in rural centers with poor travel time access (OR 0.42 [0.22–0.78]) but cholesterol tests were more likely (OR 1.81 [0.99–3.32]), although confidence intervals slightly overlapped. Cholesterol tests were more likely in highly rural areas with poor travel time access (OR 4.30 [1.59–11.65]) whereas pharmacy visits were less likely (OR 0.36 [0.13–0.99]). OR for cholesterol tests in rural poor travel time access areas seem particularly high. However, if we consider the comparison with "main urban good travel time access," the OR for cholesterol tests were particularly low in rural areas with good travel time access. Thus, the large ORs reflected a low prevalence of tests in rural areas with good travel time access rather than a high rate of testing in rural areas with poor travel time access.

Discussion

We present the results of the first nationally representative study of the effects of travel time access to health services on health service use and satisfaction. We found some evidence that poor travel time access was associated with a reduced utilization of GPs and pharmacies in rural areas and possibly secondary urban areas. Utilization may be lower in rural areas with poor travel time access because travel times in the poor travel time access category are likely to be longer on average than in urban areas of poor travel time access. Thus, in New Zealand, access to primary health care services is of particular concern in rural areas.

There was no evidence that travel time access to health care influenced health service satisfaction. However, there were fewer respondents who were very satisfied with their GP in rural centers with good travel time access compared with main urban areas with good travel time access. This finding could relate to practitioner choice with urban practices more likely to be multi, and mixed gender, practitioner clinics. Furthermore there was low prevalence of cholesterol testing in rural areas even with good travel time access. Both these findings may be indicative of some issues facing rural practices, for example less investigative tests of patients (Canterbury District Health Board 2006; Fraser 2006).

While there are many gaps in research on reasons for urban and rural healthcare differences (Fraser 2006) it has been noted that rural residents are more likely to identify "inconvenience" as a reason preventing them from seeking care (Edmondson 1989) and to criticize the quality and availability of health care in rural areas (Fraser 2006). In Australia, mental health service use and prescribing rates are low in rural areas (Judd et al. 2006) and a rising incidence risk of rural suicide may suggest a similar situation in New Zealand (Pearce, Barnett, and Jones 2007a).

Neither travel time access nor deprivation was consistently related to health care utilization. We have previously found that in New Zealand travel times to GP surgeries and pharmacies are shorter in deprived areas (Pearce et al. 2007b). Thus, it is doubtful whether travel time access to primary health care is a sizable contributor to health inequalities in New Zealand. However, it is possible that health inequalities in New Zealand are moderated by the (pro)equitable distribution of primary care services. Our inconsistent results in terms of outcomes concur with previous research, which has found that only some types of GP visits are responsive to travel time access (Arcury et al. 2005) and that results may be sensitive to the way accessibility is measured (Field and Briggs 2001).

This study has limitations. First, we have not considered the quality of the health services that were available to the respondents. Second, we have not examined the choice of health services or practictioners, available to the respondent. Choice of GP is generally more important when making an appointment than speed of access (time to appointment) (Rubin et al. 2006). Further, British and Australian work has found that travel time access can affect choice of GP and that choice can also affect satisfaction. The nearest GP is more likely to be used in areas where choice of GP surgeries is poor (Haynes, Lovett, and Sunnenberg 2003; Hyndman, Holman, and Pritchard 2003) and satisfaction with a GP is less likely where GP choice is more limited (Young, Dobson, and Byles 2001). People on lower incomes are more likely to choose practices with schemes to reduce costs and less likely to travel further to a GP (Hyndman, Holman, and Pritchard 2003; Hanlon and Halseth 2005). We measure travel time to the nearest facility but not travel time to the GP or pharmacist that the respondent uses and therefore our exposure variable is only a proxy for geographic access to health services, and it may be that a more specific measure would have disclosed stronger associations. This may explain our slightly stronger results for visiting a pharmacy compared with a GP surgery (Table 2): convenience may be a stronger factor in one's choice of pharmacy than a GP where personal relationships and quality may be more to the fore. Third, we did not consider access to alternative facilities that can provide primary care such as hospitals, accident and emergency, ambulance stations or Maori and Pacific peoples health services. Fourth, the time differences between quartiles are not large, suggesting that few neighborhoods in New Zealand face substantial travel times to health services. The range between the shortest and longest travel time access quartiles was about 6 minutes for GP surgeries and pharmacies. Thus travel time access to both primary care facilities is good for the majority of New Zealanders. Fifth, we did not measure the travel time from each respondents home but used the population-weighted meshblock centroid as a proxy. It is possible that there were systematic urban–rural differences in error in this measure. Finally, we did not include health itself in this analysis. We have assumed that controlling for sociodemographic attributes will explain away differences in utilization due to differences in sickness rates. It may, however, be that less healthy people choose to live in urban areas and/or nearer a GP and thus those living nearer a GP use the health service more. However, there are few consistent differences in health and health behaviors between New Zealand urban and rural dwellers and they are not in a uniform direction, and are often not a simple urban/rural dichotomy (Ministry of Health 2007). Exploring the relationship between health and access is an avenue for further work.

Limitations accepted, our New Zealand results suggest that there are some indications of differences in GP utilization patterned by travel time access, particularly in rural areas. Further investigation is needed to establish convincingly whether access to health care affects health service use in New Zealand, perhaps through a more nuanced exploration of how and where access might exert an influence. Thus far our work suggests that targeting travel time to health care as a way of reducing inequalities in health may be helpful only in some circumstances, particularly in rural areas. Rural practices face particular challenges that should be explored further.

ACKNOWLEDGMENTS

Joint Acknowledgment/Disclosure Statement: We recognize the Crown as the owner of the 2002/03 New Zealand Health Survey. We thank Public Health Intelligence, Ministry of Health (New Zealand) for preparing the Health Survey data and the GeoHealth Laboratory, Department of Geography, University of Canterbury, New Zealand for providing GIS calculations of the travel time to GP surgeries and pharmacies. This research was funded by the New Zealand Health Research Council, as part of the Neighbourhoods and Health project within the Health Inequalities Research Programme.

Disclosures: None.

Disclaimers: None.

REFERENCES

Adams, J., and M. White. 2005. "Socio-Economic Deprivation is Associated with Increased Proximity to General Practices in England: An Ecological Analysis." *Journal of Public Health* 27: 80–1.

Allard, S. W., R. M. Tolman, and D. Rosen. 2003. "Proximity to Service Providers and Service Utilization Among Welfare Recipients: The Interaction of Place and Race." *Journal of Policy Analysis and Management* 22 (4): 599–613.

Alwitt, L., and T. Donley. 1997. "Retail Stores in Poor Urban Neighborhoods." *Journal of Consumer Affairs* 31: 139–64.

Arcury, T. A., W. M. Gesler, J. S. Preisser, J. Sherman, J. Spencer, and J. Perin. 2005. "The Effects of Geography and Spatial Behaviour on Health Care Utilization among the Residents of a Rural Region." *Health Services Research* 40 (1): 135–55.

Barnett, R. 2001. "Coping with the Costs of Primary Care? Household and Locational Variations in the Survival Strategies of the Urban Poor." *Health and Place* 7 (2): 141–57.

Barnett, R., P. Barnett, J. Pearce, and P. Howes. 2006. "Preventing the Human Time Bomb? Barriers to Utilising Diabetes Education in Christchurch, New Zealand." *Australian and New Zealand Journal of Public Health* 30: 275–8.

Barnett, R., J. Pearce, and P. Howes. 2006. "'Help Educate, Encourage?': Geographical Variations in the Provision and Utilization of Diabetes Education in New Zealand." *Social Science and Medicine* 63: 1228–43.

Blakely, T., J. Fawcett, J. Atkinson, M. Tobias, and J. Cheung. 2005a. *Decades of Disparity II: Socioeconomic Mortality Trends in New Zealand, 1981–1999.* Wellington: Ministry of Health.

Blakely, T., M. Tobias, J. Atkinson, L. -C. Yeh, and K. Huang. 2007. *Tracking Disparity: Trends in Ethnic and Socioeconomic Inequalities in Mortality, 1981–2004.* Wellington: Ministry of Health.

Blakely, T., M. Tobias, B. Robson, S. Ajwani, M. Bonne, and A. Woodward. 2005b. "Widening Ethnic Mortality Disparities in New Zealand 1981–99." *Social Science and Medicine* 61: 2233–51.

Brabyn, L., and R. Barnett. 2004. "Population Need and Geographical Access to General Practictioners in Rural New Zealand." *Journal of the New Zealand Medical Association* 117 (1199).

Canterbury District Health Board. 2006. *Rural Health in Canterbury DHB-An Action Plan: Background Information and a Proposal for the Way Forward.* Christchurch: CDHB.

Clements, S., N. Stone, I. Diamond, and R. Ingham. 1998. "Modelling the Spatial Distribution of Teenage Conception Rates within Wessex." *British Journal of Family Planning* 24 (2): 61–71.

Department of Statistics. 1992. *New Zealand Standard Areas Classification Manual.* Wellington: Statistics New Zealand.

Dokmeci, V., and E. Ozus. 2004. "Spatial Analysis of Urban Pharmacies in Istanbul." *European Planning Studies* 12 (4): 585–94.

Exworthy, M., A. Bindman, H. Davies, and A. Washington. 2006. "Evidence into Policy and Practice? Measuring the Progress of Policies to Tackle Health Disparities and Inequalities in the US and UK." *Milbank Quarterly* 84 (1): 75–109.

Edmondson, J. 1989. *A Comparison of Rural and Urban Health in New Zealand.* Wellington: Department of Health.

Field, K. S., and D. Briggs. 2001. "Socio-Economic and Locational Determinants of Accessibility and Utilization of Primary Health-Care." *Health and Social Care in the Community* 9 (5): 294–308.

Fraser, J. 2006. *Rural Health: A Literature Review for the National Health Committee.* Wellington: Victoria University of Wellington.

Goesling, B., and G. Firebaugh. 2004. "The Trend in International Health Inequality." *Population and Development Review* 30 (1): 131–46.

Guagliardo, M. F., C. R. Ronzio, I. Cheung, E. Chacko, and J. G. Joseph. 2004. "Physician Accessibility: An Urban Case Study of Pediatric Providers." *Health and Place* 10 (3): 273–83.

Hanlon, N., and G. Halseth. 2005. "The Greying of Resource Communities in Northern British Columbia: Implications for Health Care Delivery in Already-Underserviced Communities." *The Canadian Geographer—Le Geographe canadien* 49 (1): 1–24.

Hanratty, B., T. Zhang, and M. Whitehead. 2007. "How Close Have Universal Health Systems Come to Achieving Equity in Use of Curative Services? A Systematic Review." *International Journal of Health Services* 37 (1): 89–109.

Hart, J. 1971. "The Inverse Care Law." *Lancet* 1: 405–12.

Haynes, R., A. Lovett, and G. Sunnenberg. 2003. "Potential Accessibility, Travel Time, and Consumer Choice: Geographical Variations in General Medical Practice Registrations in Eastern England." *Environment and Planning A* 35 (10): 1733–50.

Hippisley-Cox, J., and M. Pringle. 2000. "Inequalities in Access to Coronary Angiography and Revascularisation: The Association of Deprivation and Location of Primary Care Services." *British Journal of General Practice* 50 (455): 449–54.

Hyndman, J. C. G., and C. D. J. Holman. 2000. "Differential Effects on Socioeconomic Groups of Modelling the Location of Mammography Screening Clinics Using Geographic Information Systems." *Australian and New Zealand Journal of Public Health* 24 (3): 281–6.

———. 2001. "Accessibility and Spatial Distribution of General Practice Services in an Australian City by Levels of Social Disadvantage." *Social Science and Medicine* 53 (12): 1599–609.

Hyndman, J. C. G., C. D. J. Holman, and D. A. Pritchard. 2003. "The Influence of Attractiveness Factors and Distance to General Practice Surgeries by Level of Social Disadvantage and Global Access in Perth, Western Australia." *Social Science and Medicine* 56 (2): 387–403.

Iezzoni, L., M. Killeen, and B. O'Day. 2006. "Rural Residents with Disabilities Confront Substantial Barriers to Obtaining Primary Care." *Health Services Research* 41 (4): 1258–75.

Iredale, R., L. Jones, J. Gray, and J. Deaville. 2005. "'The Edge Effect': An Exploratory Study of Some Factors Affecting Referrals to Cancer Genetic Services in Rural Wales." *Health and Place* 11 (3): 197–204.

Jordan, H., P. Roderick, and D. Martin. 2004. "The Index of Multiple Deprivation 2000 and Accessibility Effects on Health." *Journal of Epidemiology and Community Health* 58 (3): 250–7.

Judd, F., A. M. Cooper, C. Fraser, and J. Davis. 2006. "Rural Suicide—People or Place Effects?" *Australian and New Zealand Journal of Psychiatry* 40 (3): 208–16.

Kennedy, J., and S. Morgan. 2006. "Health Care Access in Three Nations: Canada, Insured America, and Uninsured America." *International Journal of Health Services* 36 (4): 697–717.

Korda, R., J. Butler, M. Clements, and S. Kunitz. 2007. "Differential Impacts of Health Care in Australia: Trend Analysis of Socioeconomic Inequalities in Avoidable Mortality." *International Journal of Epidemiology* 36 (1): 157–65.

LaVela, S. L., B. Smith, F. M. Weaver, and S. A. Miskevics. 2004. "Geographical Proximity and Health Care Utilization in Veterans with SCI&D in the USA." *Social Science and Medicine* 59 (11): 2387–99.

Lovett, A., R. Haynes, G. Sunnenberg, and S. Gale. 2002. "Car Travel Time and Accessibility by Bus to General Practitioner Services: A Study Using Patient Registers and GIS." *Social Science and Medicine* 55 (1): 97–111.

Macinko, J., B. Starfield, and L. Shi. 2007. "Quantifying the Health Benefits of Primary Care Physician Supply in the United States." *International Journal of Health Services* 37 (1): 111–26.

Mackenbach, J. P., V. Bos, O. Andersen, M. Cardano, G. Costa, S. Harding, A. Reid, O. Hemstrom, T. Valkonen, and A. Kunst. 2003. "Widening Socioeconomic Inequalities in Mortality in Six Western European Countries." *International Journal of Epidemiology* 32: 830–7.

Mansfield, C. J., J. L. Wilson, E. J. Kobrinski, and J. Mitchell. 1999. "Premature Mortality in the United States: The Roles of Geographic Area, Socioeconomic Status, Household Type, and Availability of Medical Care." *American Journal of Public Health* 89 (6): 893.

McCarthy, J. F., and F. C. Blow. 2004. "Older Patients with Serious Mental Illness—Sensitivity to Distance Barriers for Outpatient Care." *Medical Care* 42 (11): 1073–80.

Ministry of Health. 2004. *A Portrait of Health: Key Results of the 2002/03 New Zealand Health Survey.* Wellington: Ministry of Health.

Ministry of Health. 2007. *Urban–Rural Health Comparisons: Key Results of the 2002/03 New Zealand Health Survey.* Wellington: Ministry of Health.

Olsen, K., and S. -A. Dahl. 2007. "Health Differences between European Countries." *Social Science and Medicine* 64 (8): 1665–78.

Parchman, M., and S. Culler. 1999. "Preventable Hospitalizations in Primary Care Shortage Areas: An Analysis of Vulnerable Medicare Beneficiaries." *Archives of Family Medicine* 8: 487–91.

Pearce, J., R. Barnett, and I. Jones. 2007a. "Have Urban/Rural Inequalities in Suicide in New Zealand Grown during the Period 1980–2001?" *Social Science and Medicine* 65: 1807–19.

Pearce, J., and D. Dorling. 2006. "Increasing Geographical Inequalities in Health in New Zealand, 1980–2001." *International Journal of Epidemiology* 35: 597–603.

Pearce, J., D. Dorling, B. Wheeler, R. Barnett, and J. Rigby. 2006. "Geographical Inequalities in Health in New Zealand, 1980–2001: The Gap Widens." *Australian and New Zealand Journal of Public Health* 30: 461–6.

Pearce, J., K. Witten, and P. Bartie. 2006. "Neighborhoods and Health: A GIS Approach to Measuring Community Resource Accessibility." *Journal of Epidemiology and Community Health* 60: 389–95.

Pearce, J., K. Witten, R. Hiscock, and T. Blakely. 2007b. "Are Socially Disadvantaged Neighborhoods Deprived of Health-Related Community Resources?" *International Journal of Epidemiology* 36 (2): 348–55.

———. in press "Regional and Urban–Rural Variations in the Association of Neighbourhood Deprivation with Community Resource Access: A National Study." *Environment and Planning A*.

Pickett, K., and M. Pearl. 2001. "Multilevel Analyses of Neighborhood Socioeconomic Context and Health Outcomes: A Critical Review." *Journal of Epidemiology and Community Health* 55: 111–22.

Pierce, R. P., H. A. Williamson, and R. L. Kruse. 1998. "Distance, Use of Resources, and Mortality among Rural Missouri Residents with Acute Myocardial Infarction." *Journal of Rural Health* 14 (1): 28–35.

Polsky, D., K. Armstrong, T. Randall, R. Ross, O. Even-Shoshan, P. Rosenbaum, and J. Silber. 2006. "Variation in Chemotherapy Utilization in Ovarian Cancer: The Relative Contribution of Geography." *Health Services Research* 41 (6): 2201–18.

Rodwin, V., and L. Neuberg. 2005. "Infant Mortality and Income in 4 World Cities: New York, London, Paris and Tokyo." *American Journal of Public Health* 95: 86–90.

Rosenthal, M., A. Zaslavsky, and J. Newhouse. 2005. "The Geographic Distribution of Physicians Revisited." *Health Services Research* 40 (6): 1931–52.

Royal Pharmaceutical Society of Great Britain. 2007. *Community Pharmacy: The Untapped Primary Care Resource*. London: Royal Pharmaceutical Society of Great Britain.

Rubin, G., A. Bate, A. George, P. Shackley, and N. Hall. 2006. "Preferences for Access to the GP: A Discrete Choice Experiment." *British Journal of General Practice* 56 (531): 743–8.

Salmond, C., and P. Crampton. 2002. *NZDep2001 Index of Deprivation*. Wellington: Department of Public Health, Wellington School of Medicine and Health Sciences.

Schmitt, S. K., C. S. Phibbs, and J. D. Piette. 2003. "The Influence of Distance on Utilization of Outpatient Mental Health Aftercare following Inpatient Substance Abuse Treatment." *Addictive Behaviors* 28 (6): 1183–92.

Seidel, J. E., W. A. Ghali, P. D. Faris, C. J. D. Bow, N. M. Waters, M. M. Graham, P. D. Galbraith, L. B. Mitchell, and M. L. Knudtson. 2004. "Geographical Location of Residence and Uniformity of Access to Cardiac Revascularization Services after Catheterization." *Canadian Journal of Cardiology* 20 (5): 517–23.

Shaw, N., and G. Hegedus. 2005. "The National Programme for Information Technology The GP as Gatekeeper—A Bastion Worth Fighting For?" *British Journal of General Practice* 55 (511): 85–6.

Silverstein, M. D., P. J. Nietert, X. B. Ye, and D. T. Lackland. 2002. "Access to Care and Stage at Diagnosis for Patients with Lung Cancer and Esophageal Cancer: Analysis of the Savannah River Region Information System Cancer Registry Data." *Southern Medical Journal* 95 (8): 900–8.

Sobo, E., M. Seid, and L. Gelhard. 2006. "Parent-Identified Barriers to Pediatric Health Care: A Process-Oriented Model." *Health Services Research* 41 (1): 148–72.

Young, A. F., A. J. Dobson, and J. E. Byles. 2001. "Determinants of General Practitioner Use among Women in Australia." *Social Science and Medicine* 53 (12): 1641–51.

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